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

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INDEX

- ABBADIE** (Antoine d'), Lightning-Flashes, 342
Abbe (Prof. Cleveland): Influence of Wind on Barometric Readings, 29; Corrections to Refraction-Tables, 134; Obituary Notice of William Babcock Hazen, 541
Abel, the Mathematician, Statue in Honour of, 352
Abel (Sir Fred., F.R.S.), Work of the Imperial Institute, 617
Abercromby (Hon. R.): on the Peculiar Sunrise Shadows of Adam's Peak, 94; on the Relation between Tropical and Extra-Tropical Cyclones, 430; an Equatorial Zone of almost Perpetual Electrical Discharge, 487; Modern Developments of Cloud Knowledge, 575
Aberdeen, Stone Circles near, 503
Aberration, New Method of determining the Constants of, M. Lowy, 263, 282, 407, 424, 431, 454, 479; M. Houzeau, 377
Aberration of Light, Phenomena connected with, 575
Abney (Capt. W. de W., F.R.S.), Sunlight Colours, 498
Abnormal-Toed Cats, Heredity in, William White, 125; E. W. Claypole, 345; Dr. H. A. Hagen, 345; J. Herbert Hodd, 53
Abnormal *Hirudo medicinalis*, an, R. J. Harvey Gibson, 392
Abnormalities in the Vertebral Column of the Common Frog, Prof. C. Lloyd Morgan, 53
Abnormality in the Urostyle of the Common Frog, Prof. C. Lloyd Morgan, 344
Aboriginal Art in California and Queen Charlotte's Island, Dr. W. J. Hoffman, 285
Abrahall (Rev. John Hoskyns-), Meteors, 29
Acclimatisation of Flat-fish in American Waters, 473
Accumulators, Complete Hand-book on the Management of, Sir David Salomons, 603
Acetonuria in Children, 551
Acland (Dr., F.R.S.), Address to the General Medical Council, 375
Acoustics, Hand-book of, T. E. Harris, 270
Actinometric Observations, 263
Action, Instinctive, 392
Adams (Prof. J. C., F.R.S.), Values of Logarithms, 381
Adam's Peak, on the Peculiar Sunrise Shadows, Hon. R. Abercromby, 94
Adelaide University, Sir W. W. Heughes's Contribution to the, 255
Aden, Earthquakes at, 593
Aërated Water, on some Phenomena connected with the Freezing of, George Maw, 325
Aërial Eddies, Experiments on, 382
Aërial Vortices, 551
Aërial Vortices and Revolving Spheres, Experiments on, Ch. Weyher, 514
Affinity, Residual, Valency and, Prof. H. E. Armstrong, F.R.S., 570, 596
Afghan Delimitation Commission: Botany of the, W. Botting Hemsley, 173; Geographical Results achieved by the Survey Officers in the, 309; Fauna and Flora of the, J. E. T. Aitchison, 381
Africa: Don Manuel Iradier's Explorations in Africa, 182; Return of the Portuguese African Expedition, 182; Botany of South, 158; Study of the Coasts of North, Dr. Theobald Fischer, 353; Dr. Lenz's Map of the Congo, 354; Pygmy Tribes in, 497; My African Home, Eliza Whigham Feilden, 221
Aino Hairiness and the Urvolk of Japan, F. V. Dickins, 534
Air, the Coefficient of Viscosity of, Herbert Tomlinson, 165
Air, Compressed, Transmission of Power by, 272
Air, Resistance of, Dr. Thiesen, 408
Air, Movements of the, M. Ch. Weyher, 431
Air, some New Micro-organisms obtained from, G. C. Frankland and Dr. Percy F. Frankland, 477
Air-free Column of Water, Cohesion of an, Prof. Helmholtz, 456
Airy (Sir G. B., F.R.S.): on the Earlier Tripos of the University of Cambridge, 397; on the Establishment of the Roman Dominion in South-East Britain, 562
Aitchison (J. E. T.), Fauna and Flora of the Afghan Boundary, 381
Alaska and the Seal Islands, an Arctic Province, Henry W. Elliott, 243
Alaska, Alpine Region of, Lieut. H. Seton-Karr, 475
Albumen-precipitate with Salt, 455
Albumen, Serous, Prof. Kronecker on, 504
Albuminous Substances, Alimentary Values of Various, Prof. Zuntz, 480
Alcock (Surgeon-Major Nathl.), Life-Energy, or the Dynamics of Health and Disease, 366
Alcohol, How to make Colourless Specimens of Plants to be preserved in, Prof. Hugo de Vries, 149; Selmer Schönland, 173
Alcohol, Effect of, on Metastasis in Man, 383
Alcohol, Clausius's Characteristic Equation for Substances applied to Messrs. Ramsay and Young's Experiments on, Prof. Fitzgerald, 574
Alcyonaria and Pennatulæ at the Arago Laboratory, 431
Alexander (Prof. W. D.), Kilauea after the Eruption of March 1886, 451
Alge, Classification of the, and Genetic Affinities, Alfred W. Bennett, 478
Algebraic Forms with p Variables, on the Theory, M. R. Perrin, 335
Algebraic Notation of Kinship, Prof. Alex. Macfarlane, 126
Algeria, Artesian Wells in, M. de Lesseps, 287, 336
Algiers Observatory, the, 16

- Algol-Type Variable, the New, Mr. Chandler, 329
 Alimentary Values of Various Albuminous Substances, Prof. Zuntz, 480
 Alkaline Solutions, Electrolysis of, M. Duter, 382
 Alkaline Vanadates, Study of the, M. A. Ditte, 600
 Allen (Alfred H.), Commercial Organic Analysis, Dr. C. R. Alder Wright, 293
 Alloys, Moduli of, 333
 Alloys, Chemical of Metals and, Prof. W. Chandler Roberts-Austen, F.R.S., 106
 Alpine Flora surviving in the Paris District, 431
 Alpine Region of Alaska, Lieut. H. Seton-Karr, 475
 Alpine Winter and its Medical Aspects, A. Tucker Wise, 170
 Alps, Australian, on some Further Evidence of Glaciation in the, James Stirling, 182
 Altai Mountains, an Ice Period in the, E. Michaelis, 149; A. Bialoveski, 513
 Alumina, Red Fluorescence of, 455, 527; Crimson Line of Phosphorescent, William Crookes, F.R.S., 310
 Amateurs, Practical Dynamo-Building for, Fred. W. Walker, 294
 America: American Journal of Science, 16, 93, 141, 237, 380, 451, 524, 621; American Journal of Mathematics, 28, 99, 477; Early Chinese Intercourse with America, Dr. W. H. Dall, 58; Industrial and High Art Education in the United States, J. Edwards Clarke, W. Odell, 97; Education of Women in, 229; American Society for Psychical Research, 281; Present Position of Science in the Secondary Schools of America, Pres. Eliot, 375; American Meteorological Journal, 376, 568; American Journal of Psychology, 400; American Association for the Advancement of Science, 444; Acclimatisation of Flat-fish in American Waters, 473; Prehistoric Remains in America, 476; American Geographical Society, 497; American Naturalist, 518; American Whitefish (*Coregonus albus*) at Burghley Park, 546; Restocking Streams in America, 546; American Exhibition, 612. See also United States.
 Amides, Decomposition of, by Water and the Diluted Acids, 144
 Ammonia, Caseine-like Substance obtained by the Addition of Hydrogen-Peroxide to White of Eggs, heated with, 576
 Ammoniacal Decomposition of Urine, Dr. W. R. Smith, 404
 Ammoniac-Magnesian Phosphate, M. Berthelot, 119
 Anatomical Society of Berlin, 517
 Anatomy, Comparative, of Vertebrates, Robert Wiedersheim, W. Newton Parker, 121
 Anatomy of the Madreporian Coral Fungia, G. C. Bourne, 404
 Anatomy, a Work on, in Chinese, 568
 Ancient History, Studies in, comprising a Reprint of "Primitive Marriage," J. Ferguson McLennan, Dr. W. Robertson Smith, 3
 Ancient Monuments Act, 518
 Anderson (W.), on the Conversion of Heat into Work, 387
 Andree (Herr Richard), Cannibalism and its Prevalence in Ancient and Modern Times, 350
 Andrews (Thos.), Pyrometers and Fusion-Points, 224
 Andromedes, the, November 27, 1886, P. F. Denza, 231
 Ångström (Knut), Sur une nouvelle Méthode de faire des Mesures absolues de la Chaleur rayonnante, 580
 Anhydrous Oxides, on the Action of the Chloride of Carbon on the, M. Eug. Demarçay, 288
 Animal Heat, Action of Glycose in Development of, A. Chauveau, 291
 Animal Life, Apparatus for studying the Influence of Pressure on, 444
 Animal Mechanics, Dr. B. W. Richardson, F.R.S., 57
 Animal Organism, Respecting the Active Oxygen in the, Dr. Gad, Dr. Wurster, 383
 Animals, Wild, Photographed and Described, J. Fortuné Nott, 220
 Animals, Geographical and Geological Distribution of, Angelo Heilprin, 510
 Annalen der Physik und Chemie, 333
 Annales de l'Institut Pasteur, 376
 Annam, Notes on, 206
 Annuaire of the Royal Observatory of Brussels, 351
 Antananarivo Annual and Madagascar Magazine, 497
 Antarctic Ocean, on the Distribution of the Temperature in the, J. Y. Buchanan, 516
Antedon rosacea, the Supposed Myzostoma-Cysts in, Dr. P. Herbert Carpenter, F.R.S., 535
 Anthropoid Apes, 383; Embryogeny of the, J. Deniker, 509
 Anthropology: Horatio Hale on the Origin of Language and the Antiquity of Speaking Man, 17; Dr. Colin on the Population of Bambouk, 22; M. Topinard on the Simian Characters of the Naulette Jaw, 22; M. de Quatrefages on Prehistoric Man, 23; M. Cartailhac, on the Human Bones found in France in Quaternary Caverns, 23; Anthropological Institute, 95, 143, 358, 431, 453, 503; Journal of the, 422; Les Ages Préhistoriques de l'Espagne et du Portugal, Emile Cartailhac, 244; Anthropological Society of Bombay, 328; General Pitt-Rivers's Anthropological Collection at Oxford University Museum, 349; Observations in Anthropology, by Dr. Ten Kate, 357; Revue d'Anthropologie, 357; Sociology of the Australian Races, 357; Anthropological Discovery in the Valley of Rebas, Prof. Miguel Marazta, 379; Histoire Générale des Races Humaines, A. de Quatrefages, 389; Anthropological Find in Belgium, 405; Ethnological Collection presented by Lieut. Quedenfeldt to the Anthropological Society of Berlin, 423; French Translation of Cæsar Lombroso's "Uomo Delinquente," 423
 Antifebrine, Dr. Weill, 445
 Antimony, Tartrate of, M. Guntz, 528
 Anti-Phylloxeric Disinfection of the Grape Vine, 382
 Antiquities of Spain and Portugal, M. Emile Cartailhac, 244
 Antituberculous Vaccination, 144
 Ants, Habits of, Sir John Lubbock, 518
 Apes: an Anthropoid Ape, 383; Embryogeny of the, J. Deniker, 509; the Lumbar Curve in Man and Apes, Prof. Cunningham, 46; Domestication of Apes, 495
 Aphides, Notes on the Recent Swarming of, G. B. Buckton, F.R.S., 15
 Apochromatic Lenses, the Value of the New, 467
 Appalachia, 354
 April Meteors, W. F. Denning, 606
 Aquarium constructed for the Fisheries Exhibition, Sale of, 306
 Aquila, Lower Italy, Earthquake Shock in, 350, 376
 Arabia, South, Herr Glaser's Journeys in, 520
 Arago (François), Proposed Statue of, 84
 Arago Laboratory, Flourishing Condition of the Alcyonaria and Pennatulæ at, 431
 Arcetri, Observations of Nebulæ at, Wilhelm Tempel, 198
 Architects, Naval, Institution of, 538
 Arctic Province, an, Alaska and the Seal Islands, Henry W. Elliott, 243
 Arctic Species of Birds, Henry Seebohm on, 256
 Ardtun Leaf-beds, J. Starkie Gardner, 382
 Argentine General Catalogue of Stars, 113
 Arithmetic, Chemical, Sydney Lupton, 74
 Armagh Catalogue of 3300 Stars, Second, 159
 Armstrong (Prof. Henry E., F.R.S.): on the Nature of Solution, 64; Benzenoid Compounds, 407; Valency and Residual Affinity, 570, 596
 Army Candidates, Geometrical Drawing for, H. T. Lilley, 28
 Aroids, Walter Gardiner on, 454
 Aroko or Symbolic Letters, Specimens of, 422
 Aromatic Bodies, Preliminary Communication on the Action of certain, T. Lauder Brunton, M.D., F.R.S., and J. Theodore Cash, 599
 Aron (Dr.), Theory of the Inductionless Coils, 383
 Arrow-Release, Ancient and Modern Methods of, Edward S. Morse, 12
 Art and Science in a New Light, 250
 Artesian Well, Attempt to sink an, to obtain Hot Water at St. Augustine, Florida, 376
 Artesian Wells in Algeria, M. de Lesseps, 287
 Artesian Wells and New Oases created in the Wed Rir', South Algeria, 336
 Asamayama, the Active Volcano in Japan, 133
 Ashes of Cider, on the Composition of the, 382
 Asia, Central: Central Asian Commercial Company Koudrine in, 258; A. D. Carey's Journey in, 475; Journeys and Discoveries in, 547
 Asia, Russian Central, Proposed Administrative Changes in, 258
 Asiatic Society of Bengal, 474
 Asiatic Society, Calcutta, Annual Address to, 375
 Asiatic Symbolism, Study of, H. G. M. Murray-Aynsley, 327
 Aspects of Clouds, Robert James Reilly, 391

- Assam, History of the Province of, during the last Fifty Years, 422
- Association's "Geometry," the, Prof. Geo. Bruce Halsted, 557
- Asteroids, Comets and, Prof. Daniel Kirkwood, 474
- Astigmatism in the Eye, Influence of, on Astronomical Observations, Prof. Seeliger, 59
- Astronomy, Astronomical Theory of the Great Ice Age, W. H. S. Monck, 7; Sir Robert S. Ball, F.R.S., 53; Rev. E. Hill, 101; Astronomical Refractions, Herr Oppolzer's, 17; Binary Star γ Coronæ Australis, H. C. Wilson, 17; Binary Star δ Equulei, 401; Temple Observatory, 401; Brightness and Mass of Binary Stars, W. H. S. Monck, 402; Astronomical Column, 17, 37, 59, 85, 113, 134, 159, 181, 206, 231, 257, 282, 307, 329, 352, 377, 401, 424, 445, 474, 496, 546, 569, 595, 614; Astronomical Phenomena for the Week, 18, 37, 59, 86, 113, 135, 160, 181, 207, 232, 258, 283, 308, 330, 353, 378, 402, 425, 446, 474, 497, 520, 546, 595, 614; Habenicht on the Morphology of the Kosmos, 35; the Leander McCormick Observatory, 35; New Map of the Moon, 58; Influence of Astigmatism in the Eye on Astronomical Observations, Prof. Seeliger, 59; Gould's Astronomical Journal, 59; Ten Years' Progress in Astronomy, Prof. C. A. Young, 67, 86, 117; Spectroscopic Method of Determining the Distance of a Double Star, A. A. Rambaut, 206; Comet Barnard (1886 *f*), 207; T. W. Backhouse, 224; Prof. A. Riccò, 296; Discovery of a New Comet (Barnard 2), 402; Comet Barnard (1887 *c*), Prof. S. Weiss, 352; Dr. H. Oppenheim, 424; Comet 1887 *d* (Barnard, February 15), Prof. Boss, 424, 446; Names of Minor Planets, 207, 402; New Minor Planet, Prof. C. H. F. Peters, 282; Observations of the Minor Planets, 312; Minor Planet No. 264, 353; Minor Planet No. 265, M. Bigourdan, 474; New Minor Planet, Herr Palisa, 425; Comet Finlay (1886 *e*), Dr. J. Holetschek, 207; Meteor, 224; Meteor of December 28, 1886, W. F. Denning, 248; the Andromedes, November 27, 1886, P. F. Denza, 231; Reduction of the Positions of Close Polar Stars from one Epoch to another, Prof. W. A. Rogers and Miss Anna Winlock, 231; Six Inner Satellites of Saturn, Prof. Asaph Hall, 257; Stellar Parallax, Prof. Asaph Hall, 258; Bright Lines in Stellar Spectra, O. T. Sherman, 378; Astronomical Prizes of the Paris Academy of Sciences, 258; Madras Observatory, Mr. Pogson, 282; New Method for the Determination of the Constant of Aberration, M. Lœwy, 282, 424, 431; M. Houzeau, 377; New Variables in Cygnus, Dr. Gould, 282; New Variables, S. C. Chandler, 307; the New Algol-Type Variable, Mr. Chandler, 329; Gore's Variable near χ^1 Orionis, Dr. G. Müller, 329; Probable New Variable, 402; Three New Comets, 307; Washington Observatory, 308; Revue Mensuelle d'Astronomie populaire de Météorologie, et de Physique du Globe, 310; Photography the Servant of Astronomy, Edward S. Holden, 317; Progress of Astronomical Photography, 321; the Southern Comet, 329, 438; a Short Method for Computing Refractions, M. Schaeberle, 329; Celestial Motions, W. T. Lynn, 350; Comet Brooks (1887 *h*), Dr. Rud. Spitaler, 352, 424, 496; Minor Planet No. 262, 497; Harvard College Observatory, 497; Mr. Peek's Report on Rousdon Observatory, 353; Application of Photography to the Determination of Stellar Parallax, Prof. Pritchard, 377; Alleged Ancient Red Colour of Sirius, Mr. Lynn, 378; Observations of Variable Stars in 1885, Edward Sawyer, 378; Note on the Origin of Comets, 381; Harvard College Observatory, Prof. Pickering, 424; Solar Activity in 1886, Prof. Tacchini, 445; Warner Observatory, Lewis Swift, 446; Tails of the Comets of 1886, Prof. Th. Bredichin, 474; Comets and Asteroids, Prof. Daniel Kirkwood, 474; Paris Astronomical Congress, 584; Homeric Astronomy, A. M. Clerke, 585, 607; U.S. Naval Observatory, 595; Researches on the Sun's Diameter, Prof. Di Legge, 595; Liverpool Astronomical Society, 402; Telegraphic Determination of Australian Longitudes, 474; Researches on the Diameter of the Sun, Herr Auwers, 496; the Parallax of Σ 1516, M. O. Struve, 546; Baron D'Engelhardt's Observatory, 546; New Red Star, 546; Orbit of the Binary Star 14 (*i*) Orionis, J. E. Gore, 569; Washington Observatory, Capt. R. L. Phythian, 569; Names of Minor Planets, 569; Barnard's First and Second Comets 1887, 614; Probable Re-discovery of Hesperia, 614; Ellipticity of Uranus, 614; Washington Observatory, 614; Paris Conference, 614
- Atkinson (W. N. and J. B.), Explosions in Coal-Mines, Prof. T. E. Thorpe, F.R.S., 1
- Atlantic Weather Charts, 469
- Atlantic, Purity of the Air of, 595
- Atlantica, Spolia, 603
- Atom, Electric Charge on the, A. P. Laurie, 131
- Atomic Weights of Elements, 612
- Atmosphäre, Grundzüge einer Theorie der kosmischen Atmosphären mit Berücksichtigung der irdischen, 389
- Atmosphäre, New Method for Quantitative Estimation of Micro-organisms in, Dr. P. F. Frankland, 188
- Atmosphere, on the Direct Fixation of the Gaseous Nitrogen of the, by Vegetable Soils, M. Berthelot, 335
- Atmosphere, Direct Fixation of the Gaseous Nitrogen of the, 479
- Atmosphere of β Lyrae, O. T. Sherman, 451
- Atmosphere, Movements of the, 479; M. Faye, 455
- Atmospheric Movements in Connection with Colladon and Lasné's Cyclonic Theories, 527
- Atmospheric Oxidation, Note on the Development of Voltaic Electricity by, C. R. Alder Wright, F.R.S., 598
- Atmospheric Temperature in Germany, 504
- Auk, the, 204
- Aurora, Prof. F. Hahn, 8; Dr. M. A. Veeder, 54, 126, 272
- Aurora Borealis: Display of, at Thronhjelm in Norway, 112; M. S. Lemström, A. M. Clerke, 433; in Northern Sweden, 443
- Australia: Australian Earthworms, J. J. Fletcher, 95; on some Further Evidence of Glaciation in the Australian Alps, James Stirling, 182; the Gould Collection of Australian Birds at Philadelphia, 204; Native Plants of Australia, 205; Baron von Mueller, on the Acacias (Wattles) of, 282; Sociology of the Australian Races, 357; Manual of Physical Geography of Australia, H. Beresford de la Poer Wall, 389; Bee-hives discovered in a Gigantic Eucalyptus-Tree in, 423; Relief of the Australian Mediterranean, Dr. Otto Krümmel, 447; Telegraphic Determinations of Australian Longitudes, 474; Catalogue of Minerals in the Australian Museum, 485; Australian Rabbit, 569
- Australasian Association for the Advancement of Science, 228
- Austria, Ice Cavern in, Discovery of, 17
- Autographometer, Floran de Villepigne, 444
- Autumnal Flowering, Dr. Maxwell T. Masters, 11
- Avifauna of the Western Spur of the Pamir Plateau, V. Bianchi, 328
- Awaruite, Oktibehite or, Dr. Jas. Hector, F.R.S., 513
- Axolotl, the, *in sicco*, 16
- Ayrton (Prof. W. E.) and Prof. John Perry, Experiment to show that Capacity varies inversely as a Thickness of the Dielectric, 526; Note on Magnetic Resistance, 526; Practical Electricity, 601
- Azines, New Method of producing, 384
- Babington (Dr. Churchill), Birds of Suffolk, 193
- Bacillus, Luminous, 383
- Bacillus, Swamp Fever and, 405
- Backhouse (T. W.), Barnard's Comet, 54, 224
- Backlund (Herr), Mass of Mercury, 85
- Bacteria, on Staining, 404
- Baert (Lieut.), Journey up the Mongalla, 446
- Baginski (Dr. A.), Acetonuria in Children, 551
- Bagshot Beds of the London Basin, Physical History of, Rev. A. Irving, 382
- Bahamas, a Balanoglossus Larva from the, W. F. R. Weldon, 477
- Bailey (E. H. S.), and Edward L. Nichols, the Sense of Smell, 74
- Bailey-Denton (T.), Ten Years' Experience in Works of Intermittent Downward Filtration, 195
- Baird's (Prof.) Annual Report of the Smithsonian Institution, 372
- Baker (J. G.), Flora of Leicestershire including the Cryptogams, 411
- Baku, Outburst of Natural Naphtha Fountain at, 352
- Balanoglossus Larva from the Bahamas, a, W. F. R. Weldon, 477
- Baldness in the United States, 595
- Balfour (Prof. Bayley): Botanical Lecture Experiment, 126; Ginger-Beer Plant, 358
- Ball (John, F.R.S.), Notes of a Naturalist in South America, 529, 553

- Ball (Sir Robert S., F.R.S.), Astronomical Theory of the Great Ice Age, 53
- Ballistic Galvanometer and Earth Inductor, Determination of Coefficients of Mutual Induction by means of the, R. H. M. Bosanquet, 478
- Ballooning, War and, Eric S. Bruce, 259
- Banbury, Remarkable Meteor near, 58
- Bareggi (Dr.), Experiment on Rabies, 422
- Barley, Examination of Specimens of Injured, Miss Ormerod's Observations on, 256
- Barnaby (Sir Nathaniel), on the Connexion between the Royal Navy and the Merchant Service, 538
- Barnard, Comets, 59; T. W. Backhouse, 54, 224; Prof. Cacciatore, 181; Dr. Wentworth Erck, 198; at Perihelion, Prof. A. Riccò, 296; Comet (1886 *f*), 207; Dr. Oppenheim, 85; Dr. Aug. Svedstrup, 134; Comet (1887 *c*), Prof. E. Weiss, 352; Dr. H. Oppenheim, 424; Comet (1887 *d*), Prof. Boss, 424, 446; (Barnard 2), Discovery of a New Comet, 402; Second Comet, John I. Plummer on, 583; Barnard's First and Second Comets 1887, 614
- Barnard and Finlay, Comets, 17
- Barograph, Dr. Sprung, 456
- Barometer, on the Determination of the Air in the Vacuum of the, Dr. Pernet, 72
- Barometer free of Air, New Method of Filling, 432
- Barometers, Comparison of, Dr. Pernet, 600
- Barometric Readings, Low, Henry F. Blanford, 344
- Barometric Readings, Influence of Wind on, Prof. Cleveland Abbe, 29; G. J. Symonds, F.R.S., 53
- Barrett (Prof. W. F.), Physical Properties of Manganese Steel, 311
- Batavia, Zoological Station at, 376
- Bateson (Anna) and Prof. Francis Darwin, F.R.S., on the Effect of certain Stimuli on Vegetable Tissues, 429
- Bathy-orographical Chart of the Clyde Sea-Area, 334
- Batten (Dr. Rayner W.), Physical Training of Girls, 495
- Battery, Water, Henry A. Rowland, 452
- Bauxite Deposits in the South-East of France, on the Age of the, 383; M. L. Collet, 288
- Beam-Trawling, Fishery Board of Scotland and, 257
- Beaumont (W. Worby), Sounding a Crater, Fusion-Points, Pyrometers, and Seismometers, 296
- Beaver stated to be extinct in Northern Norway, 112
- Beckley (Mrs. E. M.), Hawaiian Fishing-Implements and Methods of Fishing, 327
- Béclard (Prof.), Statistics of the Number of Female Medical Students in Paris, 306; Death of, 375
- Beccquerel (Edmond), Action of Manganese on Phosphorescent Quality of Carbonate of Lime, 168
- Beds of Chert in the Carboniferous Limestone of Yorkshire, on the Character of the, Geo. J. Hinde, 582
- Bee, Cell of the Honey-, Geometrical Construction, Prof. H. Hennessy, F.R.S., 502
- Bee-hives discovered in a Gigantic Eucalyptus-Tree in Australia, 423
- Beeby (W. H.), Flora of Shetland, 474
- Beetle in Motion, the, 29; Prof. C. Lloyd Morgan, 7; A. Wilkins, 414
- Beetroot, on the Destruction of Nematodes, 455
- Beetroot-Sugar, Production of, in the U.S., 351
- Begonia Veitchii*, Abnormal, 430
- Beira Alta, Earthquake in District of, 59
- Belgium, Ornithological Observations in, 423
- Bell (Louis), on the Absolute Wave-length of Light, 524
- Belladonna and Opium, Action of, in a Case of Acute Diabetes, 407
- Bengal, Eastern, Letters on Sport in, Frank B. Simson, 388
- Bengalis, Use of, in the Geological Survey of India, H. B. Medlicott, 472
- Ben Nevis Observatory, 517; Amount of the Rainfall at, 257; Rainband Observations at the, A. Rankin, 588
- Benn (T. G.), the Climate of Carlisle, 95
- Bennett (Alfred W.), Genetic Affinities and Classification of the Algæ, 478
- Bentham (Geo., F.R.S.), Hand-book of the British Flora, 341
- Bentley (Prof.), Manual of Botany, 350
- Benzenoid Compounds, Henry Armstrong, F.R.S., 407
- Béresófsky (M.), MM. Potanin, Skassy, and, Return of, from their Expedition to China and Mongolia, 309
- Beri-beri, the Disease, 206
- Berlin: Academy of Sciences, Grants for Zoological Research, 473; Proceedings of Anthropological Society, 496; Chemical Society of, 552; Opening of Ethnological Society, 180; Geographical Society, 60; Verhandlungen of the, 520; Meteorological Society of, 24, 71, 360, 455; Physical Society of, 24, 72, 264, 336, 408, 432, 456, 552, 600; Physiological Society, 264, 383, 455, 480, 504, 551, 576
- Bert (Paul): Obituary Notice of, 54; Proposed Memorial of, 84; First Year of Scientific Knowledge, 221; One of his Last Letters, 255
- Berthelot (M.): on Ammoniac-Magnesian Phosphate, 119; on the Direct Fixation of the Gaseous Nitrogen of the Atmosphere by Vegetable Soils, 335
- Berthelot and André, the Decomposition of Bicarbonate of Ammonia by Water, and Diffusion of its Components through Atmosphere, 23
- Bialoveski (A.), Ice-Period on the Altai Range, 513
- Bianchi (V.), the Avifauna of the Western Spurs of the Pamir Plateau, 328
- Bicarbonate of Soda, Production of, 624
- Bichloride of Copper, Combination of Orthotoluidine and, 383
- Bichromate of Soda Cell, 381
- Bicycles and Tricycles for the Year 1886, H. H. Griffen, 52
- Bidwell (Shelford): Electrical Resistance of Suspended Copper and Iron Wires, 526; Lecture Experiment in Self-Induction, 526
- Bigourdan (M.), Minor Planet No. 265, 474
- Bilobites, Striated, 407
- Binary Stars: γ Coronæ Australis, H. C. Wilson, 17; δ Equulei, 401; Orbit of the Binary Star 14 (*i*) Orionis, J. E. Gore, 569; Brightness and Mass of Binary Stars, W. H. S. Monck, 402
- Biology: Proposed Biological Societies for London and Liverpool, 180; W. Baldwin Spencer appointed to the Melbourne University Chair of, 280; General Biology, W. T. Sedgwick and Edmund B. Wilson, 413; Injurious Fungi in California, 521; Fertilisation of *Cassia marilandica*, 521; Variations in the Nerve-Supply of the Lumbricales Muscles in the Hand and Foot, with some Observations on the Perforating Flexors, 521; Biological Notes, 521; Elementary Practical Biology—Vegetable, Thos. W. Shore, 556
- Birch (G. J.), on a Perspective Microscope, 358
- Bird (Charles), Lecture Notes and Problems on Sound, Light, and Heat, 52
- Birds: Siberian, presented by Mr. Seebohm to Natural History Museum, 15; Dispersion of Plants by Birds, D. Morris, 151; Birds of Suffolk, Dr. Churchill Babington, 193; the Gould Collection of Australian Birds at Philadelphia, 204; the Birds of Central Asia, 204; Types of Birds in the Vienna Natural History Museum, 204; Arctic Species of, Henry Seebohm on, 256; Morphology of, Prof. W. K. Parker, F.R.S., 331; Mechanism of the Flight of Birds, studied by Chronophotography, M. Marey, 335; Morphology of the Wings of, 599; Movement of a Bird's Wing, represented according to the Three Dimensions of Space, M. Marey, 382; Birds' Nests and Eggs, H. Seebohm, 236
- Birmingham, Mason Science College, 494
- Birnbaum (Dr.), Death of, 444
- Birth-rate, on the Decline of, in France, 357
- Bischoffsheim Observatory, the Great Refracting Telescope of the, 84
- Bishop's Ring in Colorado, Disappearance of, G. H. Stone, 581
- Black (Dr. W. J.), Ozone Papers in Towns, 76
- Blake (Dr. James), on the Connexion between Chemical Constitution and Physiological Action, 6
- Blanford (Henry F.), Low Barometric Readings, 344
- Blaschko (Dr.), Structure of the Epidermis, 551
- Blastoidea, the, Robert Etheridge and P. Herbert Carpenter, 267
- Blight and Mildew on Fruit in the U.S., 422
- Blomefield (L.), Vitality of Seeds, 463
- Blood, Influence of Extremes of Temperature on the Colour of the, 576
- Blue Hill Meteorological Observatory, U.S., 472
- Boas (Dr. Franz), Indian Tribes of British Columbia, 568
- Boehmer (G. H.), Norse Naval Architecture, 445
- Bohemia, Nationalities of, 518
- Boileau (Major-Gen. J. T., F.R.S.), Death of, 57, 84; Proposed Memorial to, 84

- Bois (H. du), Earthquakes, 8
 Bolivia, Thour's Exploration of, 231
 Bollettino of the Italian Geographical Society, 403, 446
 Bolton (Sir Francis), Death of, 255
 Bolton (Thomas), Civil List Pension to, 204
 Bombay, Technical School at, 206
 Bonney (Prof. T. G., F.R.S.): Volcanic Dust from New Zealand, 56; Volcanic Eruption in Niua-Fu Friendly Islands, 127; Notes on the Structure and Relations of some of the Older Rocks of Brittany, 550; Oldhamia, 581
 Börnstein (Prof.), Investigations into Thunderstorms of July 1884, 24
 Borodin (M. Alexander), Death of, 473
 Borzi, (Prof. A.), *Nostoc ellipsosporum*, 594
 Bosanquet (R. H. M.), Determination of Coefficients of Mutual Induction, by means of the Ballistic Galvanometer and Earth Inductor, 478
 Boscovich (Father), Centenary of the Death of, 375
 Boss (Prof.), Comet 1887 *d* (Barnard, February 15), 424, 446
 Botany: Unpublished Drawings by G. J. Camelli, 34; British Fungi, Hymenomyces, Rev. John Stevenson, 4; Autumnal Flowering, Dr. Maxwell T. Masters, 11; Botanical Lecture Experiment, Prof. Bayley Balfour, 126; *Rogeria longiflora*, 158; *Entyloma Ranunculii*, Prof. H. M. Ward, 166; Hermann's "Ceylon Herbarium" and Linnaeus's "Flora Zeylanica," Dr. H. Trimen, 166; Narcissi, G. Maw, 166; Botany of the Afghan Delimitation Commission, W. Botting Hemsley, 173; the Honzo Dsufu work on Botany, 204; Native Plants of South Australia, 205; Botanical Federation in the West Indies, D. Morris, 248; Baron von Mueller on the Acacias (Wattles) of Australia, 282; Hand-book of the British Flora, Geo. Bentham, F.R.S., 341; the Crocus, Geo. Maw, 348; Manual of Botany, Prof. Bentley, 350; Report on the Botanical Garden, Saharunpur, Mr. Duthie, 356; Botanical Discoveries in the Tombs of Egypt, 405; Blight and Mildew in the U.S., 422; *Begonia Veitchii* abnormal, 430; Lemons irregularly developed, 430; *Primula imperialis*, 430; Wild White Daffodil, 430; Addition of a Commercial Laboratory to the Botanical Museum of Hamburg, 473; Dr. Urban's Proposed Botanical Investigation of the Higher Mountains of St. Domingo, 494; Thos. Moore's Botanical Collections acquired for the Herbarium, Kew Gardens, 495; on some Observations on Palaeobotany in Goebel's "Outlines of Classification and Special Morphology of Plants," Prof. W. C. Williamson, F.R.S., 535; Botanic Garden of Glasgow, 545; Hand-book of Practical Botany for the Botanical Laboratory and Private Student, Prof. E. Strasburger, 556; on the Term "Latex" in, M. A. Trécul, 600
 Bouinai (A.) and A. Paulus, La France en Indo-Chine, 221
 Bourgeois (M. L.), Preparation of a Silicostannate of Lime corresponding to Sphene, 335
 Bourne (G. C.), Anatomy of the Madreporian Coral Fungia, 404
 Boys (C. Vernon): Preliminary Note on the Radio-Micrometer, 549; on the Production, Preparation, and Properties of the Finest Fibres, 575
 Brain: Prof. T. Jeffery Parker, 208; on the Nomenclature of the, Dr. Wilder, 255; Functional Topography of the, Prof. Ferrier, F.R.S., 453
 Braun (Dr. C.): Kalocsa Observatory, 59; Sunspot Observations in Hungary, A. M. Clerke, 227
 Brazil: Longitudes in, Admiral E. Mouchez, 100; the Birds of, 204
 Bredichin (Prof. Th.), Tails of the Comets of 1886, 474
 Bright (Sir Chas. T.), Electric Telegraph, 282
 Brines, on Ice and, J. Y. Buchanan, 608
 Bristol University College, Reduction of the Salaries of the Professors, 326; Albert Fry on, 345
 Britain, Natural History, its Rise and Progress in, Prof. Alleyne Nicholson, 148
 Britain, South-East, on the Establishment of the Roman Dominion in, Sir G. B. Airy, F.R.S., 562
 British Association and Local Scientific Societies, 78; Principal Officers for the Manchester Meeting, 471
 British Columbia, Indian Tribes of, Dr. Franz Boas, 568
 British Flora, Hand-book of the, Geo. Bentham, F.R.S., 341
 British Fossils, Catalogue of, Prof. Morris's, 158
 British Fungi, Hymenomyces, Rev. John Stevenson, 4
 British Fungi, Text-book of, W. D. Hay, 364
 British International Polar Expeditions, 147
 British Islands, Coleoptera of the, Rev. W. W. Fowler, 531
 British Medical Journal, Dr. Rayner W. Batten on Physical Training of Girls, 495
 British Museum, Catalogue of Fossil Mammalia in the, Rich. Lydekker, 532
 British Stalk-eyed Crustacea and Spiders, F. A. A. Skuse, 532
 Brittany, Notes on the Structure and Relations of some of the Older Rocks of, Prof. T. G. Bonney, F.R.S., 550
 Broeck (E. Van den) and A. Rutot, Observations nouvelles sur le Tufeau de Ciplly and sur le Crétacé supérieur du Hainault, 317
 Brooks, Comet (1887 *b*), Dr. Rud. Spitaler, 352, 424, 496
 Brouardel (M. J.), elected Dean by the Medical School of Paris, 422
 Brown (J.), Theory of Voltaic Action, 142
 Brown (J. Allen), Discovery of Palaeolithic Workshop Floor of Drift Period near Ealing, 189; Palaeolithic Man in North-West Middlesex, 554
 Brown-Séguard (Dr.), Experimental Researches connected with Cerebral Functions, 47; elected President of the Society of Biology, Paris, 544
 Bruce (Eric S.), War and Ballooning, 259
 Brunton (T. Lauder, M.D., F.R.S.): Action of Caffein and Theine upon Voluntary Muscle, 599; and J. Theodore Cash, Contributions to our Knowledge of the Connexion between Chemical Constitution and Physiological Action, Preliminary Communication on the Action of certain Aromatic Bodies, 599
 Brushes, on Two Jade-handled, Prof. J. P. O'Reilly, 318
 Brydges (Rev. Thos.), Curious Subdivision of Colour among the People of Onisn, 283
 Buchanan (J. Y.): Similarities in the Physical Geography of the Great Oceans, 33, 76; on the Distribution of the Temperature in the Antarctic Ocean, 516; on Ice and Brines, 608
 Buckland Museum, Fish-Hatching at, 400
 Buckton (G. B., F.R.S.), Notes on the Recent Swarming of Aphides, 15
 Budden (Dr. E.), To prove that only One Parallel can be drawn from a given Point to a given Straight Line, 92; Prof. O. Henrici, F.R.S., 100
 Buildings Bill, Sanitary Registration of, 282
 Bulletin de l'Académie des Sciences de St. Pétersbourg, 286, 310, 356
 Bulletin of the Belgian Natural History Museum, 423
 Bulletin de l'Académie Royale de Belgique, 404
 Bulletin of the Paris Geographical Society, 353
 Bulletins de la Société d'Anthropologie de Paris, 286
 Bulletins des Sciences Mathématiques, 452
 Bunge (Dr.), Success of his Expedition, 309
 Burch (Dr. Geo. J.), Further Experiments on Flame, 165
 Burgess (William), Red Worm, 445
 Burmah, Lower and Upper, Resources of, 378
 Butler (Philip J.), Lung-Sick, 54
 Butterflies of India, Lionel de Nicéville, H. J. Elwes, 436
 Cacciatore (Prof.), Barnard's Comet, 181
 Caddy (Mrs. Florence), Through the Fields with Linnæus, 579
 Cadmium, Chloride of, 551
 Cæcilians, Classification of the, 280
 Caffein, Action of, and Theine upon Voluntary Muscle, T. Lauder Brunton, F.R.S., 599
 Cairo: Earthquake at, 112; Walks in, Major E. T. Plunkett, 256
 Calcium, Phosphorescence of the Sulphuret of, 455
 Caldwell (W. H.), Embryology of Monotremata and Marsupialia, 524
 Calendar and General Directory of the Science and Art Department, 320
 Calico-Printing, the Palissy of, the Life and Labours of John Mercer, F.R.S., Edward A. Parnell, Prof. T. E. Thorpe, F.R.S., 145
 California: Injurious Fungi in, Prof. W. G. Farlow, 521; Floods in Southern, 376; Aboriginal Art in California and Queen Charlotte's Island, Dr. W. J. Hoffman, 285
 Calorimetric Bomb and Measurement of Heats of Combustion, 551
 Calorimetric Studies on Sick Children, 528

- Cambridge: Philosophical Society, 167, 454; Cholera Fungus, Dr. E. Klein, F.R.S., 171, 295; Chas. Roy, 223; Walter Gardiner, 271, 319; George Masee, 319; Edgar Crookshank, 344; on the Earlier Tripos of the University of Cambridge, Sir G. B. Airy, F.R.S., 397; University Local Examination Report, 494; University Local Lectures, 544
- Camelidae, the Phylogeny of the, 568
- Camelli (G. J.), his Collection of Drawings of Plants, 34
- Cameron (William), Death of, 180
- Cameron (Capt.), Lecture on Urua, 259
- Cameroons Territory, Estimate of the Native Population in the, 354
- Canadian Plants, Catalogue of, Prof. J. Macoun, 350
- Canadian Species, Hand-book of Zoology, with Examples from, Sir J. W. Dawson, F.R.S., 295
- Canal and River Engineering, David Stevenson, Major Allan Cunningham, 169
- Cannibalism and its Prevalence in Ancient and Modern Times, Richard Andree, 350
- Canoe, Discovery of a Prehistoric, 423
- Capacity, Specific Inductive, Note on, John Hopkinson, F.R.S., 334
- Cape Boxwood, 444
- Cape Horn, Temperature of, 568
- Carbon, on the Action of the Chloride of, on the Anhydrous Oxides, M. Eug. Demarçay, 288
- Carbonic Acid in the Ground, 230; in the Air, 406
- Carey (A. D.), his Journey in Central Asia, 475
- Carlisle, the Climate of, T. G. Benn, 95
- Carp, German; Importation of, 16; and the Acclimatisation of, 58
- Carpenter (Dr. P. Herbert, F.R.S.); the Supposed Myzostoma-Cysts in *Antedon rosacea*, 535; and Robert Etheridge, F.R.S., on the *Blastoidea*, 267
- Carr (G. S.), Elementary Results in Pure Mathematics, 292
- Carroll (Lewis), To find the Day of the Week for any given Date, 517
- Cartailhac (M.), the Human Bones found in Quaternary Caverns in France, 23
- Cartailhac (M. Emile), *Les Ages préhistoriques de l'Espagne et du Portugal*, 244
- Carter (August), Deformities among Fish, 230
- Carter (W. A.): the Axolotl *in sicco*, 16; Marine and Fresh-water Fishes, 472
- Casey (John), a Sequel to the First Six Books of the Elements of Euclid, containing an Easy Introduction to Modern Geometry, 28
- Cash (J. Theodore) and T. Lauder Brunton, F.R.S., Contributions to our Knowledge of the Connexion between Chemical Constitution and Physiological Action, Preliminary Communication on the Action of certain Aromatic Bodies, 599
- Cassagnes (G. A.), Steno-telegraphy, 192
- Cassia marilandica*, Fertilisation of, 521
- Cassiopææ, Prof. Colbert, 59
- Castilloa Rubber-tree of Central America, 142
- Catchpool (Edmund), Origin of Species, 76
- Cats with an Abnormal Number of Toes, Observations on Heredity in, Edward B. Poulton, 38; William White, 125; J. Herbert Hodd, 53; Dr. H. A. Hagen, E. W. Claypole, 345
- Caves, Prof. T. McKenny Hughes, 454
- Cecidomyia destructor* and Barley, Miss Eleanor Ormerod's Observations on, 256
- Cecil (Henry), Tabasheer, 437
- Celestial Motions, W. T. Lynn, 350
- Celestine, Recently-discovered Deposit of, H. G. Madan, 391; R. H. Solly, 414
- Cell, Bichromate of Soda, 381
- Cell of the Honey-bee, Geometrical Construction of the, Prof. H. Hennessy, F.R.S., 502
- Cells, Dry Portable, 331
- Censuses of France and Germany, Results of New, 281
- Centenary of the La Pérouse Expedition round the World, 443
- Centennial Exposition, New Orleans, Educational Exhibits and Conventions at the World's Industrial and Cotton, 245
- Centralblatt für Physiologie, 612
- Ceratochelys sthenurus* from Lord Howe's Island, Australia, Preliminary Note on the Fossil Remains of a Chelonian Reptile, Prof. Thos. H. Huxley, F.R.S., 615
- Cerebral Functions, Experimental Researches connected with, Brown-Séquard, 47
- Cerebral Localisation, Prof. E. A. Schäfer, F.R.S., 438, 464
- Ceylon: Tea-Planting in, T. C. Owen, 268; the Veddas of, 205
- Chaetopoda of the Firth of Forth, 544
- Chaffajon (M.), Exploration of the Orinoco, 446
- Chagos Archipelago Birds, Dr. Otto Finsch, 497
- Chalande (M. J.), Respiration in Myriapods, 288
- Chalæda, Metals and Minerals from, 359
- Chaleur rayonnante, Sur une nouvelle Méthode de faire des Mesures absolues de la, Knut Angström, 580
- Chalk beneath the London Clay of the London Basin, on the Water in the, Robert B. Hayward, F.R.S., 335
- Challenger Expedition: Zoological Results of the, 49; Report of the Scientific Results of the Exploring Voyage of the, 351
- Chancourtois (M.), Death of, 57
- Chandler (S. C.): New Variables, 307; the New Algol-Type Variable, 329
- Charleston Earthquake: Report on the, Prof. T. C. Mendenhall, 31; Influence upon the Health of the Inhabitants, 281; Capt. Dutton's Report on, 351
- Charts, Atlantic Weather, 469
- Chauveau (A.), Action of Glycose in Development of Animal Heat, 291
- Chelonian Reptile, Preliminary Note on the Fossil Remains of a *Ceratochelys sthenurus*, from Lord Howe's Island, Australia, Prof. Thos. H. Huxley, F.R.S., 615
- Chemistry: Chemical Constitution and Physiological Action, Connexion between, Dr. James Blake, 6; the Decomposition of Bicarbonate of Ammonia by Water and Diffusion of its Components through Atmosphere, Berthelot and André, 23; on Atomic Weight of Oxide of Gadolinium, A. E. Nordenskjöld, 47; Chemical Society, 70, 143, 358, 384, 407, 453, 503, 526; Anniversary Meeting of the, 536; M. Moissan's Researches on Isolation of Fluor, 71; Chemical Arithmetic, Sydney Lupton, 74; Experimental Chemistry, C. W. Heaton, 74; Chemical Physics, Prof. Josiah Parsons Cooke's, 100; Action of Manganese on the Phosphorescent Quality of Carbonate of Lime, Edmond Becquerel, 168; Old or New Chemistry, Which is Fittest for Survival? Samuel Phillips, 270; a Treatise on Chemistry, Sir H. E. Roscoe and C. Schorlemmer, 316; Principle of Maximum Labour and the Laws of Chemical Equilibria, 382; on the Coefficients of Chemical Affinity, 455; Recent Progress of Chemical Science, Dr. Hugo Müller, 536; Chemical Action of Light on Mixed Hydrogen and Chlorine Gas, Dr. Pringsheim, 552; a Question for Chemists, Wm. West, 584; Chemical Constitution and Physiological Action, Contributions to our Knowledge of the Connexion between, Preliminary Communication on the Action of certain Aromatic Bodies, T. Lauder Brunton, F.R.S., and J. Theodore Cash, 599
- Chert, on the Character of the Beds of, in the Carboniferous Limestone of Yorkshire, Geo. J. Hinde, 582
- Chevrel (M.), Medal presented to, 144; Resignation of his Membership of the Academy of Sciences, 255
- Chicago Manual Training School, 444
- China: Folk-Lore of, J. H. Stewart Lockhart, 281; Return of MM. Potanin, Skassy, and Bérésófsky from their Expedition to China and Mongolia, 309; Early Chinese Intercourse with America, Dr. W. H. Dall, 58; Best Mode of conveying Scientific Knowledge to the Chinese, 112; a Work on Anatomy in Chinese, 568; Animal Worship amongst the Chinese, 613
- Chinook Winds, M. W. Harrington, 568
- Chios, Earthquake at, 112, 158
- Chlorochromic Acid and the Phosphates of Sesquioxide, on the Action of Tetrachloride of Carbon on, M. H. Quantin, 335
- Cholera Fungus, Cambridge, Dr. E. Klein, F.R.S., 171, 295; Chas. Roy, 233; Walter Gardiner, 271, 319; George Masee, 319; Edgar Crookshank, 344
- Christiania Society of Science, 336
- Christie (W. H. M., F.R.S.), the Earthquake, 462
- Chrysalides, Gilded, Edward B. Poulton, 470
- Church (A. H.), Food-Grains of India, Prof. John Wrightson, 51
- Cider, on the Composition of the Ashes of, M. G. Lechartier, 382
- Cinnabar, Gold, and Associated Sulphides, Natural Solutions of, 524
- City and Guilds of London Institute, Distribution of Prizes, 158; *Conversazione*, 494

