Max Planck Research Group
Epistemes of Modern Acoustics

Sound & Science: Digital Histories

Von Helmholtz, Hermann. “Rayleigh's 'Theory of sound'.“ Nature, Vol. 17, no. 430 (1878): 237-239.

https://acoustics.mpiwg-berlin.mpg.de/node/363

Scan licensed under: CC BY-SA 3.0 DE | Max Planck Institute for the History of Science

MAX PLANCK INSTITUTE
FOR THE HISTORY OF SCIENCE

427 — 443

NATURE

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME XVII.

NOVEMBER 1877 to APRIL 1878

January
Vol. XVII — XXX skänkta av H. H. Hildebrandsson
till
METEOROLOGISKA OBSERVATORIUM UPSALA

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

MAX-PLANCK-INSTITUT
FÜR WISSENSCHAFTSGESCHICHTE
Bibliothek

London and New York:
MACMILLAN AND CO.
1878

THURSDAY, JANUARY 24, 1878

RAYLEIGH'S "THEORY OF SOUND"

The Theory of Sound. By J. W. Strutt, Baron Rayleigh, F.R.S. Vol. I. (London: Macmillan and Co., 1877.)

THE author, who already, by a series of interesting treatises belonging to different branches of mathematical physics, has acquired a respected name in the domain of science, undertakes to give a complete and coherent theory of the phenomena of sound in the work above mentioned, the first volume of which has recently been published; and he does this with the application of all the resources furnished by mathematics, since without the latter a really complete insight into the causal connection of the phenomena of acoustics is altogether impossible. We must confess that, even in spite of the most intense exertion of the powers of mathematical analysis, in the present state of its development several problems remain unsolved, for which, indeed, the conditional equations are known, but for which it has not yet been found possible to carry out the calculation.

The author will merit in the highest degree the thanks of all who study physics and mathematics if he continues his work in the manner in which he has begun it in the first volume. The separate treatises in which the acoustic problems that have been solved hitherto are discussed, are for the most part dispersed in the publications of academies or of scientific societies, which can be found only in larger libraries, and which frequently are not at all easily traced. But even if one has found a treatise of this kind and reads it, it happens often enough that the author refers in his quotations to other works quite as difficult of access, the knowledge of which is necessary for understanding his treatise. Thus the zeal of the student is paralysed by a number of purely external difficulties, and the ordinary result at which an intelligent student arrives after a few attempts in this direction, is that for problems in which he takes great interest he prefers starting anew to find the solution, rather than trying to hunt for it in libraries. Even if we must admit that the insight into the essence of a problem for which one has found the solution oneself is much deeper and clearer than when one has obtained the solution from some other author, yet an enormous amount of time is thus lost, and the survey of the whole extent of solvable problems remains incomplete. A survey of this kind, however, is necessary for all who wish to work at the progress of science themselves. For in order to obtain decisive results by new scientific investigations it is necessary above all things to be quite clear with regard to the question for which forms of experiment or of observation the theoretical deduction from principles can be carried through as purely as the experiment itself. I know by experience that a number of young physicists lose their time and their zeal by trying to solve problems which, taken by themselves, are very interesting, but for which at present the deductions from the theoretical principles for the given case can only be drawn in coarse approximation, and where the experiments cannot be freed from important sources of error.

While praising Lord Rayleigh's book as a means of overcoming the difficulties described, I do not at all wish to designate it as a mere compilation. On the contrary, it is a perfectly coherent deduction of the special facts from the most general principles, according to a uniform method and in a consequent manner. The mechanical principles of the doctrine of minute oscillations are contained in the present volume and are developed in greater generality than in any other book known to me. For this purpose the author in the first chapter explains the general physical principles of sound, of its propagation, of pitch and its dependence on the rapidity of vibration, of the musical scale, of the quality of sound and its dependence on the harmonic over-tones; and in the second one the doctrine of the composition of harmonic motions of either equal, or nearly equal, or consonant numbers of vibrations, and further illustrates them by the description of the physical phenomena and methods in which the principles developed are applied, and to which belong the doctrines of musical beats and of the physical methods to render the forms of vibrations visible.