- Claim of Priority, a, V. Ventosa, 513
 Clarke (Dr. Hyde), Svastika Cross and Sun, 366
 Clarke (J. Edwards), Industrial and High Art Education in the United States, W. Odell, 97
 Classification of the Cæcilians, 280
 Clausius's Characteristic Equation for Substances applied to Messrs. Ramsay and Young's Experiments on Alcohol, Prof. William Ramsay and Dr. Sydney Young, 262, 346; Prof. Fitzgerald, 574
 Clayden (A. W.), on the Internal Capacity of Thermometers, 94
 Claypole (E. W.), Abnormal Cats' Paws, 345
 Cleland (Prof. John), Culminating Sauropsida, 391
 Clerke (A. M.): Sunspot Observations in Hungary, Carl Braun, 227; Aurora Borealis, M. S. Lemström, 433; Dr. K. R. Koch, 433; Homeric Astronomy, 585, 607
 Clifford (W. K., F.R.S.), Lectures and Essays, 270
 Climate of Northern Europe and the Gulf Stream, 91
 Climatology of the Croydon District, 14
 Clocks, Electricity and, T. Wilson, 173; Prof. Silvanus P. Thompson, 224; H. Dent Gardiner, 198, 231; "Horloge" on, 438
 Cloez (M. Ch.) and M. E. Grimaux, Erythrene, 288
 Cloud Knowledge, Modern Developments of, Hon. Ralph Abercromby, 575
 Clouds: Aspects of, Robert James Reilly, 391; on the Forms of, A. F. Osler, F.R.S., 164; Iridescent, Jas. C. McConnel, 533; G. H. Stone, 581; Nomenclature of, 406
 Clyde Sea-Area, Bathy-ographical Chart of the, 334
 Coahuila Meteorites, O. W. Huntingdon, 451
 Coal, on the Age of, found in the Region traversed by the Rio Grande del Norte, 380
 Coal-Dust Theory, W. Galloway, 222, 296, 343
 Coal-Mines, Explosions in, W. N. and J. B. Atkinson, Prof. T. E. Thorpe, F.R.S., 1
 Coasts of North Africa, Study of the, Dr. Theobald Fischer, 353
 Cobra, Death from the Bite of a, 111; Supposed Suicide of the, R. D. Oldham, 560
 Cochenille at Rodriguez, 179
 Cockroach, Structure and Life-History of the, L. C. Miall, 365
 Coco de Mer (*Lodoicea seychellarum*), Gen. Gordon's Collection illustrative of the, presented to Kew Gardens, 494
 Cod, Curious Knife found in the Thick Flesh of a, 545
 Cod-Fisheries (Norwegian), Japanese Mission to inquire into the, 158
 Codices, Mexican, Z. Nuttall, 307
 Coefficient of Mutual Induction of Two Coils, Method of measuring, Prof. G. Carey Foster, F.R.S., 143, 478
 Coefficient of Self-Induction, on the Determination of the, 551
 Coils, Inductionless, Dr. Aron, 383
 Coils, Method of measuring the Mutual Induction of Two, 478
 Colbert (Prof.), ζ Cassiopeia, 59
 Colchicine, Properties of, 408, 432
 Coleoptera, New Zealand, David Sharp, 177
 Coleoptera of the British Islands, Rev. W. W. Fowler, 531
 Colin (Dr.), on the Population of Bambook, 22
 Collections, National Science, 252, 272
 College of France, proposed Enlargement of the Buildings of the, 517
 College of Physicians, Edinburgh, proposed Establishment of a Laboratory for the Prosecution of Original Research, 399
 Colleges, University, Prof. Jowett, 441
 Collins (F. Howard): Herbert Spencer's Definition of Life, 487; Vitality and its Definition, 580
 Collot (M. L.), on the Age of the Bauxite Formation in the South-East of France, 288
 Colocasia, Disease of, in Jamaica, 478
 Colonial Conference, Sir Henry Holland, 544
 Colonial and Indian Exhibition, John R. Jackson, 16, 81, 225
 Colonial Science and Art Schools and the Department of Science and Art, 442
 Colorado, Disappearance of Bishop's Ring in, G. H. Stone, 581
 Colorado, Phenacite from, Sam. L. Penfield, 451
 Colour of the Blood, Influence of Extremes of Temperature on the, 576
 Colour-Hearing, 613
 Colour-Mixing Apparatus, Von Kries, Dr. König, 336
 Colourless Specimens of Plants to be preserved in Alcohol, how to make, Prof. Hugo de Vries, 149; Selmer Schönland, 173
 Colours of Metals and Alloys, Prof. W. Chandler Roberts-Austen, F.R.S., 106
 Colours, a Method of illustrating Combinations of, H. G. Madan, 513
 Colson (M. Albert), Erythrite, 288
 Colton (B. P.), Practical Zoology, 458
 Comets: Barnard's, 59; T. W. Backhouse, 54, 224; Prof. Cacciatore, 181; Dr. Wentworth Erck, 198; Prof. A. Riccò, 296; (1886 *f*), 17, 207; Dr. Oppenheim, 85; Dr. Aug. Svedstrup, 134; (1887 *e*), Prof. E. Weiss, 352; Dr. H. Oppenheim, 424; 1887 *d* (Barnard, February 15), Prof. Boss, 424, 446; First and Second of 1887, 614; Second of 1887, John I. Plummer, 583; Brooks (1887 *b*), 352; Dr. R. Spitaler, 424, 496; Finlay's 1886 *e*, 17, 59; Dr. Krueger, 85, 134; Dr. J. Holetschek, 207; Three New Comets, 307; Note on the Origin of Comets, 381; Discovery of a New, 1887 *d* (Barnard 2), 402; Tails of the Comets of 1886, Prof. Th. Bredichin, 474; the Southern, 329, 438; Comets and Asteroids, Prof. Daniel Kirkwood, 474
 Commercial Organic Analysis, Alfred H. Allen, Dr. C. R. Alder Wright, 293
 Compass in Iron Ships, Deviation of the, considered practically, W. H. Rosser, 473
 Compressed Air, Transmission of Power by, 272
 Conchology, J. C. Melvill on *Conus gloria maris*, 230
 Conder (Capt.), Translation of Hittite Inscriptions, 422
 Congo: Dr. Lenz's Exploration of, 232; his Map of the, 354; Rev. Geo. Grenfell's Exploration of the, 596; H. M. Stanley's, 615
 Conics, Pencils of, 477
 Connecticut Valley, Triassic Formation of the, 141
 Constant of Aberration, New Method of determining the, M. Lœwy, 253, 282, 407, 424, 431, 454, 479; M. Houzeau, 377
 Constants of Fluids, Dielectric, Prof. G. Quincke, 334
 Constitution of Matter, on certain Modern Developments of Graham's Ideas concerning the, Prof. T. E. Thorpe, F.R.S., 522, 547
 Continuity of the Liquid and Gaseous States of Matter, Preliminary Note on the, William Ramsay and Sydney Young, 262
Conis gloria maris, J. C. Melvill on, 230
 Cooke's (Prof. Josiah Parsons) Chemical Physics, 100
 Coombe Rock, Clement Reid on, 502
 Copper, the Higher Oxides of, 141
 Coral Reefs of the Solomon Islands, Dr. H. B. Guppy, 77
 Corea, Geology of, 518
Coregonus albus, American Whitefish at Burghley Park, 546
 Corona, Extension of the, Prof. S. P. Langley, 52
 Counterpoint, Harmony and, Elements of, F. Davenport, 339
 Cranial Nerves of a Human Embryo, 336
 Crater, Sounding a, Prof. John Milne, 152; Fusion-Points, Pyrometers, and Seismometers, Dr. H. J. Johnston-Lavis, 197; W. Worby Beaumont, 296
 Crayfish, Fresh-water, Green Gland of, 455
 Crimson Line of Phosphorescent Alumina, on the, William Crookes, F.R.S., 310
 Critical Temperatures of Nitrogen and Oxygen, 331
 Crocus, the, George Maw, 348
 Crommelin (A. C.), Invisible at Greenwich, 414
 Crookes (William, F.R.S.): on the Crimson Line of Phosphorescent Alumina, 310; on Radiant-Matter Spectroscopy, Examination of the Residual Glow, 425, 447
 Crookshank (Dr.), Flagellated Protozoa in Animals' Blood, 191
 Crookshank (Edgar), Cambridge Cholera Fungus, 344
 Cross as a Sun Symbol, Dr. Chas. R. Dryer, 345
 Croydon District, Climatology of the, 14
 Cruise of the *Marchesa*, F. H. H. Guillemard, 369
 Cruls (M.), Geographical Co-ordinates of Punta-Arenas, 382
 Crustacea of Singapore, 525
 Crustacea, British Stalk-eyed, and Spiders, F. A. A. Skuse, 532
 Cryptogams, Flora of Leicestershire, including the, J. G. Baker, 411
 Crystalline Elliptically-polarising Media, on Reflection at the Surface of, 333
 Crystallographic Notes, 141
 Crystals, Absorption of Light in, 312
 Culminating Sauropsida, Prof. John Cleland, 391

- Cunningham (Prof.), the Lumbar Curve in Man and Apes, 46
 Cunningham (Major Allan): Canal and River Engineering, David Stevenson, 169; Hydraulic Power and Hydraulic Machinery, H. Robinson, 460
 Current Sheets, on Ellipsoidal, Horace Lamb, F.R.S., 574
 Currents, North Atlantic, Experiments made to determine the Direction of the, Prince Albert of Monaco, 288
 Curvature, Critical Mean of Liquid Surfaces of Revolution, Prof. A. W. Rücker, F.R.S., 143
 Curve, Lumbar, in Man and Apes, Prof. Cunningham, 46
 Curves, Traube-Hering, 576
 Cutting of Polarising Prisms, on the, Prof. Silvanus P. Thompson, 184
 Cycling Budget, 231
 Cyclones, on the Relation between Tropical and Extra-Tropical, Hon. Ralph Abercromby, 430
 Cyclones and Concurrent Storms and Hurricanes, on the Relations that exist between, M. H. Faye, 599
 Cyclonic Storms, Central Calm in, 575
 Cyclonic Theories, Atmospheric Movements in Connexion with, 527
 Cygnus, New Variables in, Dr. Gould, 282
 Cypripedium, Peculiar Conformation of the Flowers of, Dr. Maxwell Masters, 142
 Daffodil, Wild White, 430
 Dalarlia, Central Sweden, Brilliant Meteor seen in, 495
 Dall (Dr. W. H.), Early Chinese Intercourse with America, 58
 Dallinger (Rev. Dr., F.R.S.), Changes of Temperature to which the Lower Forms of Organisms can be adapted by Slow Modifications, 550
 Dana (Jas. D.): Revelations of a Dissected Volcano, 93; Volcanic Action, 451
 Danger, Rule for Escaping a, Frank Morley, 345
 Darwin (Capt.), Preliminary Account of the Observations of the Eclipse of the Sun at Grenada in August 1886, 287
 Darwin (Prof. Francis, F.R.S.), on the Effect of Certain Stimuli on Vegetable Tissues, 429
 Darwin (Dr. G. H., F.R.S.): on Jacobi's Figure of Equilibrium for a Rotating Mass of Fluid, 188; on the Dynamical Theory of the Tides of Long Period, 287
 Davenport (F.), Elements of Harmony and Counterpoint, 339
 Dawson (Sir J. W., F.R.S.), Hand-book of Zoology, with Examples from Canadian Species, 295
 Day (Dr. Francis): Lochleven Trout, 166; Fish Culture, 282
 Day of the Week for any given Date, to find the, Lewis Carroll, 517
 Decrement, Vertical, of Temperature and Pressure, S. A. Hill, 606
 Definition, Vitality and its, F. Howard Collins, 580
 Deighton (H.), the Elements of Euclid, 269
 Delage (Yves), a New Function of the Otcysts in the Invertebrates, 48
 Demarçay (M. Eug.), on the Action of the Chloride of Carbon on the Anhydrous Oxides, 288
 Démoniaques dans l'Art, Les, 376, 454
 Deniker (J.), Recherches Anatomiques et Embryologiques sur les Singes Anthropoïdes, 509
 Denning (W. F.): Meteor, 101; Meteor of December 28, 1886, 248; April Meteors, 606; Fireball of December 4, 1886, 151
 Denza (P. F.), the Andromedes, November 27, 1886, 231
 Department of Science and Art, Schools of Science and Art in the Colonies and the, 442
 Deposits of Volcanic Dust, Prof. Geo. P. Merrill, 174
 Deprez (Marcel), on the Intensity of the Magnetic Field in Dynamo-Electric Machines, 23
 Dessau (B.), Metal Films arising from the Disruption of a Kathode, 333
 Deutsche Geographische Blätter, 497
 Diabetes, Action of Belladonna and Opium in a Case of Acute, 407
 Diameter of the Sun, Researches on the, Herr Auwers, 496
 Diamonds, Crown, of France, Proposal to sell, 424
 Diastase, Loss of Activity experienced by, under the Action of Heat, 455
 Diatoms, Fresh-water, in the Bagshot Beds, Rev. A. Irving, 101
 Dickins (F. V.), Aino Hairiness and the Urvolk of Japan, 534
 Dielectric Constants of Fluids, Prof. G. Quincke, 334
 Dielectric, Experiment to show that Capacity varies inversely as a Thickness of the, Profs. W. E. Ayerton and John Perry, 526
 Diener (Dr. Carl), the Geology of the Lebanon, Prof. Edward Hull, F.R.S., 10
 Diet in Disease, Prof. G. Sée, 327
 Di-isobutylamine, on the Hydrochlorate and Platinochlorate of, 383
 Dimensions of Physical Quantities, the *Engineer* on, 462
 Dimmock (George), Fish-destroying Insects in the United States, 327
 Disinfection by Heat, B. Strachan, 7
 Dispersion of Plants by Birds, D. Morris, 151
 Ditte (M. A.), Study of the Alkaline Vanadates, 600
 Doberck (Dr. W.): Typhoons, 36; Law of Storms in the Eastern Seas, 135; and the Hong Kong Observatory, 229
 Dodge (Frank S.), Kilauea after the Eruption of March 1886, 451
 Doldrums, Electrical Discharges in the, David Wilson-Barker, 584
 Dolmens of Enfida, 551
 Donnelly (Col. J. F. D.): Normal School of Science and Royal School of Mines, 271; Industrial Studentships, 413
 Dorno (Alessandro), Notice of, 231
 Double Star, Spectroscopic Method of Determining the Distance of a, A. A. Rambaut, 206
 Draper (Andrew S.), Educational System in New York, 445
 Draught and Dust, Permanent Matrix Excluder of, T. J. Porter, 569
 Dryer (Dr. Chas. R.), the Cross as a Sun Symbol, 345
 Dublin, Royal Society of, 311
 Dundee University College, proposed Chair of Anatomy at, 158; proposed Medical School in connection with, 349
 Dunér (M.), Gore's Nova Orionis, 85
 Dungate (E. J.), Lung-Sick, 29
 Dust, Coal-, Theory, W. Galloway, 222, 296, 343
 Dutch Colonies in South America and the West Indies, K. Martin, Dr. A. Ernst, 459
 Duter (M.), Electrolysis of Alkaline Solutions, 382
 Duthie (Mr.), Report on the Botanical Gardens, Saharunpur, 356
 Dutton's (Capt.) Report on the Charleston Earthquake, 351
 Dyer (W. T. Thiselton, F.R.S.): Ipecacuanha Cultivation in India, 227; Tabasheer, 396; a Plant which destroys the Taste of Sweetness, 557
 Dynamical Theory of the Tides of Long Period, on the, G. H. Darwin, F.R.S., 287
 Dynamical Units, Mass, Weight and, Robt. F. Hayward, F.R.S., 604
 Dynamics, Lessons in Elementary, H. G. Madan, 51
 Dynamics of Health and Disease, Life Energy or the, Surgeon-Major Nathl. Alcock, 366
 Dynamo-Building, Practical, for Amateurs, Fred. W. Walker, 294
 Earth's Current in the Telegraph Lines of the German Empire, Dr. Weinstein's Observations, 336
 Earthquakes: Dr. F. A. Forel, 8; H. du Bois, 8; Thos. W. Kingsmill, 319; M. Oppermann on, 600; the Earthquake of February 23, 1887, 419; Rev. S. J. Perry, F.R.S., 438; W. H. M. Christie, F.R.S., 462; the Charleston Earthquake, Report on, Prof. T. C. Mendenhall, 31, 36, 134; Influence upon the Health of the Inhabitants, 281; Earthquake in Beira Alta District, 59; in Switzerland, 84, 205; Prof. Forel, 442; at Cairo, 112; at Chios, 112, 158; Nordheinsund, West Coast of Norway, 158; at Smyrna, 112, 158; Earthquake Shock at Tashkend, 112, 399; at Tchesme, 112; in Sierra Leone, J. S. Hay and Jos. M. Metzger, 141; at Sea, Reginald H. Hertslet, 157; the Recent, Prof. J. P. O'Reilly, 197; at Aquila, 350, 376; in Venice, 350; in Zurich, 350; at Vilayet Konia, Asia Minor, 376; in Japan, 399; Important Points in the History of Earthquake Investigation in Japan, Prof. John Milne, 559; Earthquake in South Eastern Illinois, 444; in South-Western Indiana, 444; in Philiatra, 444; Earthquake of February 23, 551; Note on, at Marseilles Observatory, 455; in Italy, 479; at Antibes, 527; Earthquake Shock felt at Mandalay, 472; Earthquakes in Norway, Dr. Hans Reuch, 517; in the Riviera, Clement

- Reid, 534; in Travnik, 545, 568; in Campfer and St. Moritz, 545; in Stuttgart, 545; in Savona, 545; at Friedau, 568; at Forli, 568; at Aden, 593; at Lisbon, 612; Pre-Scientific Theories of the Causes of, 428; Magnetic Effects of Recent, 479; Earthquakes in Connexion with Fire-Damp, 527; Possible Cause of the Earthquakes of 1755, 1884, and 1887, 528; Sekei Sekiya on the Comparison of, 593
- Earthworms, Australian, J. G. Fletcher, 95
- Eastern Seas, Law of Storms in the, Dr. W. Doberck, 135
- Eclipse of the Sun at Grenada in August 1886, Preliminary Account of the Observations of the, Capt. Darwin, 287; Dr. Arthur Schuster, F.R.S., 549
- Ecuador, Travels in the Wilds of, Alfred Simson, 437
- Edinburgh: Mathematical Society, 71, 191, 454; Royal Society, 191, 311, 454, 479, 551, 599; College of Physicians, 399; Royal Physical Society, 454; Scottish Meteorological Society, 575
- Edison (Mr.), Illness of, 257
- Education: Industrial and High Art, in the United States, J. Edwards Clarke, W. Odell, 97; Association for Promoting a Teaching University in London, 179; Japan Educational Society, 204; the State and Higher Education, 457; Necessity for a Minister of Education, 481; Organisation of Industrial Education, Prof. Huxley, 493; Technical Education, 592; Educational Exhibits and Conventions at the World's Industrial and Cotton Centennial Exposition, New Orleans, 245; Educational System in New York, Andrew S. Draper, 445
- Eels discovered in Masonry, 400
- Eggs, Birds' Nests and, H. Seebohm, 236
- Egypt: Specimens of the Different Strata of Soil in the Delta received from, 111; Botanical Discoveries in the Tombs of, 405
- Eichler (Dr. August Wilhelm): Death of, 443; Obituary Notice of, 493
- Eight Squares, Product of Two Sums of, 455
- Ekaterinburg, Scientific and Industrial Exhibition at, 133, 400
- Elastic Fluid, on the Movement of an Indefinite and Perfectly, 120
- Elasticity, History of the Theory of, Isaac Todhunter, F.R.S., A. G. Greenhill, 313
- Elasticity of Bending of Pure Zinc, Copper, Tin, and their Alloys, 333
- Electricity: Dynamo-Electric Machines, on the Intensity of the Magnetic Field in, Marcel Deprez, 23; Electro-Metallurgy, 57; Electric Conductibility of Vapours and Gases, the, Prof. Giov. Luvini, 85; Electric Charge on the Atom, A. P. Laurie, 131; Electrical Metronome established at the Paris Opera House, 158; an Error in Maxwell's "Electricity and Magnetism," 172; James C. McConnel, 172; Rev. Henry W. Watson, 223; Prof. A. Seydler, 512; Electrical Phenomenon, Thos. Higgin, 173; Electricity and Clocks, T. Wilson, 173; Henry Dent Gardner, 198, 231; Prof. Silvanus P. Thompson, 224; "Horloge" on, 438; Electro-Statics, M. A. Vaschy, 263; Lives of the Electricians, W. T. Jeans, 270; Electric Telegraph, Sir Chas. T. Bright, 282; Latest Industrial Application of Electric Welding, 331; Electromotive Force of the Voltaic Arc, 331; Quadrant Electrometers, 331; Pyro-Electricity of Quartz, B. von Kolenko, 333; Propagation of, in Telegraph-Wires, Ed. Hagenbach, 333; Prize offered to the Inventor of a Cheap Method for the Application of, 350; Spiders and Electric Light, 351; Electrolysis of Alkaline Solutions, M. Duter, 382; Formation of Peroxide of Hydrogen by Electrolysis, Dr. Richarz, 384; Electric Motor and its Applications, T. C. Martin and Jos. Wetzler, Prof. S. P. Thompson, 410; Equatorial Zone of almost Perpetual Electrical Discharge, Hon. Ralph Abercromby, 487; Experiments on Electrical Resistance of Suspended Copper and Iron Wires, Shelford Bidwell, 526; Gas-Lighting by Electricity, 569; Electrical Discharges in the Doldrums, David Wilson-Barker, 584; Train Lighted by Electricity, 595; Note on the Development of Voltaic, by Atmospheric Oxidation, C. R. Alder Wright, F.R.S., 598; Practical Electricity, Prof. W. E. Ayton, F.R.S., 601; Electric Locomotion, 613
- Elemore Pit, W. Galloway on the Recent Explosion at, 133
- Elephantiasis, Species of, Investigations of, 473
- Eliot (President), Present Position of Science in the Secondary Schools of America, 375
- Elliot (Sir Walter, F.R.S.), Obituary Notice of, 543
- Elliott (Archd. C.), Units of Weight, Mass, and Force, 605
- Elliott (Henry W.), an Arctic Province, 243
- Ellipsoidal Current Sheets, on, Horace Lamb, F.R.S., 574
- Elliptical Integrals, 575
- Ellipticity of Uranus, Prof. W. Valentiner, 614
- Elwes (Capt. H. J.), Butterflies of India, Lionel de Nicéville, 436; Lepidoptera-Heterocera, 503
- Embryogeny of the Anthropoid Apes, J. Deniker, 509
- Embryology of Monotremata and Marsupialia, W. H. Caldwell, 524
- Emin Bey (Dr.): Proposed Expedition for Relief of, 83, 177; Dr. Junker on the Best Route by which to reach him, 258; Mr. Stanley's Expedition, 283, 330, 446, 475; Arrival of Dr. Junker's Caravan, 475; Short Biography of, 497
- Encyclopædia Britannica, 314
- Encyclopædia of Natural Science, Trewendt's, 58
- Encyclopædic Dictionary, 485
- Encyclopædie der Wissenschaften, 593
- Endowed Schools Committee, Report of, 611
- Endowment of Medical Research, 409
- Enfida, Dolmens on, 551
- Engelhardt's (Baron D'), Observatory, 546
- Engineer, the, on the Dimensions of Physical Quantities, 462
- Engineering, Canal and River, David Stevenson, Major Allan Cunningham, 169
- Engineering Laboratories, on the Use and Equipment of, Prof. Alex. B. Kennedy, 235
- Engineering, Marine, 242
- Engineering: on the Conversion of Heat into Work, W. Anderson, 387; Hydraulic Power and Hydraulic Machinery, H. Robinson, Major Allan Cunningham, 460
- Engler's Botanische Jahrbücher, 405
- English Coasts, Erosion of the, W. Topley, 37
- Entomology: Notes on the Recent Swarming of Aphides, G. B. Buckton, F.R.S., 15; Entomological Society, 70, 191, 335, 453, 503, 623; the Lepidoptera and Hymenoptera of Middlesex, S. T. Klein, 167; Macro-Lepidoptera of East Sussex, J. H. A. Jenner, 230; Miss Eleanor A. Ormerod on the Hessian Fly, 256; Entomologist's Monthly Magazine, 473
- Entropy, Felix Lucas on, 455
- Entyloma *Ranunculi*, Prof. H. M. Ward, 165
- Eosin Silver, Use of, in Photography, 432
- Epidermis, Structure of the, Dr. Blaschko, 551
- Equatorial Observations of the New Comets, 382
- Equatorial Zone of almost Perpetual Electrical Discharge, Hon. Ralph Abercromby, 487
- Equilibrium of a Fluid Mass, 479
- Equinoctial Gales, Dr. R. Müller, 612
- Erck (Dr. Wentworth): Barnard's Comet, 198; Sunset Phenomenon, 391
- Ernst (Dr. A.), Dutch Colonies in South America and the West Indies, K. Martin, 459
- Erosion of the English Coasts, W. Topley, 37
- Eruption, Volcanic, in Niua-Fu Friendly Islands, Prof. T. G. Bonney, F.R.S., 127
- Eruption of Mount Tarawera, 406, 472; Meteorological Conditions at the Time of the, Capt. F. W. Hutton, 322
- Eruption of March 1886, Kilauea after the, 451
- Eruptions, New Zealand, Red Sunsets and, Lieut.-Col. A. T. Fraser, 224
- Erythrene, MM. E. Grimaux and Ch. Cloez, 288
- Erythrite, M. Albert Colson, 288
- Eskimo, Dr. H. Rink, Prof. A. H. Keane, 309
- Eskimos, some Popular Errors in regard to the, John Murdoch, 518
- Essex Field Club, the, 158
- Essex Naturalist, 545
- Etheridge (Robert, F.R.S.) and P. Herbert Carpenter, the Blastoidæ, 267
- Ethnological Collection presented by Lieut. Quedenfeldt to the Anthropological Society, 423
- Ethnological Collection presented by Gen. Genè to the Ethnographic Museum of Rome, 496
- Ethnological Museum at Berlin, Opening of, 180
- Ethnology: Cannibalism and its Prevalence in Ancient and Modern Times, Herr Richard Andree, 350
- Etiology of Scarlet Fever, E. Klein, F.R.S., 452
- Eucalyptus-Tree, Bee-hives discovered in, 423

- Euclid, a Sequel to the First Six Books of the Elements of, John Casey, 28
- Euclid, the Elements of, H. Deighton, 269
- Euclid Revised, R. C. J. Nixon, 269
- Euclid, Definitions of, with Explanations, R. Webb, 340
- Europe, Northern, Climate of, and the Gulf Stream, 91
- European Prehistoric Races, Prof. A. H. Keane, 564
- Evolution of a Satellite, Tidal Friction and the, James Nolan, 75
- Evolution, Factors of Organic, Herbert Spencer, Dr. Geo. J. Romanes, F.R.S., 362
- Ewing (Prof. J. A.): Seismometry in Japan, 75; on Seismometry, 172; on Seismometers, 606; Magnetisation of Iron in Strong Fields, 622
- Expansion of Solids by Heat, Lecture Experiments on the, H. G. Madan, 89; C. E. Stromeyer, 126
- Experimental Chemistry, C. W. Heaton, 74
- Experimental Science in Schools and Universities, Prof. G. F. Fitzgerald, 284
- Experiments on Flame, Further, Dr. Geo. J. Burch, 165
- Explorations of the North Sea, 73
- Explosion of Meteorites, on the, M. Hirn, 303
- Explosions in Coal-Mines, W. N. and J. B. Atkinson, Prof. T. E. Thorpe, F.R.S., 1
- Extension of the Corona, Prof. S. P. Langley, 52
- Eye, Influence of Astigmatism in the, on Astronomical Observations, Prof. Seeliger, 59
- Falk (Prof.), Peristaltic Movement, 264
- Farlow (Prof. W. G.), Injurious Fungi in California, 521
- Farmer's Crop, Tobacco a, Philip Meadows Taylor, Prof. John Wrightson, 52
- Fauna and Flora of the Afghan Boundary, J. E. T. Aitchison, 381
- Faye (H.): Geodesy and Geology, 71; Movements of the Atmosphere, 455; on the Relations that exist between Cyclones and Concurrent Storms and Hurricanes, 599
- Fayrer (Sir J., F.R.S.), Scorpion Virus, 488
- Feil (M.), Death of, 306
- Feilden (Eliza Whigham), My African Home, 221
- Female Medical Students in Paris, Number of, 306
- Fère (Ch.), Sensation and Movement, 518
- Fernando Noronha, Proposed Expedition to, by H. N. Ridley, 228
- Ferrier (Prof.), Functional Topography of the Brain, 453
- Fertilisation of *Cassia marilandica*, 521
- Fewkes (J. Walter): Report on the Medusæ collected by the U.S. Fish-Commission Steamer *Albatross* in the Region of the Gulf Stream, 377; New Rhizostomatous Medusa, 451
- Fibres, on the Production, Preparation, and Properties of the Finest, C. V. Boys, 575
- Ficus, on the Genus, Dr. Geo. King, 525
- Field Club, the Essex, 158
- Field Naturalist in Eastern Bengal, 388
- Fields, through the, with Linnæus, Mrs. Florence Caddy, 579
- Filtration, Intermittent Downward, Ten Years' Experience in Works of, T. Bailey Denton, 195
- Finland, on the Upheaval of the South-West Coasts of, M. Venukoff, 600
- Finlay, Comet 1886 e, 17, 59; Dr. Krueger, 85, 134; Dr. J. Holetschek, 207
- Fir and Epicea, on the Formation of the so-called "Red Wood" in the, 383
- Fire Symbol, the Svastika as both Sun and, Mrs. J. C. Murray-Aynsley, 558
- Fire-Damp, Earthquakes in Connexion with, 527
- Fireball seen at Stonyhurst College, Blackburn, December 4, 1886, 111, 133; W. F. Denning, 151
- Firth of Forth, Chaetopoda of the, 544
- Fischer (Dr. A.), Death of, 57
- Fischer (Dr. Philip), Death of, 350
- Fischer (Dr. Theobald), Study of the Coasts of North Africa, 353
- Fish: Work of the United States Fish Commission, 54; Deformities among Fish, 58, 230; Fish-Culture, 612; in Scotland, 205; Dr. Francis Day on Fish-Culture, 282; National Fish-Culture Association, 350; W. Burgess's Fish-Culture Establishment, 444; an "Egg-bound" Trout, 231; Fishes inhabiting very Deep Waters, M. Léon Vaillant, 288; Fish-destroying Insects in the United States, George Dimmock, 327; Phosphorescence of Marine Fish, Dr. Otto Hermes, 377; Fish-hatching at the Buckland Museum, 400; Proposed Investigation of Fish-bearing Properties of Kiu Sawa, 444; Marine and Fresh-water Fishes, W. A. Carter, 472; Value of Fish landed on the Coasts of Scotland, 473; Proposed Establishment of an Institution for Technical Education with regard to Fish and Fisheries, at Grimsby, 494; Fishes in Ecuador, 502; Tasmanian Fisheries, 233; Fourth Annual Report of the Fishery Board for Scotland, 128; Fishery Board of Scotland and Beam-trawling, 257; Hawaiian Methods of Fishing, Mrs. E. M. Beckley, 327
- Fitzgerald (Prof. G. F.): Experimental Science in Schools and Universities, 284; on the Thermodynamic Properties of Substances whose Intrinsic Equation is a Linear Function of the Pressure and Temperature, 358; Clausius's Characteristic Equation for Substances applied to Messrs. Ramsay and Young's Experiments on Alcohol, 574
- Flame, Further Experiments on, Dr. Geo. J. Burch, 165
- Flat-fish, Acclimatisation of, in American Waters, 473
- Fletcher (J. J.), Australian Earthworms, 95
- Floods in Southern California, 376
- Flora, Hand-book of the British, Geo. Bentham, F.R.S., 341
- Flora of Leicestershire, including the Cryptogams, J. G. Baker, 411
- Flora, Alpine, surviving in the Paris District, 431
- Flora of Shetland, W. H. Beeby, 474
- Florida: Angelo Heilprin on the Geology of, 230; Attempt to sink an Artesian Well at St. Augustine to obtain Hot Water, 376
- Flowering, Autumnal, Dr. Maxwell T. Masters, 11
- Fluid Mass, Equilibrium of a, 479
- Fluid and Electric Agencies, on a Means of increasing the Power of, 120
- Fluids, Dielectric Constants of, Prof. G. Quincke, 334
- Fluor, Moissan's Researches on Isolation of, 71
- Fluorescence, Red, of Alumina, 455
- Fluviatile Swamps of New England, 524
- Fog, Map showing the Distribution of, on Various Parts of the Earth, 423
- Folk-Lore Society established in the Philippines, 134
- Folk-Lore of China, J. H. Stewart Lockhart, 281
- Folkestone Gault, C. E. De Rance, 296
- Fontannes (C. F.), Death of, 254, 263
- Fonvielle (W. de), La Mesure du Mètre, 388
- Food-Grains of India, A. H. Church, Prof. John Wrightson, 52
- Force, Units of Weight, Mass, and, Rev. Edward Geoghegan, 534; Prof. Alf. Lodge, 557; Archd. C. Elliott, 605
- Forel (Dr. F. A.): Earthquakes, 8; Earthquake in Switzerland, 442
- Forcrand (M. de), Glycerinate of Potassa, 288
- Forms of Clouds, on the, A. F. Osler, F.R.S., 164
- Forsyth (Sir Douglas), Death of, 179
- Fossil Mammalia in the British Museum, Catalogue of, Richd. Lydekker, 532
- Fossil Meteorite found in Coal, a, Dr. Guret, 36
- Fossil Remains of a Chelonian Reptile, *Ceratochelys sthenurus*, from Lord Howe's Island, Australia, Preliminary Note on the, Prof. Thos. H. Huxley, F.R.S., 615
- Foster (Prof. G. Carey, F.R.S.), on a Method of measuring the Coefficient of Mutual Induction of Two Coils, 143
- Fowler (Rev. W. W.), Coleoptera of the British Islands, 531
- France en Indo-Chine, La, A. Bouinain and A. Paulus, 221
- France: Result of New Census of, 281; Madagascar and, 306; the Depopulation of, 357; French Translation of Preyer's Physiology of the Embryo, 376; Number of Foreigners in France, 400; Inauguration of Railways in, 407; Proposal to sell the Crown Diamonds of, 424; Meeting of the French Congrès de Chirurgie in Paris, 444; Oyster-Culture in, 495; Enlargement of the Buildings of the College of France, 517
- Frankland (G. C., and Dr. Percy), some New Micro-organisms obtained from Air, 477
- Frankland (Dr. P. F.), a New Method for the Quantitative Estimation of Micro-organisms in Atmosphere, 188
- Franklin Institute, State Weather-Service for Pennsylvania to be formed at Philadelphia by the, 281
- Fraser (Lieut.-Colonel A. T.), Red Sunsets and New Zealand Eruptions, 224
- Fraunhofer (Joseph), Collecting Treatises by, 496

- Freezing of Aërated Water, on some Phenomena connected with the, George Maw, 325
- Fresh-water Diatoms in the Bagshot Beds, Rev. A. Irving, 101
- Fresh-water Fishes, Marine and, W. A. Carter, 472
- Friction, Tidal, and the Evolution of a Satellite, James Nolan, 75
- Frog, Abnormalities in the Vertebral Column of the Common, Prof. C. Lloyd Morgan, 53, 344
- Fröhlich (Dr.), Measurements of Solar Heat, 455
- Fruit, Blight and Mildew in the United States, 422
- Fry (Albert), University College, Bristol, 345
- Fuel-Supply in Ships of War, 539
- Fungi, British, Text-book of, W. D. Hay, 364
- Fungi, Injurious, in California, Prof. W. G. Farlow, 521
- Functional Topography of the Brain, Prof. Ferrier, 453
- Fungus, Cambridge Cholera, Dr. E. Klein, F.R.S., 171, 295; Chas. Roy, 223; Walter Gardiner, 271, 319; George Masee, 319; Edgar Crookshank, 344
- Fungus on Orchids, 230
- Fusion-Points, Pyrometers and, Thos. Andrews, 224
- Fusion-Points, Pyrometers, and Seismometers, Sounding a Crater, Dr. H. J. Johnston-Lavis, 197; W. Worby Beaumont, 296
- Gad (Dr.), Active Oxygen in the Animal Organism, 383
- Gadolinium, Oxide of, on Atomic Weight of, A. E. Nordenkjöld, 47
- Gale of October 15-16, 1886, the, C. Harding, 95
- Gales, Recent, E. J. Lowe, 150
- Galesaurus planticeps*, on the Skull and Dentition of, Sir R. Owen, F.R.S., 94
- Galileo: New Edition of the Works of, to be published at the cost of the State of Italy, 473; Monument to, erected in Rome, 612
- Galloway (W.): on the Recent Explosion at Elemore Pit, 133; Coal-Dust Theory, 222, 296, 343
- Galton (Capt. Douglas, F.R.S.), Sanitary Progress during the Reign of the Queen, 160
- Galton (Francis, F.R.S.), Pedigree Moth-breeding, 453
- Galvanometer, Ballistic, R. H. M. Bosanquet, 478
- Gambia, Climate of the Colony, 497
- Gardiner (Walter): Cambridge Cholera Fungus, 271, 319; *Tamus communis*, 454; Aroids, 454
- Gardner (Henry Dent), Electricity and Clocks, 198, 231
- Gardner (J. Starkie), Wrought Iron, 422
- Gas as a Constant Source in Experiments on Radiation, Employment of, 528
- Gas-lighting by Electricity, 569
- Gaseous Nitrogen of the Atmosphere, on the Direct Fixation of the, by Vegetable Soils, M. Berthelot, 335
- Gaseous Nitrogen of the Atmosphere, Direct Fixation of the, 479
- Gaseous State of Matter, Continuous Transition from the Liquid to the, at all Temperatures, 478
- Gases, the Electric Conductibility of Vapours and, Prof. Giov. Luvini, 85
- Gases, Kinetic Theory of, Prof. Tait, 311
- Gaskell (Dr. Walter H., F.R.S.), Sympathetic Nervous System, 185
- Gault, Folkestone, C. E. De Rance, 296
- Gecko, the, moves its Upper Jaw, Edward B. Poulton, 511
- Gems, Application of, to the Art of the Goldsmith, Alfred Phillips, 495
- Genetic Affinities and Classification of the Algæ, Alfred W. Bennett, 478
- Gentians, Notes and Queries, Prof. Huxley, 623
- Geodesy and Geology, Faye, 71
- Geodetic Conference, the, 15
- Geoghegan (Rev. Edward), Units of Weight, Mass, and Force, 534
- Geography: Similarities in the Physical Geography of the Great Oceans, J. Y. Buchanan, 33, 76; Geographical Notes, 60, 182, 258, 283, 308, 330, 353, 378, 402, 446, 475, 497, 520, 547, 596, 615; Proposed Exploration of the Moluccas, Prof. Kar, 182; Return of the Portuguese African Expedition, 182; Don Manuel Iradier's Explorations in Africa, 182; Geographical Results achieved by the Survey Officers on the Afghan Frontier Commission, 309; Physical Geography of Japan, Dr. Naumann, 330; on the Field and Methods of Geography, H. J. Mackinder, 331; Bulletin of the Paris Geographical Society, 353; Geographical Society of Paris, 354; Statistics of the Various Societies for, 354; Dr. Lenz's Map of the Congo, 354; Geographical Co-ordinates of Punta Arenas, M. Cruls, 382; Keith Johnston's Physical and Descriptive Geography, Abridged, 389; H. M. Stanley and the Relief of Emin Pasha, 446; Lieut. Baert's Journey up the Mongalla, 446; M. Chaffajou's Exploration of the Orinoco, 446; Tinguian's of the Philippine Islands, 446; Italian Possessions on the Red Sea Coast, 446; Relief of the Australian Mediterranean, Dr. Otto Krümmel, 447; Expedition to Emin Pasha, Dr. Junker and H. M. Stanley and, 475; Dr. Zintgraff's Exploration of the Cameroon District, 475; A. D. Carey's Journey in Central Asia, 475; the Alpine Regions of Alaska, Lieut. H. Seton-Karr, 475; Readership in Geography at Oxford, 475; Geography at the Universities, 492; Climate of the Colony of Gambia, 497; Geographical and Geological Distribution of Animals, Angelo Heilprin, 510; Dr. O. Lenz, Letters, 520; Herr Glaser's Journeys in South Arabia, 520; Dr. Wolf's Exploring Work on the Sankuru, 520; Herr Ferdinand Seeland, on the Rate of Movement of the Pasterz Glacier, 520; Lieut. Wissmann, Fresh Expedition from Luluaburg, 521; J. T. Wills, on the Region between the Nile and the Congo, 521; Geo. Grenfell, Ascent of the Quango, 547; Proposal to cross South-East New Guinea, 547; Central Asia, 547; Dr. Hans Schinz, on the Lake Ngami Region, 547; Dr. Ochsenius, on the Age of certain Parts of the South American Andes, 547; News from Herr G. A. Krause, 547; Exploration of the Watershed of the River Yukon, 593; Death of James Wild, 594; Geographisches Jahrbuch, 596; Geographical Exhibition, 613
- Geology: Geology of the Lebanon, Prof. Edward Hull, F.R.S., 10; Erosion of the English Coasts, W. Topley, 37; and Geodesy, Faye, 71; Geological Society, 94, 167, 190, 382, 406, 502, 526, 550, 623; Medals awarded by the, 349; Station at Landsort (in Sweden) for Measurement of Shore-Elevation, 159; on the Drift of the Vale of Clwyd, Prof. T. McK. Hughes, 167; Discovery of Identity of Sand in New Zealand Rivers with Oktibehite, Prof. Ulrich, 190; the Metamorphic Rocks of the Malvern Hills, Frank Rutley, 190; Student's Hand-book of Historical Geology, A. J. Jukes-Browne, Prof. A. H. Green, 218; Angelo Heilprin on the Geology of Florida, 230; Observations nouvelles sur le Tufeau de Cijly et sur le Crétacé supérieur du Hainault, A. Rutot and E. Van den Broeck, 317; Geological Evolution, Signor Enrico del Pozzo di Mombello, 350; the Relations between Geology and the Mineralogical Sciences, Prof. John W. Judd, F.R.S., 392, 414; Palæontological Researches near Rheims, 407; Sandstone of Organic Origin, 407; Geology of Jersey, Le P. Ch. Noury, 412; Mastodontsaurus discovered on Juckatoo Island, Sydney, 445; Geology of Lake Kelbia District, 455; Geology of Hampstead, Logan Lobley, 454; Geological Survey of India, Annual Report, 472; Geographical and Geological Distribution of Animals, Angelo Heilprin, 510
- Geometry: the Elements of Plane Geometry, 27; a Sequel to the First Six Books of the Elements of Euclid, containing an Easy Introduction to Modern Geometry, John Casey, 28; the Elements of Euclid, H. Deighton, 269; Euclid Revised, R. C. J. Nixon, 269; Geometrical Drawing for Army Candidates, H. T. Lilley, 28; Association for the Improvement of Geometrical Teaching, 204, 281; Origins of Geometry, Horace Lamb, F.R.S., 269; First Lessons in Geometry, B. Hanumanta Rau, 269; Developments of Naval Geometry, 382; Geometrical Construction of the Cell of the Honey-Bee, Prof. H. Hennessy, F.R.S., 502; the Association's "Geometry," Prof. George Bruce Halsted, 557
- German Carp, Consignment of, forwarded to Portugal by the National Fish-Culture Association, 350
- German Fishery Association, Seals destructive to Fisheries, 377
- German Lakes, North, Investigation of, by Dr. Otto Zacharias, 473
- Germany: Result of New Census of, 281; Atmospheric Temperature in, 504
- Gibney (Robert D.), Peculiar Radiation of Light, 536
- Gibson (E.) and R. E. Gregory, Tenacity of Spun Glass, 406
- Gibson (R. J. Harvey), an Abnormal *Hirudo medicinalis*, 392
- Giglioli (Prof. Henry H.): *Lepidosiren paradoxa*, 343; Dr. Modigliani's Exploration of Nias, 342

- Gilded Chrysalides, Edward B. Poulton, 470
 Gilman (Dr.), Johns Hopkins University, Baltimore, 399
 Ginger-Beer Plant, Prof. Bayley Balfour, 358
 Ginnerup, in Denmark, Discovery of a Kitchen-Midden at, 112
 Girls, Physical Training of, Dr. Rayner W. Batten, 495
 Glacial Action, C. L. Griesbach, 594
 Glaciation in the Australian Alps, on some Further Evidence of, James Stirling, 182
 Glaciation, Lunar, S. E. Peal, 100
 Glaciation of North America, Great Britain and Ireland, Comparative Studies upon, Prof. H. Carvill Lewis, 89
 Glacier, the Muir, G. Frederick Wright, 380
 Glacier, Rate of Movement of the Pasterz, Herr Ferdinand Seeland, 520
 Gladstone (Dr. J. H., F.R.S.), on the Nature of Solution, 64
 Glaisher (Prof. J. W. L., F.R.S.), Mathematical Tripos, 101, 153, 199
 Gland, Green, of Fresh-water Crayfish, 455
 Glaser (Herr), his Journeys in South Arabia, 520
 Glasgow, Botanic Garden, 545
 Glass and other Surfaces, on the Intensity of Reflection from, Lord Rayleigh, F.R.S., 64
 Glass containing Lead, Note on the Manipulation of, H. G. Madan, 150; Prof. W. A. Shenstone, 223
 Glass-blowing, Methods of, W. A. Shenstone, 123
 Glass, Spun, Tenacity of, E. Gibson and R. E. Gregory, 406
 Glow, Residual, Examination of the, on Radiant-Matter Spectroscopy, W. Crookes, F.R.S., 425, 447
 Glycerinate of Potassa, M. de Forcrand, 288
 Glycose in Development of Animal Heat, Action of, A. Chauveau, 120, 144, 191
 Goebel's (Dr. K.) "Outlines of Classification and Special Morphology of Plants," on some Observations on Palæontology in, Prof. W. C. Williamson, F.R.S., 535, 577
 Gordon (General), Collection illustrative of the Coco de Mer (*Lodoicea seychellarum*) presented to the Museum, Kew Gardens, 494
 Gore (J. E.): Nova Orionis, M. Dunér, Herr Schwab, 85; Variable near χ^1 Orionis, Dr. G. Müller, 329; Orbit of the Binary Star 14 (*i*) Orionis, 569
 Gorgeu (M. Alex.), on the Artificial Production of Zincite and Willemite, 288
 Goss (Herbert), *Aporia cratagi*, 473
 Gothenburg, Proposed Free University at, 281
 Gould's (Dr.) Astronomical Journal, 59; New Variables in Cygnus, 282
 Gould Collection of Australian Birds at Philadelphia, 204
 Graham's Ideas concerning the Constitution of Matter, on certain Modern Developments of, Prof. T. E. Thorpe, F.R.S., 522, 547
 Grande Encyclopédie, 613
 Grape-Vine: Treatment of, with Salts of Copper against Mildew, 144; Anti-Phylloxeric Disinfection of, 382
 Gray (Thos.), Seismometry, 126, 198
 Great Britain and Ireland, North America, Comparative Studies upon Glaciation of, Prof. H. Carvill Lewis, 89
 Great Ice Age, Astronomical Theory of the, W. H. S. Monck, 7; Sir Robert S. Ball, F.R.S., 53; Rev. E. Hill, 101
 Great Men, Longevity of Joseph Jastrow, 10
 Great Oceans, Similarities in the Physical Geography of the, J. Y. Buchanan, 76
 Greely (Capt. A. W.), appointed Successor to the late Gen. Hazen, 443
 Green (Prof. A. H., F.R.S.): Student's Handbook of Historical Geology, A. J. Jukes-Browne, 218; Origin of Mountain Ranges, T. M. Reade, 361, 463
 Green Light at Sunset, R. T. Omond, 391
 Green Light at Sunrise and Sunset, Prof. A. Riccò, 584
 Greenhill (A. G.): History of the Theory of Elasticity, Isaac Todhunter, F.R.S., 313; Wave-Motion in Hydrodynamics, 477; Units of Weight, Mass, and Force, 486
 Greenleaf's Bequest to Harvard College, 229
 Greenwich, Solar Eclipse "Invisible" at, A. C. Crommelin, 414
 Grenfell (Rev. Geo.): Ascent of the Quango, 547; Exploration of the Congo, 596
 Gresham Lecture Fund, the, 16
 Gresham Lectures, 229
 Griesbach (C. L.), Glacial Action, 594
 Griffen (H. H.), Bicycles and Tricycles for the Year 1886, 52
 Grimaux (M. E.) and M. Ch. Cloez, Erythrene, 288
 Grönland, Berättelse om en Resa til, Nils O. Holst, 340
 Grosse (A.), a Wire Tape Rheostat, 334
 Grote (Arthur), Death of, 133
 Grothe (Dr.), Death of, 423
 Guillelard (F. H. H.), Cruise of the *Marchesa*, 369
 Gulf of Genoa, on the Existence of Submerged Valleys in the, 336
 Gulf Stream, Climate of Northern Europe and the, 91
 Guppy (Dr. H. B.), Coral Reefs of the Solomon Islands, 77
 Gurlt (Dr.), a Fossil Meteorite found in Coal, 36
 Gurney (Edmund), Phantasms of the Living, Prof. C. Lloyd Morgan, 290, 345
 Guthrie (Frederick), Obituary Notice of, 8; Guthrie Memorial Fund, 127, 327
 Guthrie (F.), Virtual Velocities, 149
 Gymnasial Instruction, Report of the Swiss Commission for the Reform of, 257
Gymnema sylvestre, an Examination of the Leaves of, David Hooper, 565; Hooper's Paper on, J. C. Shenstone, 594
Gymnodinium polyphemus, Pouchet, 48
 Gyroscope, New Collimating, 600
 Habenicht, on the Morphology of the Kosmos, 35
 Hæmatoscopy, Hénocque, 48
 Hagen (Dr. H. A.), Abnormal Cats' Paws, 345
 Hagenbach (Ed.), Propagation of Electricity in Telegraph-Wires, 333
 Hahn (Prof. F.), Aurora, 8
 Hailstones, Top-shaped, C. S. Middlemiss, 413; J. Spencer Smithson, 438; Alex. Johnstone, 536
 Hairiness, Aino, and the Urvolk of Japan, F. V. Dickins, 534
 Haldane (Dr. Daniel Rutherford), Death of, 567
 Hale (Horatio), on the Origin of Languages, 17
 Halibut, Capture of a, in the Lower Potomac, 569
 Hall (Prof. Asaph): Six Inner Satellites of Saturn, 257; Stellar Parallax, 258
 Hall (Maxwell): Temperature and Pressure in Jamaica, 437; West Indian Meteorological Confederation, 485
 Halo with Parhelia observed at Fontainebleau, 359
 Halo, Solar, J. J. Walker, 272; R. T. Omond, 582
 Halos, Lunar, Prof. S. T. Moreland, 414
 Halsted (Prof. Geo. Bruce), the Association's "Geometry," 557
 Hampstead, Geology of, Logan Lobley, 454
 Hand and Foot, Variations in the Nerve-Supply of the Lumbrical Muscles in the, with some Observations on the Perforating Flexors, 521
 Harcourt (A. Vernon, F.R.S.), Lighthouse Illuminants, 41, 60
 Harding (Chas.): High Temperature in October, 18; the Gale of October 15-16, 1886, 95
 Harley (Rev. Timothy), Lunar Science, 246
 Harmony and Counterpoint, Elements of, F. Davenport, 339
 Harrington (M. W.), the Chinook Winds, 568
 Harris (T. E.), Hand-book of Acoustics, 270
 Hartley (Prof. W. N.), on the Nature of Solution, 64
 Harvard College: Stellar Photography at, Prof. Pickering, 37; Mr. Greenleaf's Bequest to, 229; Observatory of, 424, 497
 Hatch (Dr. Fred. B.), Petrography, 482
 Hawaiian Fishing Implements and Methods of Fishing, Mrs. E. M. Beckley, 327
 Hawaiian Volcano Mauna Loa, Discharge from, 376
 Hay (J. S.) and Jos. M. Metzger, Earthquake in Sierra Leone, 141
 Hay (W. D.), Text-book of British Fungi, 364
 Hayward (Robert B., F.R.S.): on the Water in the Chalk beneath the London Clay of the London Basin, 335; Mass, Weight, and Dynamical Units, 604
 Hazen (William Babcock), Obituary Notice of, Prof. Cleveland Abbe, 541
 Health and Disease; Dynamics of, Life-Energy or the, Surgeon-Major Nathl. Alcock, 366
 Hearing, Acuteness of, Dr. König, 480
 Hearth, Prehistoric, under the Quaternary Deposits in Western New York, 476
 Heat, Disinfection by, R. Strachan, 7
 Heat, Lecture Experiments on the Expansion of Solids by, H. G. Madan, 89; C. E. Stromeyer, 126
 Heat, the Sun's, Sir William Thomson, F.R.S., 297
 Heat into Work, on the Conversion of, W. Anderson, 387

- Heaton (C. W.), Experimental Chemistry, 74
 Heats of Combustion, Calorimetric Bomb and Measurement of, 551
 Heavens, Proposed Photographic Map of the, 35
 Hector (Dr. Jas., F.R.S.), Oktibehite or Awaruite, 513
 Heilprin (Angelo), Geographical and Geological Distribution of Animals, 510
 Heliography, Prof. Spörer on Sunspots, 72
 Helmholtz (Prof. von): the Formation of a Thunderstorm, 24; Cohesion of an Air-free Column of Water, 456
 Hensley (W. Botting): Botany of the Afghan Delimitation Commission, 173; Primroses, 561
 Hennessy (Prof. H., F.R.S.): Trains of Pulleys and Drums, 452; Geometrical Construction of the Cell of the Honey-Bee, 502
 Hénoque (N.), Hæmatoscopy, 48
 Henri (Prof. O., F.R.S.) Note on Mr. Budden's Proof that only One Parallel can be drawn from a given Point to a given Straight Line, 100
 Heptene, Action of Heat on, 455
 Herbarium, Lamarck's, Removal of, 312
 Heredity in Cats, with an Abnormal Number of Toes, Observations on, Edward B. Poulton, 38; William White, 125
 Heredity, Pedigree Moth-breeding as a Means of Verifying certain Important Constants in the Theory of, Francis Galton, F.R.S., 453
 Heritsch (A.), on Radiophony, 333
 Hermes (Dr. Otto), Phosphorescence of Marine Fish, 377
 Herring, Puzzling Migratory Habits of the, 567
 Hertslet (Reginald H.), Earthquake at Sea, 157
 Hesperia, Probable Re-Discovery of, Dr. R. Luther, 614
 Hessian Fly, Miss Eleanor A. Ormerod, on the, 256
 Heughes (Sir W. W.), Contributions to the Adelaide University, 255
 Heurck (Dr. Van), Photo-Micrographs, 359
 Hidden (William Earl), Mazapil Meteoric Iron, 572
 Higgin (Thos.), Electrical Phenomenon, 173
 Hill (Rev. E.), Astronomical Theory of the Great Ice Age, 101
 Hill (S. A.), Vertical Decrement of Temperature and Pressure, 606
 Hinde (Geo. J.), on the Character of the Beds of Chert in the Carboniferous Limestone of Yorkshire, 582
 Hirn (M.), on the Explosion of Meteorites, 303
Hirudo medicinalis, an Abnormal, R. J. Harvey Gibson, 392
 Historical Geology, Student's Hand-book of, A. J. Jukes-Browne, Prof. A. H. Green, 218
 Hittite Inscriptions, Capt. Conder's Translation of, 422
 Hodd (J. Herbert), Abnormality in Cats' Paws, 53
 Hoffman (Dr. W. J.), Aboriginal Art in California and Queen Charlotte's Island, 285
 Holden (Edward S.), Photography the Servant of Astronomy, 317
 Holetschek (Dr. J.), Comet Finlay (1886 *e*), 207
 Holland (Sir Henry), Colonial Conference, 544
 Holmes (W. H.), on the Great Serpent Mound in Ohio, 281
 Holmesdale Natural History Club, 206
 Holmestrand, Brilliant Meteor observed at, 352
 Holst (Dr. Nils O.), Berättelse om en Resa til Grönland, 340
 Holub (Dr.), Supposed Murder of, 379
 Homeric Astronomy, A. M. Clerke, 585, 607
 Hong Kong, the Meteorological Observatory of, 229
 Honzo Dsufu, the, Japanese Work on Botany, 204
 Hooper (David), an Examination of the Leaves of *Gymnema sylvestre*, 565; J. C. Shenstone, 594
 Hopkinson (John, F.R.S.), Note on Specific Inductive Capacity, 334
 Hours with a Three-Inch Telescope, Capt. Wm. Noble, 246
 Houzeau (M.), Method for the Determination of the Constant of Aberration, 377
 Howell (Mr.), Technical Education and the House, 326
 Howietoun, the History of, Sir J. Ramsay Gibson Maitland, 337
 Hughes (Prof. T. McK.): on the Drift of the Vale of Clwyd, 167; on Caves, 454
 Hulke (J. W., F.R.S.), Note on *Polacanthus foxii*, 357
 Hull (Prof. Edward, F.R.S.), the Geology of the Lebanon, 10
 Hungary, Sunspot Observations in, Carl Braun, A. M. Clerke, 227
 Hunt (Thos. Sterry), Mineral Physiology and Physiography, 578
 Hunterian Oration, W. S. Savory, F.R.S., 379
 Huntington (O. W.): on the Crystalline Structure of Iron Meteorites, 16, 93; Coahuila Meteorites, 461
 Hutton (Capt. F. W.), Meteorological Conditions at the Time of the Eruption of Mount Tarawera, New Zealand, 322
 Huxley (Prof.): and Prince of Wales on the Imperial Institute, 265; on the True Functions of the Imperial Institute, 305; Royal Society and Scientific Federation, 289; Organisation of Industrial Education, 493; Preliminary Note on the Fossil Remains of a Chelonian Reptile, *Ceratochelys sthenurus*, from Lord Howe's Island, Australia, 615; the Gentians—Notes and Queries, 623
 Hydrate of Chloral, Prof. Liebreich, 264
 Hydraulic Power and Hydraulic Machinery, H. Robinson, Major Allan Cunningham, 460
 Hydrodynamics, on Jacobi's Figure of Equilibrium for a Rotating Mass of Fluid, Dr. G. H. Darwin, F.R.S., 188
 Hydrodynamics, Wave-Motion in, A. G. Greenhill, 477
 Hydrogen and Chlorine Gas, Mixed, Chemical Action of Light on, Dr. Pringsheim, 552
 Hydrophobia, M. Pasteur's Treatment of, 30
 Hydrophobia, Society for Prevention of, 57
 Hygiene, Proposed School of, at the University of Michigan, 377
 Hygiene, School, Arther Newsholme, 604
 Hygrometers: Sensitive, 331; Recording, 331
 Hymenomycetes, British Fungi, Rev. John Stevenson, 4
 Hyotherium from the Pliocene of India, on a Jaw of, R. Lydekker, 94
 Hysteria Studied in Art Manifestations of the Past, 376
 Ice, Thickness of the, in North-Eastern Pennsylvania during the Glacial Epoch, 141
 Ice Age, Astronomical Theory of the Great, W. H. S. Monck, 7; Sir Robert S. Ball, F.R.S., 53; Rev. E. Hill, 101
 Ice Cavern in Austria, Discovery of, 17
 Ice Period in the Altai Mountains, an, E. Michaelis, 149; A. Bialoveski, 513
 Ice and Brines, J. Y. Buchanan, 608
 Iceland, Introduction of New Plants into, 356
 Ichthyology, Fishes inhabiting very Deep Waters, M. Léon Vaillant, 288
 Illinois, South-Eastern, Earthquake in, 444
 Illuminants, Lighthouse, A. Vernon Harcourt, F.R.S., 41, 60; T. and D. Stevenson, 63
 Imperial Institute, 34, 210; Sir Frederick Abel, elected Organising Secretary to the, 111; Scientific Basis of Proposed, 254; Prince of Wales and Prof. Huxley on, 265; Possible Results of the, 280; on the True Functions of the, Prof. Huxley, 305; Work of the, Sir Fred. Abel, F.R.S., 617
 Imperial University of Japan, Calendar of the, 401
 Index-Catalogue, Medical, A. T. Myers, 196
 Index, Subject, Two Hours with a, 123
 India: Food-Grains of, A. H. Church, Prof. John Wrightson, 52; Indian Silk Industry, the Decline of the, 84; on the Cultivation of the so-called Wild Silks of India, T. F. Peppe, 256; Ipecacuanha Cultivation in, W. T. Thiselton Dyer, F.R.S., 227; Indian Survey Staff, 281; Queen's Jubilee in, India, 349; Administration Report of the Meteorological Department of India, 365; Butterflies of India, Lionel de Nicéville, H. J. Elwes, 436; Annual Report of the Geological Survey of, 472; Indian Engineering, Survey of the Straits Settlements, 472
 Indian, West, Meteorological Confederation, Maxwell Hall, 485
 Indian, West, Seal (*Monachus tropicalis*), Henry A. Ward, 392
 Indian Tribes of British Columbia, Dr. Franz Boas, 568
 Indiana, South Western, Earthquake in, 444
 Indians, Consumption among the, 400
 Indo-Chine, La France en, A. Bouinai and A. Paulus, 221
 Inductionless Coils, Theory of the, Dr. Aron, 383
 Inductive Capacity, Specific Note on, John Hopkinson, F.R.S., 334
 Industrial Education, Organisation of, Prof. Huxley, 493
 Industrial Studentships, Col. J. F. D. Donnelly, 413
 Infant Navajos, Notes on Certain Traits of, R. W. Shufeldt, 346

- Influence of Wind on Barometric Readings, G. J. Symonds, F.R.S., 53
 Ingram (William), the Recent Weather, 173
 Inosite, Preparation, Properties, and Constitution of, M. Maquenne, 335
 Insect-Life in the East, 527
 Insects and Petunias, J. W. Slater, 70
 Insects, Protective, Value of Coloured Markings in, 502
 Instantaneous Shutters: A. Mallock, 324; Col. H. Stuart-Wortley, 366
 Instinctive Action, 392
 Institute of France, Change of Professorships in the, 256
 Institution of Civil Engineers, 503
 Institution of Mechanical Engineers, 355
 Institution of Naval Architects, 538
 Intensity of Reflection from Glass and other Surfaces, on the, Lord Rayleigh, F.R.S., 64
 Intermittent Downward Filtration, Ten Years' Experience in Works of, T. Bailey-Denton, 195
 International Committee of Weights and Measures, 203
 International Medical Congress at Washington, Ninth Triennial Meeting of the, 350
 International Polar Expeditions, 147
 International Statistical Institute, 255
 Invertebrates, a New Function of the Otocysts in the, Yves Delage, 48
 Invisible at Greenwich, A. C. Crommelin, 414
 Ipecacuanha Cultivation in India, W. T. Thiselton Dyer, F.R.S., 227
 Iradier's (Don Manuel) Explorations in Africa, 182
 Ireland, North America, Great Britain and, Comparative Studies upon Glaciation of, Prof. H. Carvill Lewis, 89
 Iridescent Clouds, Jas. C. McConnel, 533; G. H. Stone, 581
 Iron, Mazapil Meteoric, William Earl Hidden, 572
 Iron in Strong Fields, Magnetisation of, Prof. J. A. Ewing, 622
 Iron Ships, Deviation of the Compass in, considered practically, W. H. Rosser, 437
 Iron, Wrought, J. Starkie Gardner, 422
 Irritation in the Throat, Various Effects of, 575
 Irving, (Rev. A.): Fresh-water Diatoms in the Bagshot Beds, 101; Physical History of the Bagshot Beds of the London Basin, 382
 Isopycnal Lines, Rotation between the Gaseous and Liquid States of Matter by, 333
 Italy: Geographical Society of, 60; Learned Society formed in Italy for the Study of Eastern Languages and Archæology, 328; Scientific Renaissance in, 350; Italian Emigration, 403; Italian Possessions on the Red Sea Coast, 446; New Edition of the Works of Galileo to be published at the Cost of the State, 473; Earthquake of February 23 in, 479; Stations established by the Italian Meteorological Society, 612
 Jackson (John R.), Colonial and Indian Exhibition, 81, 225
 Jade-handled Brushes, on Two, Prof. J. P. O'Reilly, 318
 Jamaica: Temperature and Pressure in, Maxwell Hall, 437; Disease of Colocasia in, 478
 Japan: Volcanoes of, Prof. Milne, 19; Seismometry in, Prof. John Milne, 36; Prof. J. A. Ewing, 75; Seismological Society of, 518; the Active Volcano Asamayama, 133; Japanese Mission to inquire into the Norwegian Cod-Fisheries, 158; the Honzo Dsufu, Work on Botany, 204; Japan Educational Society, 204; Education of Women in, 229; Magnetic Map of, 330; Physical Geography of, Dr. Naumann, 330; Earthquake in, 399; Calendar of the Imperial University of, 401; Aino Hairiness and the Urvolk of, F. V. Dickins, 534; Important Points in the History of Earthquake Investigation in, Prof. John Milne, 559
 Jastrow (Joseph), Longevity of Great Men, 10
 Java, the Disease *Beri-beri* in, 206
 Jaw, the Gecko moves its Upper, Edward B. Poulton, 511
 Jeans (W. T.), Lives of the Electricians, 270
 Jenner (J. H. A.), Macro-Lepidoptera of East Sussex, 230
 Jersey, Geology of, Le P. Ch. Noury, 412
 Jevons (W. Stanley), Letters and Journal of, 25
 Johns Hopkins University: Marine Laboratory connected with, 329; Dr. Gillan on, 399
 Johnston-Lavis (Dr. H. J.), Sounding a Crater, Fusion-Points, Pyrometers, and Seismometers, 197
 Johnstone (Alex.), Top-shaped Hailstones, 536
 Joule (James Prescott, F.R.S.), Joint Scientific Papers of, 461
 Journal of Botany, 212, 404
 Journal of the Royal Agricultural Society of England, Prof. John Wrightson, 148
 Journal of the Royal Horticultural Society, 569
 Journal of the Society of Telegraph-Engineers, 569
 Jowett (Prof.), on University Colleges, 441
 Jubilee, Science and the, 217, 241; the Jubilee in India, 349
 Judd (Prof. John W., F.R.S.): the Relations between Geology and the Mineralogical Sciences, 392, 414; the Relation of Tabasheer to Mineral Substances, 488; Vitality and its Definition, 511
 Jukes-Browne (A. J.), Student's Hand-book of Historical Geology, Prof. A. H. Green, 218
 Junker (Dr.), on the Best Route by which to reach Emin Pasha, 258, 475
 Jupiter: Rotation-Time of the Red Spot on, Prof. Young, 181; Mean Periodicity of the Spots of, 359
 Jurassic Mammals, American, 622
 Kakke, the Disease, 206
 Kaloca Observatory, Dr. C. Braun, 59
 Kan (Prof.) Proposed Geographical and Geological Exploration of the Moluccas, 182
 Karachi Museum, W. D. Cumming at, 593
 Kathode, Metal Films arising from the Disruption of a, B. Dessau, 333
 Keane (Prof. A. H.): European Prehistoric Races, 564; the Eskimo, Dr. H. Rink, 309
 Kempe (A. B., F.R.S.), on the Theory of Mathematical Form, 574
 Kennedy (Prof. Alex. B.), on the Use and Equipment of Engineering Laboratories, 235
 Kent (Saville), Report on Tasmanian Fisheries, 233
 Kew, Bulletin of Miscellaneous Information issued from the Royal Gardens, 306
 Kew Gardens: Presentation to, of Gen. Gordon's Collection Illustrative of the Cocco de Mer (*Lydoicea seychellarum*), 494; Thos. Moore's Botanical Collection acquired for the Herbarium, 495
 Kew, a Plant of Manilla Hemp at, 567
 Kew Observatory, Report of the Committee, 307
 "Khevir," or Great Salt Desert, 232
 Kilauea after the Eruption of March 1886, 451
 Kilogramme, Standard, 408
 Kinetic Theory of Gases, Prof. Tait, 311
 King (Dr. Geo.), on the Genus *Ficus*, 525
 Kingsmill (Thos. W.), Earthquakes, 319
 Kinship, Algebraic Notation of, Prof. Alex. Macfarlane, 126
 Kirchenpauer (Dr. Gustav Heinrich), Death of, 473
 Kirkwood (Prof. Daniel), Comets and Asteroids, 474
 Kitchen-Midden discovered at Ginnerup in Denmark, 112
 Kiu Sawa, Proposed Investigation of the Fish-bearing Properties of, 444
 Klein (Dr. E., F.R.S.): the Cambridge Cholera Fungus, 171, 295; Etiology of Scarlet Fever, 452
 Klein (Dr. L. Martial), Vitality of Seeds, 463
 Klein (Sydney T.): the Lepidoptera and Hymenoptera of Middlesex, 167; Best Method of capturing Lepidoptera, 282
 Klumpke (Miss), Assistantship in the Paris Hospitals, 306
 Knife of Curious Workmanship found in the Thick Flesh of a Cod, 545
 Knowledge, Scientific, First Year of, Paul Bert, 221
 Koch (Dr. K. R.), Aurora Borealis, A. M. Clerke, 433
 Kolenko (B. von), Pyro-Electricity of Quartz, 333
 König (Dr.), Von Kries' Colour-mixing Apparatus, 336
 König (Dr.), Acuteness of Hearing and its Estimation by means of Tuning-Forks, the Sound of which gradually died away, 480
 Kosmos, Habenicht on the Morphology of the, 35
 Kötter (Dr.), Mean Rate of Flow of a Fluid from a Small Aperture, 600
 Krause (Herr G. A.), News from, 547

- Kronecker (Prof.), on Serous Albumen, 504
 Krueger (Dr. A.), Comet Finlay (1886 *c*), 85, 134
 Krümmel (Dr. Otto), Der Ozean, 6; Relief of the Australian Mediterranean, 447
 Kurrachee Technical College, the, 84
- La Pérouse Expedition round the World, Centenary of the, 443
 Laboratories, Engineering, on the Use and Equipment of, Prof. Alex. B. Kennedy, 235
 Laboratories, New Building for the, of the Paris Medical School, 473
 Lacaze-Duthiers (Prof. de), Presentation from his Pupils, 473
 Lake, Soundings at Crater, 353
 Lake Ngami Region, Dr. Hans Schinz on, 547
 Lake Kelbia District, Geology of, 455
 Lake-Dwelling recently discovered at Wallishafen on the Lake of Zurich, 423
 Lakes, North German, Dr. Otto Zacharias's Investigation of, 473
 Lamarck's Herbarium, Removal of, 312
 Lamb (Horace, F.R.S.): Origins of Geometry, 269; Ellipsoidal Current Sheets, 574
 Lamellary Thomsonite from Bishopton, Renfrewshire, Description of a, 335
 Lamp, Herr Linnemann's New, 432
 Länderkunde des Erdteils Europa, 473
 Langley (Prof. S. P.), Extension of the Corona, 52
 Langner (Herr Hugo), Ueber eine Methode zur Messung kleiner Winkeldifferenzen, 329
 Languages, on the Origin of, Horatio Hale, 17
 Lapouge (M. de), on the Decline of the Birth-rate in France, 357
 Larva, a *Balanoglossus*, from the Bahamas, W. F. R. Weldon, 477
 Latent Heats of Vaporisation of some very Volatile Substances, 551
 "Latex," on the Term, in Botany, M. A. Trécul, 600
 Laurie (A. P.), Electric Charge on the Atom, 131
 Lavas, Acid, Nature and Origin of Lithophysæ and the Lamination of, J. P. Iddings, 380
 Law of Storms in the Eastern Seas, Dr. W. Doberck, 135
 Le Conte (Prof. Joh.), Lightning Flashes, 342
 Lead, Note on the Manipulation of Glass containing, H. G. Madan, 150; W. A. Shenstone, 223
 Leaf-beds, Ardtun, J. Starkie Gardner, 382
 Leaves of *Gymnema sylvestre*, an Examination of the, David Hooper, 565
 Lebanon, Geology of the, Prof. Edward Hull, F.R.S., 10
 Lechartier (M. G.), on the Composition of the Ashes of Cider, 382
 Leclanché Battery, Modifications of the, 331
 Lecture Experiment on the Expansion of Solids by Heat, H. G. Madan, 89
 Lectures and Essays, W. K. Clifford, F.R.S., 270
 Legge (Prof. Di), Researches on the Sun's Diameter, 595
 Leicester Literary and Philosophical Society, 180
 Leicestershire, Flora of, including the Cryptogams, J. G. Baker, 411
 Lemons, Irregularly Developed, 430
 Lemström (M. S.), L'Aurore Boréale, A. M. Clerke, 433
 Lenses: Magnifying, Flat on both Sides, 331; Value of the New Apochromatic, 467
 Lenz (Dr. Oscar): Exploration of the Upper Congo, 232; his Arrival at Zanzibar, 283; his Map of the Congo, 354; Return of, from Zanzibar, 378; Letters from, 402, 520
 Lepidoptera, Best Method of capturing, Sydney T. Klein, 282
 Lepidoptera-Heterocera, Capt. H. J. Elwes, 503
Lepidosiren paradoxa, Prof. Henry H. Giglioli, 343
 Leprosy on the West Coast of Norway, 519
 Lesseps (M. de), Artesian Wells in Algeria, 287
 Lewis (A. L.), Stone Circles, 503
 Lewis (Prof. H. Carvill), Comparative Studies upon Glaciation of North America, Great Britain, and Ireland, 89
 Ley (Rev. W. Clement): the Recent Weather, 54; a Few of our Weather Terms, 323
 Leyden Museum, 181
 Leyden Museum, Notes from the, 477
- Leyst (Herr), Remarkable Forms of Lightning-Flash, 85
 Libraries of the United States, Statistics concerning, 519
 Lice, Tree-, at Rodriguez, Ravages of, 179
 Lieberkühn (Dr. Nathaniel), Death of, 612
 Liebreich (Prof.), Hydrate of Chloral, 264
 Life, Herbert Spencer's Definition of, F. Howard Collins, 487
 Life-Energy, or the Dynamics of Health and Disease, Surgeon-Major Nathl. Alcock, 366
 Light, Diffraction of, Hermann Struve, 423
 Light, on the Absolute Wave-length of, Louis Bell, 524
 Light, Peculiar Radiation of, Robert D. Gibney, 536
 Light, Chemical Action of, on Mixed Hydrogen and Chlorine Gas, Dr. Pringsheim, 552
 Light, Aberration of, Phenomena connected with, 575
 Light, the Zirconia Oxyhydrogen, Lewis Wright, 583
 Lighthouse Illuminants, A. Vernon Harcourt, F.R.S., 41, 60; T. and D. Stevenson, 63
 Lightning, Effects of, in Schleswig-Holstein, 360
 Lightning-Flash, Remarkable Form of, Herr Leyst, 85
 Lightning-Flashes, Prof. John Le Conte, Antoine d'Abbadie, 342
 Lightning-Rods, Radius of the Circle of Protection of, Herr Schiller, 376
 Lilley (H. T.), Geometrical Drawing for Army Candidates, 28
 Lime, Silicostannate of, Preparation of a, corresponding to Spheue, M. L. Bourgeois, 335
 Linnaeus, Through the Fields with, Mrs. Florence Caddy, 579
 Linnean Society, 70, 142, 165, 358, 381, 430, 478, 525, 623
 Linnean Society of New South Wales, 95; Annual General Meeting of, 519
 Liquid Surfaces of Revolution, Critical Mean Curvature of, Prof. A. W. Rücker, F.R.S., 143
 Liquid and Gaseous States of Matter, Preliminary Note on the Continuity of the, William Ramsay and Sydney Young, 262
 Lisbon, Earthquake at, 612
 Literature, Study of, John Morley, 422
 Lithophysæ, Nature and Origin of, and the Lamination of Acid Lavas, J. P. Iddings, 380
 Liverpool Astronomical Society, 402
 Liverpool Biological Society, 454
 Liverpool Literary and Philosophical Society, 546
 Lives of the Electricians, W. T. Jeans, 270
 Living: Phantasms of the, Edmund Gurney, Fred. W. H. Myers, and Frank Podmore, Prof. C. Lloyd Morgan, 290, 345
 Lobley (Logan), Geology of Hampstead, 454
 Local Scientific Societies, British Association and, 78
 Localisation, Cerebral, Prof. E. A. Schäfer, F.R.S., 438, 464
 Loch-buie Observatory, the, 58
 Loch-buie Marine Institute, 205
 Loch Creran, W. Alexander Smith, 484
 Lochleven Trout, Dr. Day, 166
 Lockhart (J. H. Stewart), Folk-Lore of China, 281
 Lockwood (Samuel), Snowflakes, 414
 Lodge (Prof. Alf.), Units of Weight, Mass, and Force, 557
 Lœwy (M.), New Method for the Determination of the Constant of Aberration, 263, 282, 407, 424, 431, 454, 479
 Logarithms, Values of, Prof. J. C. Adams, F.R.S., 381
 London Institution Lectures, the, 84
 London, University for, 505
 Long Lost Reefs, Capt. W. J. L. Wharton, F.R.S., 347
 Longevity of Great Men, Joseph Jastrow, 10
 Longitude of Rio, Prof. C. A. Young, 172
 Longitudes in Brazil, Admiral E. Mouchez, 100
 Loo-Choo Islands, Collection of Reptiles and Batrachians from, the, 431
 Lord Howe's Island, Australia, Preliminary Note on the Fossil Remains of a Chelonian Reptile, *Ceratochelys sthenurus*, from, Prof. Thos. H. Huxley, F.R.S., 615
 Louisville, University of, Semi-Centennial Anniversary of, 545
 Lowe (E. J., F.R.S.): Recent Gales, 150; Snowstorm of January 7, 1887, 271
 Lu River of Tibet, General J. T. Walker, F.R.S., on the, 615
 Lubbock (Sir John, F.R.S.): the Forms of Seedlings—the Causes to which they are due, 235; Lecture on Savages, 255; Phytobiological Observations, 430; Habits of Ants, 518
 Lucas (Felix), Entropy, 455
 Lucasite, a New Variety of Vermiculite, 141
 Lumbar Curve in Man and Apes, Prof. Cunningham, 46

- Lumbricales Muscles in the Hand and Foot, Variations in the Nerve-Supply of the, with some Observations on the Perforating Flexors, 521
- Lunar Glaciation, S. E. Peal, 100
- Lunar Halos, Prof. S. T. Moreland, 414
- Lunar Science, Rev. Timothy Harley, 246
- Lung-Sick, E. J. Dungate, 29; Philip J. Butler, 54; Dr. Gérard Smets, 76
- Lupton (Sydney), Chemical Arithmetic, 74
- Luther (Dr. R.), Probable Re-discovery of *Hesperia*, 614
- Lütlich (Dr. Julius), Death of, 307
- Luvini (Prof. Giov.), the Electric Conductibility of Vapours and Gases, 85
- Lydekker (Richard): on a Jaw of *Hyotherium* from the Pliocene of India, 94; the Cetacea of the Suffolk Crag, 94; Catalogue of Fossil Mammalia in the British Museum, 532
- Lynn (Mr.), Alleged Ancient Red Colour of Sirius, 378
- Lyræ, β , Atmosphere of, O. T. Sherman, 451
- Macadam (Prof.), Sample of Talc used in Paper-making, 423
- McConnel (James C.): an Error in Maxwell's Electricity and Magnetism, 172; Magnetic Theory, 344; Iridescent Clouds, 533
- Macfarlane (Prof. Alex.), Algebraic Notation of Kinship, 126
- Machinery, Means of Controlling the Irregular Action of, 479
- Mackinder (H. J.), on the Field and Methods of Geography, 331
- McLennan (J. Ferguson), Studies in Ancient History, Dr. W. Robertson Smith, 3
- Macro-Lepidoptera of East Sussex, J. H. A. Jenner, 230
- Madagascar, Capt. Samuel Pasfield Oliver, 149
- Madagascar: the French and, 306; Mr. Sibree on, 497
- Madan (H. G.): Lessons in Elementary Dynamics, 51; Lecture Experiments on the Expansion of Solids by Heat, 89; Note on the Manipulation of Glass containing Lead, 150; Recently-discovered Deposit of Celestine, 391; a Method of illustrating Combinations of Colours, 513; the Production of Newton's Rings by Plane Soap-Films, 583
- Madras Observatory, Mr. Pogson, 282
- Madreporian Coral Fungia, Anatomy of the, G. C. Bourne, 404
- Madrid Geographical Society, 182
- Magnetism: on the Cause of Magnetic Rotatory Polarisation, 141; Magnetic Horizontal Intensity in Northern Siberia, A. C. von Tillo, 170; Theory of Magnetic Measurements, Francis E. Nipher, 295; Magnetic Theory, Rev. H. W. Watson, 296; Jas. C. McConnel, 344; Magnetic Map of Japan, 330; Determination of the Poles in Magnets, 479; Magnetic Effects of Recent Earthquakes, 479; an Error in Maxwell's "Electricity and Magnetism," Prof. A. Seydler, 512; Note on Magnetic Resistance, Profs. W. E. Ayrton and John Perry, 526; Magnetisation of Iron in Strong Fields, Prof. J. A. Ewing, 622
- Maitland (Sir J. Ramsay Gibson), the History of Howietoun, 337
- Mallock (A.), Note on Instantaneous Shutters, 324
- Malvern Hills: the Metamorphic Rocks of the, Frank Rutley, 190, 623; Inquiry into the Genesis of the Crystalline Schists of the, Dr. C. Callaway, 623
- Mammalia, Fossil, in the British Museum, Catalogue of, Richd. Lydekker, 532
- Man and Apes, the Lumbar Curve in, Prof. Cunningham, 46
- Man, Palæolithic, in North-West Middlesex, J. A. Brown, 554
- Manchester Literary and Philosophical Society, 527
- Manchester, Report of the Public Free Libraries of the City of, 134
- Mandalay, Earthquake Shock, 472
- Manganese and Bismuth, Fluorescence of, 144
- Manganese Steel, Physical Properties of, Prof. W. F. Barrett, 311
- Manilla Hemp at Kew, 567
- Manipulation of Glass containing Lead, Note on the, H. G. Madan, 150
- Manipulation of Glass containing Lead, Prof. W. A. Shenstone, 223
- Manipur District, Dr. G. Watts's Observations in, 308
- Map of the World, lent by the Pope, Facsimile of the Famous, 447
- Maps of the River Ogové in West Africa, 353
- Maquenne (M.), Preparation, Properties, and Constitution of Inosite, 335
- Marayta (Prof. Miguel), Anthropological Discovery in the Valley of Rebas, 379
- Marche (Alfred), Expedition to the Marianne Islands, 231
- Marchesa, Cruise of the, F. H. H. Guillemard, 369
- Mares and Foals attacked by Wolves, George Maw, 297
- Marey (M.), Mechanism of the Flight of Birds studied by Chrono-Photography, 335; Movement of a Bird's Wing represented according to the Three Dimensions of Space, 382
- Marianne Islands, Alfred Marche's Expedition to, 231
- Marine Biology, Pouchet on *Gymnodinium polyphemus*, 48
- Marine Meteorological Instruments and Apparatus, Exhibition of, 352, 443, 491
- Marine Engineering, Die Schiffsmaschine, ihre Construction Wirkungsweise und Bedienung, 242
- Marine Fish, Phosphorescence of, Dr. Otto Hermes, 377
- Marine and Fresh-water Fishes, W. A. Carter, 472
- Marine Temperature Observations, Dr. H. R. Mill, 527
- Marion's Practical Guide to Photography, 52
- Maroni, Journey up the River, 354
- Marseilles Observatory, Note on Earthquake of February 23 at, 455
- Marshall (A. Milnes, F.R.S.), a Junior Course of Practical Zoology, 506
- Marsupialia, Embryology of Monotremata and, W. H. Caldwell, 524
- Martin (K.), Westindische Skizzen, Reise-Erinnerungen, Dr. A. Ernst, 459
- Martin (T. C.) and Jos. Wetzler, Electric Motor and its Applications, Prof. Silvanus P. Thompson, 410
- Marx (Dr. Walfried), Death of, 400
- Mascart (M.), Waterspouts, 431
- Mason Science College, Birmingham, 494
- Mass, Weight and, 512
- Mass and Force, Units of Weight, Prof. A. G. Greenhill, 486; Rev. Edward Geoghegan, 534; Prof. Alf. Lodge, 557; Archd. C. Elliott, 605; Robt. F. Hayward, F.R.S., 604
- Masse (George), Cambridge Cholera Fungus, 319
- Masters (Dr. Maxwell T.): Autumnal Flowering, 11; on the Peculiar Conformation of the Flowers of *Cypripedium*, 142
- Mastodonsaurus discovered on Juckatoo Island, Sydney, 445
- Mathematics: American Journal of, 28; Mathematical Society, 70, 166, 287, 406, 503, 599; Music and Mathematics, Prof. J. J. Sylvester, F.R.S., 132; Mathematical Tripos, Prof. J. W. L. Glaisher, F.R.S., 101, 153, 199; Acta Mathematica, 123; Elementary Results in Pure, G. S. Carr, 292; on the Theory of Mathematical Form, A. B. Kempe, F.R.S., 574
- Matrix Excluder of Draught and Dust, Permanent, T. J. Porter, 569
- Matter, Preliminary Note on the Continuity of the Liquid and Gaseous States of, William Ramsay and Sydney Young, 262
- Matter, on certain Modern Developments of Graham's Ideas concerning the Constitution of, Prof. T. E. Thorpe, F.R.S., 522, 547
- Mauna Loa, Eruption of the Volcano of, 423
- Maw (George): *Narcissus cyclamineus*, 166, 381; Wolves, Mares, and Foals, 297; on some Phenomena connected with the Freezing of Aërated Water, 325; the Crocus, 348
- Maxwell's "Electricity and Magnetism," an Error in, James C. McConnel, 172; Rev. Henry W. Watson, 223; Prof. A. Seydler, 512
- Mazapil Meteoric Iron, William Earl Hidden, 572
- Mean Values, on the Determination of, 120
- Measurements, Theory of Magnetic, Francis E. Nipher, 295
- Measuring-Instruments used in testing Materials, on some New, Prof. W. C. Unwin, F.R.S., 334
- Mechanics, Animal, Dr. B. W. Richardson, 57
- Mechanism of the Flight of Birds studied by Chrono-Photography, M. Marey, 335
- Medical Aspects, Alpine Winter and its, A. Tucker Wise, 170
- Medical Index-Catalogue, A. T. Myers, 196
- Medical Profession, Laws relating to, in the State of New York, 443
- Medical Research, Endowment of, 409
- Medical School in connexion with Dundee University College, proposed, 349
- Medical School of Paris, M. Brouardel elected Dean, 422
- Medical Students, Female, in Paris, Number of, 306