Then follows the development of the most general peculiarities of oscillating motions, first, in the third chapter, for mechanical systems to the motion of which only one degree of freedom is allowed, and then, in the fourth chapter, for systems with a finite number of degrees of freedom. There is a great multitude of peculiarities common to the most heterogeneous sounding bodies, which up to the present have mostly been found in certain instances only, but which can also be deduced from the most universal form of the motion-equations of systems of one or more degrees of freedom of motion. The author in the form of the equations and in the manner of denotation, closely follows the "Natural Philosophy" of Thomson and Tait; in fact the whole manner of treatment of the mathematical problems corresponds so closely to that adopted in the work just mentioned, that Lord Rayleigh's book may be looked upon as the acoustic part of the excellent handbook of the two celebrated physicists named.

With all systems of this kind if there are no exterior forces acting upon them, we find, on the whole, a number of proper tones equal to the number of degrees of freedom, and the pitch of which does not depend on the amplitude of the vibrations as long as this one remains small enough. Exceptionally, however, several of these proper tones may be of equal pitch. If there is no friction or dissipation of energy the amplitude of every kind of oscillation remains constant. To each separate proper tone a certain form of motion of the whole system belongs; so that the directions and magnitudes of the displacement of the separate points of the system are different in each case. Each arbitrary motion of the system produced in any arbitrary manner, may be regarded as a superposition of these forms of vibrations belonging to the various proper tones of the system. In order to find the amplitude and phase of these different vibrations for a given original displacement and of given velocities of its different parts, quite similar methods are adopted as those which are employed to develop a given periodical function into one of Fourier's series; only the whole method here becomes far more intelligible and has a thoroughly certain foundation, because we have to do with a finite number of unknown factors instead of with the infinite number of continuously

succeeding values of a function, with finite sums instead of with integrals or with infinite series. Of course for Fourier's series as well as for the developments of Laplace by means of spherical harmonic functions the proof for the correctness of their values can also be furnished in the case of continuous functions. For a large number of other functions which are given by differential equations of the second degree this proof results, under certain suppositions regarding the continuity of the functions and the limit conditions, from the theorems of Sturm and Liouville, which Lord Rayleigh explains when speaking of the vibrations of strings of unequal thickness. Yet in mathematical physics we are still compelled to employ a great number of series-developments of functions which do not belong to this class ; and even the vibrations of rods and plates are cases in point. In this respect the treatment of the problems mentioned with a finite but arbitrarily large number of degrees of freedom of motion is interesting also with regard to analysis.

For vibrating systems of one degree of freedom, the oscillations of which are subjected to damping, the doctrine of the laws of resonance is developed in the third chapter. The author calls the vibrations which are continuously maintained by the influence of a periodical force acting externally, *forced vibrations*. In all cases their intensity is greatest when their period of vibration, which equals the period in which the force changes, is also equal to the period of the system vibrating freely and without friction. For the relations between the intensity and the phase of the co-vibration, between the breadth of the co-vibration in case of small alterations in the pitch and the degree of damping, which I had myself proved for certain instances and used for certain observations, the general proof is given here. The author has further employed these chapters to set up certain general maxims respecting the direction and magnitude of the corrections which must be made in cases where one cannot completely solve an acoustic problem, but can only find the solution for a somewhat altered vibrating system. These are like the outlines of a "theory of perturbations" applied to acoustic problems. The author illustrates these maxims by many various examples. Thus, for instance, he replaces a string by an imponderable stretched thread which carries weights either in the middle only or at certain distances from each other; or a tuning-fork by two imponderable springs with weights at the ends.