- Medland's Cabinet for Microscope-Slides, 158
 Medlicott (H. B.), the Use of the Bengal in the Geological Survey of India, 472
 Medusa, New Rhizomatous, J. Walter Fewkes, 451
 Medusæ, Report on the, J. Walter Fewkes, 377
 Melbourne Centennial International Exhibition, 421; First Meeting of the London Commission, 518
 Melinite, the New Gun-powder, Accident with, 472
 Melvill (J. C.), on *Conus gloria maris*, 230
 Men, Longevity of Great, Joseph Jastrow, 10
 Mendenhall (Prof. T. C.), Report on the Charleston Earthquake, 31
 Mental Straining in Young Persons, Bad Results of, 495
 Mercadier (M.), Death of, 306
 Mercer (John, F.R.S.), the Life and Labours of, Edward A. Parnell, Prof. T. E. Thorpe, F.R.S., 145
 Mercury, Mass of, Herr Backlund, 85
 Mercury, on the Physical Properties of, 120
 Merrill (Prof. Geo. P.), Deposits of Volcanic Dust, 174
 Metal Films arising from the Disruption of a Kathode, B. Dessau, 333
 Metal Plates, on the Deformation of, by grinding, 333
 Metallic Propionates, 551
 Metals and Alloys, Colours of, Prof. W. Chandler Roberts-Austen, F.R.S., 106
 Metastasis in Man, Effect of Alcohol on, 383
 Meteoric Iron from Augusta County, Virginia, 381
 Meteoric Iron, Mazapil, William Earl Hidden, 572
 Meteorites, Iron: on the Crystalline Structure of, O. W. Huntington, 16; a Fossil found in Coal, Dr. Gurlt, 36; on the Crystalline Structure of Iron Meteorites, O. W. Huntington, 93; on the Explosion of, M. Hirn, 303; Coahuila, O. W. Huntington, 451
 Meteorology: Algiers Observatory, 16; High Temperature in October, Chas. Harding, 18; Investigations into Thunderstorms of July 1884, Prof. Börnstein, 24; Prof. von Helmholtz on the Formation of a Thunderstorm, 24; Sea-Level and Ocean-Currents, Prof. J. S. Newberry, 35; the Squall that capsized H.M.S. *Eurydice*, Hon. R. Abercromby, 36; the Law of Storms in the Eastern Seas, Dr. Doberck, 36; the Recent Weather, 198; F. T. Mott, 173; William Ingram, 173; Rev. W. Clement Ley, 54; the Climate of Carlisle, F. G. Benn, 95; the Gale of October 15-16, 1886, C. Harding, 95; Remarkable Phenomenon in Norway, 159; the Hong Kong Observatory, 229; Meteorological Conditions at the Time of the Eruption of Mount Tarawera, New Zealand, Capt. F. W. Hutton, 322; a Few of our Weather Terms, Rev. W. Clement Ley, 323; Low Barometric Readings, Henry F. Blanford, 344; Army Signal Service in the United States, 349; Comparison of the Daily Forecast issued by the Meteorological Office for the Midland District with the Actual Weather experienced in 1886, G. T. Ryves, 350; Exhibition of Marine Meteorological Instruments and Apparatus, 352; Exhibition of Marine Meteorological Instruments, 443, 491; Meteorological Society, 384, 504; Scottish Meteorological Society, 355; Berlin Meteorological Society, 360; Administration Report of the Meteorological Department, India, 365; Atlantic Weather Charts, 469; Blue Hill Meteorological Observatory, U.S., 472; West Indian Meteorological Confederation, Maxwell Hall, 485; Marine Temperature Observations, Dr. H. K. Mill, 527; Meteorological Stations established by Italian Meteorological Society, 612; Areas of High Pressure, Elias Loomis, 621
 Meteors, 58, 224; Joseph John Murphy on a, 118; Rev. John Hoskyns-Abraham, 29; E. Parry, 29; Meteor, November 17, 1886, P. L. Sclater, F.R.S., 76; W. F. Denning, 101; Meteor of December 28, 1886, W. F. Denning, 248; Brilliant Meteor seen on the South-West Coast of Sweden, 112; at Holmstrand, 352; in Dalarlia, Central Sweden, 495; in Central Norway, 443; in Værdalen, Norway, 612; April Meteors, W. F. Denning, 606; Meteors and Auroras, Dr. M. A. Veeder, 126
 Method of measuring the Mutual Induction of Two Coils, 478
 Methyl Alcohol, Thermal Properties of, William Ramsay and Sydney Young, 358
 Methylal, on the Physiological Action of, 336
 Metre, the Measure of the, W. de Fonvielle, 388
 Metronome, Electrical, established at the Paris Opera House, 158
 Metronome, New, 479
 Metzger (Jos. M.) and J. S. Hay, Earthquake in Sierra Leone, 141
 Mexican Codices and Graven Inscriptions, Mrs. Zelia Nuttall, 307, 328
 Miall (L. C.), the Structure and Life-History of the Cockroach, 365
 Michaelis (E.), an Ice Period in the Altai Mountains, 149
 Michigan, University of, Proposed School of Hygiene at, 377
 Microbe of Yellow Fever, 528
 Microscopy: Medland's Cabinet for Microscope-Slides, 158; Flagellated Protozoa in Animals' Blood, Dr. Crookshank, 191; Microscope, on a Perspective, G. J. Birch, 358; Size of Ancient Microscopes, 359; the Value of the New Apochromatic Lenses, 467; the Watson-Draper Microscope, 550; Studies in Microscopical Science, A. C. Cole, 568
 Micro-organisms in Atmosphere, New Method for the Quantitative Estimation of, Dr. P. F. Frankland, 188
 Micro-organisms obtained from Air, some New, G. C. Frankland and Dr. Percy F. Frankland, 477
 Midden, Kitchen, at Ginnerup, Denmark, 112
 Middlemiss (C. S.), Top-shaped Hailstones, 413
 Middlesex County Natural History Society, 167, 335, 454
 Middlesex, North-West, Palæolithic Man in, J. A. Brown, 554
 Migration of Primitive Peoples, 205
 Mill (Dr. H. R.), Marine Temperature Observations, 527
 Milne (Prof. John), Volcanoes of Japan, 19; Seismometry in Japan, 36; Sounding a Crater, 152; Important Points in the History of Earthquake Investigation in Japan, 559
 Mineralogy: O. W. Huntington on the Crystalline Structure of Iron Meteorites, 16; Mineralogical Society, 382; the Relations between Geology and the Mineralogical Sciences, Prof. John W. Judd, F.R.S., 392, 414; Mineral Resources of the United States, 401; Mineralogical Magazine, 423; Catalogue of Minerals in the Australian Museum, 485; the Relation of Tabasheer to Mineral Substances, Prof. J. W. Judd, F.R.S., 488; Mineralogical Study of the Fort Duncan Meteoric Iron, 528; Constituents of Mineral Naphthas, 552; Mineral Physiology and Physiography, Thos. Sterry Hunt, 578
 Mines, Royal School of, and Normal School of Science, Colonel J. F. D. Donnelly, 271
 Minister of Education, Necessity for a, 481
 Minor Planets: No. 262, 497; No. 264, 353; No. 265, M. Bigourdan, 474; New, Prof. C. H. F. Peters, 59, 282; Herr Palisa, 59, 425; Names of, 207, 569; Observations of, 312
 Miocene Vertebrate Fauna, 383
 Mitteilungen of the Vienna Geographical Society, 446
 Mittheilungen aus dem Gebiete des Seewesens, 612
 Mittheilungen of the Zurich Antiquarian Society, 423
 Modern War-Ships, W. H. White, 306
 Modigliani (Dr. E.), Excursion to Island of Nias, 60; Exploration of Nias, Prof. Henry H. Giglioli, 259, 342
 Moduli of Alloys, 333
 Moissan's Researches on Isolation of Fluor, 71
 Moluccas, Proposed Geographical and Geological Exploration of the, Prof. Kan, 182
 Monaco (Prince Albert of), Experiments made to determine the Direction of the North Atlantic Currents, 288
 Monck (W. H. S.): Astronomical Theory of the Great Ice Age, 7; Brightness and Mass of Binary Stars, 402
 Mongalla, Lieut. Baert's Journey up the, 446
 Monotremata and Marsupialia, Embryology of, W. H. Caldwell, 524
 Montagne Noire, French Pyrenees, Age of the Upheaval of, 551
 Montgaudier Cave, the, 119
 Moon, New Map of the, 58
 Moore's (Thos.) Botanical Collections acquired for the Herbarium, Kew Gardens, 495
 Moreland (Prof. S. T.), Lunar Halos, 414
 Morgan (Prof. C. Lloyd): the Beetle in Motion, 7; Abnormalities in the Vertebral Column of the Common Frog, 53; Supernormal Psychology, 290; Abnormality in the Urostyle of the Common Frog, 344; Scorpion Virus, 534
 Morley (Frank), Rule for escaping a Danger, 345
 Morley (John), Study of Literature, 422
 Morphiomaniacs, Characteristics of the Pulse in, 528
 Morphology of Birds, Prof. W. K. Parker, F.R.S., 331

- Morphology of the Wings of Birds, 599
Morphology of the Sporophore in Mosses, J. R. Vaizey, 358
Morris (D.): Dispersion of Plants by Birds, 151; Botanical Federation in the West Indies, 248
Morris's (the late Prof.) Catalogue of British Fossils, 158
Morse (Edward S.), Ancient and Modern Methods of Arrow-Release, 12
Mosses, Morphology of the Sporophore in, J. R. Vaizey, 358
Moth-breeding, Pedigree, Francis Galton, F.R.S., 453
Mott (F. T.), the Recent Weather, 173
Mouchez (Admiral E.), Longitudes in Brazil, 100
Mount Tarawera: New Zealand, Meteorological Conditions at the Time of the Eruption of, Capt. F. W. Hutton, 322; Eruption of, 406, 472
Mountain Ranges, Origin of, T. Mellard Reade, 361, 463; Prof. A. H. Green, F.R.S., 361, 463
Movements of the Atmosphere, 479
Mueller (Baron Von), on the Acacias (Wattles) of Australia, 282
Muir Glacier, the, G. Frederick Wright, 380
Müller (Dr. G.), Gore's Variable near χ^1 Orionis, 329
Müller (Dr. Hugo), Recent Progress of Chemical Science, 536
Müller (Dr. R.), Equinoctial Gales, 612
Mummy Seeds, Vitality of, Geo. Murray, 582
Murdoch (John), some Popular Errors in regard to the Eskimos, 518
Murphy (Joseph John): Meteor, 8; Origin of Species, 76
Murray (Geo.), Vitality of Mummy Seeds, 582
Murray (John): Scientific Knowledge in Scotland, 305; Total Rainfall of the Globe, 311
Murray-Aynsley (H. G. M.), Study of Asiatic Symbolism, 327; the Svastika as both Sun and Fire Symbol, 558
Muscle, Voluntary, Action of Caffeïn and Theine upon, T. Lauder Brunton, F.R.S., 599
Muscles in the Hand and Foot, Variations in the Nerve-Supply of the Lumbricales, 521
Music and Mathematics, Prof. J. J. Sylvester, F.R.S., 132
Mutual Induction of Two Coils, Method of measuring, 478; Prof. G. Carey Foster, F.R.S., 143
Myers (A. T.), Medical Index-Catalogue, 196
Myers (Fred. W. H.), Phantasms of the Living, Prof. C. Lloyd Morgan, 290
Myriapods, Respiration in, M. J. Chalande, 288
Mythical Zoology of the Far East, 591
Myzostoma-Cysts in *Antedon rosacea*, the Supposed, Dr. P. Herbert Carpenter, F.R.S., 535
- Naphtha Fountain, Outburst of Natural, at Baku, 352
Naphtha, on the Constituents of Mineral, 552
Narcissus cyclamineus, G. Maw, 166, 381
Nasal Index of the Living Subject, 357
Natal Observatory, Mr. Neison, 85
National Fish-Culture Association, 112, 350; Consignment of Whitefish Ova to the, 519
National Science Collections, 252, 272
National Union of Elementary Teachers, 567
Nationalities of Bohemia, 518
Natterer (Johann), his Ornithological Collection at the Vienna Natural History Museum, 204
Natural History Museum, 15; Additions to, 593
Natural History, its Rise and Progress in Britain, Prof. Alleyne Nicholson, 148
Natural History, the Handy, J. G. Wood, 341
Natural Philosophy, Mr. Maclean, 350
Natural Science at Oxford, 229
Naturalist in South America, Notes of a, John Ball, F.R.S., 529, 553
Naturalist, Field, in Eastern Bengal, 388
Naumann (Dr.), Physical Geography of Japan, 330
Navajos, Notes on Certain Traits of Infant, R. W. Shufeldt, 346
Naval Architects, Institution of, 538
Naval Geometry, Developments of, 382
Naval Observatory, United States, 595
Nebulæ at Arcetri, Observations of, Wilhelm Tempel, 198
Neison (Mr.), Natal Observatory, 85
Nematodes of Beetroot, Destruction of, 455
- Nerve-Supply of the Lumbricales Muscles in the Hand and Foot, Variations in the, with some Observations on the Perforating Flexors, 521
Nervous System, Sympathetic, Dr. Walter H. Gaskell, F.R.S., 185
Nests and Eggs, Birds', H. Seebohm, 236
New England: Planting of Foreign Trees in, 519; Fluvialite Swamps of, 524
New Guinea: German Exploration in, 403, 615; Proposal to cross South-East, 547
New York, Laws relating to the Medical Profession in the State of, 443; Educational System in, Andrew S. Draper, 445
New Zealand: Volcanic Dust from, Prof. T. G. Bonney, F.R.S., 56; Salmon Ova sent to, 112; Coleoptera of, David Sharp, 177; Red Sunsets and New Zealand Eruptions, Lieut.-Colonel A. T. Fraser, 224; Signs of Fresh Disturbances in the Lake District in, 306
Newberry (Prof. J. S.), Sea-Level and Ocean-Currents, 35
Newsholme (Arthur), School Hygiene, 604
Newton's Rings, the Production of, by Plane Soap-Films, H. G. Madan, 583
Nias: Dr. E. Modigliani's Expeditions to, 60, 259; Prof. Henry H. Giglioli, 342
Nicaragua, Proposed Canal across, 353
Nicaragua and Costa Rica, Twelve Jade Objects found in, 496
Nice, the Great Refracting Telescope of the Bischoffshelm Observatory at, 84
Nicéville (Lionel de), Butterflies of India, H. J. Elwes, 436
Nichols (Edward L.), and E. H. S. Bailey, the Sense of Smell, 74
Nicholson (Prof. Alleyne), Natural History, its Rise and Progress in Britain, 148
Nicols (Dr. W. W. J.): on the Nature of Solution, 64; Super-saturation of Salt-Solutions, 527
Niederrheinische Gesellschaft für Naturkunde, 36
Nile Valley North of Khartoum, on the Tribes of the, Sir Chas. Wilson on, 431
Nile and the Congo, on the Region between the, J. T. Wills, 521
Nipher (Francis E.), Theory of Magnetic Measurements, 295
Nitrate of Silver, Action of some Metals on Weak Solutions of, 431
Nitric Acid, Action of, on Sugar, 432
Nitrogen and Oxygen, Critical Temperatures of, 331
Nitrogenous Organic Matter of Soils, on the Condition of the, R. Warington, F.R.S., 403
Niua-Fu Friendly Islands, Volcanic Eruption in, Prof. T. G. Bonney, F.R.S., 127
Nixon (R. C. J.), Euclid Revised, 269
Noble (Capt. Wm.), Hours with a Three-Inch Telescope, 246
Nolan (James), Tidal Friction and the Evolution of a Satellite, 75
Nordenskjöld (A. E.), on Atomic Weight of Oxide of Gadolinium, 47
Nordheinsund, West Coast of Norway, Earthquake at, 158
Norites of the Cortlandt Series, 524; G. H. Williams, 452
Normal School of Science and Royal School of Mines, 111; Col. J. F. D. Donnelly, 271
Norse Naval Architecture, G. K. Boehmer, 445
North America, Great Britain, and Ireland, Comparative Studies upon Glaciation of, Prof. H. Carvill Lewis, 89
North Atlantic Currents, Experiments made to determine the Direction of the, Prince Albert of Monaco, 288
North Sea, Exploration of the, 73
Norway: Science in, 122; New Journal of Science, 356; Remarkable Meteor in, 159; Proposal for fixing a Standard Time for, 280; Brilliant Meteor seen in, 443; Earthquakes in, Dr. Hans Reuch, 517; Leprosy on the West Coast of, 519
Notation of Kinship, Algebraic, Prof. Alex. Macfarlane, 126
Nott (J. Fortuné), Wild Animals Photographed and Described, 220
Noury (Le P. Ch.), Geology of Jersey, 412
Nova Orionis, Gore's, M. Dunér, Herr Schwab, 85
Number, Theory of, 477
Nuovo Giornale Botanico Italiano, 212, 405
Nuttall (Zelia), Mexican Codices and Graven Inscriptions, 307, 328
Nyt Magazin for Naturvidenskaberne, 356

- Obernetter (Herr J. B.), Death of, 612
- Observatories: the Algiers, 16; Ben Nevis, 517; Amount of the Rainfall at, 257; A. Rankin, 588; Blue Hill Meteorological, U.S., 472; Baron D'Engelhardt's, 546; Harvard College, 497; Prof. Pickering, 424; Kalocsa, Dr. C. Braun, 59; Report of the Leander McCormick, 35; Madras, Mr. Pogson, 282; Note on Earthquake of February 23, at Marseilles, 455; Report of the Natal, 85; Observatory of Rio de Janeiro, transferred to Santa Cruz, 593; Report of the Rousdon, 353; Sonnblick, 519; Temple, Mr. Seabroke, 401; U.S. Naval, 595; Washington, 308, 614; Captain R. L. Phythian, 569; for Women in America, 229
- Ocean, the, Otto Kriimmel, 6
- Ocean Air, Purity of, 595
- Oceans, Similarities in the Physical Geography of the Great, J. Y. Buchanan, 33, 76
- Ochsenius (Dr.), on the Age of certain Parts of the South American Andes, 547
- October, High Temperature in, Charles Harding, 18
- Odell (W.), Industrial and High Art Education in the United States, J. Edwards Clarke, 97
- Ogorodnikoff (M.), Tin-Mines near Meshed, 376
- Ogové, Maps of the River, in West Africa, 353
- Ohio, Great Serpent Mound in, W. H. Holmes, 281
- Oil, the Use of, in lessening the Effect of Dangerous Seas, 63, 376
- Oktibehite or Awaruite, Dr. Jas. Hector, F.R.S., 513
- Oldham (R. D.), Supposed Suicide of the Cobra, 560
- Oldhamia, on, 515; Prof. T. G. Bonney, F.R.S., 581
- Olive Oils, Characteristic Properties of, 383
- Oliver (Capt. Samuel Pasfield), Madagascar, 149
- Olzewski (M.): Critical Temperatures of Nitrogen and Oxygen, 331; his Experiments, 592
- Omond (R. T.): Green Light at Sunset, 391; Solar Halos, 582
- Onisin, Rev. Thos. Brydges on the Curious Subdivision of Labour among the People of, 283
- Oppenheim (Dr. H.): Comet Barnard (1886*f*), 85; Comet 1887*c* (Barnard, January 23), 424
- Oppermann (M.), Earthquakes, 600
- Oppölzer (Theodor von): on Astronomical Refractions, 17; Obituary Notice of, 224
- Orbit of the Binary Star 14 (*z*) Orionis, J. E. Gore, 569
- Orchids, Fungus on, 230
- Ordnance Survey of the United Kingdom, Lieut.-Colonel T. Pilkington White, 170
- O'Reilly (Prof. J. P.): the Recent Earthquakes, 197; on Two Jade-handled Brushes, 318
- Organic Analysis, Commercial, Alfred H. Allen, Dr. C. R. Alder Wright, 293
- Organic Evolution, Factors of, Herbert Spencer, Dr. Geo. J. Romanes, F.R.S., 362
- Organism, Demonstration of Active Oxygen in the Living, 383
- Origin of Mountain Ranges, T. Mellard Reade, Prof. A. H. Green, F.R.S., 361, 463
- Origin of Species, Joseph J. Murphy, 76; Edmund Catchpool, 76; Dr. Geo. J. Romanes, F.R.S., 124
- Orinoco, Exploration of the, M. Chaffaujon, 446
- Orionis, Orbit of the Binary Star 14 (*z*), J. E. Gore, 569
- Orionis, χ^1 , Gore's Variable near, Dr. G. Müller, 329
- Ormerod (Eleanor A.), on the Hessian Fly and Barley, 256
- Ornithology: H. Seebohm's Specimens of Siberian Birds, 15; the Birds of Central Asia, 204; the Auk, 204; the Birds of Tasmania, 204; Types of Birds in the Vienna Natural History Museum, 204; Arctic Species of Birds, Henry Seebohm on, 256; Ornithological Observations in Belgium, 423; Additions to the Natural History Museum, 593
- Osler (A. F., F.R.S.), on the Forms of Clouds, 164
- Otago University Museum, Notes from the, Prof. T. Jeffery Parker, 208
- Otaria hookeri* at the Zoological Gardens, 327
- Otocysts in Invertebrates, a New Function of the, Yves Delage, 48
- Owen (Sir Richard, F.R.S.), on the Skull and Dentition of *Galesaurus planiceps*, 94; *Thylacoleo carnifex*, 111; *Thylacoleo*, Fossil, Lower Jaw of, 142
- Owen (T. C.), Tea Planter's Manual, 268
- Owens College, the, Joseph Thompson, 385
- Ox-Warble, Enormous Loss from, John Walker, 7; Dr. John Wrightson, 29
- Oxford: Natural Science at, 229; General Pitt-Rivers' Anthropological Collection at Oxford University Museum, 349; Readership in Geography at, 475
- Oxidation, Atmospheric, Note on the Development of Voltaic Electricity by, C. R. Alder Wright, F.R.S., 598
- Oxide of Lead, Action of the, on some Dissolved Chlorides, 382
- Oxygen, Active, in the Animal Organism, Dr. Gad, Dr. Wurster, 383
- Oxyhydrogen Light, the Zirconia, Lewis Wright, 583
- Oyster-Culture in France, 400, 495
- Oyster-Culture in Germany, 400
- Oyster-Fisheries of Isle of Wight, 57
- Oyster-Fisheries of Tasmania, 233
- Ozone, Dr. A. Tucker Wise, 584
- Ozone, Production of, 248
- Ozone Papers in Towns, Dr. W. J. Black, 76
- Palæobotany in Goebel's "Outlines of Classification and Special Morphology of Plants," on some Observations on, Prof. W. C. Williamson, F.R.S., 535
- Palæolithic Man in North-West Middlesex, J. Allen Brown, 554
- Palæolithic Workshop Floor of Drift Period near Ealing, Discovery of, J. Allen Brown, 189
- Palæontology: on the Skull and Dentition of a Triassic Saurian, *Galesaurus planiceps*, Sir R. Owen, F.R.S., 94; the Cetacea of the Suffolk Crag, R. Lydekker, 94; on a Jaw of Hyotherium from the Pliocene of India, R. Lydekker, 94; Discovery of Rare Fossils at Sydney, 159; Discovery of Skull of *Ceratodus* in Austria, 181; Fossil *Chilostomatous* Bryozoa from New Zealand, A. W. Waters, 190; Purchase of the Hill-ck of Sansan by the French Government, 323; Palæontological Researches near Rheims, 407
- Palisa (Herr), New Minor Planet, 59, 425
- Palissy, the, of Calico Printing, the Life and Labours of John Mercer, F.R.S., Edward A. Parnell, Prof. T. E. Thorpe, F.R.S., 145
- Papers, Ozone, in Towns, Dr. W. J. Black, 76
- Parallel, to prove that only One, can be drawn from a given Point to a given Straight Line, Dr. E. Budden, 92
- Parallax, Stellar, Prof. Asaph Hall, 258
- Parallax of the Sun, New Method of determining the, 455
- Parallax of Σ 1516, the, M. O. Struve, 546
- Paris: Academy of Sciences, 23, 47, 71, 96, 119, 144, 167, 191, 263, 287, 312, 335, 359, 382, 407, 431, 454, 479, 503, 527, 551, 575, 599, 624; Astronomical Prizes of the, 258; Paris Geographical Society, 60, 180, 182, 354; Bulletin of the, 353; Proposed Telephonic Line between Paris and Brussels, 133; Number of Female Medical Students in, 306; New Medical Paper to be published in, 376; Alpine Flora Surviving in the Paris District, 431; Meeting of the French Congrès de Chirurgie in, 444; New Building for the Laboratories of the Paris Medical School, 473; Bad Results of Mental Straining in Young Persons at Paris Academy of Medicine, 495; Alteration in the Mode of Competition for Fellowships of Paris Medical Faculty, 517; Proposed Telephone Line from Paris to London, 544; Statistics in Paris, 568; Astronomical Congress, 584
- Parker (Prof. T. Jeffery), Notes from the Otago University Museum, 208
- Parker (Prof. W. K., F.R.S.), Morphology of Bird, 331
- Parker (W. Newton), Comparative Anatomy of Vertebrates, Robert Wiedersheim, 121
- Parnell (Edward A.), the Life and Labours of John Mercer, F.R.S., Prof. T. E. Thorpe, F.R.S., 145
- Parry (E.), Meteors, 29
- Pasterz Glacier, Rate of Movement of the, Herr Ferdinand Seeland, 520
- Pasteur, Institute, the, 83; Statistics of Persons treated at the, 335; Treatment of Rabies, 30
- Pathological Anatomy and Pathogenesis, a Text-book of, E. Ziegler, 246
- Pathology, an Introduction to France, J. B. Sutton, 26
- Paulus (A.) and A. Bouinain, La General in Indo-Chine, 221
- Paws, Cats', Abnormality in, J. Herbert Hodd, 53; E. W. Claypole, 345; Dr. H. A. Hagen, 345
- Peach (C. W.), Memorial Fund, 83

- Peal (S. E.), Lunar Glaciation, 100
 Pearls and Pearly Life, Edwin W. Streeter, 339
 Pedigree Moth-breeding, Francis Galton, F.R.S., 453
 Peek (Mr.), Report on Rousdon Observatory, 353
 Penfield (Sam. L.), Phenacite from Colorado, 451
 Pennsylvania, North-Eastern, Thickness of the Ice in, during the Glacial Epoch, 141
 Peppe (T. F.), on the Cultivation of the so-called Wild Silks of India, 256
 Peripatus, Species of, obtained in British Guiana, 381
 Peristaltic Movement, Prof. Falk, 264
 Pernet (Dr.), on the Determination of the Air in the Vacuum of the Barometer, 72; Comparison of Barometers, 600
 Peronospora of the Vine, 382
 Peroxide of Hydrogen, Formation of, by Electrolysis, Dr. Richarz, 384
 Perrin (M. R.), on the Theory of Algebraic Forms with p Variables, 335
 Perry (Rev. S. J., F.R.S.), the Earthquake, 438
 Perthshire Society of Natural Science, 206
 Petermann's Mitteilungen, 182, 232, 353, 403, 475
 Peters (Prof.), New Minor Planets, 59, 282
 Petrie (Prof.), Siberia as a Colony, 158
 Petrography, H. Rosenbusch, Dr. Fred. B. Hatch, 482
 Petroleum, Russian, the Coming Deluge of, C. Marvin, 120, 295
Petromyzon fluviatilis, some Points in the Development of, 404
 Petunias and Insects, J. W. Slater, 70
 Phantasms of the Living, Edmund Gurney, Fred. W. H. Myers, and Frank Podmore, Prof. C. Lloyd Morgan, 290; Edmund Gurney, 345
 Phenacite from Colorado, Sam. L. Penfield, 451
 Philadelphia, the Wagner Free Institute of Science, 230; Museum of the Academy of Natural Sciences, 424
 Philiatra, Earthquake Shocks in, 444
 Philippine Archipelago, Exhibition of the Products of, 567
 Philippine Islands, Tinguianus of the, 446
 Philippines, Folk-Lore Society established in the, 134
 Phillips (Alfred), the Application of Gems to the Art of the Goldsmith, 495
 Phillips (John Arthur, F.R.S.): Obituary Notice of, 248; Death of, 382
 Phillips (Samuel), Old or New Chemistry, Which is fittest for Survival? 270
 Philosophical Transactions of the Royal Society, 399
 Phosphorescence of Marine Fish, Dr. Otto Hermes, 377
 Phosphorescent Alumina, Crimson Line of, William Crookes, F.R.S., 310
 Photography: Celestial, 35; Stellar Photography at Harvard College, Prof. Pickering, 37; Marion's Practical Guide to Photography, 52; Wild Animals Photographed and Described, J. Fortuné Nott, 220; Photography the Servant of Astronomy, Edward S. Holden, 317; Progress of Astronomical, 321; Instantaneous Shutters, 324, 366; Mechanism of the Flight of Birds studied by Chrono-Photography, M. Marey, 335; Photo-Micrographs, Dr. van Heurck, 359; Application of, to the Determination of Stellar Parallax, Prof. Pritchard, 377; Convention of Photographers in the Hall of the Society of Arts, 377; Photograph of the Nebula No. 1180, M. Mouchez, 407; Photographic Chart of the Heavens, proposed, 567; Use of Eosin Silver in Photography, 432; Measurement of the Photographic Plates of the Transit of Venus 1882, 455
 Phylloxera, Incubation of, during the Winter Season, 431, 600
 Phylogeny of the Camelidae, 568
 Physical Geography of the Great Oceans, Similarities of the, J. Y. Buchanan, 33, 76
 Physical Geography of Japan, Dr. Naumann, 330
 Physical Geography of Australia, Manual of, H. Beresford de la Poer Wall, 389
 Physical History of the Bagshot Beds of the London Basin, Rev. A. Irving, 382
 Physical Notes, 331
 Physical Society, 94, 143, 334, 383, 478, 526, 575
 Physical Quantities, the *Engineer* on Dimensions of, 462
 Physics, Chemical, Prof. Josiah Parsons Cooke, 100
 Physiology: on the Connexion between Physiological Action and Chemical Constitution, Dr. James Blake, 6; Experimental Researches on the Cerebral Functions, Brown-Séquard, 47; a New Function of the Otocysts in the Invertebrates, Yves Delage, 48; Mr. Wallace on Physiological Selection, Dr. Geo. J. Romanes, F.R.S., 247, 366, 390; Proposal to devote the Legacy bequeathed by Sir Erasmus Wilson to Physiological and Pathological Research, 280; Preyer's French Translation of "Physiology of the Embryo," 376; Mineral Physiology and Physiography, Thos. Sterry Hunt, 578; Contributions to our Knowledge of the Connexion between Chemical Constitution and Physiological Action, Preliminary Communication on the Action of certain Aromatic Bodies, T. Lauder Brunton, F.R.S., and J. Theodore Cash, 599
 Pythian (Capt. R. L.), Washington Observatory, 569
 Phytobiological Observations, Sir J. Lubbock, 430
 Piano, on the Time of Contact between the Hammer and String in a, 141
 Pickering (Prof. S. U.): Stellar Photography at Harvard College, 37; Harvard College Observatory, 424; Influence of Temperature on the Heat of Dissolution of Salts, 453
 Pierie (Dr. Victor), Death of, 16
 Pierre (M.), Pension to, 545
 Pigeons, Sparrows chasing Two, 536; J. Jenner Weir, 584
 Pigeons, Fancy, Books on, 544
 Pisciculture: Spawning of Brook Trout, 16; the Acclimatisation of German Carp, 58; the Lochbuie Observatory, 58; Exportation of Salmon Ova to Antipodes, 181; Fish-hatching at the National Fish-Culture Association, 159
 Pitt-Rivers' (General) Anthropological Collection at Oxford Museum, 349
 Plane Geometry, the Elements of, 27
 Plane Soap-Films, the Production of Newton's Rings by, H. G. Madan, 583
 Planets, Minor: No. 262, 497; No. 264, 353; No. 265, M. Bigourdan, 474; Names of, 207, 569; New Minor, Herr Palisa, 59, 425; Prof. C. H. F. Peters, 59, 282; Observations of, 312
 Plant which destroys the Taste of Sweetness, W. T. Thiselton Dyer, F.R.S., 557
 Plants, how to make Colourless Specimens of, to be preserved in Alcohol, Prof. Hugo de Vries, 149; Selmer Schönland, 173
 Plants by Birds, Dispersion of, D. Morris, 151
 Plants, Outlines of Classification and Special Morphology of, Dr. K. Goebel, 577
 Plummer (John L.), Barnard's Second Comet, 583
 Plunkett (Major E. T.), Walks in Cairo, 256
 Podmore (Frank), Phantasms of the Living, Prof. C. Lloyd Morgan, 290
 Pogson (Mr.), Madras Observatory, 282
Pogonanthus foxii, Note on, J. W. Hulke, F.R.S., 357
 Polar Expeditions, British International, 147
 Polar Stars, Reduction of the Positions of Close, from one Epoch to another, Prof. W. A. Rogers and Miss Anna Winlock, 231
 Polarisation, Magnetic Rotatory, on the Cause of, 141
 Polarisng Prisms, on the Cutting of, Prof. Silvanus P. Thompson, 184
 Poles in Magnets, Determination of the, 479
 Porter (T. J.), Permanent Matrix Excluder of Draught and Dust, 569
 Portugal, Consignment of German Carp forwarded to, 350
 Potanin (M.), M. Skassy, and M. Bérésosky, Return of, from their Expedition to China and Mongolia, 309
 Potassa, Glycerinate of, M. de Forcrand, 288
 Potato Tercentenary, 16, 175
 Pouchet, *Gymnodinium polyphemus*, 48
 Poulton (Edward B.): Observations on Heredity in Cats with an Abnormal Number of Toes, 38; Gilded Chrysalides, 470; the Gecko moves its Upper Jaw, 511
 Power, Transmission of, by Compressed Air, 272
 Pre-Scientific Theories of the Causes of Earthquakes, 428
 Preece (W. H., F.R.S.), on the Limiting Distance of Speech by Telephone, 501
 Prehistoric Man, A. de Quatrefages, 23
 Prehistoric Races, European, Prof. A. H. Keane, 564
 Prehistoric Remains in America, 476
 Prehistoric Station in the Wood of Chaville, Discovery of, 613
 Pressure, Vertical Decrement of Temperature and, S. A. Hill, 606
 Preyer's "Physiology of the Embryo," French Translation of, 376
 Price (F. G. Hilton), Vitality of Seeds, 463

- "Primitive Marriage," Reprint of McLennan's, Dr. W. Robertson Smith, 3
- Primroses, W. Botting Hemsley, 561
- Primula imperialis*, 430
- Pringsheim (Dr.), Chemical Action of Light on Mixed Hydrogen and Chlorine Gas, 552
- Priority, a Claim of, V. Ventosa, 513; Prof. H. S. Hele Shaw, 581
- Prisms, on the Cutting of Polarising, Prof. Silvanus P. Thompson, 184
- Pritchard (Prof.), Application of Photography to the Determination of Stellar Parallax, 377
- Proceedings of the Liverpool Geological Society, 133
- Professorships, *Science* on advertising for Candidates for Vacant, 229
- Protoplasm, Prof. H. Marshall Ward, 300
- Protoplasm, Living, Method for subjecting, to the Action of Different Liquids, 452
- Psychical Research, American Society for, 281
- Psychology, American Journal of, 400
- Psychology, Supernormal, Phantasms of the Living, Edmund Gurney, Fred. W. H. Myers, and Frank Podmore, Prof. C. Lloyd Morgan, 290, 345
- Ptarmigan, the, Robert Service, 445
- Pulleys and Drums, Trains of, Prof. H. Hennessy, F.R.S., 452
- Pygmy Tribes in Africa, 497
- Pyrometers, and Seismometers, Sounding a Crater, Fusion-Points, Dr. H. J. Johnston-Lavis, 197; W. Worby Beaumont, 296
- Pyrometers and Fusion-Points, Thos. Andrews, 224
- Quadrant Electrometers, 331
- Quantin (M. H.), on the Action of Tetrachloride of Carbon on Chlorochromic Acid and the Phosphates of Sesquioxide, 335
- Quarterly Journal of Microscopical Science, 404
- Quartz, Pyro-Electricity of, B. von Kolenko, 333
- Quaternary Beds of Nevada, finding of a Spear-head in the, 476
- Quaternary Deposits in Western New York, Prehistoric Hearth under the, 476
- Quatrefages (A. de): on Prehistoric Man, 23; Histoire générale des Races humaines, 389
- Quedenfeldt (Lieut.), Ethnological Collection presented to the Anthropological Society by, 423
- Queen, Sanitary Progress during the Reign of the, Capt. Douglas Galton, F.R.S., 160
- Queen's Jubilee in India, 349
- Quincke (Prof. G.), Dielectric Constants of Fluids, 334
- Rabbit, the Australian, 569
- Rabies, M. Pasteur's Treatment of, 30
- Races, European Prehistoric, Prof. A. H. Keane, 564
- Races humaines, Histoire générale des, A. de Quatrefages, 389
- Radiant-Matter Spectroscopy, on Examination of the Residual Glow, W. Crookes, F.R.S., 425, 447
- Radiation of Light, Peculiar, Robert D. Gibney, 536
- Radio-Micrometer, Preliminary Note on, C. Vernon Boys, 549
- Radiophony, A. Heritsch on, 333
- Railways, Inauguration of, in France, 407
- Rain-band Observations at the Ben Nevis Observatory, A. Rankin, 588
- Rainfall of the Globe, Total, John Murray, 311
- Ralstonite, Chemical Composition of, 141
- Rambaut (A. A.), Spectroscopic Method of determining the Distance of a Double Star, 206
- Ramsay (Prof. William) and Dr. Sydney Young: Preliminary Note on the Continuity of the Liquid and Gaseous States of Matter, 262; on Clausius's Formula, 346; on Thermal Properties of Methyl Alcohol, 358
- Rance (C. E. De), Folkestone Gault, 296
- Rankin (A.), Rain-band Observations at the Ben Nevis Observatory, 588
- Rats at the South Kensington Exhibitions, 205
- Rau (B. Hanumanta), First Lessons in Geometry, 269
- Rayleigh (Lord, F.R.S.), on the Intensity of Reflection from Glass and other Surfaces, 64
- Rays and Bands, Law of Distribution of the Common to several Spectra of Bands, 576
- Reade, (T. M.), Origin of Mountain Ranges, Prof. A. H. Green, F.R.S., 361, 463
- Recording Hygrometers, 331
- Red Colour of Sirius, Alleged Ancient, 378, 391
- Red Sea Coast, Italian Possessions on the, 446
- Red Spot on Jupiter, Rotation-Time of the, Prof. Young, 181
- Red Star, New, 546
- Red Sunsets and New Zealand Eruptions, Lieut.-Col. A. T. Fraser, 224
- "Red Wood," on the Formation of the so-called, in the Fir and Epicea, 383
- Red Worm, William Burgess, 445
- Reefs, Coral, of the Solomon Islands, Dr. H. B. Guppy, 77
- Reefs, Long Lost, Capt. W. J. L. Wharton, F.R.S., 347
- Reflection from Glass and other Surfaces, on the Intensity of, Lord Rayleigh, F.R.S., 64
- Refraction Tables, Corrections to, Prof. Cleveland Abbe, 134
- Refractions, Astronomical, Herr Oppölzer's, 17
- Refractions, Schaeberle's Short Method for computing, 329
- Reichenbach (Dr. Reinhold von), Death of, 444
- Reid (Clement), Coombe Rock, 502; Earthquake in the Riviera, 534
- Reilly (Robert James), Aspects of Clouds, 391
- Reinold (Prof. A. W., F.R.S.), Lecture on Soap Bubbles, 229
- Rendiconti della R. Accademia dei Lincei, 405
- Rendiconti del Reale Istituto Lombardo, 286, 357, 405, 477, 524
- Residual Affinity, Valency and, Prof. H. E. Armstrong, F.R.S., 570, 596
- Residual Glow, Examination of the, on Radiant-Matter Spectroscopy, W. Crookes, F.R.S., 425, 447
- Respighi (L.), on the Objective Spectroscope, 405
- Reuch (Dr. Hans), Earthquakes in Norway, 517
- Revolving Spheres, Aërial Vortices, or Experiments on, Ch. Weyher, 514
- Revue d'Anthropologie, 22, 187, 357, 495
- Revue mensuelle d'Astronomie populaire de Météorologie, et de Physique du Globe, 310
- Rheostat, a Wire Tape, A. Grosse, 334
- Rhinolophus ferrum-equinum*, Drawings of the, in the *Zoologist*, 256
- Riccò (Prof. A.), Barnard's Comet at Perihelion, 296; Green Light at Sunrise and Sun-set, 584
- Richardson (Dr. B. W., F.R.S.), Animal Mechanics, 57
- Richarz (Dr.), Formation of Peroxide of Hydrogen by Electrolysis, 384
- Ridley (H. N.), Proposed Expedition to Fernando Noronha, 228
- Righi (Prof. Augusto), on the Cause of Magnetic Rotatory Polarisation, 141
- Right Hand and Left-Handedness, Dr. Daniel Wilson, 307
- Rink (Dr. H.), the Eskimo, Prof. A. H. Keane, 309
- Rio, Longitude of, Prof. C. A. Young, 172
- Rio de Janeiro, Observatory of, 593
- Rivers, List of 374, Dr. von Klöden, 354
- Riviera, Earthquake in the, Clement Reid, 534
- Rivista Scientifico-Industriale, 141, 237, 357, 405, 524
- Rix (Herbert) Royal Society's *Soirée*, 607
- Roberts-Austen (Prof. W. Chandler, F.R.S.), Colours of Metals and Alloys, 106
- Robinson (H.), Hydraulic Power and Hydraulic Machinery, Major Allan Cunningham, 460
- Rocks: on the Texture of Massive, 381; Abrasion of, 383; Notes on the Structure and Relations of some of the Older Rocks of Brittany, Prof. T. G. Bonney, F.R.S., 550; Rocks of the Malvern Hills, Frank Rutley, 623
- Rodriguez, Cochenille at, 179
- Rogeria longiflora*, 158
- Rogers (Prof. W. A.) and Miss Anna Winlock, Reduction of the Position of Close Polar Stars from one Epoch to another, 231
- Roman Dominion, on the Establishment of the, in South-East Britain, Sir G. B. Airy, F.R.S., 562
- Romanes (Dr. Geo. J., F.R.S.): Origin of Species, 124; Mr. Wallace on Physiological Selection, 247, 366, 390; Factors of Organic Evolution, Herbert Spencer, 362
- Rome, First General Meeting of the International Statistical Institute at, Preparations for, 306; Monument to Galileo in, 612
- Roscoe (Sir H. E., F.R.S.), a Treatise on Chemistry, 316

- Rosenbusch (H.), Petrography, Dr. Fred. B. Hatch, 482
 Rosser (W. H.), Deviation of the Compass in Iron Ships considered practically, 437
 Rostock, University of, Removal of Lamarck's Herbarium from, 312
 Rotation-Time of the Red Spot on Jupiter, Prof. Young, 181
 Rotatory Polarisation, Magnetic, on the Cause of, 141
 Rousdon Observatory, Report of, 353
 Rowland (Prof. Henry A.), Wave-Length of the Lines of the Solar Spectrum, 524
 Rowney (Thos.), Tabasheer, 512
 Roy (Chas.), Cambridge Cholera Fungus, 223
 Royal Agricultural Society of England, Journal of the, Prof. John Wrightson, 148
 Royal Geographical Society, New President of the, 615
 Royal Institution, Lecture Arrangements, 133
 Royal Meteorological Society, 95, 335, 406, 527
 Royal Microscopical Society, 191, 359, 550
 Royal Navy and the Merchant Service, Connexion between the, Sir Nathaniel Barnaby, 538
 Royal School of Mines, Normal School of Science and, Col. J. F. D. Donnelly, 271
 Royal Society, 34, 83, 142, 165, 188, 262, 287, 310, 334, 357, 381, 430, 452, 477, 501, 524, 549, 598, 622; Anniversary Address by Prof. G. G. Stokes, F.R.S., 113; Royal Society and Scientific Federation, Prof. Huxley, F.R.S., 289; Philosophical Transactions of, 399; Annual General Meeting, 406; *Soirée*, Herbert Rix, 607
 Royal Society of Göttingen, Prize offered by the, 350
 Royal Society of New South Wales, 71, 305
 Royal Society of Victoria, Transactions and Proceedings of the, 473
 Rücker (Prof. A. W., F.R.S.), Critical Mean Curvature of Liquid Surfaces of Revolution, 143
 Rule for escaping a Danger, Frank Morley, 345
 Russian Central Asia, Proposed Administrative Changes in, 258
 Russian Petroleum, 120
 Russian Petroleum, the Coming Deluge of, C. Marvin, 295
 Rust, Nature and Genesis of, 539
 Rutley (Frank), the Metamorphic Rocks of the Malvern Hills, 190
 Rutot (A.) and E. Van den Broeck, Observations nouvelles sur le Tuffeau de Ciply, et sur le Crétacé supérieur du Hainault, 317
 Ryves (G. T.), Comparison of the Daily Forecast issued by the Meteorological Office for the Midland District with the Actual Weather experienced in 1886, 350
- Saharanpur, Report on the Botanical Garden, Mr. Duthie, 356
 St. Domingo, Botanical Investigation of the Higher Mountains of, Dr. Urban, 494
 St. Petersburg, University of, Sixty-eighth Anniversary of, 422
 Salmon Ova sent to New Zealand, 112
 Salomons (Sir David), Complete Hand-book on the Management of Accumulators, 603
 Salt-Solutions, Supersaturation of, Dr. W. W. J. Nicol, 527
 Salts, Influence of Temperature on the Heat of, Dissolution of, Prof. S. U. Pickering, 453
 Sandstone of Organic Origin, 407
 Sanitary Assurance Association, Sixth Annual Meeting of, 375
 Sanitary Conditions of the City of York, 423
 Sanitary Institute of Great Britain, 257
 Sanitary Legislative Conference, 593
 Sanitary Progress during the Reign of the Queen, Capt. Douglas Galton, F.R.S., 160
 Sanitary Registration of Buildings Bill, 282, 352
 Sankuru, Dr. Wolf's Exploring Work on the, 520
 Sansan, Purchase by the French Government of the Hillock of, 328
 Sardine-fishing, 383
 Sardine, on the Food of the, 479
 Satellite, Evolution of a, Tidal Friction and the, James Nolan, 75
 Saturn, Six Inner Satellites of, Prof. Asaph Hall, 257
 Sauropsida, Culminating, Prof. John Cleland, 391
 Savages, Sir John Lubbock's, F.R.S., Lecture on, 255
 Savory (W. S., F.R.S.), John Hunter, 379
- Sawyer (Edward), Observations of Variable Stars in 1885, 378
 Scarlet Fever, Etiology of, E. Klein, F.R.S., 452
 Schaeberle (Mr.), a Short Method for computing Refractions, 329
 Schäfer (Prof. E. A., F.R.S.), Cerebral Localisation, 438, 464
 Schiller (Herr), Radius of the Circle of Protection of Lightning-Rods, 376
 Schinz (Dr. Hanz), Lake Ngami Region, 547
 Schizonemertians, Peculiarities in the Organisation of the, 336
 Schleswig-Holstein, Effects of Lightning in, 360
 Schönland (Selmer), how to make Colourless Specimens of Plants to be preserved in Alcohol, 173
 School Hygiene, Arthur Newsholme, 604
 Schorlemmer (C.), a Treatise on Chemistry, 316
 Schöyner (Herr), *Tylenchus hordei*, 336
 Schuster (Arthur, F.R.S.), Total Solar Eclipse of August 29, 1886, 549
 Schwab (Herr), Gore's Nova Orionis, 85
Science and Art, 544
 Science, Art and, in a New Light, 250
 Science and Art Department, Calendar and General Directory of the, 320
 Science and Art Department, Speeches in the House of Commons on, 443
 Science Collections, National, 252, 272
 Science, English and American Professors, Difference in the Number of Lectures given by, 351
 Science, Experimental, in Schools and Universities, Prof. G. F. Fitzgerald, 284
 Science and the Jubilee, 217, 241
 Science, Lunar, Rev. Timothy Harley, 246
 Science, Normal School of, and Royal School of Mines, Col. J. F. D. Donnelly, 271
 Science in Norway, 122
 Science, Popular Lectures on, 35
 Science in the Secondary Schools of America, Present Position of, Pres. Eliot, 375
 Scientific Basis of the Proposed Imperial Institute, 254
 Scientific Federation, 289
 Scientific Knowledge, First Year of, Paul Bert, 221
 Scientific Knowledge in Scotland, 305
 Scientific Papers, Joint, of James Prescott Joule, F.R.S., 461
 Scientific Relief Fund, Sir William Armstrong, 349
 Scientific Renaissance in Italy, 350
 Scientific Research, Mrs. Elizabeth Thompson's Fund for the Advancement of, 471
 Scientific Results of the Exploring Voyage of the *Challenger*, Report of the, 351
 Scientific Societies, Local, and the British Association, 78
 "Scientist," Meaning of the Word, 519
 Selater (P. L., F.R.S.), Meteor, 76
 Scorpion Virus, Sir J. Fayrer, F.R.S., 488; Prof. C. Lloyd Morgan, 534
 Scorpions, Do they commit Suicide? 590
 Scortechini (Father), Death of, 157
 Scotland: Fishery Board for, Fourth Annual Report of the, 128; Fish-Culture in, 205; Scientific Knowledge in, 305; Trial of University Extension Scheme in, 327; Scottish Geographical Magazine, 334; Scottish Meteorological Society, 355, 544; Value of Fish landed on the Coasts of, 473; Scottish Naturalist, 474; Physical and Biological Work at Scottish Marine Station, 575
 Sea, Earthquake at, Reginald H. Hertslet, 157
 Sea, Official Report on the Use of Oil at, for modifying the Effect of Breaking Waves, 63
 Sea-Level and Ocean-Currents, Prof. J. S. Newberry, 35
 Sea-Lion, or Eared Seal of the Auckland Islands, Specimens of, at the Zoological Gardens, 327
 Sea-Trout in the Delaford Park Fishery, 519
 Seabroke (Mr.), Temple Observatories, 401
 Seal, West Indian, *Monachus tropicalis*, Henry A. Ward, 392
 Seal-Fisheries, W. H. Emory's Investigation of, 351
 Seals destructive to Fisheries, 377
 Seas, Law of Storms in Eastern, Dr. W. Doberck, 135
 Sedgwick (W. T.), General Biology, 413
 Sedgwick Memorial Museum, Cambridge, Sites for, 494
 Sée (Prof. G.), Diet in Disease, 327
 Seebohm (Henry): Specimens of Siberian Birds, 15; Birds' Nests and Eggs, 236; Arctic Species of Birds, 256

- Seedlings, the Forms of, the Causes to which they are due, Sir John Lubbock, F.R.S., 235
- Seeds, Vitality of, 414; F. G. Hilton Price, 463; L. Blomefield, 463; Dr. L. Martin Klein, 463; Geo. Murray, 582
- Seeland (Herr Ferdinand), on the Rate of Movement of the Pasterz Glacier, 520
- Seelberg, Further Excavations in, 518
- Seeliger (Prof.), Influence of Astigmatism in the Eye on Astronomical Observations, 59
- Seismology: Volcanoes of Japan, Prof. Milne, 19, 36; Seismometry in Japan, Prof. J. A. Ewing, 75, 172, 606; Thomas Gray, 126, 198; the Recent Earthquakes, Prof. J. P. O'Reilly, 197; Sounding a Crater, Fusion-Points, Pyrometers, and Seismometers, Dr. H. J. Johnston-Lavis, 197; W. Worby Beaumont, 296; Report on the Charleston Earthquake, Prof. T. C. Mendenhall, 31; Earthquakes, Thos. W. Kingsmill, 319; Earthquake at Aquila, 376; at Vilayet Konia, 376; Earthquake in Japan, 399; Earthquake Shock at Tashkend, 399; Pre-scientific Theories of the Causes of Earthquakes, 428; the Earthquake, Rev. J. S. Perry, F.R.S., 438; Seismological Society of Japan, 518; Seismic Phenomena of February 1887, 575
- Sekei Sekiya on the Comparison of Earthquakes, 593
- Selborne Society, Letters on the Objects and Work of, 328
- Selection, Physiological, Mr. Wallace on, Dr. Geo. J. Romanes, F.R.S., 390
- Self-Induction: Lecture Experiment in, Shelford Bidwell, 526; on the Determination of the Coefficient of, 551
- Sensation and Movement, Ch. Féré, 518
- Sense of Smell, Edward L. Nichols and E. H. S. Bailey, 74
- Sensitive Hygrometers, 331
- Serous Albumen, Prof. Kronecker on, 504
- Serpent Mound in Ohio, Great, W. H. Holmes, 281
- Service (Robert), the Ptarmigan, 445
- Seton-Karr (Lieut. H.), Alpine Regions of Alaska, 475
- Seyn Fishery Board Almanac, 257
- Seydler (Prof. A.), an Error in Maxwell's "Electricity and Magnetism," 512
- Sharp (David), New Zealand Coleoptera, 177
- Shaw (Prof. H. S. Hele), a Claim of Priority, 581
- Sheets, on Ellipsoidal Current, Horace Lamb, F.R.S., 574
- Shenstone (J. C.), Hooper's Paper on *Gymnema sylvestre*, 594
- Shenstone (W. A.), Methods of Glass-blowing, 123; Manipulation of Glass containing Lead, 223
- Sherman (O. T.): Bright-Lines in Stellar Spectra, 378; Atmosphere of β Lyrae, 451
- Shetland, Flora of, W. H. Beeby, 474
- Ships of War: Fuel-Supply in, 539; Armour of, 540
- Shore (Thos. W.), Elementary Practical Biology—Vegetable, 556
- Showers, Frequency and Duration of, 479
- Shufeldt (R. W.), Notes on certain Traits of Infant Navajos, 346
- Shutter, Instantaneous, A. Mallock, 324; Col. H. Stuart-Wortley, 366
- Siberia as a Colony, Prof. Petrie, 158
- Siberia, Northern, Magnetic Horizontal Intensity in, A. C. von Tillo, 170
- Siberian Birds presented by Mr. Seebohm to Natural History Museum, 15
- Sierra Leone, Earthquake in, J. S. Hay and Jos. M. Metzger, 141
- Silicostannate of Lime, Preparation of a, corresponding to Sphene, M. L. Bourgeois, 335
- Silk, Indian, Industry, the Decline of the, 84
- Silk Cocoons, Machinery for winding from, 595
- Silks, Wild, of India, Cultivation of the, J. F. Peppe, 256
- Silver, on the Phosphates and Arseniates of, 144
- Similarities in the Physical Geography of the Great Oceans, J. Y. Buchanan, 33, 76
- Simson (Alfred), Travels in the Wilds of Ecuador, 437
- Simson (Frank B.), Letters on Sport in Eastern Bengal, 388
- Singapore, Crustacea of, 525
- Sirius, Alleged Ancient Red Colour of, Mr. Lynn, 378, 391
- Skassy (M.), MM. Bérésosky, Potanin and, Return of, from their Expedition to China and Mongolia, 309
- Skuse (F. A. A.), British Stalk-eyed Crustacea and Spiders, 532
- Slater (J. W.), Insects and Petunias, 70
- Smell, the Sense of, Edward L. Nichols and E. H. S. Bailey, 74
- Smets (Dr. Gérard), Lung-Sick, 76
- Smith (Charles Shaler), Death of, 229
- Smith (W. Alexander), Loch Creran, 484
- Smith (Dr. W. Robertson), Studies in Ancient History, J. Ferguson McLennan, 3
- Smith (Dr. W. R.), Ammoniacal Decomposition of Urine, 404
- Smithson (T. Spencer), Top-shaped Hailstones, 438
- Smithsonian Institution, Prof. Baird's Annual Report of the, 372
- Smyrna, Earthquake at, 112, 158
- Snowflakes, Samuel Lockwood, 414
- Snowstorm of January 7, 1887, E. J. Lowe, 271
- Soap-Bubbles, Prof. A. W. Reinold's Lecture on, 229
- Soap-Films, Plane, the Production of Newton's Rings by, H. G. Madan, 583
- Society of Antiquaries, 189
- Society of Arts, 57
- Soda, Heat of Formation of some Alcoholates of, 312
- Soda Cell, Bichromate of, 381
- Soils, on the Constitution of the Nitrogenous Organic Matter of, R. Warrington, F.R.S., 403
- Solar Activity in 1886, Prof. Tacchini, 445
- Solar Eclipse, Total, of August 29, 1886, Arthur Schuster, F.R.S., 549
- Solar Halos, J. J. Walker, 272; R. T. Omond, 582
- Solar Heat, Measurements of, Dr. Frölich, 455
- Solar Phenomena during the Year 1886, M. P. Tacchini, 335-479
- Solar Spectrum, Wave-Length of the Lines of the, Prof. Henry A. Rowland, 524
- Solid in a Liquid, on the Movement of a, 527
- Solids, Expansion of, by Heat, Lecture Experiments on the, H. G. Madan, 89
- Solids by Heat, Lecture Experiment on the Expansion of, C. E. Stromeier, 126
- Solly (R. H.), Recently-discovered Deposit of Celestine, 414
- Solomon Islands, Coral Reefs of the, Dr. H. B. Guppy, 77
- Solubility of Substances, on the Variation of, 551
- Solution, Opening of the Discussion by Prof. Tilden, British Association, 21, 64
- Solution, on the Nature of, Dr. Nicols, Prof. Tilden, Dr. Armstrong, Prof. W. N. Hartley, Dr. Gladstone, 64
- Solutions, Natural, of Cinnabar Gold and Associated Sulphides, 524
- Sonnblick Observatory, 519
- Sorghum Sugar, 184; Experiments in the Manufacture of, at Fort Scott, 472
- Soudan, the Western, Dr. Colin on the Population of Bambouk, 22
- Sound, Light, and Heat, Lecture Problems on, Charles Bird, 52
- Sounding a Crater, Fusion-Points, Pyrometers, and Seismometers, Prof. John Milne, 152; Dr. H. J. Johnston-Lavis, 197
- Soundings in the Australian Mediterranean, Dr. Otto Krümmel, 447
- South America, Dutch Colonies in, and the West Indies, K. Martin, Dr. A. Ernst, 459
- South America, Notes of a Naturalist in, John Ball, F.R.S., 529, 553
- South American Andes, on the Age of certain Parts of the, Dr. Ochsensius, 547
- South Kensington Exhibitions, the Rats at, 205
- Southampton, Proposed University College for, 473
- Southern Comet, 329
- Spain and Portugal, Antiquities of, M. Emile Cartailhac, 244
- Sparrow chasing Pigeons, a, 536; J. Jenner Weir, 584
- Spear-head in the Quaternary Beds of Nevada, finding of, 476
- Species, Origin of, Joseph J. Murphy, 76; Edmund Catchpool, 76; Dr. Geo. J. Romanes, F.R.S., 124
- Specific Inductive Capacity, Note on, John Hopkinson, F.R.S., 334
- Spectrum Analysis: a New Method of Analysing Blood by means of the Spectroscope, Hénocque, 48; Spectroscopic Method of determining the Distance of a Double Star, A. A. Rambaut, 206; on the Objective Spectroscope, L. Respighi, 405; on Radiant-Matter Spectroscopy—Examination of the Re-

- sidual Glow, W. Crookes, F.R.S., 425, 447; Sunlight Colours, Capt. W. de W. Abney, F.R.S., 498
- Speech by Telephone, on the Limiting Distance of, W. H. Preece, F.R.S., 501
- Spencer (Herbert): Factors of Organic Evolution, Dr. Geo. J. Romanes, F.R.S., 362; Definition of Life, F. Howard Collins, 487
- Sphene, Preparation of a Silicostannate of Lime corresponding to, M. L. Bourgeois, 335
- Spheres, Revolving, Aerial Vortices and Experiments on, Ch. Weyher, 514
- Spiders, British Stalk-eyed Crustacea and, F. A. A. Skuse, 532
- Spitaler (Dr. R.), Comet 1887 *b* (Brooks, January 22), 352, 424, 496
- Spitzer (Prof. Simon), Death of, 518
- Spolia Atlantica, 603
- Spörer (Prof.): Stormy Movements in the Atmosphere of the Sun, 71; on Sunspots, 72
- Sporophore in Mosses, Morphology of the, J. R. Vaizey, 358
- Sport, Letters on, in Eastern Bengal, Frank B. Simson, 388
- Sprung (Dr.): Hadley's Principle, 384; Barograph, 456
- Spun Glass, Tenacity of, E. Gibson and R. E. Gregory, 406
- Stalk-eyed Crustacea, British, and Spiders, F. A. A. Skuse, 532
- Stanley (H. M.): Honorary Freedom of the City of London conferred on, 280; Relief Expedition to Emin Pasha, 283; Letter from, 353; Expedition to Emin Pasha, 475; and the Relief of Emin Pasha, 446; Congo Expedition, 615
- Stars: Binary, γ Coronæ Australis, H. C. Wilson, 17; Binary, δ Equule, 401; Brightness and Mass of Binary, W. H. S. Monck, 402; Binary Star, 14 (*z*) Orionis Orbit of the, J. E. Gore, 569; Argentine General Catalogue of Stars, 113; Second Armagh Catalogue of 3300, 159; Spectroscopic Method of determining the Distance of a Double Star, A. A. Rambaut, 206; Reduction of the Position of Close Polar Stars from one Epoch to another, Prof. W. A. Rogers and Miss Anna Winlock, 231; Variable, Observations of, in 1885, Edward Sawyer, 378; New Red Star, 546
- State, the, and Higher Education, 457
- Statesman's Year-book for 1887, 461
- Statistical Institute, International, 255
- Steam Navigation, Progress in, 538
- Steel, Manganese, Physical Properties of, Prof. W. F. Barrett, 311
- Steel, Viscosity of, C. Barus and V. Strouhal, 380
- Steel and Ingot Iron, Quantity made in a Year, 231
- Stellar Parallax: Prof. Asaph Hall, 258; Application of Photography to the Determination of, Prof. Pritchard, 377
- Stellar Photography at Harvard College, Prof. Pickering, 37
- Stellar Spectra, Bright Lines in, O. T. Sherman, 378
- Steno-Telegraphy, G. A. Cassagnes, 192
- Stevens Indicator, on the Prosperity of the Stevens Institute, 568
- Stevenson (T. and D.), Lighthouse Illuminants, 63
- Stevenson (David), Canal and River Engineering, Major Allan Cunningham, 169
- Stimuli on Vegetable Tissues, on the Effect of certain, Anna Bateson and Prof. Francis Darwin, F.R.S., 429
- Stirling (James), on some Further Evidence of Glaciation in the Australian Alps, 182
- Stockholm Academy of Sciences, 48, 144, 312, 528
- Stokes (Prof. G. G., P.R.S.), Address at the Royal Society Anniversary, 113
- Stone (G. H.), Iridescent Clouds, 581; Disappearance of Bi-hop's Ring in Colorado, 581
- Stone Circles, A. L. Lewis on, 503
- Storm, Recent Severe Storm, 157
- Storms in the Eastern Seas, Law of, W. Doberck, 135
- Strachan (R.), Disinfection by Heat, 7
- Straight Line, to prove that only one Parallel can be drawn from a given Point to a given, Dr. E. Budden, 92
- Strain-Indicator, Stromeyer's, 540
- Straburger (Prof. E.), Hand-book of Practical Botany for the Botanical Laboratory and Private Student, 556
- Streeter (Edwin W.), Pearls and Pearl Life, 339
- Stromeyer (C. E.), Lecture Experiment on the Expansion of Solids by Heat, 126
- Stromeyer's Strain-Indicator, 540
- Struve (Hermann) Diffraction of Light, 423
- Struve's (Prof. Otto) Jubilee, 422; the Parallax of Σ , 1516, 546
- Stuart-Wortley (Col. H.), Instantaneous Shutters, 366
- Students, Number of, at the University of Berlin, 444
- Studentships, Industrial, Colonel J. F. D. Donnelly, 413
- Studies in Ancient History, comprising a Reprint of "Primitive Marriage," J. Ferguson McLennan, Dr. W. Robertson Smith, 3
- Study of Literature, John Morley, 422
- Subject-Index, Two Hours with a, 123
- Submerged Valleys in the Gulf of Genoa, on the Existence of, 336
- Suffolk, Birds of, Dr. Churchill Babington, 193
- Sugar, Sorghum, 184; Experiments in the Manufacture of, 472
- Sugar, Beetroot, Production of, in the United States, 351
- Sugar, Action of Nitric Acid on, 432
- Sugar, on the Treatment of New Wines with, 432
- Suicide of the Cobra, Supposed, R. D. Oldham, 560
- Suicide, Do Scorpions Commit? 590
- Sulphuret of Calcium, Phosphorescence of the, 431, 455
- Sulphuric Acid, Action of, on the Solubility of the Sulphates, 432
- Sulphuric Anhydride, Experiments on, 384
- Sumatra, Volcanoes in, Verbeek, 60
- Sun, Stormy Movements in the Atmosphere of the, Prof. Spörer, 71
- Sun, Eclipse of the, at Grenada, Preliminary Account of the Observations of the, Capt. Darwin, 287
- Sun Symbol, the Cross as a, Dr. Chas. R. Dryer, 345; Dr. Hyde Clarke, 366; Mrs. J. C. Murray-Aynsley, 558
- Sun, New Method of determining the Parallax of the, 455
- Sun, Researches on the Diameter of the, Herr Auwers, 496
- Sun's Diameter, Researches on the, Prof. Di Legge, 595
- Sun's Heat, Sir William Thomson, F.R.S., 297
- Sunlight Colours, Capt. W. de W. Abney, F.R.S., 498
- Sunrise Shadows of Adam's Peak, on the Peculiar, Hon. R. Abercromby, 94
- Sunrise and Sunset, Green Light at, Prof. A. Riccò, 584
- Sunset Phenomenon, Dr. Wentworth Erck, 391
- Sunsets: Red, and New Zealand Eruptions, Lieut.-Col. A. T. Fraser, 224; Green Light at, R. T. Omond, 391; Prof. A. Riccò, 584
- Sunspots: Observations in Hungary, Carl Braun, A. M. Clerke, 227; Prof. Spörer, 72; Dr. M. A. Veeder, 584
- Supernormal Psychology, Phantasms of the Living, Edmund Gurney, Fred. W. H. Myers, and Frank Podmore, Prof. C. Lloyd Morgan, 290
- Suvsaturation of Salt-Solutions, Dr. W. W. J. Nicol, 527
- Surgeons, Royal College of, proposed Extension of Museum and Library, 229
- Sutton (J. B.), an Introduction to General Pathology, 26
- Svastika: Cross and Sun, Dr. Hyde Clarke, 366; as both Sun and Fire Symbol, Mrs. J. C. Murray-Aynsley, 558
- Svedstrup (Dr. Aug.), Comet Barnard (1886 *f*), 134
- Swamp Fever and Bacillus, 405
- Swarming of Aphides, Notes on the Recent, G. H. Buckton, F.R.S., 15
- Sweden: Station at Landsort for Measurement of Shore-Elevation, 159; Aurora Borealis in Northern, 443
- Sweetness, a Plant which destroys the Taste of, W. T. Thistelton Dyer, F.R.S., 557
- Swift (Lewis), Warner Observatory, 446
- Switzerland, Earthquake in, 84, 205; Prof. Forel, 442
- Sydney: Discovery of Rare Fossils at, 159; Discovery of a Mastodonsaurus on Juckatoo Island, 445
- Symbol, the Svastika as both Sun and Fire, Mrs. J. C. Murray-Aynsley, 558
- Symbolism, Asiatic, Study of, H. G. M. Murray-Aynsley, 327
- Symonds (G. J., F.R.S.), Influence of Wind on Barometric Readings, 53
- Sympathetic Nervous System, Dr. Walter H. Gaskell, F.R.S., 185
- Tabasheer: W. T. Thistelton Dyer, F.R.S., 396; Henry Cecil, 437; Tokutaro Ito, 462; Thos. Rowney, 512; the Relation of, to Mineral Substances, Prof. J. W. Judd, F.R.S., 488

- Tacchini (Prof.): Solar Activity in 1886, 445; Solar Observations for the Second Half of the Year 1886, 335; Solar Phenomena during the Year 1886, 479
- Taconic Rocks, 622
- Tails of the Comets of 1886, Prof. Th. Bredichin, 474
- Tait (Prof.), Kinetic Theory of Gases, 311
- Talc, Sample of, used in Paper-making, Prof. Macadam, 423
- Tamus communis*, Walter Gardiner on, 454
- Tartrate of Antimony, M. Guntz, 528
- Tashkend, Earthquake at, 112, 399
- Tasmania, the Birds of, 204
- Tasmanian Fisheries, 233
- Taste of Sweetness, a Plant which destroys the, W. T. Thiselton Dyer, F.R.S., 557
- Taylor (Philip Meadows), Tobacco a Farmer's Crop, Prof. John Wrightson, 52
- Tchesme, Earthquake at, 112
- Tea-Planter's Manual, T. C. Owen, 268
- Technical Education, 592; Mr. Girling, 567; and the House of Commons, Mr. Howell, 326
- Technical School at Bombay, 206
- Telegraph Wires, Propagation of Electricity in, Ed. Hagenbach, 333
- Telegraphic Determinations of Australian Longitudes, 474
- Telephone, on the Limiting Distance of Speech by, W. H. Preece, F.R.S., 501
- Telephone Line from Paris to London, Proposed, 544
- Telephonic Line between Paris and Brussels, Proposed, 133
- Telescope of the Bischoffsheim Observatory, the Great Refracting, 84
- Telescope, Hours with a Three-Inch, Capt. Wm. Noble, 246
- Tempel (Wilhelm), Observations of Nebulæ at Arcetri, 198
- Temperature: High, in October, Charles Harding, 18; Critical Temperatures of Nitrogen and Oxygen, 331; Influence of Temperature on the Heat of Dissolution of Salts, Prof. S. U. Pickering, 453; Continuous Transition from the Liquid to the Gaseous State of Matter at all Temperatures, 478; Temperatures of the Atlantic Coast Waters, Charts showing, 495; on the Distribution of Temperature in the Antarctic Ocean, J. Y. Buchanan, 516; Changes of Temperature to which the Lower Forms of Organisms can be adapted by Slow Modifications, Dr. Dallinger, F.R.S., 550; Temperature off Cape Horn, 568; Influence of Extremes of Temperature on the Colour of the Blood, 576; Temperature and Pressure in Jamaica, Maxwell Hall, 437; Vertical Decrement of Temperature and Pressure, S. A. Hill, 606
- Temple Observatory, Mr. Seabroke, 401
- Ten Years' Progress in Astronomy, Prof. C. A. Young, 67, 86, 117
- Tepper (J. G. Otto), Native Plants of South Australia, 205
- Tercentenary, the Potato, 175
- Terrestrial Crust, on the Conditions of Form and Density, 120
- Terrestrial Radius, Contraction of the, 479
- Testing Materials, on some New Measuring-Instruments used in, Prof. W. C. Unwin, F.R.S., 334
- Tetrachloride of Carbon, on the Action of, on Chlorochromic Acid and the Phosphates of Sesquioxide, M. H. Quantin, 335
- Tetuan, Exploration of, 232
- Texture of Massive Rocks, 381
- Theine, Action of Caffein and, upon Voluntary Muscle, T. Lauder Brunton, F.R.S., 599
- Theory of Numbers, 477
- Thermometer, New Form of Standard Mercurial, Dr. Pernet, 600
- Thermometers, on the Internal Capacity of, A. W. Clayden, 94
- Thiesen (Dr.), Resistance of Air, 408; on the Standard Kilogramme, 408
- Thollon (M.), Death of, 592
- Thome (Mr.), New Comet, 307
- Thompson (Mrs. Elizabeth), Fund for the Endowment of Research, 471
- Thompson (Joseph), the Owens College, 385
- Thompson (Prof. Silvanus P.): on the Cutting of Polarising Prisms, 184; Electricity and Clocks, 224; Electric Motor and its Applications, T. C. Martin and Jos. Wetzler, 410
- Thomson (Sir William, F.R.S.), the Sun's Heat, 297
- Thorpe (Prof. T. E., F.R.S.): Explosions in Coal-Mines, W. N. and J. B. Atkinson, 1; the Life and Labours of John Mercer, F.R.S., Edward A. Parnell, 145; on certain Modern Developments of Graham's Ideas concerning the Constitution of Matter, 522, 547
- Thouar's Exploration of Bolivia, 231
- Throat, Various Effects of Irritation in the, 575
- Thronhjelm, in Norway, Display of Aurora Borealis at, 112
- Thunderstorm, on the Formation of a, Prof. von Helmholtz, 24
- Thunderstorms of July 1884, Investigations into, Prof. Börnstein, 24
- Thunderstorms, Dr. Hann's Observations on, 112
- Thylacoleo carnifex*, Sir Richard Owen, F.R.S., 111, 142
- Tibet, Lu River of, Gen. J. T. Walker, F.R.S., 615
- Tidal Friction and the Evolution of a Satellite, James Nolan, 75
- Tides of Long Period, on the Dynamical Theory of the, G. H. Darwin, F.R.S., 287
- Tilden (Prof.), on the Nature of Solution, 21, 64
- Tillo (A. C. von), Magnetic Horizontal Intensity in Northern Siberia, 170
- Time, an Apparatus by which, may be communicated to Performers out of the Conductor's Sight, 120
- Tin, Deposits of, 455
- Tin Mines near Meshed, M. Ogorodnikoff, 376
- Tinguangs of the Philippine Islands, 446
- Tippoo Tip and the Emin Pasha Expedition, 402
- Tissues, Vegetable, on the Effect of certain Stimuli on, Anna Bateson and Prof. Francis Darwin, F.R.S., 429
- Tobacco: a Farmer's Crop, Philip Meadows Taylor, Prof. John Wrightson, 52; Cultivation of, in England and Ireland, 443
- Todhunter (Isaac, F.R.S.), History of the Theory of Elasticity, A. G. Greenhill, 313
- Toes, Observations on Heredity in Cats with an Abnormal Number of, Edward B. Poulton, 38
- Tokutaro Ito, Tabasheer, 462
- Tolmie (Dr. W. F.), Death of, 228
- Tomlinson (Herbert), the Coefficient of Viscosity of Air, 165
- Topaz from Thomas Range, Utah, A. N. Alling, 452
- Top-shaped Hailstones, C. S. Middlemiss, 413; T. Spencer Smithson, 438; Alex. Johnstone, 536
- Topinard (M.), on the Simian Characters of the Naulette Jaw, 22
- Topley (W.), Erosion of the English Coasts, 37
- Topography, Functional, of the Brain, Prof. Ferrier, 453
- Torpedo Boats, 539
- Torpedoes, proposed Examination of, by Prof. Burdon Sanderson and Mr. Gotch, 132
- Total Solar Eclipse of August 29, 1886, Arthur Schuster, F.R.S., 549
- Towns, Ozone Papers in, Dr. W. J. Black, 76
- Traill (Dr. William), of Woodwick, Obituary Notice of, 419
- Train lighted by Electricity, 595
- Trains of Pulleys and Drums, Prof. H. Hennessy, F.R.S., 452
- Transmission of Power by Compressed Air, 272
- Traube-Hering Curves, 576
- Trécul (M.A.), on the Term "Latex" in Botany, 600
- Trees, Planting of Foreign, in New England, 519
- Trewendt's Encyclopædia of Natural Sciences, 58
- Triassic Formation of the Connecticut Valley, 141
- Tribes of the Nile Valley North of Khartoum, Sir Chas. Wilson on, 431
- Trimen (Dr. H.), Hermann's "Ceylon Herbarium" and Linnaeus's "Flora Zeylanica," 166
- Tripes, Mathematical, Prof. J. W. L. Glaisher, F.R.S., 101, 153, 199
- Tripes, on the Earlier, of the University of Cambridge, Sir G. B. Airy, F.R.S., 397
- Tropical and Extra-Tropical Cyclones, on the Relation between, Hon. Ralph Abercromby, 430
- Trout: Brook, Spawning of, 16; Lochleven, Dr. Day, 166; an "Egg-bound," 231
- Tunicata, on the Colonial Vascular System of the, 336
- Tuning-Fork of Variable Pitch of Tone, 383
- Zylenchus hordæi*, Herr Schöyén, 336
- Tyndall (Dr.), the Retirement of, 560
- Typhoons, Dr. Doberck, 36

- Ulrich (Prof.), Discovery of Identity of Sand in the New Zealand Rivers with Oktibehite, 190
- Umberto, *Il re*, the Engines of, 352
- United Kingdom, Ordnance Survey of the, Lieut.-Col. T. Pilkington White, 170
- United States: Earthquakes in, 36; Fish Commission, Work of the, 55, 545; Observatory for Women in, 229; Greenleaf's Bequest at Harvard College, 229; Science on advertising for Candidates for Vacant Professorships, 229; A. Heilprin, on the Geology of Florida, 230; Fish-destroying Insects in the, George Dimmock, 327; Number of Female Teachers in the, 375; Coast Survey, 400; Geological Survey on Mineral Resources of the United States, 401; Blight and Mildew on Fruit in the, 422; National Museum, Report for the Year 1884 of the, 544; Baldness of Men in the, 595; Naval Observatory, 595. (See also America.)
- Units of Weight, Mass, and Force, Prof. A. G. Greenhill, 486; Rev. Edward Geoghegan, 534; Prof. A. Lodge, 557; Archd. C. Elliott, 605; Robert F. Hayward, F.R.S., 604
- University of Berlin, Number of Students, 444
- University of Bologna, Eight Hundredth Anniversary, 399
- University College, the Career of, 179
- University College, Bristol, Albert Fry, 345
- University College, Liverpool, Generous Endowments, 280
- University Colleges, Prof. Jowett on, 441
- Universities: University Extension Scheme, 611; Trial of, in Scotland, 327; University Intelligence, 22, 69, 119, 212, 285, 380, 404, 451, 477, 501, 598, 621; University for London, 505; Semi-Centennial Anniversary of Louisville, 545; Sixty-eighth Anniversary of St. Petersburg, 422
- Unwin (Prof. W. C., F.R.S.), on some New Measuring-Instruments, used in testing Materials, 334
- Uppsala University, Female Students at, 306; New University Building at, 518
- Uralian Society of Natural Sciences, 133
- Uranus, Ellipticity of, Prof. W. Valentiner, 614
- Urine, Ammoniacal Decomposition of, Dr. W. R. Smith, 404
- Urostyle of the Common Frog, Abnormality in the, Prof. C. Lloyd Morgan, 344
- Urua, Capt. Cameron's Lecture on, 259
- Urvoik of Japan, Aino Hairiness and the, F. V. Dickens, 534
- Vaerdalen, Norway, Brilliant Meteor seen in, 612
- Vaizey (J. R.), the Morphology of the Sporophore in Mosses, 358
- Valency and Residual Affinity, Prof. H. E. Armstrong, F.R.S., 570, 596
- Valentiner (Prof. W.), Ellipticity of Uranus, 614
- Van Slyke (L. L.), Kilauea after the Eruption of March 1886, 451
- Vanadic Acid, Quantitative Analysis of, 576
- Vanadium occurring in Rocks and Mineral Ores, on the Extraction and Analysis of the, 576
- Vaporisation of some very Volatile Substances, on the Latent Heats of, 551
- Variables: New, S. C. Chandler, 307; New, in Cygnus, Dr. Gould, 282; Gore's, near χ^1 Orionis, Dr. G. Müller, 329; in the New Algol-Type, Mr. Chandler, 329; Observations of, in 1885, Edward Sawyer, 378; Probable New, 402
- Vaschy (M. A.), on the Nature of the Electric Actions in an Insulating Medium, 263
- Veddahs, C. Stevens on the, 134
- Veddahs of Ceylon, 205
- Veeder (Dr. M. A.): Aurora, 54; Meteors and Auroras, 126; Auroras, 272; Sunspots, 584
- Vegetable Soils, on the Direct Fixation of the Gaseous Nitrogen of the Atmosphere by, M. Berthelot, 335
- Vegetable Tissues, on the Effect of certain Stimuli on, Anna Bateson and Prof. Francis Darwin, F.R.S., 429
- Velocities, Virtual, F. Guthrie, 149
- Venezuela, Anthropological Notes from, 496
- Venice, Earthquake Shock in, 350
- Ventosa (V.), a Claim of Priority, 513
- Venukoff (M.), on the Upheaval of the South-West Coasts of Finland, 600
- Verbeek, Volcanoes in Sumatra, 60
- Verhandlungen of the Berlin Geographical Society, 520
- Vertebral Column of the Common Frog, Abnormalities in the, Prof. C. Lloyd Morgan, 53
- Vertebrates, Comparative Anatomy of, Robert Wiedersheim, W. Newton Parker, 121
- Vertical Decrement of Temperature and Pressure, S. A. Hill, 606
- Victoria Hall Lectures, 35
- Victoria Institute, 191, 454, 527
- Vienna Geographical Society, 354; Imperial Academy of Sciences, 72; Types of Birds in the Vienna Natural History Museum, 204
- Vilayet Konia, Asia Minor, Earthquake at, 375
- Villepigne (Floran de), Autographome'er, 444
- Vine, Anti-Phylloxeric Disinfection of the Grape, 382
- Vine, Peronospora of the, 382
- Virginia, Astronomy in, 35
- Virtual Velocities, F. Guthrie, 149
- Virus, Scorpion, Sir J. Fayerer, F.R.S., 488; Prof. C. Lloyd Morgan, 534
- Vitality of Mummy Seeds, Geo. Murray, 582
- Vitality of Seeds, 414; F. G. Hilton Price, 463; L. Blomefield, 463; Dr. L. Martial Klein, 463
- Vitality and its Definition, Prof. John W. Judd, F.R.S., 511; F. Howard Collins, 580
- Volcanoes: of Japan, Prof. Milne, 19; in Sumatra, Verbeek, 60; Revelations of a Dissected Volcano, Jas. D. Dana, 93; Active Volcano in Japan, 133; Volcano of Mauna Loa in Eruption, 423; Volcanic Action, Jas. D. Dana, 451; Deposits of Volcanic Dust, Prof. Geo. P. Merrill, 174; Volcanic Dust from New Zealand, Prof. T. G. Bonney, F.R.S., 56; Volcanic Eruption in Niua-Fu, Friendly Islands, Prof. T. G. Bonney, F.R.S., 127; Volcanic Eruption in Mount Tarumai, in Yezo, 472; in Northern California, 380
- Voltaic Action, Theory of, J. Brown, 142
- Voltaic Arc, on the, 576; Electromotive Force of the, 331
- Voltaic Electricity, Note on the Development of, by Atmospheric Oxidation, C. R. Alder Wright, F.R.S., 598
- Volumetric Determination of Hydrogen Sulphide, 384
- Vortices, Aërial, 551
- Vortices, Aërial, and Revolving Spheres, Experiments on, Ch. Weyher, 514
- Vries (Prof. Hugo de), how to make Colourless Specimens of Plants to be preserved in Alcohol, 149
- Wagner Free Institute of Science, 230
- Währlich on Fungus and Orchids, 230
- Wales (Prince of), Imperial Institute, Prof. Huxley, 265
- Walker (John), Enormous Loss from Ox-Warble, 7
- Walker (J. J.), Solar Halo, 272
- Walker (Gen. J. T., F.R.S.), on the Lu River of Tibet, 615
- Walker (Fred. W.), Practical Dynamo-building for Amateurs, 294
- Wall (H. Beresford de la Poer), Manual of Physical Geography of Australia, 389
- Wallace (Dr. Alfred R.), Geo. J. Romanes, F.R.S., on Physiological Selection, 247, 366, 390
- War and Ballooning, Eric S. Bruce, 259
- War-Ships, Modern, W. H. White, 306
- Ward (Henry A.), West Indian Seal, *Monachus tropicalis*, 392
- Ward (Prof. H. Marshall), *Entyloma Ranunculii*, 166; Proto-plasm, 300
- Warington (R., F.R.S.), on the Constitution of the Nitrogenous Organic Matter of Soils, 403
- Washburn Observatory, Publications of the, 159
- Washington, Ninth Triennial Meeting of the International Medical Congress at, 350
- Washington Observatory, 308, 614; Capt. R. L. Phythian, 569
- Watch, Means to Convert a, into a Repeater, 312
- Water, Aërated, on some Phenomena connected with the Freezing of, George Maw, 325
- Water Battery, Henry A. Rowland, 452
- Water in the Chalk beneath the London Clay of the London Basin, on the, Robert B. Hayward, F.R.S., 335
- Water, Cohesion of an Air-free Column of, Prof. Helmholtz, 456
- Waters (A. W.), Fossil Chilostomatous Bryozoa from New Zealand, 190
- Waterspouts, Ch. Weyher on, 407; M. Mascart, 431; on a Complementary Experiment relative to, 600

- Watson (Rev. Henry W.), an Error in Maxwell's "Electricity and Magnetism," 223; Magnetic Theory, 296
- Watson-Draper Microscope, 550
- Watt's (Dr. G.), Observations in the Manipur District, 308
- Wave-Length of the Ray of Light $D_{2\beta}$, 432; on the Absolute, Louis Bell, 524
- Wave-Length of the Lines of the Solar Spectrum, Prof. Henry A. Rowland, 524
- Wave-Measurements, 180
- Wave-Motion in Hydrodynamics, Prof. A. G. Greenhill, 477
- Weather Charts, Atlantic, 469
- Weather, the Recent, 198; Rev. W. Clement Ley, 54; F. T. Mott, 173; William Ingram, 173
- Weather Terms, a Few of our, Rev. W. Clement Ley, 323
- Webb (R.), Definitions of Euclid with Explanations, 340
- Weight and Mass, 512
- Weight, Mass, and Force, Units of, Prof. A. G. Greenhill, 486; Rev. Edward Geoghegan, 534; Prof. Alf. Lodge, 557; Archd. C. Elliott, 605
- Weight, and Dynamical Units, Mass, Robt. F. Hayward, F.R.S., 604
- Weights and Measures, International Committee of, 203
- Weill (Dr.), Antifebrine, 445
- Weinstein (Dr.), Observations of the Earth's Current in the Telegraph Lines of the German Empire, 336
- Weir (J. Jenner), Sparrow chasing Pigeons, 584
- Weiss (Prof. E.), Comet Barnard (1887 c), 352
- Weldon (W. F. R.), a *Balanoglossus* Larva from the Bahamas, 477
- Wesley Naturalist*, 444
- Wesley Scientific Society, 84
- West (Wm.), a Question for Chemists, 584
- West Indies: Botanical Federation in the, D. Morris, 248; Dutch Colonies in South America and the, K. Martin, Dr. A. Ernst, 459
- Wetzler (Jos.) and T. C. Martin, Electric Motor and its Applications, Prof. Silvanus P. Thompson, 410
- Weyher (Ch.): on Waterspouts, 407; Movements of the Air, 431; Aerial Vortices and Revolving Spheres, 514
- Wharton (Capt. W. J. L., F.R.S.), Long-Lost Reefs, 347
- White (Lieut.-Colonel T. Pilkington), Ordnance Survey of the United Kingdom, 170
- White (W. K.), Modern War-Ships, 306
- White (William), Heredity in Abnormal-Toed Cats, 125
- White Epidote, Note on a, from Beagle Channel, Tierra del Fuego, 335
- Whitworth (Sir Joseph): Obituary Notice of, 304; his Will, 473
- Wieder-heim (Robert), Comparative Anatomy of Vertebrates, W. Newton Parker, 121
- Wight (Isle of), Oyster Fisheries of, 57
- Wild (James), Death of, 594
- Wilder (Dr.), on the Nomenclature of the Brain, 255
- Wilkins (A.), Beetle in Motion, 414
- Willemite, on the Artificial Production of Zincite and, M. Alex. Gorgeu, 288
- Williams (G. H.), Norites of the Cortlandt Series, 452
- Williamson (Prof. W. C., F.R.S.), on some Observations on Palæobotany in Goebel's "Outlines of Classification and Special Morphology of Plants," 535
- Wills (J. T.), on the Region between the Nile and the Congo, 521
- Wilson (Sir Chas.), on the Tribes of the Nile Valley North of Khartoum, 431
- Wilson (Dr. Daniel), Right Hand and Left-Handedness, 307
- Wilson (Edmund B.), General Biology, 413
- Wilson (H. C.), Binary Star γ Coronæ Australis, 17
- Wilson (T.), Electricity and Clocks, 173
- Wilson-Barker (David), Electrical Discharges in the Doldrums, 584
- Wind, Influence of, on Barometric Readings, Prof. Cleveland Abbe, 29; G. J. Symonds, F.R.S., 53
- Winds, the Chinook, M. W. Harrington, 568
- Wines, Copper detected in, 312
- Wines, New, on the Treatment of, with Sugar, 432
- Winlock (Miss Anna) and Prof. W. A. Rogers, Reduction of the Position of Close Polar Stars from one Epoch to another, 231
- Winter, Alpine, and its Medical Aspects, A. Tucker Wise, 170
- Wires, Electrical Resistance of suspended Copper and Iron, Shelford Bidwell, 526
- Wise (Dr. A. Tucker): Alpine Winter and its Medical Aspects, 170; Ozone, 584
- Wissmann (Lieut.), Fresh Expedition from Luluaburg, 521
- Wolf (Dr.), Explorations on the Sankuru, 520
- Wolves, Mares, and Foals, George Maw, 297
- Women: Education of, in Japan, 229; Observatory for, in America, 229
- Wood (J. G.), the Handy Natural History, 341
- Worcester Victoria Institute, 205
- Wragge (Clement) appointed Meteorologist to the Government of Queensland, 229
- Wright (Dr. C. R. Alder): Commercial Organic Analysis, Alfred H. Allen, 293; Note on the Development of Voltaic Electricity by Atmospheric Oxidation, 598
- Wright (G. Frederick), the Muir Glacier, 380
- Wright (Lewis), the Zirconia Oxy-hydrogen Light, 583
- Wrightson (Prof. John): Enormous Loss from Ox-Warble, 29; Food-Grains of India, A. H. Church, 52; Tobacco a Farmer's Crop, Philip Meadows Taylor, 52; Journal of the Royal Agricultural Society of England, 148
- Wrought Iron, J. Starkie Gardner, 422
- Wurster (Dr.), Active Oxygen in the Animal Organism, 383
- Yacht-building, Fifty Years of, 539
- Yellow Fever: Microbe of, 528; Results obtained by the Preventive Inoculation of the Attenuated Virus of, 576
- York, Sanitary Conditions of the City of, 423
- Yorkshire, on the Character of the Beds of Chert in the Carboniferous Limestone of, Geo. J. Hinde, 582
- Youmans (Edward Livingstone), Death of, 305
- Young (Prof. C. A.), Ten Years' Progress in Astronomy, 67, 86, 117; Longitude of Rio, 172; Rotation-Time of the Red Spot on Jupiter, 181
- Young (Dr. Sydney) and Prof. William Ramsay: Preliminary Note on the Continuity of the Liquid and Gaseous States of Matter, 262; Clausius's Formula, 346
- Yukon, Exploration of the Watershed of the River, 593
- Zacharias (Dr. Otto), Investigation of North German Lakes, 473
- Zanzibar, Dr. Lenz's arrival at, 283
- Zeitschrift für physikalische Chemie, 376
- Ziegler (E.), a Text-book of Pathological Anatomy and Pathogenesis, 246
- Zincite and Willemite, on the Artificial Production of, M. Alex. Gorgeu, 288
- Zintgraff (Dr.), Exploration of the Cameroon District, 475
- Zirconia Oxyhydrogen Light, Lewis Wright, 583
- Zone, Equatorial, of almost Perpetual Electrical Discharge, Hon. Ralph Abercromby, 487
- Zoological Gardens: Additions to, 17, 36, 59, 85, 113, 134, 159, 181, 206, 231, 257, 282, 307, 329, 352, 377, 401, 424, 445, 474, 496, 520, 546, 569, 595, 614; Specimens of the Sea-Lion or Eared Seal of the Auckland Islands at the, 327
- Zoological Record for 1885, 341
- Zoological Record, 613
- Zoological Research, Grants for, Berlin Academy of Sciences, 473
- Zoological Results of the *Challenger* Expedition, 49
- Zoological Society, 93, 166, 311, 381, 431, 502, 526, 599
- Zoologist, 446; Drawings of the *Rhinolophus ferrum-equinum* in the, 256
- Zoology, Hand-book of, with Examples from Canadian Species, Sir J. W. Dawson, F.R.S., 295
- Zoology, Practical, B. P. Colton, 458
- Zoology, a Junior Course of Practical, A. Milnes Marshall, F.R.S., 506
- Zoology, Proposed Lectures on, at the Zoological Gardens, 567
- Zoology, Mythical, of the Far East, 591
- Zuntz (Prof.), Alimentary Values of Various Albuminous Substances, 480
- Zurich, Earthquake Shock in, 350

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

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EXPLOSIONS IN COAL-MINES

Explosions in Coal-Mines. By W. N. and J. B. Atkinson, H.M. Inspectors of Mines. (London: Longmans, 1886.)

EVERYBODY in the least degree conversant with matters connected with coal-mining will at once admit that our knowledge of the remote causes of colliery explosions has increased enormously during the last few years. Whether, however, the practical application of this knowledge has kept pace with the rate of increase in the knowledge itself is another matter. Since 1851, when the first Mines Inspection Act was in force, the number of fatal explosions in collieries has steadily diminished, but the annual loss of life from these catastrophes is as great as ever. During the ten years ending 1860 there were 820 fatal explosions, resulting in 2441 deaths, or an average of 2.98 deaths per fatal explosion; during this decade there was an average of 3000 persons employed in and about the mines for every fatal explosion, and 1008 persons for each resulting death. During the ten years ending 1870 the number of fatal explosions fell to 565; the deaths were 2267, or an average of 4.01 per fatal explosion; and the ratio of persons employed to each fatal explosion was 5650, and hence to each resulting death 1408. During the ten years ending 1880 the number of fatal explosions was 424; the resulting deaths were 2686, or an average of 6.33 per fatal explosion; the ratio of persons employed to each fatal explosion was 11,372, and to each resulting death 1795. During the five years ending 1885 we have had 146 fatal explosions, with a loss of 906 persons, or an average of 6.20 deaths from each explosion; the ratio of persons employed to each fatal explosion was 17,503, and to each resulting death 2820. These figures are in the highest degree significant, but they are not capable of telling everything. They do not, for example, bring out the fact that the actual violence of colliery explosions when they do occur is nowadays greater than formerly. This may seem to be indicated by the increase in the average number of deaths from

each fatal explosion, but then, on the other hand, there are far more men employed in pits now than formerly. The diminished number of explosions is probably due, in the first instance, to the more general employment of safety-lamps, and, during late years, to the restrictions which have been placed upon the use of explosives. The increase in the average number of deaths to each explosion is doubtless owing to the gradual deepening of the pits and to differences in the mode of origin and character of the explosion. Thirty years ago the pits as a rule were comparatively shallow and damp. Such a sinking as that of the Ashton Moss pit at Audenshaw, which is upwards of half a mile deep, was unknown. Explosions in these damp shallow pits were usually caused by the ignition of gas, most frequently by naked lights; they were very local in their action, and the loss of life was small. Nowadays an explosion in a deep and dry mine not unfrequently penetrates throughout the whole pit; it is often extremely violent, and the number of deaths, mainly from after-damp, is correspondingly great.