For vibrations of very small amplitude, the forces which tend to lead the moving points back to their position of equilibrium may always be considered proportional to the magnitude of their distance from the position of equilibrium. As long as this law holds good, the motions belonging to different tones are superposed, without disturbing one another. But when the vibrations become more extensive, so that the law of proportionality just named no longer applies, then perturbations occur which become manifest by the appearance of new tones, the combination tones. In my book on acoustic sensations ("Die Lehre von den Tonempfindungen") I have myself explained this manner of origin of the combination tones, only for the motion of but a single material point. In Lord Rayleigh's book this explanation is given with reference to any compound vibrating system of one degree of freedom, and it is further amplified with regard to the manner in which the forces deviate with the displacements from the law of proportionality.

Certain laws of reciprocity, of which I had given single instances in my investigations on the vibration of the air in organ pipes, may be proved in a general way for all kinds of vibrating elastic systems. If on the one hand at point A an impulse is given, and the motion at point B is determined after the time t has elapsed, and if on the other hand an impulse is given at point B in the direction of the motion, which occurred there, and, after the time t, the motion-component falling into the direction of the first impulse is examined at point A, then the two motions in question are equal if the impulses were equal.

Chapters VI. to X. of Lord Rayleigh's book treat of the vibrations of strings, rods, membranes, and plates. The vibrations of strings have played an important part in acoustics ; their laws are simple, and the physical conditions which the theory demands are fulfilled with comparative facility, different modes of producing the tones may be employed, and a number of various motions may thus be produced. It is just because the physical phenomena in connection with strings were well known, that the observation of the way in which the ear is affected by their various modes of vibration has materially facilitated the solution of the problems of physiological acoustics. The musical importance of strings rests on the circumstance that the series of their proper tones corresponds to that of the harmonics, the vibration-numbers of which are entire multiples of those of the fundamental tone. For this reason, if the motions of many proper tones are superposed on one string, a periodical motion again results, and this is the cause why on strings we can produce notes of the most varied quality. We need only remember how differently the same string sounds according to whether it is plucked with the finger or with a metallic point, whether a violin bow is drawn across it or whether it is caused to vibrate by means of a tuning-fork

In this chapter less new work remained to the author ; however, this example shows how much easier it is to understand all these separate problems if they are not treated separately but developed in coherent representation, after the most general principles, the validity of which is independent of the special peculiarity of the case, have been first explained.

The short chapter VII. gives the laws for the longitudinal and torsional vibrations of rods ; the laws are simple and resemble those of the open and stopped organ pipes. The lateral vibrations of rods, during which these bend, give more complicated analytical expressions ; their proper tones do not form a harmonic series, but are given by the roots of a transcendental equation. The tones are different according to whether one or both ends of the rod are free to rotate and to move, or free to rotate, but hindered from moving (supported), or hindered from rotating and moving (damped). With this more complicated problem the advantage of first treating of the general principles becomes clearly apparent. The forms of the simplest vibrations are calculated and represented graphically. The mode of vibration of a stretched rod, for which Seebeck and Donkin have already given the solution, is also treated here in order to determine the influence of rigidity upon the vibrations of strings.

Then the vibrations of a uniformly-stretched membrane are investigated. This investigation is of more theoretical than physical importance, since it shows in a case which may be treated in an easier way, the peculiarities of vibrations which are capable of spreading in two dimensions. Unfortunately we have not yet succeeded up to the present in obtaining good membranes which would be fit for experiments of measuring in order to investigate, with some degree of exactness, how far theory corresponds with the experiment.

On the contrary, in the case of elastic plates, the vibrations of which the author treats in the last chapter of the present volume, the experiments can be made with more accuracy, while the analytical difficulties are so great that, on the whole, only few cases permit of a solution of the problem. Indeed, even the formulæ expressing the conditions which must be fulfilled at the edge of the plate have given rise to discussions. Poisson had thought that three conditional equations were necessary for the edge; Kirchhoff has shown that in reality only two are required. Lately M. Mathieu opposed this view. Lord Rayleigh has adopted Kirchhoff's views, and no doubt with perfect right. He gives the analysis of the latter of the vibrations of a circular plate, and has made an important addition of his own to the solvable cases, by teaching us how to deduce theoretically a series of vibration forms of square plates, at least for that case where they consist of an elastic substance the resistance of which to change of volume may be neglected; and these theoretical deductions sufficiently correspond with the forms observed. Also for elastic rings and for cylinders vibrating in the manner of bells, he has improved the theory in an essential point, by proving theoretically and experimentally, that the node lines of such plates execute vibrations in a tangential direction. These tangential vibrations are the ones which are first produced if the edge of a drinking-glass is rubbed with the wet finger.