There can be very little doubt that such explosions are, in the main, caused by dust. The fact that fire-damp is not the only explosive agent which may be present in coal-mines is now generally recognised. It is, however, a moot point with many practical men whether coal-dust alone, in the entire absence of gas, can bring about an explosion of any magnitude. It is generally conceded that a very small amount of gas, an amount, indeed, too small to be recognised by the elongation of the flame of a safety-lamp, or the formation of a "cap," is sufficient in the presence of coal-dust to form a dangerously explosive atmosphere, but colliery managers and many mining engineers have, apparently, been slow to believe that dust itself may, under certain conditions, effect an explosion quite as violent in its character as the most formidable gas explosion of which we have any record. The Royal Commissioners appointed to inquire into accidents in mines reported that in their opinion it was well established that even when the air is quite free from fire-damp, an exceptionally inflammable coal-dust, in a very finely-divided and dry condition, and existing in abundance in the immediate vicinity of a blown-out shot, may when

raised by the shot be ignited so readily and carry on the flame so rapidly that it may produce explosive effects of a similar character to those caused by a gas explosion. The flame as it rushes along, if fed by freshly raised dust, may extend under these circumstances to very considerable distances, with results resembling, in their disastrous nature, those of explosions originating with, and mainly due to, fire-damp. This conclusion is very greatly strengthened by the evidence which the Messrs. Atkinson have brought together in the book before us. Their work indeed constitutes the most formidable indictment against coal-dust as a cause of colliery explosions which has yet been drawn up. In their capacity of Inspectors they have investigated with the most patient care the circumstances connected with what we may call six typical explosions. These were—

Date 1880	Name of colliery	Deaths	Time of explosion	Seams affected
Sept. 8	Seaham	164	2.20 a.m.	Maudlin and Hutton
1882				
Feb. 16	Trimdon Grange	74	2.30 p.m.	Harvey
April 18	Tudhoe	37	1.15 a.m.	Brockwell
April 19	West Stanley	13	1.0 a.m.	Basty
April 25	Whitehaven	4	11.15 p.m.	Main Band
1885				
March 2	Usworth	42	8.58 p.m.	Maudlin

All the explosions with the exception of that at Whitehaven were in the county of Durham. It would be quite impossible in the space at our disposal to follow the successive steps in the minute analysis to which the authors have subjected each of these explosions. We should require, moreover, many of the numerous plans of the colliery workings with which the book is illustrated were we to attempt such a task. All that can now be done is to point out the characteristic features of the several explosions, and to indicate the general conclusions which the authors draw from the consideration of the various circumstances connected with them. We are conscious that in some respects this method of treating their work hardly does justice to the authors. It fails to convey any idea of the thoroughly scientific manner in which the Messrs. Atkinson's investigations have been conducted; of the minute and painstaking mode of their observation; or of the care and skill with which their deductions have been made. The authors, even in the earlier pages of the book, make their position in regard to the question of Gas *versus* Dust perfectly clear, but not even the most prejudiced opponent of the dust hypothesis can complain of the manner in which the evidence is presented.

The Durham explosions presented many features in common. In the first place no accumulations of gas were known to exist in quantity sufficient to cause the widespread destruction which happened, nor were such accumulations considered possible. In all these explosions the downcast shafts were more or less damaged. At Trimdon Grange, Tudhoe, West Stanley, and Usworth the explosions did not cross the downcast shafts; these were wet, and the roadways near them were damp. At Seaham the shaft was dry, and the explosion crossed it and extended far beyond it. In all cases the violence and *ame* of the explosions were confined to roads on which there was much coal-dust. The explosions were most violent in the intake and haulage roads, or between the downcast shafts and lamp-stations, *i.e.* in places where

practically no gas was to be expected, and where naked lights were in constant use. The path of the explosion was in all cases that of the fresh air traversing the pit: in no case did it extend by means of the return air-way. The return air-ways carry off the gases evolved in the pit, but are practically free from dust. In certain of the intake air-ways at Seaham and Usworth no coals were led, and they were consequently comparatively free from coal-dust: no traces of the explosions were observed in these roads. The explosions were in many cases arrested where the haulage roads were wet. In no instance did the explosion ascend or descend vertically through staples or shafts communicating with other planes of workings. If the explosions were due to gas, their extension would not be influenced by the direction of a communicating passage; on the other hand, very little coal-dust collects in vertical passages. In almost every case of an explosion which could with certainty be attributed to fire-damp, there is evidence that men have been alarmed and have attempted to escape from the workings before the actual occurrence of the disaster: in all the five Durham explosions there was no indication that any movements had taken place amongst the men suggestive of alarm; their bodies were found in the places where their work required them to be, close to their tools and lamps.

At Seaham, Tudhoe, West Stanley, and Usworth the explosions were simultaneous with the firing of shots in stone; in these cases the explosions occurred when the pits were occupied by stonemen and repairers and at the only time when the operations of the mines allowed the firing of shots. At Seaham, Tudhoe, and Usworth the shots were fired on a main intake air-road and at points where currents of air of between 20,000 and 30,000 cubic feet per minute were passing. At West Stanley the shot was fired, in stone, at a working place by a naked flame, and the air in the vicinity would probably contain a small quantity of fire-damp, but not sufficient in amount to show its presence in the safety-lamp or by itself to be explosive. In the other cases it is almost impossible to conceive that the air could contain any sensible quantity of gas. At Seaham it would be necessary to assume that the gas came down the shaft, or that there were three separate and simultaneous outbursts of it on the three main roads diverging from the shaft. At Tudhoe, where the air came direct from the surface by two shafts, it would be necessary to assume two separate and simultaneous outbursts. At Usworth the air had passed no working place, and could hardly have contained even a trace of fire-damp. At West Stanley no appreciable quantity of gas could be present in the main intakes, although a small quantity might be contained in the air near the place where the shot was fired.

There remains the Trimdon Grange explosion, which, was unconnected with shot-firing. There was distinct evidence that it originated with the ignition of gas at the light of a boy engaged at a pump in connection with some drowned workings from which gas was found to issue and that it extended with great force to parts of the pit more than a mile distant from its origin along the main intake air-ways.

Now all the circumstances connected with the Durham disasters make it almost certain that the main agent in the propagation of the explosion was dust, and in three

out of the five cases it was dust alone. In four out of the five cases the immediate cause was shot-firing, *but in no instance was the shot blown out*. It is not at all necessary that the shot should be blown out to cause the ignition of the dust-cloud which the concussion raises in a dusty road. Properly fired shots show flame even when they dislodge the stone or coal; and the flame is often considerable if there has been an overcharge of powder, or if small coal or earth mixed with coal-dust has been used, as frequently happens, in the tamping. At Seaham, Tudhoe, West Stanley, and Usworth the flame of the shot ignited the dry inflammable dust dislodged from the roof or raised from the floor by the concussion of air which followed, and the explosion was propagated by fresh dust-clouds raised in the manner described by the Royal Commissioners. At Trimdon Grange an explosion of fire-damp operated in the same way: the violent movement of air resulting from the ignition of fire-damp and air raised a cloud of coal-dust into which the flame from the fire-damp passed, and the ignition of the coal-dust propagated itself as in the other cases, and, as in these, continued so long as it was fed by fresh fuel. This rapid ignition of dust containing upwards of 80 per cent. of carbon would result in the formation of large quantities of carbonic acid, and possibly even of the more poisonous carbonic oxide: when it is considered that it is impossible to live in air containing even $3\frac{1}{2}$ per cent. of carbonic acid, the deadly character of the after-damp so formed is readily conceivable.

In striking contrast to the Durham explosions was that at Whitehaven. This was in a wet pit; the coal being worked was wet, and all the surroundings were damp, and free from dust. The cause of the explosion was gas, which was known to be in the pit, and frequently present in large quantities. Although it is probable that some 30,000 cubic feet of an inflammable mixture of air and fire-damp were ignited, the explosion was confined to a limited area of the workings, which extend to nearly three miles from the shafts. Seven men were within the district of the explosion, of whom three escaped. The survivors stated that all the men were alarmed by the appearance of gas immediately before the explosion, and hurried away. In the act of retreating the gas ignited at a lamp which was afterwards proved to have been defective and to allow of the passage of the flame. This the authors say was the most considerable explosion of fire-damp and air that they are acquainted with. They have personally investigated during the last twelve years almost all the explosions occurring in the North of England, and they cannot point to a case where there was direct evidence of so large a quantity of fire-damp and air exploding.

The moral of all this is obvious. It can scarcely be gainsaid that some of the most disastrous explosions of the last thirty years are primarily to be attributed to the practice of firing gunpowder in dusty mines. That under certain circumstances gunpowder can be used with safety is allowed. But the Royal Commissioners have issued a warning in no uncertain terms. They have convinced themselves that the abolition of the use of powder in dry and dusty mines will not generally involve any formidable inconvenience, inasmuch as the work which is accomplished by its employment both in coal and in stone can now be performed with equal efficiency, and at very little

if any greater outlay, by other means. Unless, therefore, mining engineers, or those immediately responsible for the working of collieries, can devise some satisfactory method of minimising the danger due to dust, they will be compelled before very long, in deference to public opinion, to renounce the practice of blasting by means of gunpowder, or by any other agent which causes a flame.

T. E. THORPE

McLENNAN'S "STUDIES IN ANCIENT HISTORY"

Studies in Ancient History: comprising a Reprint of "Primitive Marriage." By the late John Ferguson McLennan. A New Edition. (London: Macmillan and Co., 1886.)

THE first edition of "Primitive Marriage" appeared in 1865, and the book was already extremely rare when, in 1876, it was reprinted as the first part of the "Studies in Ancient History." The reprint also soon became scarce, and while the influence of the author has been steadily growing, and almost all students of early society have come to attach great importance to his speculations, his principal writings have for some years been almost inaccessible. This new edition therefore supplies a real want, and it is doubly welcome for the sparing, but judicious, notes and appendixes which the editor, Mr. D. McLennan, has attached to his brother's book. "Primitive Marriage" broke ground in a new field of research, and, as the point of view was wholly novel, the collection, sifting, and marshalling of the evidence on which the argument was based was entirely pioneer's work. At the close of his life, McLennan was in possession of a much larger material; he had pursued his argument in new directions and to further conclusions, and on one or two points he had come to change his views. But new research had only confirmed the main lines of the argument sketched with so firm a hand in his original essay; and read with the *caveats* which his brother has introduced at one or two points—chiefly as regards the interpretation of the Levirate, and the prevalence of Agnation—the present reprint may be taken as generally representing, so far as it goes, the author's final conclusions on the subjects discussed. I say *so far as it goes*, for in many directions his conclusions had been added to and his views developed. The editor promises us a second volume, to consist for the most part of writings hitherto unpublished, which will throw a good deal of light on these new developments; meanwhile he has restricted himself in the notes "to certain matters on which the author had announced a change of view, and to certain others where circumstances had made an additional statement imperative." Of the additional statements, the most important is contained in two long notes appended to the essay on Morgan's "classificatory system" of relationships, in which it is clearly made out that Morgan's theory rests on misconception of the facts, and that the supposed classificatory system of relationship is not a system of relationship at all, but a system of terms of ceremonial or friendly address, used in conversation even between persons who are not related to one another in any way. This comes out so clearly in the cases about which we are best informed, that it is very questionable

whether the facts so laboriously collected by Mr. Morgan can be used to throw light on the early history of the family.

From his plan of reprinting the book as it stood, with no more annotation than was absolutely necessary, the editor has departed only in one point. The appendix containing "additional examples of the form of capture" has been re-cast and enlarged upon the basis of a paper of J. F. McLennan published in the *Argosy* in 1866, but with additions from other and more accurate sources. The reasons for adopting this course are obvious: the new matter in this appendix could not conveniently have been reserved for the promised second volume, and the facts are so arranged and explained as to confirm the author's argument, and effectually dispose of the notion that the form of capture in marriage is to be explained by maidenly bashfulness.

It will be seen from this brief account that, sparing as the editor's additions are, they make the new edition of the "Studies" well worthy of the attention of those who already possess the book in its older form. And to the not small class of students of early society who know McLennan's work only at second hand or by one hasty perusal, it may not be unprofitable to say that this is emphatically a book of which a general knowledge is not sufficient, inasmuch as some of the most important and interesting points are precisely those which are almost sure to be missed on a first reading. For this, perhaps, McLennan himself is partly responsible, for in giving to "Primitive Marriage" the subordinate title "an inquiry into the origin of the form of capture in marriage ceremonies," he seems to fix attention on what is only the starting-point of a far-reaching research. In print and in conversation one often meets with the notion that the doctrines of marriage by capture and kinship through women only are mere archæological *curiosa*, and that for the study of later law and custom it is quite indifferent whether these things are true, or whether, on the contrary, mankind started from the first with male kinship. But the importance of McLennan's researches lies largely in the demonstration that the structure of society under a system of kinship in the male line which has been preceded by kinship through women cannot be the same as would be reached by a race which has had male kinship from the first. Other writers have taught a doctrine of the priority of kinship through women, but no one except McLennan has accurately developed the consequences of the doctrine, and shown how it solves a problem which, though ignored by most writers, is of the highest importance, namely, the origin of *gentes* within a nation. Like all really original thinkers, McLennan has for one of his chief merits that he recognised the existence of difficult problems in matters which ordinary people pass over without seeing any difficulty at all. And therefore precisely those passages in his writings which on a hasty reading seem needlessly laboured and proper to be skipped are found upon re-perusal to be particularly useful and stimulating.

A word may be said in conclusion on what is promised for the second volume. It is satisfactory to know (p. 75) that it will include a short essay on the origin of exogamy. And from a note at p. 176 it may be inferred that in this essay the origin of exogamy will be sought in a state of

society where marriage by capture was an established custom. We are also promised (p. 63) an essay on the marriage law of the Australian Kamiraloï, one of those highly complex problems in which McLennan's powers of analysis ought to appear at their best. From notes on pp. 109 and 228 it appears that part at least of McLennan's hitherto uncollected essays in the *Fortnightly Review*, including the papers on Totemism, or "On the Worship of Plants and Animals" (1869-70), will also be republished. It is to be hoped that in these reprints the editor will allow himself, in one direction, greater freedom of annotation than in the present volume. The Totem papers are in some respects the least finished of McLennan's writings, the evidence of totemism in the nations of ancient civilisation being much too largely drawn from second-hand sources. This gives an appearance of weakness to the whole structure of the argument, which has been very prejudicial to the influence of a most original and striking investigation. In point of fact a few of the detailed pieces of evidence ought to be abandoned altogether, but enough remains to leave the substance of the argument unaffected, and this ought to be clearly brought out by notes, referring to original authorities of unquestioned reputation, or giving up statements that cannot be authenticated. Even in the present volume one misses some notes of this kind. The polyandria of the Athenians (p. 235) rests on better evidence than the story which Augustine cites from Varro (Clearchus *ap.* Athen. xiii. p. 556 d.). Again, the note at p. 47, in which an attempt is made to prove the existence of the form of capture among the Hebrews from the phrase "to take a wife," ought rather to have been withdrawn than again built upon by the editor at p. 181; and what is said of the marriages of the Persians at p. 219 *sq.* requires careful revision.

W. ROBERTSON SMITH

BRITISH HYMENOMYCETES

British Fungi, Hymenomycetes. By Rev. John Stevenson. With Illustrations. Vol. II. Cortinarius—Dacrymyces. Pp. 336. 8vo. (Edinburgh: William Blackwood and Sons, 1886.)

WE are glad to welcome this second volume so speedily after the first, although we fear that expedition has been secured by some sacrifice of efficiency. It is a misfortune when the reader is impressed at once with the feeling that a volume has been hurried out to meet certain exigencies. That feeling is by no means absent in scanning these pages. As soon as p. 165 is reached, and there is no longer Fries's "Monographia" to fall back upon, *descriptions* give place to *diagnoses*, notwithstanding the remarks in the preface, which would seem to regard diagnoses with something of contempt. From p. 166 to the end the *student* must be content with the diagnoses from Fries's "Hymenomycetes Europæi," although there might have been collected together valuable notes from Fries's "Systema," "Observationes," and "Elenchus." Nevertheless some advantage has been taken of the few descriptions published in the letterpress to Fries's "Icones."

It is of considerable importance to students that a work which professes to include all British species, up to date, should satisfy all reasonable expectations. The first

volume omitted some forty species, and the present is by no means perfect. We open at p. 232, and find under the genus *Solenia* one solitary British species recorded, that of *Solenia ochracea*. Surely our author could not have been ignorant of the fact that *Solenia anomala*, P., is still more common, and was recorded by Berkeley in the "English Flora" (p. 199) fully fifty years ago. Neither could he have forgotten that another species was included in Cooke's "Hand-book" (p. 329) under the name of *S. candida*, since corrected to *S. fasciculata*. As these specimens were collected near Batheaston, by no other than Mr. C. E. Broome, and confirmed by the Rev. M. J. Berkeley, no doubt can be entertained of their being authentic. Furthermore, the name was corrected and the species figured by Berkeley and Broome in the *Annals of Natural History*, December 1870, No. 1301. The fourth species is *Solenia stipitata*, Fuckel, of which there are specimens in the Kew Herbarium. It cannot be conceded that a "Flora" satisfies all reasonable expectations when in one genus only one of four species is recorded.

Turning to an allied genus, that of *Cyphella*, we seek in vain for *C. Curreyi* or *C. albo-violascens* (which may be identical), *C. cyclas*, Cke. and Phil., *C. punctiformis*, Fries, *C. villosa*, Pers., all but one of which are well-known and widely-distributed species.

Whether the species under the genera *Stereum* and *Corticium* might have been arranged in a manner more in accordance with modern ideas, and far more useful to the student in their identification, may be left an open question. Those who are not facile in the use of the microscope may find it convenient to follow Fries, who paid little attention to microscopical characters, but surely in a large and difficult genus, such as *Corticium*, no assistance should be despised.

We observe, with some surprise, the genus *Microcera*, of Desmazières, included in a work devoted to British Hymenomycetes (p. 308) with the intimation "no British species." The fact is that *Microcera coccophila*, Desm., which is the type of the genus, has been found in Britain, and is recorded on p. 556 of Cooke's "Hand-book," and furthermore it is also true that it is not a Hymenomyce at all, but the conidia of one of the *Sphaeriacei*, and is included as such in Saccardo's "Sylloge Fungorum" (vol. ii. p. 513). This singular double error might have been avoided had some mycologist been consulted who had not confined his attention exclusively to the Hymenomycetes.

The limits of species is another open question, and it is scarcely advisable to make too much of the insertion of what some may regard as doubtful species in a "Flora" wherein the author is not free to give reasons in their favour; nevertheless, we venture to hint that *Polyporus armeniacus*, Berk. (p. 215), is generally admitted to be only a resupinate condition of *P. amorphus*, Fries, and should not be continued as a distinct species. *P. Herbergii*, Rost (p. 195), is placed as an ally of *P. sulphureus* in the section "Caseosi," whereas *P. cuticularis* is found (at p. 202) in "Spongiosi." Unfortunately for this arrangement, the two species (*P. Herbergii* and *P. cuticularis*) are so closely allied that sometimes it is difficult to distinguish the one from the other, except by the difference in size of the pores, and hence some regard

them as varieties of one species. At any rate, there is no good reason why such closely-allied forms should be separated by four-and-twenty intermediate species.

The mention of localities for species throughout the work is so vague, that some explanation should have been offered. When only one locality is given, the inference which would be drawn by the majority of readers would be that no other British locality was known at the time for that particular species. That this conclusion would be wrong is manifest from *Hydnum Weinmanni* (p. 242), which may be taken as an example. The locality cited is "Bristol," but Bristol is not the only, or the most important station for this species in Britain, because it occurs plentifully in the neighbourhood of Carlisle. If the intention was simply to indicate the locality where the species was first found in these islands, then again we fancy it is inaccurate, because, as we believe, it was first discovered by the late Rev. A. Bloxam, at Gopsall. The only solution we could suggest is that "Bristol" is the locality mentioned in Berkeley's "Outlines," and it was accepted as the only authentic record, without inquiry. Some species are stated to be "common," others "frequent," and others "rare," and when, in the absence of any one of these terms, a single locality is given, it is a fair inference that only one locality was known to our author, and that was the reason why it was given. Assuming this to be the case, we fancy that a very large number of these single localities could be challenged as not unique.

In addition to a "Glossary" of five pages, we are glad to find a good index of genera and species, but we search in vain for any clue to the contractions, in some cases only a single letter, employed in quoting authorities. Under nearly every species follows a line or two, sometimes five or six lines, of hieroglyphics, to which figures are appended. It may be all clear enough to the Rev. John Stevenson what is intended to be conveyed by "Quel. t. II, f. 1," or "Viv. t. 27," or "C. Illust., pl. 276," but who these illustrious persons are, or what they have done, to be curtailed in such wise, is nowhere indicated. Surely the author must have determined upon giving a key to these mysteries when he first commenced to employ them, and, in the hurry to issue the second volume, quite forgot the "students," even if he remembered the "scholars," and closed the book before he had finished his work.

A summary of the contents of these volumes, as they stand, exhibits the following results as compared with the last preceding work on the same subject:—

"Hand-book of British Fungi" ...	1044
Stevenson's "British Fungi" ...	1675

or, an addition of 631 species of Hymenomycetes since the year 1871. The majority of the additions have been made in the Agaricini, which stand thus:—

"Hand-book of British Fungi" ...	699
Stevenson's "British Fungi" ...	1183

or, an addition of 484 species, leaving only 147 species to be distributed over the residue of the genera of Hymenomycetes. These results are at any rate a justification, if any were needed, for the publication of a new work, especially when the older one is entirely out of print.

There can be no doubt that all that portion of the work which contains translations from the "Monographia" of Fries will be exceedingly valuable to British mycologists, and this extends through the whole of the first volume and 165 pages into the second; the only regret being that the few remaining species, which have not as yet been recorded in these Isles, were not inserted in brackets, or published as an appendix, so that the whole of Fries's excellent work might have been in the hands of every mycologist in this country. Perhaps even now such an appendix might be published, and no doubt it would meet with a hearty welcome.

Despite of such strictures as we have been impelled to make, we venture to hope that the present edition will soon be exhausted, and that its author will be called upon to prepare a new and revised edition, with a key to all the mysteries of the old one. M. C. C.

THE OCEAN

Der Ocean. Von Otto Krümmel. (Leipzig und Prag: Freytag-Lempsky, 1886.)

THE great interest which oceanographical studies have aroused within the last few years is shown in a marked manner by the publications destined to popularise the notions acquired respecting this vast and important chapter of physical geography. Not long after the appearance of the "Lehrbuch der Ozeanographie" by Boguslawski, whose untimely death has interrupted the publication of the second volume, we have a new and small manual by Dr. Otto Krümmel, whose name is already known to oceanographers.

This little treatise is clearly written, and the most important general notions concerning the physical geography of the sea are well stated, and discussed with ability. The author has succeeded in expressing briefly the essential notions about the ocean, which have been recently acquired by the *Challenger* and other deep-sea expeditions.

The author describes, in the first place, the ocean's surface and its subdivisions ("Die Meeresflächen und ihre Gliederung"); discusses the relation of oceanic and terrestrial areas from the point of view of their respective size; indicates the distribution according to hemispheres; and points out the classification he has adopted into *oceans*, properly so called, with their general systems of ocean currents, and *secondary seas*, which are more or less cut off from the great oceans. The *secondary seas* are again subdivided into *interior*, or *inter-continental*, and *border seas*, situated on the outer edges of the continents. The volume of oceanic water is then estimated. In the second chapter the interesting questions connected with the deformation of the level and surface of the ocean, owing to the attraction of the continental masses, are examined. The depths and contours of the ocean basins are next pointed out, and the work of the *Challenger* and other deep-sea expeditions, together with the apparatus employed, is described. The observations of the *Challenger* upon the nature and distribution of deep-sea deposits are summarised. The physical and chemical properties of sea-water are set forth in a special chapter—the salinity of the ocean, its distribution and origin; the gas contents; the transparency and colour, are, in turn,

treated of. After having made known the principal phenomena regarding the temperature of the ocean and its distribution, Krümmel treats of the glacial phenomena of the Arctic and Antarctic Oceans, pointing out the limits of the floating ice and icebergs in each region, and the influence of these regions on the questions of general oceanic circulation. The last chapter is reserved for a consideration of the movements of water, such as currents, waves, and tides.

Such is the general order and method of this manual. There is no attempt to give any general notion of the life of the shores, deep sea, and surface of the ocean, or of any of the phenomena due to organisms. The author shows himself to be everywhere *au courant* with the most recent discoveries in his subject. It would appear, however, that he has not had an opportunity of consulting the "Narrative of the Cruise of the *Challenger*," published last year, or he would have embraced in his descriptions some additional interesting details and general views. The work is illustrated by many woodcuts and small charts, some of which are instructive, others conveying little information to the reader, but when the low price of the book (one shilling) is remembered it would be unfair to criticise closely these illustrations. Dr. Krümmel has attained the object he had in view—to popularise in a scientific manner our knowledge relative to the physical geography of the sea, a subject full of interesting questions for all cultured minds. J. 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. No notice is taken of anonymous communications.]
- [The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

On the Connection between Chemical Constitution and Physiological Action

AS regards Dr. Brunton's letter in last week's NATURE (p. 617), I would express myself as more than satisfied with the personal explanation, but Dr. Brunton has not noticed the most important point to which I wished to call attention, viz. that whatever may be the value of my experiments, as showing a connection between physiological action and chemical constitution, the researches of Crum Brown and Fraser have really no bearing on the subject, for the simple reason that they had no knowledge of the chemical constitution of the re-agents they employed. There is an old receipt for cooking a hare which commences "First catch your hare," and in attempting to show the influence of change in chemical constitution on physiological action, it is well first to get a constitution. In the last edition of Watts's "Organic Chemistry" (1886) it is stated, "All these bases (the alkaloids), like the amines, are derivatives of ammonia, but their molecular structure is for the most part unknown." Even as regards inorganic compounds, our knowledge of their chemical constitution is not the most definite, but I believe that the arrangement of the elements in isomorphous groups expresses most clearly the resemblance in the chemical constitution of their compounds.

After again reading carefully Dr. Brunton's paper, I must confess that I cannot find anything showing the connection between chemical constitution and physiological action, except, perhaps, in the case of the alcohols. Here we have a class of bodies in which the different members of the series have probably the same relation to each other as the elements in the same isomorphous group, and it is an interesting fact that not

only do they resemble each other in their physiological action, but that their toxic action increases with their molecular weight, as I have shown to be the case with the inorganic elements, where, in each isomorphous group, the toxic action increases with the atomic weight of the elements.

In conclusion, I would reprint an extract from a paper published forty years ago:—"A moment's reflection on the problems to be solved will suffice to show that experiments conducted with this class (inorganic) of substances are more likely to furnish useful results than those made with bodies derived from the animal or vegetable kingdom, although, owing to the striking effects caused by some of these substances, physiologists have mostly directed their attention to them. By so doing, however, we are employing re-agents with the properties and composition of which we are imperfectly acquainted, to the neglect of those on the nature of which chemistry has already thrown much light, for not only are we better acquainted with the more purely chemical properties of inorganic compounds, but their relation to heat, electricity, and molecular polarity has been to a considerable extent made out." JAMES BLAKE

Disinfection by Heat

IN Dr. Parsons's Report on Disinfection by Heat (NATURE, vol. xxxiv, p. 583) occurs the statement: "It appears that there are no tables or formulæ in existence by which the degree of humidity of the air corresponding to a given difference between the wet and dry bulb thermometers at these high temperatures can be ascertained." There are both tables and formulæ; but the tables are the numerical values for the formulæ, and such tables are to be found in Balfour Stewart on "Heat," Dixon's "Treatise on Heat," Blanford's "Meteorologist's Vade-mecum," and numerous works on the steam-engine.

Let the degree of humidity be represented by h ; vapour-tension at dew-point by x ; wet-bulb temperature by t , its vapour-tension by f ; dry-bulb temperature by T , its vapour-tension by F ; barometric pressure by b . Then, the theory of the dew-point gives

$$h = \frac{x}{F};$$

and

$$x = f - \frac{0.382 (T - t)b}{1115 - 0.7t};$$

hence

$$h = \frac{f}{F} - \frac{0.382 (T - t)b}{(1115 - 0.7t)F}$$

The tables give the vapour-tension, consequently if T , t , and b are known, h can be found. At these high temperatures the degree of humidity would probably not be required very accurately. If within 1 or 2 per cent. of accuracy would suffice, the second term may be omitted. This results from the fact that the higher the temperature of the air, the nearer is the dew-point to the wet-bulb temperature.

The quantity sought then is $h = \frac{f}{F}$. Given $T = 299, 299$, and 249 ; $t = 146, 165, 190$; and taking F and f in pounds from a table in "Lardner on the Steam-Engine":—

(1) $h = \frac{3.5}{63} = .05;$

(2) $h = \frac{5.5}{63} = .08;$

(3) $h = \frac{9.5}{29} = .32.$

Here saturation is represented by unity. This is at once a short and simple method of calculating the degree of humidity at these very high temperatures. If the barometrical pressure were observed, and the long second term worked out, the results would not be materially different, but would be something less.

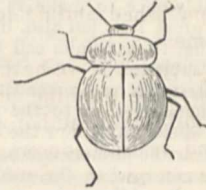
R. STRACHAN

11, Offord Road, London, N., October 25

The Beetle in Motion

MUCH has been written on "the horse in motion." Can any readers of NATURE supply me with references to published matter on the subject of hexapod progression?

The few observations I have made may be summed up in a few words. I use the letters r and l to signify the right and left legs respectively, and number the limbs from before backwards. When walking rapidly the appearance is as if $l1, r2$, and $l3$ moved forward together simultaneously, alternating with $r1, l2$, and $r3$. When the pace is slower it is seen that $l1$ and $r2$ start together and come down at about the same time, some-



times one sometimes the other being a little the first. Then, lifted almost but apparently not quite at the same time, $l3$ starts. The motion of this leg being somewhat slower, and the limb having further to travel, the foot generally comes to the ground appreciably later than $l1$ or $r2$. The general effect is to produce, at the moments of pause between the strides, the position indicated in the figure, which differs considerably from the conventional position delineated by artists who seek to represent the beetle in motion.

C. LLOYD MORGAN

University College, Bristol

The Astronomical Theory of the Great Ice Age

IN Sir Robert Ball's paper on this subject, which appears in your last number (p. 607), that author states that the calculation given "has convinced him that Mr. Croll's theory affords an adequate explanation of the Ice age." It is more in the hope of obtaining from Sir Robert a statement of the grounds of this conviction than for the purpose of controversy that I write this letter.

It will of course be conceded that the frost and snow of a single winter, melted off during the following summer, would not produce an Ice age. But, on Sir Robert Ball's figures, the increase of winter cold at the period in question was accompanied by a corresponding and equal increase of summer heat. Why, then, should the latter prove insufficient to melt the winter accumulation of snow and ice in any locality where it now suffices to melt it?

The question is one of the joint result of two opposing forces. Both, under the supposed conditions, are intensified and equally intensified. How does this affect the result? More snow and ice is doubtless formed in the winter, but then more heat is employed in melting it during the ensuing summer. Why, then, was it not melted in any place where it is now melted? A kind of answer to this question may be extracted from the writings of Mr. Croll, but not, I think, a satisfactory one. I am therefore anxious (in common, I am sure, with many others of your readers) to hear the reply of Sir Robert Ball.

Llandudno, October 25

W. H. S. MONCK

The Enormous Loss from Ox-Warble

I VENTURE to solicit your co-operation in making some points better known in order that farmers may be better able to protect themselves from the enormous loss from warbles on cattle from the bot-fly, positive proof having been furnished that it largely exceeds 2,000,000*l.* to 3,000,000*l.* yearly! To begin: I appeal to those farmers who have somewhat studied the question to make it clear to those who have not done so that *each warble lump has a large maggot under it*, feeding on the juices of the hide or flesh. These lumps many call "health lumps" or "thriving bumps," and seem to prefer that their cattle should have them. It is readily seen how this serious fallacy has arisen, viz. from the fact that the warble lumps begin to show about Christmas (from the growth of the maggot under them), which also happens to be the time that the cattle receive their most nourishing food, and are then warmly housed or sheltered. But there could be no greater mistake than to think that the swellings

from the ravages of these horrid maggots are proof of a thriving condition! A correspondent writes me: "Since reading recent issues on the ox-bot or warble-fly, I have visited several cattle markets and slaughter-houses to see for myself if the ravages of the maggots are so serious as the statements led one to believe. I must frankly state that what I have seen convinces me that the statements are much under the mark rather than over it. The first beast I handled showed 42 warbles, some only 3 to 6, whilst many others showed 30 to 70; and on examining hides at slaughter-houses this state of things was again confirmed (the warbles are more readily seen upon the *under*-side of the skin, and many are small ones that would not show as a lump. I am certain a farmer has only once to make such a visit to be not only convinced of the great loss, but also, if he has any neighbourly feeling about him, to make him call the attention of his brother-farmers to the subject."

I am anxious to indorse this recommendation, for the farmers should now satisfy themselves as to the actual state of the matter, as in a few weeks from now the warble lumps will have vanished, and I fear the farmers will hardly take protective measures during the summer, when the warbles are not visible, unless they are convinced; whilst seeing would be believing. I may remark that the following simple remedies are all efficacious to destroy the maggots: mercurial ointment and carbolised oil, to be applied with caution by a careful man; or, better still, quoting from the Report of the Royal Agricultural Society, "As a general application, safe in all hands, McDougall's preparation has proved excellently useful," and I have convinced myself it is the best and safest remedy that can be applied, not only for destroying the maggots, but, later on, as a wash to prevent the attacks of the flies. I would not have occupied so much of your space, but I am convinced this is a subject of national importance.

JOHN WALKER

Southport

P.S.—Farmers wishing for further information should read "Observations on Ox-Warble or Bot-Fly," 1884, and a second Report on "Ox-Warble or Bot-Fly," 1885, by Eleanor A. Ormerod, F.R. Met. Soc., &c. (London: Simpkin, Marshall, and Co.), and a new pamphlet called "The Bot-Fly," just issued by J. C. Jack, Grange Publishing Works, Edinburgh. This work fully defines every minute detail of the history, life, prevention, and losses sustained by the dreaded pest.

Aurora

THE remarkable aurora borealis observed by Prof. Piazzini Smyth at Edinburgh on July 27 (*NATURE*, vol. xxxiv. p. 312) seems to have been visible over a very great area. In my meteorological journal it is remarked on July 27 that the bright silver-clouds appeared beautiful between 9.30 and 11 p.m. "The colour of the northern sky above the silver-clouds was misty and brownish, though not cloudy." I had never seen such a tint in the sky. I have no hesitation in saying that the unusual darkness was the same as observed at Edinburgh. The fair white arc I did not see; clouds came up at midnight. It may be interesting to state that I also saw, on July 26 at 9.30 p.m., an aurora-like white cloud in the north-west. This cloud was very different from the well-known silver-clouds so often described in 1885 and 1886. On the 28th and 29th nothing extraordinary is mentioned in my journal, but on the 30th faint traces of the silver-clouds and again "a very strange yellow-brownish colour of the north and north-west sky" are remarked. The great aurora on March 30 we also observed very well at Königsberg.

F. HAHN,

Professor of Geography at the Königsberg University
Königsberg, Prussia, October 25

Earthquakes

It is always interesting to look for coincidences in the earthquakes in different parts of the world. In *NATURE*, vol. xxxiv. p. 627, you announce that a violent earthquake was felt at Charleston and many other places in the United States of North America, on the 22nd inst. at 3 o'clock in the afternoon, *i.e.* 20h. 20m. Greenwich time. On the same day a very slight shock is recorded as having occurred at Neuchâtel, Switzerland, at 9h. 20m. evening, Berne time, *i.e.* 20h. 50m. Greenwich time. It is not impossible, but I must confess scarcely probable,

that the faint shock at Neuchâtel was the re-percussion of the severe earthquake of North America.

F. A. FOREL

Morges, Switzerland, October 31

In connection with Prof. O'Reilly's letters in *NATURE* of October 14 and 28 (pp. 570, 618), and your notice of October 21 (p. 599), I supply a few data, which at first I thought of too little interest for your columns. At 6.12 p.m. local time (17h. 41m. universal time), on October 16, two shocks occurred with a short interval, the direction being approximately that of the meridian. The intensity was such as might be produced by very heavy carts passing.

H. DU BOIS

Strasbourg, October 31

Meteor

THIS evening, at about 8.25, I saw a magnificent meteor, of a blue colour, falling a little to the left of the Pleiades.

Belfast, October 31

JOSEPH JOHN MURPHY

FREDERICK GUTHRIE

FREDERICK GUTHRIE was born in Bayswater on October 15, 1833, and was the youngest of six children. His father, Alexander Guthrie, was a tailor, carrying on business in New Bond Street, and is said to have been a man of literary taste and ability; that he was a man of cultivation is shown by the education he provided for his children, one of whom, Francis, early distinguished himself at University College, London, and at the London University, as a mathematician, and is now Principal of the South African College, Cape Town. As a boy, Frederick Guthrie was taught privately until his twelfth year by the late Henry Watts, F.R.S.; afterwards he was sent to University College School, then under the head-mastership of Prof. Key, whence he passed into University College, London. There he remained three years, the last two of which were devoted mainly to the study of chemistry, under Profs. Graham and Williamson, and of mathematics under De Morgan, a teacher with whom it was impossible for a young man of Guthrie's power to come into contact without receiving a life-long impress. There also he again came into contact with Watts, who was then principal assistant in Prof. Williamson's laboratory, and an intimate friendship was cemented with his old tutor that remained unbroken till the death of the latter. In the spring of 1854 Guthrie went to Germany to continue his chemical studies, and worked first at Heidelberg, under Bunsen, and then at Marburg, under Kolbe, where he took the degree of Doctor of Philosophy ("*summa cum laude*") in 1855, having previously graduated as Bachelor of Arts of the University of London. After returning to England he was appointed, in 1856, assistant to Dr. Frankland, then Professor of Chemistry in Owens College, Manchester. In 1859 he went to Edinburgh as assistant to the late Vice-President of the Council, who had just succeeded Dr. William Gregory as Professor of Chemistry in the Edinburgh University.

Two years later Guthrie accepted the Professorship of Chemistry and Physics in the Royal College, Mauritius. He arrived in the island in May 1861, and for six years he devoted himself to endeavouring to introduce and establish on a durable basis scientific instruction in the colony. Here one of his colleagues was Mr. Walter Besant, the eminent novelist, with whom he formed a friendship that remained intimate and uninterrupted through life. He returned to London on leave in 1867, and in 1869 he was elected Lecturer on Physics in the Royal School of Mines, a post which, with extended duties and modified title, he retained till his death.

In the spring and early summer of this year many of Guthrie's friends remarked upon his looking ill and seeming to be in low spirits. After a while he complained of a difficulty in swallowing, which presently became so

serious that he was unable to take solid food. When at last he was prevailed upon to consult a physician, it was discovered that he was suffering from cancer of the throat. He sank rapidly during the last two or three months, and the inevitable end of his disease came on October 21. He was buried in Kensal Green Cemetery on the 26th.

Such were some of the chief outward and visible stages in Frederick Guthrie's career. Perhaps the first thing to strike any one on making his acquaintance was his strongly-marked individuality. His opinions were, much more than most men's, of his own forming, not simply picked up as they floated about in talk or in print. And his conduct followed his opinions: he did what he thought right, with very little regard to the consequences to himself, or to what might be thought of him by others. His scientific knowledge, too, was, much more than most men's, of his own getting, the result of his own observation and experiment. In others, also, he valued even a small scrap of self-gotten knowledge more than a large store of secondhand erudition. In this respect he sometimes went to excess, and, though not without mathematical knowledge, he was somewhat apt to underrate the scientific importance of the work of mathematical physicists in comparison with that of pure experimentalists. But even this mistake had root in the thoroughly sound conviction that it is the duty of a man of science to be a strictly faithful interpreter of the observed facts of Nature, and that, the further he ventures in the field of theoretical deduction the more room is there for self-deception. He seemed, however, sometimes to forget that phenomena do not present themselves to the natural philosopher ready clothed in words, and that all that can be expressed in human language is the conception formed in the mind of the observer. The true function of the mathematical physicist is in reality, as Kirchhoff has pointed out, nothing more than to find out the simplest statements that are consistent with observation.

Guthrie's devotion to science was complete and single-minded. He had a deep conviction of the value and dignity of any kind of genuine, self-forgetful, scientific work, and he knew how, if necessity arose, to claim the dignity due to a sharer in such work. But from affectation or vanity he seemed entirely free. His wonderful gift of humour and power of terse and telling speech made it easier for him, than for most men, to put down any approach to impertinence or presumption; but, except where he felt that a lesson was needed, he was most considerate of others, both in speech and action. He delighted in playful mystifications (see, for example, Prof. von Nudeln's letter in NATURE, vol. xxi. p. 185, on the "Potential Dimensions of Differentiated Energy"), but his drollery was never ill-natured. He was generous and kind-hearted in the extreme; as a friend he was steady and faithful. Although essentially a man of science, he had considerable literary attainments, and had an excellent knowledge of both German and French, while his powers of literary expression were remarkable. It will not astonish those who knew his ability in this direction to learn that as a young man he published (under the *nom-de-plume* of Frederick Cerny) a poem called "The Jew," and a metrical drama called "Logroño."

With regard to Guthrie's scientific position and achievements it may be remarked, in the first place, that he belonged to a class that was probably commoner in his generation, and in that which preceded it, than it is likely to be in the future—that, namely, of physicists who served their time as chemists. Until within the last twenty years or so the only accessible school of experimental science was a chemical laboratory, and consequently, for the last two generations, a large proportion of the most prominent physicists have been men who began their scientific career as chemists. Among many others, it may suffice to mention Faraday and Regnault. Guthrie's first published investigation seems to have been his

dissertation on taking his Ph.D. degree; it was entitled "Ueber die chemische Constitution der ätherschwefelsauren Salze und über Amyloxydphosphorsäure." In the six years between taking his degree and going to Mauritius, he published eight or ten papers, mostly on points of organic chemistry—one of them, on the amyl group, contains the discovery of the therapeutic action of nitrite of amyl, and suggestions for its introduction into the pharmacopœia. His first physical investigations were published while he was in Mauritius, and included two researches into the formation of drops and one into the properties of bubbles. It is striking evidence of the reality of Guthrie's love of science and of his force of character that, under circumstances in almost all respects adverse to scientific work beyond what was required by his official position, he should have persevered steadily with his experiments and produced papers of great value. While in Mauritius he also published a paper on the iodide of iodammonium, and a pamphlet on "The Sugar-Cane and Cane-Sugar," and made complete analyses of the waters of the principal rivers of the island. After his return to England his scientific work was almost wholly confined to physics, but it is perhaps significant of the side from which he approached the study that the subjects that occupied him principally had relation to what is usually called in the text-books "molecular physics." Among many other researches the following may be specially mentioned: on the thermal conductivity of liquids; on approach caused by vibration; on stationary vibrations of liquids in rectangular and circular troughs; on salt-solutions and attached water (the results of this investigation were contained in a series of eight papers, and included the discovery of the substances named by Guthrie "cryohydrates," a class of solid hydrated salts which melt without change of composition, in most cases below 0° C.); on "Eutexia," an investigation into the properties, especially the melting-points, of metallic alloys and mixtures of salts.

As a teacher, it has been well said of Guthrie by one who knew him well, that "he did not desire merely to fill his pupils' heads, but to make them use them"—a far more valuable but more difficult result to attain. A large proportion of his pupils consisted of "certificated science teachers," and for these he introduced a system of instruction, consisting largely in making them construct with their own hands the apparatus required for their experiments, which was probably more fruitful (especially in the case of this particular class of pupils) than any other that he could have adopted.

In 1873 Guthrie issued to his scientific friends a characteristically worded little circular, which resulted in the formation, early in the following year, of the Physical Society of London, a Society which now includes, with very few exceptions, all the leading physicists of the United Kingdom. Through his intervention, permission was obtained from the Lords of the Committee of Council on Education for the meetings of the Society to be held in the Physical Laboratory of the Science Schools at South Kensington. He chose for himself the somewhat onerous post of "Demonstrator" to the Society, and in this capacity placed his time and the resources of his laboratory freely at the disposal of those who wished to exhibit experiments or apparatus at the Society's meetings. It was not till 1884 that he consented to become President.

In the early part of the present year he gave a course of three lectures before the Society of Arts on "Science Teaching," in which he advocated with equal vigour and humour the advantages of a training in experimental science.

Besides the poetical works already mentioned, and his numerous papers on scientific subjects, Guthrie was the author of the following books:—"Elements of Heat and Non-Metallic Chemistry," "Electricity and Magnetism,"

"Molecular Physics and Sound," and "The First Book of Knowledge."

He was elected a Fellow of the Royal Society of Edinburgh in 1859, and a Fellow of the Royal Society of London in 1873.

G. C. F.

THE LONGEVITY OF GREAT MEN¹

THE conclusion that the intellectual giants of the race are favoured by an abundance of years on the scene of their heroic activity, and are thus further differentiated from their more common fellow-men, seems natural, and has been accepted upon evidence which, in a less pleasing conclusion, would be considered ridiculously insufficient, and even false. The usual method of attempting to answer the question whether great men are longer-lived than others, is to prepare a list of the ages, at death, of a number of eminent men, take the average age, and compare it with a similar average of a number of ordinary men, or even with the average lifetime of the race, and in this way to make the results speak decidedly in favour of the superior longevity of great men. All that such a method can prove (and this it does prove) is that it takes long to become great. It neglects to consider that a select class of men is dealt with, and that, to be even potentially included in this class, one must have lived a certain number of years.

For example: in an article translated in the *Popular Science Monthly* for May 1884, it is argued that astronomers are a long-lived race because the average life-period of 1741 astronomers is 64 years and 3 months. An average human life is only 33 years; but as one cannot be an astronomer before adult life, the author takes the expectation of life at 18 years, which is 61 years, and thus makes an excess of over 3 years in favour of astronomers. He also divides his astronomers into four degrees of eminence, and finds that those of the first rank live longer than those of the second, and they in turn longer than those of the third, and so on, thus implying that the best astronomers are most favoured with years. The true conclusion is, that it takes longer to become a first-rank astronomer than it does to become a less eminent one.²

If great men were great from their infancy, and we had the means of ascertaining this fact, the method would be correct. But, as it is, we must define in some way or other what we mean by greatness, and then fix the average age at which it becomes possible to distinguish an amount of talent sufficient to enable its possessor to be enrolled in the ranks of the great as already defined. What is known as the "expectation of life" at any number of years tells the most probable age at death of one who has attained the years under consideration: a comparison of this age with the age at death of great men will decide whether they are longer-lived or not.

The attempt was made to select about 280 to 300 of the greatest men that ever lived.³ Throwing out about 30 of the doubtful names, there remain 250 men, about whom the statement is hazarded that a list of the 250 greatest men, prepared by another set of persons, will not mate-

¹ From *Science*.

² Mr. Galton ("Hereditary Genius," p. 34) has allowed himself to neglect a similar consideration. In giving the number of men in each class that the population of the United Kingdom would have between certain ages, he gives 35 as the number of men of class G (a very high degree of eminence) between the ages 20 and 30, and only 21 such men between 40 and 50 years. But this cannot be true, because only a very small proportion of men could possibly attain the eminence requisite to be classed among the G's in 20 to 30 years, while almost all (of those who will attain it at all) will have attained it before the end of their fiftieth year. And this consideration far outbalances the excess in absolute number of men between the former ages over those between the latter. Similarly the falling-off in the number of men of class G, i.e. idiots, from decade to decade, would be more rapid than in ordinary men,—a fact which the tables fail to show.

³ The names were selected by three others and myself, while engaged in a study of what might be called the natural history of great men. The process of selection was most rigid and careful; by a system which it would take too long to describe.

rially differ from our list, as far as all the purposes for which it is to be used are concerned. From this list I have selected at random a set of men of whom it was probably easy to fix the age at which they had done work which would entitle them to a place on this list, or work which almost inevitably led to such distinction: it is a date about midway between the first important work and the greatest work. The average of over 60 such ages is 37 years; which means, that, on the average, a man must be 37 years old in order to be a candidate for a place on this list. The real question, then, is, How does the longevity of this select class of 37-year-old men compare with that of more ordinary individuals? The answer is given by the expectation of life at 37 years, which is 29 years, making the average age at death 66 years. And this is precisely the age at death of these 60 great men; showing, that, as a class (for these 60 may be considered a fair sample), great men are not distinguished by their longevity from other men.

Further interesting conclusions can be drawn if we divide the men into classes, according to real psychological and physiological differences in the ways of manifestation of the several kinds of genius. It is almost surprising how well the ordinary trinity of faculties—intellect, emotions, and will—accomplishes this purpose. Greatness seems to appear either in a brilliant thought, a deep feeling, or a powerful will. Under men of thought would be included philosophers, scientists, historians, &c.; under men of feeling, poets, musicians, religionists, &c.; under men of action, rulers, commanders, statesmen, &c. Before comparing the relative longevity of these three classes of men, I assure myself that the period at which greatness begins to be possible does not materially differ¹ in the three classes, and, as was done in the former case, I exclude all cases of unnatural death. I find that men of thought live 69.5 years, or 3.5 years longer than ordinary men; while the lives of men of feeling are 3 years, those of men of action 5 years, shorter than those of average men,—a conclusion that agrees with the commonly accepted view on the subject. If we subdivide these three classes, we find, that, while all classes of men of thought live longer than ordinary men, the moralists live longest, scientists coming next; that among the men of feeling the religionists alone live the full period of life, while poets' lives are 5 years, and musicians' lives 8 years, too short; that, of men of action, rulers and commanders both fail to complete the full term of life by 4 years. One sees from these statements (which, however, in their detail at least, must be accepted with hesitation, owing to the fewness of examples) that the kind of psychical and physical activity pursued influences the life-period; that certain types of genius are apt to die young, while others are particularly favoured with a full allowance of years.

The question of longevity becomes important when we consider that through it the leaders of civilisation are allowed to exercise their important function a few years longer, thus enabling more great men to be alive at the same time; and that, by its tendency to be inherited by the offspring, the children of great men will begin life with a better chance of reaching maturity, and, in turn, of becoming important to the world, if, as we have reason to believe it would, the genius of their ancestors has left its traces in them.

JOSEPH JASTROW

THE GEOLOGY OF THE LEBANON

WE are indebted to Dr. Carl Diener, of the University of Vienna, for an able monograph on the geological and physical formation of the Lebanon and surrounding districts, accompanied by maps, sections, and

¹ Mr. Sully (*Nineteenth Century*, June 1886) has shown that men of feeling are more precocious than men of thought; but the difference in the age at which their first great work is done, though in favour of men of feeling, is very slight indeed.

illustrations reproduced from photographs.¹ Notwithstanding the observations of Russegger, Fraas, and others, on the physical features and structure of this region, a complete monograph on its geology has long been a desideratum, and the work of Dr. C. Diener forms a fitting continuation of the survey of Lartet in Palestine, and of the Palestine Exploration Society in Arabia Petraea and the Jordan Valley.

Down to a comparatively recent period, the ranges of the Lebanon and Anti-Lebanon were supposed to be formed of Jurassic limestones, but the observations of Oscar Fraas showed that this was an error, and that they are mainly formed of Cretaceous and Eocene limestones. It is only within the limits of a narrow belt at the western base of Mount Hermon that Jurassic beds really occur; this being their first appearance on proceeding northwards from Arabia Petraea. The formations overlying the Jurassic strata are referable to the "Neocomian" (?), Cenomanian, Turonian, Senonian, Eocene, and newer Tertiary periods; while great sheets of basaltic lava of late Tertiary age occur both to the north and to the south of the region embraced by the memoir.

Dr. Diener has worked out with great success the numerous lines of faulting and flexuring which the strata have undergone since their deposition, and which have been produced mainly during the Miocene epoch. Mount Hermon itself owes its position in a great degree to the elevation of its mass along the line of a great fault which coincides with its western base. Its beds of limestone, belonging to the age of the Lower Chalk of Europe, are disposed in the form of a low arch, the axis of which passes under the summit, and ranges in a north-north-east direction along the line of the heights of Anti-Lebanon. Other faults range along the southern and eastern flanks of the great dome-shaped mount which has thus been bodily upheaved in respect of the bordering strata. There can be no question that the system of terrestrial disturbances along which the Syrian mountains have been fractured and dislocated is the same as that which has given origin to the Jordan-Arabah depression; and amongst the lines of displacement traced out by Dr. Diener, we can have no difficulty in recognising that which is the actual prolongation of the leading fault of the Jordan Valley. This great line of fracture and displacement appears to enter the valley of the Leontes (Litany) at the western base of Hermon, where a complete change of the stratification takes place on either side, and the "Lebanon Limestone," with the subordinate Lower Cretaceous beds, are thrown into a nearly vertical position, and brought into contact with horizontal strata of the Upper Chalk (Senonkreide). It may therefore be inferred that the great valley of Cœle-Syria (El Bekâ'a), separating the range of the Lebanon from that of Anti-Lebanon, owes its origin, in the first instance, to the same system of faults which has caused the depression of the Jordan Valley, the original features having been modified by extensive denudation; and if we suppose that the primary line of fault reaches as far north as the Lake of Homs, in the valley of the Orontes, and as far south as the Gulf of Akabah, the distance through which this great line of fracture of the earth's crust will have been traced will amount to about 350 English miles.

Dr. Diener expresses some doubts regarding the former existence of glaciers in the Lebanon, notwithstanding the opinions of such observers as Hooker, Fraas, Girard, and others. Hooker especially identifies the mound upon which the grove of ancient cedars is planted as an ancient moraine. The author throws some doubt upon this view, because he was unable, after three hours of search, to find scratched or striated boulders, although he admits that, viewed in certain directions, the mounds do present the appearance of a terminal moraine. In reference to this

subject, it may be observed that the position and altitude of the Lebanon Range makes it extremely probable that perennial snow, giving origin to glaciers, occupied the higher regions during the Glacial epoch. Amongst the Caucasus, which are only a few degrees further north, though somewhat higher, glaciers occur at the present day, and during the Glacial epoch the valleys were brimful of ice. Hence it would be strange if in the Lebanon it were proved that they had been entirely absent. The scarcity or absence of glacial striations, on which Dr. Diener founds his objection, is easily accounted for when we recollect that the blocks and stones consist of rather friable limestone which has been exposed through thousands of years to the effects of frost, heat, and rain. It is only when the surface of a rock, or of a boulder, has been protected by a coat of stiff glacial clay, that we can expect the striae and scars to be preserved throughout a long period of time.

On another point Dr. Diener expresses his dissent from the views of previous observers, arising, as it seems to the writer, from his want of appreciation of the full effect of eroding agencies. The neck of land which connects the Râs Beyrût with the outer ridges of the Lebanon is formed of beds of stratified gravel or conglomerate rising from 120 to 150 feet above the sea. This is to all appearance an old sea-bed formed at a time when the land was submerged to the extent above indicated, during which Râs Beyrût was an island. The author cannot accept this view, because his observations of the coast-line of Syria, bearing on the present state of the harbours, do not appear to show a change of level of more than a few feet; less, in fact, than would be necessary to submerge the neck of land. On the other hand, he accepts the evidence offered by Lartet and the writer of a submergence of the coast of Southern Palestine and Philistia to an extent even greater than this, namely 200 feet and upwards; and he points to the evidence of great changes of level on the coast of Northern Syria and Asia Minor. May not the absence of raised beaches on the coast of Southern and Middle Syria be due to the waste caused by the wave action of the Mediterranean, which would tend to carry away such soft materials during the period of emergence where exposed and unprotected? In another case the author throws doubt on the observations of Dr. Post regarding the presence of shell-beds at levels of 150 to 250 feet near Lâdikieh, an account of which appeared in NATURE, vol. xxx. p. 385, and which is given with much detail. It seems an instance of hypercriticism to call in question an authenticated statement merely on the ground that the author was unable to personally verify it.

The above instances will, however, go to show with what care and labour Dr. Diener has accomplished his task, and he is to be congratulated upon the production of a work which will doubtless be considered a standard of reference regarding the physical history of the Syrian mountains. I may perhaps be allowed to remark that his admirable geological map would have been improved by following the English custom of showing the dip of the strata by means of small arrows, and of distinguishing between ordinary boundaries of formations and those which are produced by faults and fractures, and the book itself would have been rendered easier for reference by an index.

EDWARD HULL

AUTUMNAL FLOWERING

THE "extraordinary gooseberry" season seems to have set in this year with more than usual severity. Country clergymen and amateur gardeners, who would see nothing unusual in the autumnal flowering of a hybrid perpetual rose (which reminds them, perhaps, of their old school-days, when they read of "*biferique*

¹ "Libanon; Grundlinien der physischen Geographie und Geologie von Mittel-Syrien." (Wien, 1886.)

rosaria Pesti"), are moved with astonishment at the sight of a second crop of flowers on an apple-tree or a laburnum. Common as the phenomenon is, however, not many persons, even among botanists, bestow a thought as to how it is brought about. Gardeners recognise two distinct modes in which flowers may be produced, either from the "old wood," meaning the wood formed in the previous season, or from the shoot of the present year's growth. A rhododendron with its flowers packed up in a "winter-bud" destined to unfold in spring, an apple or a laburnum with their winter-buds at the ends of short contracted shoots or "spurs," afford illustrations of the one type, while a rose, with its newly-formed shoots crowned with one or more rose-buds, supplies an example of the latter. There is the same sort of difference between these two kinds of flowers that there is between the so-called "annual" plants whose course of life is outrun in a single season, and "herbaceous perennials" which die down in winter, leaving a winter-bud to carry on the work when circumstances become propitious in spring. The second growth of flowers in autumn may, therefore, be due to two different causes. In the one case it is an anticipation of spring; the flowers being produced afore time. Conditions of growth being persistently favourable, the winter-bud, instead of remaining dormant, bursts prematurely into growth, and repeats in autumn what its predecessor had done in spring. The great difficulty in such a case is to explain why one bud, or at any rate only a small proportion of the total number of buds, acts in this way when the circumstances of the case would appear to be substantially alike in all. To talk of the individuality of buds is to denote a fact which every observer must be conversant with, but which does not supply any explanation. In the second class of cases the flowers are, as in "hybrid perpetual" roses, placed at the ends of some of the shoots of the year. In this case gardeners have availed themselves of what was originally an occasional tendency to continue the development of flowers on the end of certain shoots, and have, as it were, converted an accidental into a constant occurrence. Doubtless they might do the same in the case of the laburnum, were they so disposed. It is here that the skill of the gardener comes in, and even enables him, to some extent, to baffle adverse climatic influence and induce a plant, as a regular thing, to flower twice in a season, or even more or less continuously, when, if left to itself it would either not do so at all, or only in a fitful, uncertain manner. It is worth notice, too, that these second blooms are often (but by no means invariably) malformed. Some rhododendrons now before me are so, while the double-flowered apples that one occasionally sees are always, in my experience, formed on the midsummer shoots of the tree. So, again, with pears, the second crop of flowers is usually produced on shoots of the year, and very generally the flowers are more or less imperfect or misshapen. The "Napoleon" pear behaves in this way every year. Every year, too, I am indebted to Mr. Burbidge, of the Trinity College Botanic Garden, Dublin, for specimens of "Bishop's Thumb" pears, produced on the summer shoots. These pears are more like fingers than thumbs, and are destitute of core. The flower-stalk swells up as usual, and produces an eatable pear, but the carpels and seeds are conspicuous by their absence. The developing force has been energetic enough to produce flower- and fruit-stalk, but it has failed in the more essential process of seed- and embryo-formation. Possibly in some cases the absence of seed may be the result of want of fertilisation. It may be that in the flowers some at least of the carpels are present with their contained ovules, but, owing to the want of effective fertilisation, they have dwindled away and left no trace.

It would be a curious and important matter to ascertain whether, and to what extent, this repeated flowering process exhausts the plant. If no seed were produced the

extra outlay of energy would probably not be severely felt. But every rose-grower knows how great are his losses, and how difficult it is to keep his "standards" in good form and good health. Of course there are many causes for this, but it is not unreasonable to suppose that one of them arises from exhaustion from continuous flowering, which produces a condition that predisposes to disease.

Another phenomenon of a somewhat similar character is very commonly met with this autumn, although, not unnaturally, it does not attract so much attention. I allude to the production of buds and leaf-shoots on the partially withered stems of herbaceous perennial plants, such as various species of *Epilobium*, *Malva*, &c. The branches of these plants usually dry up after flowering, leaving only a rosette of leaves or a winter-bud to carry on the growth next season; but occasionally they retain some amount of vitality, and, as at this season, produce a new generation of shoots from the old ones.

These variations show how artificial are the distinctions denoted by the terms annual, perennial, herbaceous, and the like, and they show what a wide range of physiological diversity may exist within the limits of the same species.

MAXWELL T. MASTERS

ARROW-RELEASE¹

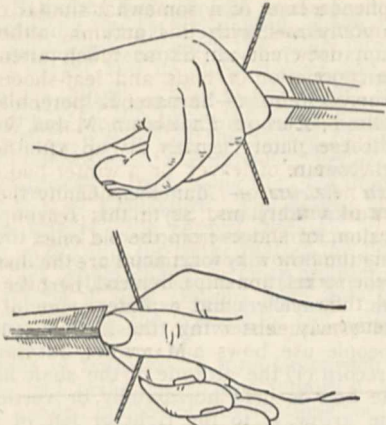
AT the commencement of this very interesting and instructive monograph, Prof. Morse tells us that when he began collecting data illustrating the various methods of releasing the arrow from the bow, as practised by different races, he was animated merely by curiosity; nor was it until he had accumulated quite a collection of sketches and other memoranda on the methods of arrow-release, not only of existing but of ancient races, as shown by frescoes and rock-sculptures, that he realised that even so trivial an art as that of releasing the arrow might possibly lead to interesting results in tracing the affinities of races. Hence he publishes in the present pamphlet the data which he has thus far collected, in the hope that further material may be secured for a more extended memoir on the subject. The great difference which Prof. Morse observed between the ordinary English and Japanese methods of using the bow first led him to investigate the subject, with the curious results to be presently narrated. The various forms of release, with their different modifications, are classified, and perhaps Prof. Morse's investigations may be most succinctly described by using his classification.

(1) *Ordinary Release*.—This is the simplest form of release, and is that which children all the world over naturally adopt in first using the bow. It consists in simply grasping the arrow between the end of the straightened thumb, and the first and second joints of the bent forefinger (Figs. 1 and 2). With a light or weak bow, says Prof. Morse, this release is the simplest and best; it makes little difference on which side of the bow the arrow rests, provided the bow is held vertically. On the other hand, however, a stiff bow cannot be drawn in this way, unless one possesses enormous strength in the fingers. This simple or primary release is that in use amongst the Ainos of Yezo, by the Demerara Indians, apparently also by the Utes. The Navajos employ it when shooting at prairie dogs, so that the arrow will not penetrate the ground if it misses its mark; so do the Chippewas. The Micmac Indians of the Cascapedia settlement, on the north shore of the Bay of Chaleur, used it, and it is said that the other tribes in this part of Canada draw the arrow in the same way. A member of the Penobscot tribe at Moosehead Lake, seemed incredulous when Prof.

¹ "Ancient and Modern Methods of Arrow-Release." By Edward S. Morse, Director Peabody Academy of Science. Essex Institute Bulletin, October-December, 1885.

Morse told him that there were other methods of drawing the arrow.

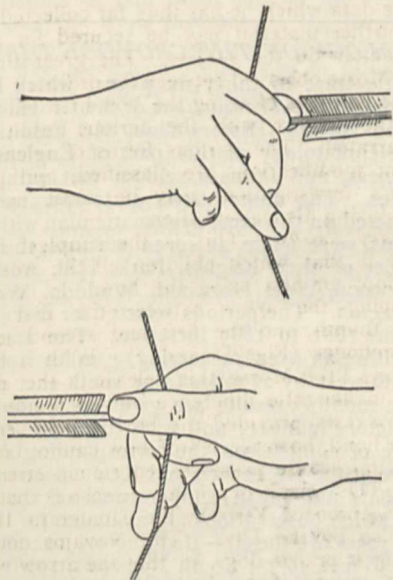
(2) *Secondary Release*.—This is a direct outgrowth from the primary release. It consists in grasping the arrow with the straightened thumb and bent forefinger, while the ends of the second and third fingers are brought to bear on the string to assist in drawing (Figs. 3 and 4).



Figs. 1 & 2. Primary release.

The Ottawas and Zuni Indians practised this, as also did the Chippewas of Northern Wisconsin.

(3) The *Tertiary Release* differs little from the secondary. The forefinger, instead of being bent, is nearly straight, with its tip, as well as the tips of the second and third fingers, pressing or pulling on the string, the thumb, as in the primary and secondary release, active in assisting in pinching the arrow and pulling it back. This is used amongst various tribes of American Indians—Sioux, Arapahoes, Cheyenne, Assinboins, Comanches,

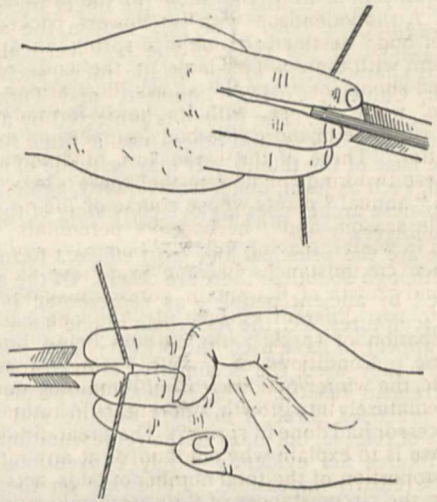


Figs. 3 & 4. Secondary release.

Crows, and Blackfeet. The Siamese, too, practise this release, with the difference that one finger only is used on the string instead of two. It appears, too, from Mr. Man's recent paper before the Anthropological Institute, that the Andaman Islanders use this method.

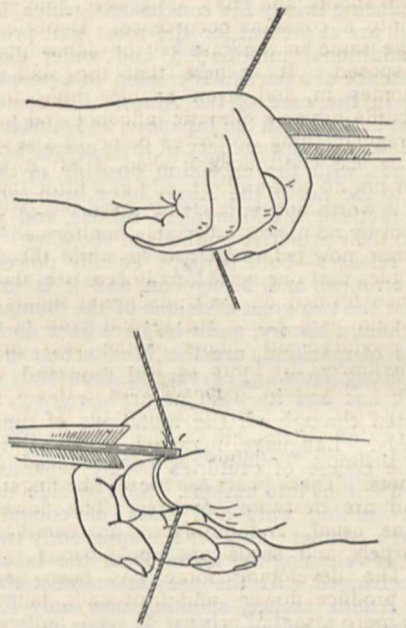
(4) *The Mediterranean Release*.—This release has been in vogue among the northern Mediterranean nations for

centuries, and among those of the southern Mediterranean for tens of centuries, and is the oldest release of which we have any knowledge. It is practised to-day, continues Prof. Morse, by all modern English, French, and American archers, and is the release used by the European archers of the Middle Ages. It consists in drawing the string back with the tips of the first, second,



Figs. 5 & 6. Mediterranean release.

and third fingers, the balls of the fingers clinging to the string, with the terminal joints of the fingers slightly flexed. The arrow is held lightly between the first and second fingers, the thumb straight and inactive (Figs. 5 and 6). A leather glove or leather finger-strings are worn, as Roger Ascham expresses it in his "Toxophilus," published in 1584, "to save a man's fingers from hurtinge,



Figs. 7 & 8 Mongolian release.

that he may be able to bear the sharpe stringe to the uttermoste of his strength." In this release, the arrow must be to the left of the bow vertical. The Eskimo of Alaska employ this release, using, however, only the first and second fingers in drawing the string, and it appears to be almost universal in the Arctic regions.

These four releases may be considered, Prof. Morse

thinks, as successive modifications of each other; but the next release is an entirely independent form, having no relation to the other.

(5) *The Mongolian Release*.—In this the string is drawn by the flexed thumb bent over the string, the end of the forefinger assisting in holding the thumb in position (Figs. 7 and 8). The arrow is held at the junction of the thumb and forefinger, the base of the finger pressing the arrow against the bow. For this reason the arrow is always placed to the right of the bow vertical. This release is characteristic of the Asiatic races, such as the Manchu, Chinese, Korean, Japanese, and Turk. The Persians also use it. The thumb is protected by a guard: the Manchus, Chinese, and others use a thick ring worn near the base of the thumb. It may be made of any hard material, such as horn, bone, ivory, quartz, agate, or jade. The Japanese archer uses a glove consisting of the thumb and two fingers.

These are the principal and most efficient forms of release, although doubtless there are others. Of the methods employed by ancient peoples, as represented in manuscripts, sculptures, &c., the Assyrians at one stage of their history appear to have used the primary form, while subsequently they used the secondary, and still later the Mediterranean release. The ancient Egyptians appear to have practised three, if not four, definite and distinct methods of release, but many of the representations in the old sculptures are evidently purely conventional, while some are clearly impossible. Following on these, Prof. Morse discusses the methods employed in ancient Greece, Persia, Japan, China, India, Mexico. Here he is naturally on less secure ground, for he has to endeavour to spell out a conclusion from various and conflicting positions of the hand in various ancient graphic representations of life amongst these peoples. The discussion involves a considerable amount of detail and numerous woodcuts by way of illustration, for which the reader must be referred to Prof. Morse's pamphlet. We must content ourselves with reproducing briefly his conclusions, which, it will be understood, are at present for the most part provisional, pending additional information and wider discussion. The persistence of a particular release in a people is well illustrated in the case of the Ainos. For centuries the Ainos have battled with the Japanese, and must have been mindful of the superior archery of their enemies; indeed, on all hands, with the exception possibly of the Kamchatdales to the north, the Ainos have been surrounded by races practising the Mongolian release, and yet have adhered to their primitive methods of shooting. The two strongest releases—both perhaps equally powerful—are the Mediterranean and Mongolian, and it is interesting to note that the two great divisions of the human family who can claim a history, and who have been dominant in the affairs of mankind, are the Mediterranean nations and the Mongolians. For several thousands of years each stock has had its peculiar arrow-release, and this has persisted through all the mutations of time to the present day. Language, manners, customs, religions, have in the course of centuries widely separated these two great divisions into nations. Side by side they have lived; devastating wars and wars of conquest have marked their contact; and yet the apparently trivial and simple act of releasing the arrow from the bow has remained unchanged. At the present moment the European and Asiatic archer, shooting now only for sport, practise each the release which characterised their remote ancestors. The following classified list shows in a general way that the primary, secondary, and tertiary releases are practised by savage races to-day, as well as by certain ancient civilised races, while the Mediterranean and Mongolian releases, though originating early in time, have always characterised the civilised and dominant races. The exceptions to this generalisation are curious: the Little Andaman Islanders practise the Mediterranean

release, and those of the Great Andamans the Tertiary; various groups of Eskimo practise the Mediterranean release, and have designed a distinct form of arrow for this method.

Primary Release.—Savage: Ainos, Demerara Indians, various North American tribes; civilised: early Assyrian, Egyptian, and Grecian (?)

Secondary Release.—Savage: some North American tribes; civilised: later Assyrian and Indian (?)

Tertiary Release.—Savage: North American tribes, Great Andamans; civilised: Siamese, Egyptian, Grecian, and Mexican (?)

Mediterranean Release.—Savage: Eskimo, Little Andamans; civilised: European nations now, and the archers of the Middle Ages, later Assyrian, early Egyptian, Arabian, Indian, and Roman.

Mongolian Release.—Manchus, Chinese, Koreans, Japanese, Turks, Persians, Scythians, Egyptians (?)

In conclusion, Prof. Morse expresses a belief that the method of using the bow may form another point in establishing or disproving relationships, in identifying the affinities of past races. Travellers and explorers should not content themselves with observing the simple fact that such and such people use bows and arrows, but they should accurately record (1) the attitude of the shaft hand; (2) whether the bow is held horizontally or vertically; (3) whether the arrow is to the right or left of the bow vertical; and (4) whether the extra arrows are carried in the bow hand or shaft hand. The method of bracing the bow is of importance also. While anxious to get information respecting the arrow-releases of tribes and peoples, he is particularly desirous of hearing about those employed by the Veddahs of Ceylon, the hill-tribes of India, African tribes, and those of South America, especially the Fuegians. Such material, in the shape of descriptions, photographs, drawings, and if possible specimens of bows and arrows, may be sent to Prof. E. S. Morse, Peabody Academy of Science, Salem, Massachusetts, and will be acknowledged and used in a future publication on the subject.

CLIMATOLOGY OF THE CROYDON DISTRICT¹

IN a little tract of thirty-six pages, which has just appeared in the *Transactions* of the Croydon Microscopical and Natural History Club, Mr. Eaton has discussed the climatology of this part of England with a skill, clearness, and fairness seldom met with in local climatologies. The observations of temperature, which were conducted on the same systematic plan with Stevenson's screens, were made at seven stations, these being, in the order of their heights, Park Hill, Addiscombe, South Norwood, West Norwood, Waddon, Wallington, and Beddington. The periods selected for discussion are the five years 1881 to 1885 inclusive. The stations are included within an area measuring 4 miles from north-east to south-west by 2½ miles from south-east to north-west. The monthly results are given on fourteen pages with satisfactory fullness; and with them are conjoined, for the sake of comparison, the corresponding records of temperature at the Greenwich and Kew Observatories.

The heights and mean temperatures of the five stations from which observations are available for the whole of the five years are these:—Beddington, 102 feet, 48°·8; Waddon, 156 feet, 49°·0; South Norwood, 190 feet, 49°·4; Addiscombe, 202 feet, 49°·3; and Park Hill, 259 feet, 49°·4, —Park Hill, the highest station, being thus 0°·6 warmer than Beddington, the lowest station. This subversion of the general rule that the temperature diminishes with greater elevation is shown to be due to the frequency with which, on clear calm nights, the air in contact with the ground is cooled and rendered denser by radiation,

¹ "Report on the Temperature and the Rainfall of the Croydon District, 1881-85," by Henry Storks Eaton.

and thereafter descends to the low-lying grounds of the valleys, displacing the warmer air below. During the unusually dry clear months of January and July 1881 the mean temperature of Park Hill exceeded that of Beddington by $3^{\circ}5$ and $2^{\circ}5$ respectively. Hence the first three of the five stations which are on sloping ground have, though at greater elevations than the other two stations below, higher mean temperatures.

This peculiarity in the distribution of the night and the winter temperature becomes the more intensified as the valley is deeper and its sides steeper, and as calms and light winds prevail. Thus at Klagenfurt, situated in one of the valleys of the Tyrol, the mean temperature of January is $20^{\circ}7$, whereas at the station of Obergipfel, about seven miles distant and 4270 feet higher, the mean for the same month is $19^{\circ}9$, being thus less than a degree lower than that of Klagenfurt. The subject is one that has seldom received the earnest attention it deserves, particularly in drawing the isothermals of the globe. The Croydon Club would make a clear addition to their observing-system if new stations were established on knolls in the valley of the Wandle for the further prosecution of this inquiry.

The means of temperature from Greenwich and Kew would have had real value in this inquiry if Mr. Eaton could have availed himself of observations made at these Observatories with thermometers exposed in the Stevenson screen. But, as pointed out, the different modes of exposing the thermometers render the results of the three systems of observing incomparable *inter se*. Thus the mean of the daily highest temperature of August for the five years is $72^{\circ}5$ for Greenwich, and $69^{\circ}5$ for Kew.

The rainfall has been far more extensively observed in the district, the returns of no fewer than seventy stations being available. Grouping the stations according to height, the annual amounts at stations below 200 feet show a mean of 23.27 inches; 200 to 400 feet, 25.39 inches; 400 to 600 feet, 29.12 inches; 600 to 800 feet, 31.66 inches; and above 800 feet, 31.36 inches. The largest amounts of rain occur not on the ridge of the North Downs, but some distance on the lee-side in regard to the prevalent rainy south-westerly winds; and the amount at like elevations seems also to diminish from west to east. As regards the monthly rainfall, the depth is greater in the upper groups; but the ratios of the monthly to the annual fall show that in spring, but more particularly in summer, there falls proportionally a larger amount of rain in the lower group of stations, whose average elevation is 193 feet. The relatively large increase in the summer rainfall over low-lying plains is one of the most striking facts in the geographical distribution of the rainfall, and is probably due to the physical causes concerned in the development of thunderstorms.

NOTES ON THE RECENT SWARMING OF APHIDES

THE immediate cause of the sudden appearance of clouds of insects in certain localities is not very apparent, but it may be surmised that the predominance or scarceness of their natural insect foes has much control over the phenomenon; added to which must be taken into account the effects of weather and temperature. A few days ago I had a notice from an obliging Birmingham correspondent, Mr. George Baker, who kindly furnished me with the following particulars:—

On October 5 the town of Mansfield, on the borders of Sherwood Forest, was visited by a cloud of Aphides, which swarmed in the town and over the country round, across an area of many miles. The town was visited "literally by millions; every one, as they walked along, waving their handkerchiefs or newspapers before their faces to avoid inhaling the insects. . . . Wet paint was covered by a mass of these black Aphides." This swarm

continued with decreasing numbers throughout five days, and heavy rain during part of this time did not seem much to affect them. On the road to Nottingham these insects were noticed as engaged in singular gyrations and undulatory dances above the tops of the spruce-firs, there forming dense pyramidal columns.

A similar cloud, but less remarkable as to numbers, was observed about the same time at Birmingham; which, however, as the town must be at least 50 miles distant, can be scarcely considered as forming a part of this same swarm. Possibly similar causes operated to produce the like phenomenon in both places.

These insects proved on examination to be *Rhopalosiphum dianthi* of Schrank, which is identical with *Aphis persica* of Morren, and *A. rapæ* of Curtis, and *A. vastator* of Smeë. It is a veritable pest in some years, doing considerable damage to turnip, mangel, and other crops, and in our gardens injuring our peach-trees. This present notice of its swarming is, however, by no means unprecedented.

In September and October 1834 Morren noted an immense swarm all over Belgium, and states his belief that it came across the sea from England. He says they obscured the light of day, and covered the walls of the houses so as partially to conceal them. Gilbert White notes that in August 1785 the people of Selborne were surprised by a swarm of "smother flies." Those that were walking in the street found themselves covered with these insects, which blackened the hedges and vegetables round. White thought these might be emigrations from the hop-gardens of Kent and Sussex, and from those near Farnham. If so, the species differs from the insects above noticed.

The choice of high objects to dance over is not confined to Aphides, e.g. many of the Tipulidæ. The singular persistent dance of *Anthomyia meteorica* over the heads of horses is familiar to all.

G. B. BUCKTON

NOTES

A MOST attractive group of birds has just been placed by Prof. Flower in the great hall of the Natural History Museum at South Kensington. The case is intended to illustrate the hybridisation of species in a state of nature, and the species selected are the hooded and carrion crows (*Corvus cornix* and *C. corone*) and the European and Asiatic goldfinches (*Carduelis elegans* and *C. orientalis*). The series of these birds has been presented to the Museum by Mr. Henry Seebohm, who procured the specimens himself during his travels in Siberia. The case of the crows is one of the few instances known of actual wild hybridisation, though many more are suspected, especially among the game birds. It is certain, however, that wherever the colonies of hooded crows meet the carrion crow throughout the Palæartic region the two species interbreed freely, and the result is shown in the young, the gray saddle-back of the hooded crow exhibiting a considerable admixture of black owing to the strain of *C. corone* in the parentage. The case of the goldfinches is not quite so completely proved, but is apparently a parallel instance of hybridisation. The British Museum has been for some time indebted to Mr. Seebohm for very valuable presents of birds, which have been mounted in the bird-galleries. Not long ago he gave a specimen of Ross's gull (*Rhodostethia rossii*), one of the rarest of the *Laridæ*, and a species which was a *desideratum* to the national collection. He presented also, last year, a fine case of Steller's sea-eagle (*Haliaeetus pelagicus*) from Kamchatka.

THE Geodetic Conference began its meetings in Berlin last week. The countries represented are Belgium, by two delegates; Denmark, by one; Germany, by fourteen, including Prof. Dr. Förster, of the Royal Observatory, Prof. Helmholtz,

Dr. W. Siemens, and Colonel Golz, of the Trigonometrical Survey: France, by two, namely, MM. Faye and Tisserand; Italy, by one; the Netherlands, by one; Norway, by one; Austria, by three; Portugal, by one; Roumania, by two; Russia, by two, including Dr. von Struve, of the Observatory at Pulkowa; Sweden, Switzerland, and Spain, each by one. England, strange to say, is not represented; nor has any one come from the United States. Prof. Dr. Förster, of Berlin, was elected President, and Dr. von Struve, of Pulkowa, Vice-President of the Conference. In his opening address, Herr von Gossler, Prussian Minister of Public Worship, indulged in some general observations as to the progress and aims of geodetic science, and, in the name of the Prussian Government, thanked the various foreign deputies for their appearance in Berlin. The chief task of the present Conference has been to settle the organisation of the central geodetic bureau, which is to have its permanent seat in Berlin, in connection with the Geodetic Institute of Prussia, founded by the late Lieut.-General von Bayer. It was at the instance of Lieut.-General Bayer that the first constituent international meeting of geodetic experts was held in Berlin in 1864, and it is by the establishment of a central international bureau here, supported by quotas from the various countries which it represents, that it is intended to preserve to Prussia the leading part she has always taken in promoting the science of earth-measuring and all its kindred branches. The permanent Committee elected includes Prof. Hirsch, of the Neuchâtel Observatory (Secretary), Professors Förster (Prussia), Sande (Holland), Faye (France), Ferrero (Italy), Ibannez (Spain), Ragel (Saxony), Oppolzer (Austria), Stepnicki (Russia), and Zachariae (Denmark). The next Conference will be held in 1887 at Nice, on the invitation of M. Bischoffsheim, owner of the great Observatory there. Before separating, the Conference passed a resolution requesting the Prussian Government to invite other States to join the International Geodetic Society.

At a recent meeting of the Common Council it was decided that it be referred to the Gresham Committee to consider whether the moneys now paid for lectures under the provisions of Sir Thomas Gresham's will might be devoted to the encouragement of students destined for commercial careers acquiring a useful knowledge of modern languages, with instructions to confer with the Mercers' Company, and to report thereon forthwith.

THE Professor of Physics of the University of Vienna, Dr. Victor Pierie, died suddenly of apoplexy in his laboratory on Friday last.

At the Potato Centenary on December 2 and 3, to which we have already referred, the following subjects for conferences have been proposed:—First day, Morning: (1) historic consideration of the question, Whence came the potato to England? (2) the Inca and their cultivation of the potato; (3) distinct wild species of the potato as at present recognised; (4) the production of varieties by cultivation. Afternoon: (5) the potato disease; (a) historic sketch, (b) our present knowledge of the disease. Second day, Morning: (1) proposed methods for preventing the disease; (2) methods for using partly diseased potatoes; (3) methods for storing and preserving potatoes. Afternoon: conference of cultivators on rates for transport of potatoes.

THE French Government has granted the funds required for the completion of the Algiers Observatory, which will be in full operation next spring. Two assistant astronomers have already been sent to join M. Trépied, and two others will be selected from among the pupils of the School of Astronomy this winter. A special Congress will be held in Paris, in the month of April,

for determining the part that the Algiers Observatory will take in stellar photography. The direct image of the sun will be 6 centimetres in diameter. A spectroscope by Thollon will be put into operation. The extent of the spectrum will be 10 metres. M. Trépied has organised the electrical transmission of the time to the Hôtel de Ville of Algiers and Tunis. Colonel Perrier, head of the French and Algerian Survey, is arranging the measurement of the requisite triangles for connecting the Algiers Observatory with the Colonne Voirol, the starting-point of the Algerio-Tunisian system of triangulation.

MR. W. A. CARTER, of the Colonial and Indian Exhibition, writes to us that during this last spring he placed a specimen of the Mexican axolotl in an empty (? dry) receptacle, where it has remained ever since. It is in a lively condition. The colour of the animal has become less intense, the gills have apparently disappeared, and the powers of locomotion seem quickened.

IT is worthy of note that at the establishment of the National Fish Culture Association many of the brook trout (*Salmo fontinalis*) hatched during February 1885 commenced to spawn last week, yielding about five hundred ova each. This fact is another proof of the extraordinary reproductive capacity of fishes in spite of age and artificial existence, for the fish in question have been maintained in a pond of limited dimensions. The size of the ova is small as compared with those of mature fish, therefore it is not likely that the trout when hatched will be large. The parents are in a healthy condition, and seem in no way weakened.

A CONSIGNMENT of nearly a thousand German carp of various kinds has arrived at the Colonial and Indian Exhibition. The great hardihood of the carp is evidenced by the fact that the fish in question were retained in carriers for sixty hours before being placed in tanks, when only two were found to have succumbed.

In a paper in the October number of the *American Journal of Science* by Mr. O. W. Huntington, "On the Crystalline Structure of Iron Meteorites," the author concludes as follows:—"We have tried in this paper to establish the following points: (1) that many of the masses of meteoric iron in our collections are cleavage crystals, broken off probably by the impact of the mass against the atmosphere; (2) that these masses show cleavages parallel to the planes of all the three fundamental forms of the isometric or regular system, namely, the octahedron, the cube, and the dodecahedron; (3) that the Widmanstätten figures and Neumann lines are sections of planes of crystalline growth parallel to the same three fundamental forms of the isometric system; (4) that on different sections of meteorites Widmanstätten figures and Neumann lines can be exhibited in every gradation, from the broadest bands to the finest markings, with no break where a natural line of division can be drawn; (5) that the features of the Widmanstätten figures are due to the eliminations of incompatible material during the process of crystallisation. This investigation throws no new light upon the origin of meteorites, except so far as it strengthens the opinion that the process of crystallisation must have been extremely slow. The occurrence of large masses of native iron occluding hydrogen gas, and containing nickel, cobalt, phosphorus, sulphur, &c., implies a combination of conditions which the spectroscope indicates as actually realised in our own sun and in other suns among the fixed stars, and the most probable theory seems to be that these masses were thrown off from such a sun, and that they very slowly cooled, while revolving in a zone of intense heat. In this paper we have not taken into consideration a number of iron masses, whose meteoric origin has been generally accepted, which show no Widmanstätten figures, and not even any Neumann lines. A considerable proportion of these are certainly not meteoric. In the Harvard cabinet there are two specimens, labelled respectively Campbell County (Tennessee), and Hominy

Creek (North Carolina), which are evidently nothing but cast-iron, and a third, labelled Tarapaca Hemalga (Chili), which is probably of similar material. We could find on the specimens of this class in the Harvard collection no distinct evidences of crystallisation; but also we could find no features incompatible with that unity of structure which it has been the chief object of this paper to illustrate."

MR. HORATIO HALE has issued in pamphlet form his address "On the Origin of Languages and the Antiquity of Speaking Man," delivered before the Anthropological Section of the American Association for the Advancement of Science at Buffalo last August. The author's views were much discussed at the time, and those interested in the subject will be thankful to have them presented in this convenient form. Rejecting all the theories hitherto advanced by Lyell, Frederick Müller, and others, he endeavours to account for the vast number of *specifically distinct* languages spoken by races *not specifically distinct* by assuming that they originated from children's prattle in independent centres after the spread of speechless man over the globe. The cases are mentioned of the Boston twins born in 1860 and of some other "Geschwister," who appear to have evolved and practised for some time infantile jargons understood only amongst themselves, which it is argued might, under favourable conditions of isolation and so forth, develop into regular forms of speech consistently worked out with their own vocabularies and grammatical structure. In this way linguistic families differing absolutely one from the other need not be of any great antiquity, and in fact may have been developed from slight germs in many places and at different times since the dispersion of the "homo alallus" from some given centre. This *homo alallus* himself is admitted to be the lineal descendant of the men of the Stone Age, who are assumed to have been speechless, so that all forms of speech now current may be of comparatively recent date, say, not more than 8000 or 10,000 years, notwithstanding their great number and profound differences. This theory, which refers human speech in the first instance to "the language-making instinct of very young children," is presented with considerable force and plausibility, but will scarcely be taken seriously either by philologists or anthropologists. The latter especially will find it difficult to accept the conclusion that man properly so called, the *homo sapiens*, as distinguished from his precursor of the Neolithic Age, does not date further back than "somewhere between 6000 and 10,000 years ago." The theory also requires us to regard this first speaking man as already fully developed, possessing "intellectual faculties of the highest order, such as none of his descendants has surpassed," thus reversing the conclusions of modern anthropology.

It is reported from Vienna that a great ice cavern has been discovered on the southern slope of the Dachstein, or Schneeberg, the very conspicuous lofty mountain in Lower Austria, which is visible from the ramparts of the capital. The general direction of the cavern runs from south to north, and it has been explored for a distance of 600 metres, a sharp precipice seemingly 14 metres deep having stopped for the time further progress. The cavern is from 5 to 6 metres broad, and very lofty, giving the impression that the ice is enormously thick. The explorers are of opinion that a subterranean lake will be found in the cavern.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus* ♀) from India, presented by Miss Edith Prowse; four Common Hedgehogs (*Erinaceus europæus*), British, presented by Mr. W. Walkinshaw; a — Buzzard (*Buteo* —) from Mogador, North Africa, presented by Mr. P. L. Forwood; a Ring-necked Parrakeet (*Palæornis torquatus* ♀) from India, presented by Mr. W. S. Bradshaw; an Aldrovandi's Skink (*Plestiodon*

auratus) from North Africa, deposited; a Rusty-spotted Cat (*Felis rubiginosa*) from Ceylon, two Diuca Finches (*Diuca grisea*) from Chili, two Wood Larks (*Alauda arborea*), British, purchased; eight Long-fronted Gerbilles (*Gerbillus longifrons*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE BINARY STAR γ CORONÆ AUSTRALIS.—Mr. H. C. Wilson, of Cincinnati Observatory, has published elements of the orbit of this interesting southern double star in the *Sidereal Messenger* for October. These elements, which do not differ much from a set recently computed by Mr. Gore (*Monthly Notices*, vol. xlv. p. 104), are as follows:—

P = 78.80 years	$\lambda = 139^{\circ}.0$
T = 1887.40	$\Omega = 41^{\circ}.0$
$e = 0.324$	$a = 1''.85$
$\gamma = 50''.5$	

Comparing observations made 1834.47 to 1883.62 with this orbit, Mr. Wilson finds that the position-angles are well represented, with the exception of those observed by Powell from 1859 to 1864, which seem to be affected by systematic error, and thinks we may conclude the period is not far from eighty years. It is to be hoped that numerous observations of this star will be obtained during the next ten years, while the distance is small and the angular motion rapid.

OPPOLZER'S ASTRONOMICAL REFRACTIONS.—Herr Oppolzer has recently published, in the *Transactions* of the Mathematical and Natural Science Section of the Imperial Academy of Sciences of Vienna, vol. liii., a paper containing a theoretical discussion of the problem of astronomical refraction, followed by numerical tables intended to facilitate the practical application of the results at which he arrives. The relation between the temperature (t) and density (ρ) of the atmosphere which Herr Oppolzer adopts is

$$\frac{\delta t}{\delta \rho} = \epsilon + \sum k \rho^{\sigma-1},$$

where k and σ are quantities depending on the state of the atmosphere and on the place of observation. Whatever may be thought of the legitimacy of a relation of this form from a theoretical point of view, it at all events has the advantage, in Herr Oppolzer's skilful hands, of leading to a comparatively simple expression for the amount of refraction, deduced from a modification of the ordinary differential equation. And that it is capable, when the approximations are carried far enough, of giving results of great accuracy for large zenith distances, is shown by a comparison made between the computed values of the refraction and the well-known observations of Argelander, which form the basis of Bessel's supplementary table given in the "Tabulæ Regiomontanæ," with the following results:—

Z.D.	Observed—Computed	Z.D.	Observed—Computed
85 0	... - 1".1	88 0	... - 2".5
86 0	... + 1".2	89 0	... + 2".3
87 0	... - 1".3	89 30	... + 1".8

COMETS FINLAY AND BARNARD.—The following ephemerides for Berlin midnight are from the *Astronomische Nachrichten*, No. 2752:—

Comet Finlay (1886 e)

1886	R.A.	Decl.	Log r	Log Δ
Nov. 8	19 25 22	24 56.8 S.	0.0751	0.0970
10	33 49	24 36.5		
12	42 24	24 14.1	0.0718	0.0932
14	51 5	23 49.5		
16	19 59 51	23 22.7 S.	0.0697	0.0899

Comet Barnard (1886 f)

1886	R.A.	Decl.	Log r	Log Δ
Nov. 7	12 7 8	8 18.5 N.	0.0735	0.2031
9	15 5	9 0.3		
11	23 31	9 44.3	0.0551	0.1772
13	32 29	10 30.7		
15	12 42 1	11 19.2 N.	0.0366	0.1507

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 NOVEMBER 7-13

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on November 7

Sun rises, 7h. 6m.; souths, 11h. 43m. 49.6s.; sets, 16h. 22m.; decl. on meridian, 16° 21' S.: Sidereal Time at Sunset, 19h. 29m.

Moon (Full on November 11) rises, 15h. 4m.; souths, 20h. 58m.; sets, 3h. 2m.*; decl. on meridian, 1° 49' S.

Table with 5 columns: Planet, Rises (h. m.), Souths (h. m.), Sets (h. m.), Decl. on meridian. Rows include Mercury, Venus, Mars, Jupiter, Saturn.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich)

Table with 5 columns: Nov., Star, Mag., Disap., Reap. and corresponding angles from vertex to right for inverted image. Lists occultations for stars like Ceti, B.A.C., Piscium, Tauri, and Aldebaran.

Saturn, Nov. 7.—Outer major axis of outer ring = 43.5; outer minor axis of outer ring = 16.8; southern surface visible.

Table with 3 columns: Nov., h., and Mercury at greatest elongation from the Sun, 22° east.

Variable Stars

Table with 5 columns: Star, R.A., Decl., h. m., and M. Lists stars like S Cassiopeiæ, U Cephei, Algol, R Aurigæ, S Cancri, U Ophiuchi, and others.

Meteor Showers

A radiant near δ Hydræ, R.A. 124°, Decl. 4° N., and one in Camelopardus, R.A. 102°, Decl. 73° N., are active in the early part of this week.

THE HIGH TEMPERATURE IN OCTOBER

THE warm weather which occurred at the commencement of the month was so exceptional for the season, and extended over so large a part of Europe, that a few facts as to its general character may be of interest...

The highest temperatures were experienced during the first five days of the month, and were chiefly confined to Western, Central, and Southern Europe.

pressure was generally high over Central Europe, and decreased towards the western or Atlantic coasts, so that the conditions of pressure were favourable to anticyclonic circulation over France and the south-east of England...

At this season of the year our warmest weather in England is commonly experienced with south-easterly winds, as is well shown in the valuable discussion of the Greenwich observations for the years 1849 to 1868...

Table with 8 columns: N, N.E., E, S.E., S, S.W., W, N.W. Rows for Monthly means and Highest hourly means.

The same discussion also shows the striking difference which exists, in October, between the temperature with a cloudless and a cloudy sky:—

Table with 4 columns: Cloudless sky, Cloudy sky, Mean, Mean max., Mean min.

The high temperatures experienced over England in October this year occurred with an exceptionally clear sky, as well as with a remarkably steady south-easterly wind...

The following table gives the maximum day temperatures at twenty stations selected from the Daily Weather Report of the Meteorological Office and from the Paris Bulletin International for the first five days of October:—

Table with 7 columns: Station, Day 1, 2, 3, 4, 5, Mean. Lists stations like British Islands, France, Germany, Belgium, Austria, Spain, Portugal, Italy.

The stations have been selected as representative of Western, Central, and Southern Europe, and the table shows well the area over which the warm weather extended.

The more northern parts of Europe did not experience any exceptional heat, the highest temperature at Copenhagen being 63°, and at Stockholm 61°.

The Greenwich observations from 1841 show that a higher temperature has only once been registered in October, viz. 81° on the 4th in 1859; but the daily mean, which was 67.1 on the 4th this year, is higher than any previously recorded.

The observations which were made in the apartments of the Royal Society from the year 1794, excepting the years 1811 to 1819, do not show so high a reading between 1794 and 1840.

on the 4th, and this is the highest ever observed in the month of October; on the 5th, 76° was registered, which corresponds with the temperature observed on October 4, 1859. The returns of the Meteorological Office show that 80° was observed on the 4th in London and at Cambridge, whilst 77° was registered at several stations in the east of England and in the Midland Counties.

It is difficult to make any satisfactory comparison with previous records, except at one or two places, but these tend to show that so high a temperature at this season does not occur more than about twice in a century. CHAS. HARDING

VOLCANOES OF JAPAN

THE last number (vol. ix. part 2) of the *Transactions* of the Seismological Society of Japan is wholly occupied by a paper of Prof. Milne's, on Japanese volcanoes, which is the longest contribution that has yet appeared in the Society's *Transactions*. The paper is partly historical and partly scientific, and contains, so far as the writer has been able to collect, references to everything that is known on the subject. Very much comes from his own observations, for he has travelled over the greater part of Japan, and has ascended many of the volcanoes. The paper also contains an epitome of some thirty or forty works in Japanese. On the whole, it is a systematic account of material which has been accumulating for the last eleven years.

The following are the more important conclusions which Prof. Milne has formulated in the paper:—

1. *Number of Volcanoes.*—As Japan has not yet been completely explored, and, moreover, as there is considerable difficulty in defining the kind of mountain to be regarded as a volcano, it is impossible to give an absolute statement as to the number of volcanoes in the country. If under the term volcano be included all mountains which have been in a state of eruption within the historical period, those which have a true volcanic form, together with those which still exhibit on their flanks matter ejected from a crater, we may conclude that there are at least 100 such mountains in the Japanese Empire. If to this list be added the ruins and basalt wrecks of volcanic cones, the number would be considerably increased. These mountains are distributed as follows:—

Northern Region..	{ Kuriles	23
	{ Yezo	28
Central Region ...	{ Northern main island	} 35
	{ Central ,,	
	{ Oshima group	
Southern Region..	{ Southern main island ...	1
	{ Kiusiu.....	} 13
	{ Southern islands }	
	Total	100

Of this number about 48 are still active, or have been so during the historical period. These active volcanoes are distributed as follows:—

Northern Region..	{ Kuriles	16	} 27
	{ Yezo	11	
Central Region.....		12	
Southern Region		9	
	Total	48	

From this it will be seen that volcanic activity in Japan decreases from the north towards the south.

2. *Number of Eruptions.*—Altogether about 232 eruptions have been recorded, and of these the greater number took place in the southern districts. This may perhaps be accounted for by the fact that Japanese civilisation advanced from the south. In consequence of this, records were made of various phenomena in the south when the northern districts were still unknown and unexplored regions. The greater number of eruptions took place in February and April. Comparing the frequency of eruptions in the different seasons, the volcanoes of Japan appear to have followed the same law as the earthquakes, a greater number having taken place during the cold months. This winter frequency of volcanic eruptions may possibly be accounted for in the same manner that Dr. Knott accounted for the winter frequency of earthquakes. During the winter months the average barometric gradient across Japan is steeper than in

summer. This, coupled with the piling up of snow in the northern regions, gives rise to long-continued stresses, in consequence of which certain portions of the earth's crust are more prepared to give way during the winter months than they are in summer.

3. *Position and Relative Age of Japanese Volcanoes.*—The youngest of the Japanese volcanoes appear to be those which exist as, or on, small islands. On the islands in the Kuriles, in the Oshima group, and in the Satsuma sea, many of the volcanoes are yet young and vigorous. Moreover, many of these islands have been formed during the historical period. The island-forming period in the Satsuma sea, for example, was about the year 1780.

The volcanoes of Japan form a long chain running from N.E. towards S.W.; but a closer examination of the distribution of the volcanic vents shows that there are probably four lines:—

(a) The N.E.—S.W. line running from Kamchatka through the Kuriles and Northern Yezo.

(b) The curved line following the backbone of the main island, and terminating on the western side of the Yezo anticlinal.

(c) The N.N.W.—S.S.E. line of the Oshima group. This line, coming from the Ladrões, passes through Oshima and Fujian parallel to and near to the line of a supposed fault. Here it intersects the main line running through the main island. Volcanic vents are here very numerous. As the main island line is intersected, while the Oshima line is the intersector, it may be argued that the Oshima-Fujian line of volcanoes are younger than many of those on the main island line.

(d) The Satsuma line, coming from the Philippines through Sakurajima and culminating in the famous Mount Aso, which is the nucleus of Kiusiu.

4. *Lithological and Chemical Character of Lavas.*—Although Prof. Milne has made an extensive collection of the volcanic rocks of Japan, the opportunity for examining them has not yet presented itself, and therefore he can only speak of them in general terms. They are at present being carefully studied by the officers of the Geological Survey. The rocks in his possession are chiefly andesites. Those containing augite, like the rocks of Fujian, closely approximate to basalts. True basalt is, however, rare. Another common rock is hornblende andesite, some of which contains free quartz. Quartz trachytes occur in the north of Japan. The following table shows the percentages of silica, and ferrous and ferric oxide, contained in the rocks of ten volcanoes:—

Locality.	SiO ₂	FeO	Fe ₂ O ₃
1. Norokura	61.72	1.35	3.50
2. Misake	59.97	3.27	3.86
3. Kusatsu	61.49	3.30	4.35
4. Amagi (Hakone)	65.34	2.45	3.09
5. Komagadake.....	56.27	2.19	6.69
6. Moriyoshi	59.17	2.65	4.15
7. Chokai	{ 60.64	{ 3.81	{ 3.14
	{ 54.55	{ 5.19	{ 4.42
8. Hakone (Tonosawa).....	48.97	4.02	4.81
9. Fujisan	49.00	5.1	6.06
10. Oshima	52.00	13.70(?)	

One feature exhibited by the table is that the rocks of Oshima, Fujian, and Tonosawa are basic, while those like Chokaisan and Moriyoshiyama belonging to the line of volcanoes of the main island, are relatively acidic. More extended observations of this description may show that different lines of volcanoes have thrown out different lavas, or that the lavas of different constitution are of different ages.

5. *Magnetic Character of Rocks.*—In a study of the soils in the neighbourhood of Tokio, Mr. E. Kinch refers specially to the magnetite they contain. A great portion of this comes from the disintegration of volcanic rocks. Many of the Japanese lavas have a distinct effect upon a compass needle, and many of the black lavas from the crater of Fujian will easily turn the needle of an ordinary compass through 360°. Many of the pieces of lava are not only magnetic but polar. Dr. Naumann found a block of augite trachyte on the top of Moriyoshiyama which would deflect the needle of a compass through 155°. The most curious observation made by this investigator was that the magnetic declination near Gaujusan has during the last eighty years (when it was about 14° 30' E.) decreased 19°, being now about 5° W. As we recede from this mountain the amount of

change is less. Assuming this result to be correct, it would seem justifiable to look to Gaujusan as connected with these local changes. Some of the volcanoes in the Kuriles are said to exert a marked influence upon the compasses of ships. When a vessel is lying near certain mountains, as, for instance, in Bear Bay at the north end of Iturup, a distant mountain will have a very different bearing to that which is indicated by the same compass when the vessel is a short distance outside Bear Bay. In both cases the ship may be lying in the same direction, and the direction of observation is practically along the same line. This leads Prof. Milne to urge, as he has already done, that a magnetic observatory should be placed on or near one of the nine active volcanoes of Japan. Changes in volcanic activity are probably accompanied by local changes in the magnetic effects produced by subterranean volcanic magmas. These changes may be due to alterations in position, alterations in chemical constitution, and changes due to the acquisition or loss of heat. If such is the case, he argues, the records of a magnetic observatory would lead up to a knowledge of the changes taking place beneath the ground. When it is remembered that volcanoes like Oshima (Vries Island), where it seems probable that there may be local and rapid changes in magnetic variation taking place, lie in the track of so many vessels, the proposed investigation has a practical as well as a scientific aspect. An investigation of earth-currents at and near volcanoes might be added to the magnetic investigations.

6. *Intensity of Eruptions.*—It appears from the accounts of eruptions which are given in the paper that the intensity of volcanic action in Japan has been as great as in any other part of the world. One period of unusual activity was between the years 1780 and 1800, a time when there was great activity elsewhere in the globe. It was during this period that part of Mount Unsen was blown up, and from 27,000 to 53,000 persons (according to different accounts) perished, that many islands were formed in the Satsuma sea, that Sakurajima threw out so much pumice material that it was possible to walk a distance of 23 miles upon the floating *débris* in the sea, and that Asama ejected so many blocks of stone—one of which is said to have been 42 feet in diameter—and a lava-stream 68 kilometres in length.

7. *The Form of Volcanoes.*—The regular so-called conical form is very noticeable in many of the Japanese mountains, especially perhaps in those of recent origin. Outlines of these volcanoes, as exhibited either by sketches or photographs, show curvatures which are similar to each other. From a collection of photographs Prof. Milne traced the profiles of a number of important mountains in Japan. These are reproduced in the paper (see Fig. 1). From an examination of these figures he found that the

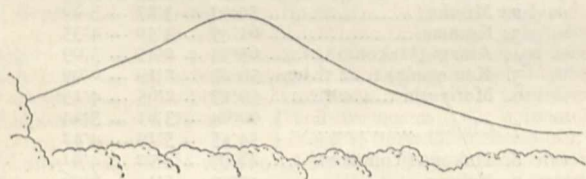


FIG. 1.—Outline of Fujiyama, from a photograph. This may be taken as typical of many Japanese volcanoes.

curvature of a typical volcano was logarithmic, or, in other words, the form of such a mountain was such as might be produced by the revolution of a logarithmic curve round its asymptote. In his original paper on the subject he said that the form agreed with that which would be produced by the piling up of loose material. He ought to have said it was the form assumed by a self-supporting mass of coherent material. Mr. George F. Becker (*American Journal of Science*, October 1885) continues these observations by an analytical investigation of the conditions of such equilibrium. If the height of a column is a , its radius y , the distance of any horizontal plane from the base x , the specific gravity of the material ρ , and the co-efficient of resistance to crushing at the elastic limit k , then the equation of the curve, which by its revolution about the x axis will generate the finite unloaded column of the "least variable resistance" is—

$$\frac{y}{c} = \frac{e^{-\frac{x}{c}} - e^{-\frac{a}{c}}}{2}$$

where

$$c = \frac{2k}{\rho}$$

This latter quantity is of course different for different materials. It can be expressed in terms of x and y —

$$\frac{2k}{\rho} = \frac{y}{(\tan^2 d - 1)^{-\frac{1}{2}}}$$

d being the angle which the tangent at any point makes with the x axis. The value of c can be obtained from photographs or drawings of a mountain, while ρ may be obtained from pendulum experiments or from specimens of volcanic material. With these data we can determine the modulus of resistance at the elastic limit of the materials which compose a mountain on a large scale for many constituents of the earth's crust. Mr. Becker concludes his observations by remarking that a study of the form and dimensions of lunar volcanoes would lead to values of $\frac{k}{\rho}$, from

whence we might approximately determine whether the lunar lava is similar to that of terrestrial origin. In the table which follows, Prof. Milne has followed out Mr. Becker's suggestion, and calculated the modulus of resistance to crushing at the elastic limit in pounds per square foot for a number of Japanese mountains. The different values for $\frac{2k}{\rho}$ for the same mountain

is in great measure due to the absence of an accurate scale for the various photographs which had to be investigated. Another difficulty was obtaining a value for r , or the density of the mountain. Prof. Mendenhall, who made a number of experiments with pendulums on the summit of Fujisan, says the rocks of that mountain have a density of 1.75. This is when they have air in their pores. As powder the density becomes 2.5. Wada gives the specific gravity of the rock on Fujisan as 2.6.

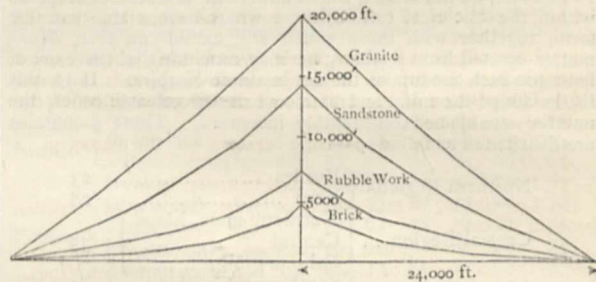


FIG. 2.—Theoretical Mountains.

Assuming the density of the earth at 5.67, then the density of Fujisan, as determined by Prof. Mendenhall's experiments, is 2.08. In the following table the density of the materials of all the mountains mentioned is taken at 2.5.

	Height in feet	$\frac{2k}{\rho}$	$\frac{k}{\rho}$	Load in lbs. per square foot	
Fujisan	12,441	4200	...	...	Photograph
	...	5000	...	...	"
	...	4240	...	...	"
	...	3500	...	...	"
	...	{ 5420 }	...	...	"
	...	{ 5450 }	...	...	"
	...	5440	...	...	"
	...	{ 3945 }	...	...	"
	...	{ 4133 }	...	...	"
	...	4430	...	...	Surveyed section
	...	3640	...	...	" "
Average for					
Fujisan	...	4490	2245	350,220	" "
Iwakisan	5260	2360	1180	174,080	Photograph
Nantaisan	3800 ¹	2000	1000	156,000	"
Alaid	7773	{ 2195 }	1078	163,168	"
		{ 2120 }			
Krakatão	2745	1310	655	102,180	Surveyed section
	...	1310			

Comparing the results given in the above table with the numbers given in the next section, which are based on experi-

¹ This is the height above Lake Chuzenji.

ments referred to in Rankine's "Civil Engineering," it may be said that the average strength of Fujisan lies between that of rubble work and sandstone; Iwakisan, Nantaisan, and Alaid are like good rubble masonry, while the strength of the ill-fated Krakatão is not much above that of ordinary brickwork.

8. *Theoretical Mountains.*—As it might be interesting to compare actual mountains with theoretical mountains constructed from the equation—

$$y = \frac{c}{2} \left(\frac{n}{e^x} - e^{-\frac{n}{c}} \right)$$

such mountains have been drawn, and are shown in Fig. 2. The values of c are given in the following table.

In drawing up the table the instantaneous breaking strength of granite and its crumbling strength, which is the largest possible value for k , are taken as being equal. For sandstone the crumbling strength is assumed to be three-fourths of the breaking strength, while for rubble work and brickwork it has been taken as one-half.

Material	Instantaneous breaking strength in lbs. square feet	Crumbling strength or k in lbs.	Weight cubic foot lbs.	$c = \frac{2k}{\rho}$
Granite	1,584,000	1,580,000	170	18,500
Sandstone.....	790,000	590,000	144	8,200
Rubble masonry ...	316,000	150,000	120	2,500
Brickwork	144,000	72,000	112	1,300

The diameter of the base of each of these mountains is 48,000 feet, and the height to which mountains of the following different materials could be built upon such a base without crushing would approximately be:—

Brickwork	4,600 feet	Sandstone.....	14,500 feet
Rubble masonry ..	7,300 "	Granite	20,000 "

9. *Causes Modifying Volcanic Forms.*—Causes modifying the natural curvature of a mountain are:—

- (1) The tendency during the building up of the mountain of the larger particles to roll farther down the mountain than the smaller particles.
- (2) The effects of atmospheric denudation, which carries materials from the top of the mountain down towards the base.
- (3) The position of the crater, and the direction in which the materials are ejected.
- (4) The existence of parasitic craters on the flanks of a mountain.
- (5) The direction of the wind during an eruption.
- (6) The sinking of a mountain in consequence of evisceration beneath its base.

(7) The expansions and contractions at the base of a mountain due to the acquisition or loss of heat before and after eruptions.

10. *Effect of Volcanic Eruptions on the People.*—The eruptions in Japan from time to time have exerted a very marked influence upon the minds of the Japanese people. Divine interference has been sought to prevent eruptions, priests have been ordered to pray, taxes have been repealed, charities have been instituted, special prayers against volcanic disturbances have been formulated, and have remained in use for the period of 100 years, while special days for the annual offering up of these prayers have been appointed. At the present day a form of worship to mountain deities is not uncommon.

SOLUTION¹

Opening of the Discussion by Prof. Tilden

FOR want of time, the consideration of various phenomena connected with the subject was necessarily omitted. Thus no reference could be made to the various formulæ relating to expansion or density of solutions, nor to their optical properties, magnetic rotation, nor to the subject of electrolysis. In what follows, a review is presented of the principal phenomena observed in the act of solution of solids (especially metallic salts and other comparatively simple compounds) in liquids, and the chief properties of the resulting solutions, with the object of arriving (if possible) at some conclusion as to the physical explanation of the facts. The question must at once arise whether these phenomena are to be considered as chemical or mechanical, and all the theories which have been put forward to explain the nature of solution are roughly divisible into two classes, according as, on the one hand, they represent the process as a kind of chemical combination, or, on the other, explain the

phenomena by reference to the mechanical intermixture of molecules, or by the influence of the rival attractions of cohesion in the solid and liquid, and of adhesion of the solid to the liquid. The former hypothesis seems to have been universally adopted by the older writers, such as Henry and Turner, and it seems pretty clear that Berthelot also regarded solution as an act of chemical combination. Among modern chemists, Prof. Josiah P. Cooke takes a similar view, but M. Berthelot is the most consistent and powerful supporter of the same hypothesis. In his "Mécannique Chimique," tome ii. p. 160, will be found a very clear and formal statement of the views upon this subject which, it is interesting to know, are retained by M. Berthelot without modification in any essential particular.

On the other hand, there are a number of writers who, whilst referring the phenomena of solution to a molecular attraction of some kind, do not attribute solubility to the formation of chemical compounds of definite composition. Graham distinctly ranges himself on this side. Brande also appears to have taken a similar view; Daniell, Miller, Nicol, and Dossios may be more or less ranked with them. A theory differing in some important respects from those of the above writers was briefly enunciated in a paper communicated to the Royal Society by Tilden and Shenstone in 1883. In discussing the connection between fusibility and solubility of salts, the authors point out that the facts tend to "support a kinetic theory of solution, based on the mechanical theory of heat. The solution of a solid in a liquid would accordingly be analogous to the sublimation of a solid into a gas, and proceeds from the intermixture of molecules detached from the solid with those of the surrounding liquid. Such a process is promoted by rise of temperature, partly because the molecules of the still solid substance make longer excursions from their normal centre when heated, partly because they are subjected to more violent encounter with the moving molecules of liquid." This theory, however, only relates to the initial stage of the process of solution, and does not sufficiently explain saturation nor the influence of dissolved substances upon vapour-pressure, specific heat, specific volume, &c. How far is it true that evolution of heat indicates chemical combination: does the evolution of heat which often takes place on dissolving a solid in water, or on adding more water to its solution, indicate the formation of hydrates, *i.e.* compounds of the dissolved body with water in definite proportions? Thomsen answers this question in the negative ("Thermochemische Untersuch.," Band iii. p. 20).

Take the case of sulphuric anhydride (SO₃). It is evident from the diagram exhibited that more than half the total evolution of heat occurs on addition of the first molecule of water to the solid substance; yet the succeeding molecules give quite an appreciable thermal change. At what point in such a curve should we be justified in setting up a distinction between the effect due to chemical combination and that due to other causes, such as the change of volume consequent on dilution or the possible loss of energy from the adjustment of the motion of the molecules of the constituents to the conditions requisite for the formation of a homogeneous liquid, or (though not in the present case) the decomposition of the compound by the water? In the act of solution of the solids, and especially of anhydrous salts in water, the volume of the solution is always less than the sum of the volumes of the solid and its solvent, with the exception of some ammonium salts in which expansion occurs. Similarly the addition of water to a solution is followed by contraction. This contraction may be due to mere mechanical fitting of the molecules of the one liquid into the interspaces between the molecules of the other (see Mendelejeff's abstract in *Journ. Chem. Soc.*, Feb. 1885, p. 114). This would probably not be attended by loss of energy. Or the contraction may arise from the readjustment of molecular motion already referred to.

If we know the coefficient of expansion of the liquid and its specific heat, we can calculate the amount of heat evolved for a given contraction. If this is done for sulphuric acid, and many other cases, it is found that, after accounting for the thermal change due to alteration of volume alone, there is a surplus of heat evolved which may really indicate some kind or some amount of chemical combination.

Thomsen has found that as a rule the heat of solution and of dilution are both either positive or negative. Of thirty-five salts examined, only four supply well-marked exceptions. However we may ultimately explain the anomaly exhibited by these salts, the fact remains that the heat evolved or absorbed during the admixture of any substance with water is in every case a continuous function of the quantity of water added. Similarly

¹ Report of a discussion at the Birmingham meeting of the British Association.

the contraction which ensues on diluting an aqueous solution proceeds continuously, and the molecular volume of a salt in solutions of different strengths is continuously greater the larger the amount of salt present. So that in none of these thermal or volumetric phenomena is any discontinuity observed, or any indication of the formation of compounds of definite composition, distinguishable by characteristic properties.

The question we are now considering, as to whether in a solution the solvent and the substance dissolved in it—or any portion thereof—exist independently of each other, is in some degree answered by the facts known as to the specific heats and vapour-pressures. For instance, when water is added to a solution of sodium nitrate, the molecular heat of the resulting liquid seems to show that all the water added is influenced at least until a very large quantity is present. In this case one molecule of sodium nitrate can affect the movements of a hundred molecules of water, and probably more. It is also well known that the vapour-pressures of water holding in solution almost any dissolved solid is less than the vapour-pressure of pure water, and that the boiling-point of a liquid is raised by the addition to it of any soluble non-volatile substance. This fact of reduction of pressure can only be explained upon the hypothesis that there is no free water present at all; that is, that there is no water present which is not more or less under the influence of the dissolved substance.

What becomes of water of crystallisation forms a part of the same question as to the relation of solvent to solvent. Observed facts lead us to conclude that white copper sulphate, blue anhydrous cobalt chloride—and, by analogy, other salts which are colourless—retain their hold upon water of crystallisation when they are dissolved in water. A very important observation has been made by Dr. Nicol which bears directly upon this question. In his study of the molecular volumes of salt solutions he finds that, when a salt containing water of crystallisation is dissolved, this water is indistinguishable by its volume from the rest of the water of the solution. In the report presented to the British Association last year, the following passage occurs: "These results point to the presence in solution of what may be termed the anhydrous salt in contradistinction to the view that a hydrate, definite or indefinite results from solution; or in other words, no part of the water in a solution is in a position relatively to the salt different from the remainder."

These two statements, however, are not strictly consequent upon each other. The view seems preferable that (save, perhaps, in excessively dilute solutions) the dissolved substance is attached in some mysterious way—it matters not whether it be supposed to be chemical or physical—to the whole of the water. We cannot otherwise get over the difficulty presented by the hydrated salts, which give coloured solutions, by the control of the vapour-pressure of the dissolved salt, and by the altered specific heat. With regard to water of crystallisation, E. Wiedemann has shown that hydrated salts in general expand enormously at the melting-point; and the observations of Thorpe and Watts on the specific volume of water of crystallisation in the sulphates of the so-called magnesium group show that, whilst the constitutional water occupies less space than the remaining molecules, each successive additional molecule occupies a gradually increasing volume. So that when a salt, with its water of crystallisation, passes into the liquid state (either by melting or by solution in water), it requires a very slight relaxation of the bonds which hold the water to the salt for it to acquire the full volume of liquid water, whilst the water of constitution is not so easily released. And this conclusion accords with Nicol's observations on the molecular volumes of the salts when in solution.

Now comes the question as to what determines the solubility of a substance. Why, for example, is magnesium sulphate very soluble in water, whilst barium sulphate is almost totally insoluble? With regard to salts the following propositions seem to be true:—(1) Nearly all salts which contain water of crystallisation are soluble in water, and for the most part are easily soluble; (2) insoluble salts are almost always destitute of water of crystallisation and rarely contain the elements of water; (3) in a series of salts containing nearly allied metals the solubility, and capacity for uniting with water of crystallisation generally, diminish as the atomic weight increases.

The fusibility of a substance has also much to do with its solubility. Neither fusibility alone nor chemical constitution alone seems to be sufficient to determine whether a solid shall be soluble or not. But it may be taken as a rule to which there

are no exceptions that when there is a close connection in chemical constitution between a liquid and a solid, and the solid is at the same time easily fusible, it will also be easily soluble in that liquid.

Salts containing water of crystallisation may be considered as closely resembling water itself, and these are for the most part both easily fusible and easily soluble in water. But space is wanting for the discussion of the details of these matters, as well as of the relation of molecular volume to fusibility of solids.

The fascinating character of the phenomena of supersaturation has attracted a host of experimenters, but no definite explanation has been generally accepted. In the opinion of the speaker supersaturation is identical with superfusion. Supersaturated solution of, say, alum, thiosulphate of sodium melted in its water of crystallisation, and fused sulphur at 100°, exhibit phenomena of exactly the same kind.

Finally, we are led to the consideration of what is meant by chemical combination. From the phenomena under discussion, and others, the conclusion seems inevitable that chemical combination is not to be distinguished by any absolute criterion from mere physical or mechanical aggregation; and it will probably turn out ultimately that chemical combination differs from mechanical combination, called cohesion or adhesion, chiefly in the fact that the atoms or molecules of the bodies concerned come relatively closer together, and the consequent loss of energy is greater.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—Of the students in Natural Science entered at Cambridge this term no fewer than 116 have already announced their intention of studying medicine.

DUBLIN.—The Senate of the Royal University has conferred the degree of Doctor of Science *honoris causa* upon James Bell, Ph.D., F.R.S., Principal of the Somerset House Laboratory.

SCIENTIFIC SERIALS

Revue d'Anthropologie, troisième série, tome 1, Paris, 1886.—On the Simian characters of the Naulette jaw, by M. Topinard. This celebrated find, which was discovered at the bottom of an obscure cavern 25 m. below the present level of the Lesse, near Dinant, in Belgium, is chiefly remarkable for its excessive prognathism, which is due alike to the great thickness of the horizontal branch of the jaw when compared with its height, and to the special obliquity of the axis of the alveolus of the second molar. In its relative proportions the Naulette jaw must be characterised not only as non-human, but as plus-Simian. A careful comparison of the Naulette jaw with the maxillary processes of the anthropoids, and of several of the lowest extant human races, has led M. Topinard to the conclusion that in the age of the mammoth, tichorine rhinoceros, and cave-bear, there had already appeared numerous mixed human types, to one of the lowest of which it may be presumed that the Naulette jaw belonged.—On the population of Bambouk, on the Niger, by Dr. Colin. An interesting paper on an extensive, but very imperfectly-known, region of Western Soudan, exclusively inhabited by a branch of the great Manding race, known as the Mali-nkés. The Bambouk territories, more than 600 kilometres in length, and from 80 to 150 in width, are divided into numerous little States, most of which enjoy a complete autonomy. Their want of consolidation, and the indifference of the people to all forms of religion, have made the Mali-nkés objects of contempt to their Mussulman black neighbours, but according to the narrations of the Griotes, or itinerant bards, who are to be met with in every part of Western Africa, they had at one time extended their dominion over all the tribes on the right banks of the Niger, and were preparing to invade Saigon when the advance of the French forced them to fall back within their original limits. For a time they submitted to the restrictions of Mohammedanism, but now they appear to have absolutely no religion. They prepare an intoxicating drink from honey, called "dolo," in which women as well as men indulge to excess. The men are indolent, hunting only to avert starvation, and working their exten-

sive gold-mines imperfectly, and chiefly by the help of the women, to whom falls the chief share of providing for the wants of the community, but who, after marriage, enjoy great freedom, although the young girls are kept under strict supervision.—On the human bones found in France in caverns belonging to the Quaternary age, by M. Cartailhac. Of such finds, none can be referred to the early period of the Saint Acheul, or Chelles deposits, the oldest belonging apparently to the Mousterian age, while the most abundant human remains are found in the comparatively recent beds of Solutré and La Madelaine. The former of these are remarkable for the enormous number of horse-bones accumulated about the stone hearths and in the kitchen-middens of this station. According to Dr. Cartailhac, 40,000 skeletons might be reconstructed from these equine remains, which seem to have been exposed to the action of fire, the greater number of the bones having been broken for the extraction of the marrow, whence he assumes that the horse must have reached its maximum development and served in the place of all other game at the period of the Solutré deposits. The writer compares together the human and other remains found in various Mediterranean and inland caves, with the special object of ascertaining how far the condition and mode of deposition of the skeletons can throw light on the vexed question whether the great preponderance of fractured over whole bones in these primæval graves indicates the practice of cannibalism, or whether it may not be dependent on the observance of special modes of burial, involving the burning or dismemberment of the body after death.—The facial angle proposed by Cuvier and Geoffroy Saint-Hilaire for comparative anatomical determinations and for measuring facial differences in the living subject, by Dr. Collignon. The writer, who considers at length the merits of the various angles proposed by Camper and others, concludes by showing the superiority, for practical purposes, of adopting Cuvier's facial angle, measured by Topinard's goniometer for determining the median angle.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, October 26.—M. Jurién de la Gravière, President, in the chair.—On the unequal flow of gases, by M. Haton de la Goupillière. In continuation of his recent communication on this subject the author here deals with the reverse problem of a receptacle originally filled with compressed air discharging itself freely into the atmosphere.—On the intensity of the magnetic field in dynamo-electric machines, by Marcel Deprez. Assuming that the most important element of a dynamo-electric machine, whether employed as a generator or receiver, is the magnetic field, the author deals with the influence of the deviation of the magnetic pieces, and shows that, contrary to the opinion of certain electricians, the intensity of the field decreases far less rapidly than the distance of the magnetic pieces increases. The influence of the dimensions perpendicular to the lines of force is also considered.—Researches on the decomposition of the bicarbonate of ammonia by water, and on the diffusion of its components through the atmosphere, by MM. Berthelot and André. From the experiments here described, the authors are led to the conclusion that it is the diffusion of the carbonic acid that determines the decomposition by water of the bicarbonate of ammonia, and consequently the transport of the ammonia itself. These results are of the greatest importance even for the purely physical study of the circulation of gases between the ground, the waters, and atmospheric air, apart altogether from the phenomena of vegetation.—Note accompanying the presentation of his work entitled "An Introduction to the Study of the Human Races," by M. de Quatrefages. This is the first volume of the "Bibliothèque d'Ethnologie," edited jointly by the author and M. Hamy. It contains a summary of the views expounded in greater or less detail in his other writings, while dealing more fully with a number of other matters, which he had hitherto merely indicated, or else entirely neglected for lack of the fresh data and discoveries which now enable him to discuss them seriously. One of the most important is the question of prehistoric man, and he now shows that even in Quaternary times the human race had already spread over the whole earth to the remotest extremities of the Old and New World. This ubiquity of Quaternary man already suggested the existence of the species in the previous epoch, and direct proofs of

this fact have recently been multiplied to such an extent that the presence of man in Europe during Tertiary times may now be regarded as placed beyond reasonable doubt, although his presence in America is not yet established. The results yielded by palæontology, geology, and even history point to the extreme north of Asia as the cradle of the human race and the centre of dispersion, which had already begun in Tertiary times. Here also were differentiated the three fundamental types, to which all races may still be reduced, as well as the three linguistic types diffused throughout the globe. It is further shown that hypsistenocephaly is the main feature distinguishing the American from the European primitive race, and that the man of Canstadt, hitherto regarded as the oldest Quaternary type, in reality dates back to the Tertiary epoch.—Note on the meteorite which fell on January 27, 1886, at Nammiantheu, in the Presidency of Madras, by M. Daubrée. This meteorite, a specimen of which has been received from Mr. Medlicott, of the Indian Geological Survey, presents the ordinary characters of the group of small sporadic asters.—Experiments on the transmission of force by means of a series of dynamo-electric machines coupled together, by M. Hippolyte Fontaine. These important experiments (carried out with seven Gramme machines, under the inspection of the Commissioners, MM. Bertrand, Becquerel, Cornu, Maurice Lévy, Marcel Deprez, and Mascart) show that it is possible to transmit an effective force of fifty horse-power through a resistance of 100 ohms at a loss of less than 50 per cent.—On algebraic surfaces capable of a double infinity of birational transformations, by M. E. Picard. In supplement to his previous communication on algebraic surfaces, the author here shows that, for all surfaces capable of a double infinity of birational transformation, the co-ordinates of any given point are expressed by the uniform (Abelian) functions of two parameters.—On the transformation of surfaces in themselves, by M. H. Poincaré. It is shown in connection with M. Picard's theorem that, in certain cases, the Abelian functions may degenerate into triply periodical, elliptical, or even rational functions.—Extension of Riemann-Roch's theorem to algebraic surfaces, by MM. Noether.—On the recomposition of white light by means of the colours of the spectrum, by M. Stroumbo. A process is described by means of which the recomposition of white light is effected, taking as the starting-point the very colours of the spectrum, and utilising, as in Newton's experiment with the disk, the persistence of the images on the retina.—Note on the principal showers of shooting-stars and the aurora borealis, by M. Ch. V. Zenger. A careful study of M. Rubenson's great Catalogue of the Auroras from 1800 to 1877 has unexpectedly revealed the fact that August 10 and November 14 show a great frequency of these lights, thus coinciding with the periods of the shooting-stars and suggesting a connection between these two orders of phenomena.—Influence of the amplitude of the lunar oscillation in declination on the shiftings of the northern trade-winds, by M. A. Poincaré. A study of the tables for 1880-83 shows certain relations between these phenomena, which, however, differ greatly according to the seasons.—On the phenomena associated with the heating and cooling of molten steel, by M. Osmond. It is shown that, as the quantity of carbon is increased, the temperature of transformation of the iron is lowered, and that of recalcence raised, so that both coincide in the hard steel.—Saturation of normal arsenic acid by the water of baryta, by Ch. Blarez.—On the function of the semicircular canals of the inner ear, by M. Yves Delage. The chief function of this apparatus, as already recognised by Goltz, Flourens, and others, is shown to be distinct from that of the auditory sense, and connected rather with the rotatory movements of the head, either alone or with the body.—On Syndesmis, a new type of Turbellariæ described by W. A. Sillimann, by M. Ph. François. This organism is shown to be, not an ectoparasite of the large green nematoid, as supposed by Sillimann, but a true endoparasite of *Strg. lividus*.—On two Synascidians new to the French sea-board (*Diazona hebridica*, Forbes and Goodsir, and *Distaplia rosea*, Della Valle), by M. A. Giard.—Organisation of *Lepidomenia hystrix*, a new type of Sôlenogaster, by MM. Marion and Kowalevsky.—On the Gêphyrians belonging to the family of the Priapulidæ collected by the Cape Horn Mission, by M. Jules de Guerne. The discovery of these organisms is a remarkable instance of the presence in the southern seas of forms almost identical with those of the Arctic Ocean.—The simple epidermis of plants considered as a reservoir of water, by M. J. Vesque.—Remarks on *Poroxylon stephanense*, by MM. C. Eg. Bertrand and R. Renault.—On

the taxonomic importance of the petiole, by M. Louis Petit.—On the reproductive organs of vegetable hybrids, by M. Léon Guignard.—On the relations of geodesy and geology: a reply to the observations of M. Faye, by M. A. de Lapparent.

BERLIN

Meteorological Society, October 5.—Dr. Brix, in the name of the Telegraph Administration, handed over to the Society a paper containing the results of observations respecting earth-currents instituted through the medium of German telegraph lines, and giving a brief history of these investigations.—Dr. Assmann spoke of the thunderstorms of the summer of 1886.

Physical Society, October 22.—Prof. von Helmholtz in the chair.—Prof. Börnstein communicated the results of his investigations into the thunderstorms of July 1884. The days from July 13 to 17 were very prolific in thunderstorms, and respecting them the speaker had collected and elaborated observations from more than 200 stations in Germany. For twenty-four separate thunderstorms, drawings were made of the "isobronts," isobars, and isothermals, from which it appeared that a fall in the barometer always preceded the outburst of the storm; that with the occurrence of the sinking of the barometer the atmospheric pressure rose very steeply and then relapsed gradually to its former level; and that the temperature, which was very high before the storm, declined rapidly with the outbreak of the storm. Local observations had formerly led to the same result. The "isobronts," or the lines uniting the places where the first peal of thunder was simultaneously heard, had in general a north-south direction. The "isobronts" made the passage from west to east with an average swiftness of from 38 to 39 kilometres an hour. The "isobronts" were attracted by the mountains, so that the part in whose west-east direction a mountain was situated approached it sooner, and, after the passage of the "isobront," delayed there longer than did the remaining part. Rivers retarded the progress of thunderstorms, and small thunderstorms often terminated at large rivers without crossing them. This relation of thunderstorms to mountains and rivers might be explained on the assumption that the storms were caused by ascending air-currents. When such an ascending air-current approached a mountain, then the mountain hindered the horizontal air from flowing in at the anterior side of the ascending current. The air flowing in at the posterior side, on the other hand, thereby obtained the preponderance, and urged the phenomenon with all the greater force to the mountain. The reverse occurred after the thunderstorm had surmounted the mountain. The horizontal currents in front then obtained the preponderance, and delayed the progress of the storm. The influence of the rivers found its explanation in the fact that the air above the water was considerably cooler than the air above the land, whereby a descending air-current was continuously maintained, operating in opposition to the ascending current of the thunderstorm, to the possible degree even of annulling it. The speaker had been able artificially to produce an imitation of all these processes by causing, in accordance with the directions of Dr. Vettin, visible currents to ascend in a glass box filled with tobacco smoke, by means of local depressions of temperature, by setting these currents in constant motion, and making them strike against obstructions (corresponding with the mountains), as also on descending currents which were likewise artificially created. In the discussion which followed the above address, Dr. Vettin laid stress on the fact that precisely at the moment when the barometer mounted steeply from its lowest position, the thunder followed the lightning most rapidly, and discussed how, in accordance with his conception of the nature of thunderstorms, by the curving round of the ascending air-current, a whirling movement round a horizontal axis came into shape, whereby, as determined by its situation and its extent, were produced thunderstorms, sleet, and hail.—Prof. von Helmholtz described the formation of a thunderstorm observed by him in Rigi-Kaltbad. From a free point of prospect, allowing a survey of the plain as far as the Jura, he observed how the lower warm and moist layer of air was distinguished by a sharp horizontal boundary of somewhat long strips of cloud from the upper dry and cooler air. The cloud-masses resembling the stripe-shaped cirri diffused themselves and formed a coherent level boundary-layer between the two air-masses. He next noticed, at different spots, balls of cloud arise above the boundary-layer, evidently as the effects of ascending air-currents. The different cloud-heaps then rose higher and grew into larger cloud-masses

within which different electric sparks leapt from one spot to another. It was only subsequently that he saw the lightning fly downward to the earth. At last a heavy rain rendered the lower air-mass, bounded by the horizontal cloud-basis occupying a position nearly at a level with the height of the stand-point, which had hitherto been clear, opaque. The phenomenon had developed itself under weather in which the wind was at rest, and could be followed very precisely into its details.—Prof. Schwalbe reported on an investigation of Herr Meissner, who, in the Strasburg Laboratory, had determined the warmth effect on the wetting of powdery bodies. In the way of powder were used amorphous silicic acid, glass, emery, carbon; as fluids, distilled water, benzol, and amyl alcohol. In all cases an increase of temperature was observed.

BOOKS AND PAMPHLETS RECEIVED

La France en Indo-Chine: Bouinain and Paulus (Challamel, Paris).—Zeitschrift für Wissenschaftliche Zoologie, October 1886 (Engelmann, Leipzig).—Huddersfield Technical School Calendar for 1886-87 (Broadbent, Huddersfield).—Student's Hand-Book of Historical Geology: A. J. Jukes-Browne (Bell and Sons).—Units and Physical Constants, 2nd edition: J. D. Everett (Macmillan and Co.).—Principles and Practice of Canal and River Engineering, 3rd edition: D. Stevenson (Black, Edinburgh).—Monthly Weather Report, June 1886.—Quarterly Weather Report, January to March 1886.—Report of the United States Commission of Fish and Fisheries, Part 11, for 1883 (Washington).—Phantasms of the Living, 2 vols.: Gurney, Myers, and Podmore (Tribner and Co.).—Den Norske Nordhøus Expedition, 1876-78. XV. Zoologi: Crustacea, II: G. O. Sars (Grøndahl, Christiania).—Bulletin of the U.S. National Museum, No. 30: J. B. Marcou (Washington).—Proceedings of the Society for Psychical Research, October (Trübner and Co.).—Scientific Prevention of Consumption: G. W. Hambleton (Churchill).

CONTENTS

PAGE

Explosions in Coal-Mines. By Prof. T. E. Thorpe, F.R.S.	1
McLennan's "Studies in Ancient History." By Dr. W. Robertson Smith	3
British Hymenomyces	4
The Ocean	6
Letters to the Editor:—	
On the Connection between Chemical Constitution and Physiological Action.—Dr. James Blake	6
Disinfection by Heat.—R. Strachan	7
The Beetle in Motion.—Prof. C. Lloyd Morgan. (Illustrated)	7
The Astronomical Theory of the Great Ice Age.—W. H. S. Monck	7
The Enormous Loss from Ox-Warble.—John Walker	7
Aurora.—Prof. F. Hahn	8
Earthquakes.—Dr. F. A. Forel; H. du Bois	8
Meteor.—Joseph John Murphy	8
Frederick Guthrie	8
The Longevity of Great Men. By Joseph Jastrow	10
The Geology of the Lebanon. By Prof. Edward Hull, F.R.S.	10
Autumnal Flowering. By Dr. Maxwell T. Masters	11
Arrow-Release. (Illustrated)	12
Climatology of the Croydon District	14
Notes on the Recent Swarming of Aphides. By G. B. Buckton, F.R.S.	15
Notes	15
Our Astronomical Column:—	
The Binary Star γ Coronæ Australis	17
Oppolzer's Astronomical Refractions	17
Comets Finlay and Barnard	17
Astronomical Phenomena for the Week 1886	
November 7-13	18
The High Temperature in October. By Chas. Harding	18
Volcanoes of Japan. By Prof. Milne. (Illustrated)	19
Solution	21
University and Educational Intelligence	22
Scientific Serials	22
Societies and Academies	23
Books and Pamphlets Received	24