The above survey will give an idea of the numerous contents of the book. As in the treatment of the separate problems it touches everywhere the limits of our present knowledge, it cannot but demand sound mathematical knowledge on the part of the reader. Yet the author has rendered it possible, by the very convenient systematic arrangement of the whole, for the most difficult problems of acoustics to be now studied with far greater ease than hitherto. He thus proves himself to be a philosopher who does not lose the liberty of intellectual supervision, even when he is occupied with the most abstruse calculations. H. HELMHOLTZ

HINDUISM, BUDDHISM, AND ISLÁM

1. *Hinduism.* By Monier Williams, D.C.L. 2. *Buddhism.* By T. W. Rhys Davids. 3. *Islám and its Founder.* By J. W. H. Stobart, B.A. (London: Society for Promoting Christian Knowledge, 1877.)

IT is a sign of the times that a "Society for Promoting Christian Knowledge" should undertake a series of works on "non-Christian religious systems." Nor is it a less striking characteristic of our day that it should entrust the work to scholars of so liberal a faith as Prof. Monier Williams and Mr. Rhys Davids. Dr. Monier Williams's volume on Hinduism forms a model of a popular exposition of a religious system. He explains with great clearness the historical *catena* of the sacred writings on which the Sanskrit religion was based. He delineates the various movements, from the Buddhistic reformation 2,500 years ago, down to the modern revivals among the Sivaite and Vishnuvite sects, which have developed the Vedic worship into that complex structure of ritual, dogma, and social institutions, which we call Hinduism. To the ordinary English reader, this little volume will reveal a different aspect of Hindu faith and morals from that which he has been accustomed to hear from the pulpit or missionary platform. He will find that the great questions of how a man should rule his life, and what prospect lies before him after he has done with this world, have formed the subjects of religious thought and practical experience, not less anxious nor less deep among the people of India than among the western races. The ethical replies which they have given to those questions differ more in form than in spirit from the higher beliefs of Christendom. The hard and narrow judgments of the elder Mill and the zealous statements of missionaries, have too long possessed the popular mind. Prof. Williams does not appear as the advocate or admirer of Hinduism. In fact he tacks on to the end of his book a proselytising page or two, which, however in accord with the object of the Society for which he writes, form a strange contrast to the scholarly tone of his volume.

Dr. Monier Williams's tours in India have enabled him to deal with the modern phases of Hinduism from a practical, as well as from the professorial point of view. Three features of Hinduism must be distinctly realised in order to understand its vitality and influence on the people. Hinduism represents, in the first place, a very ancient growth of worship and belief; and is invested with all the authority of age and unquestioned prescription. In the second place, it is a very modern religion, whose later developments have neither been reduced to, nor are restrained by, any systematic theology; which is, therefore, plastic, sensitive to every change in the popular beliefs or modes of thought; and which, in each province of India, takes on a local colouring adapted to the necessities or customs of the local population. In the third place, Hinduism is not only a religious system, but an all-powerful social institution. It forms the outcome of religious and philosophical thought in India during several thousands of years; it also represents the organised modes of life at which a great variety of tribes and races have slowly arrived. This threefold source of strength makes itself felt in every detail. To take one instance: Caste is enforced alike by the sanctions of ancient prescription, modern religion, and social utility. It articulates the population into communities, each bound together by ties of a useful, not less than of a doctrinal sort. Caste, with the feelings of kindred and family on which it rests, forms the substitute for a Poor-Law in India; it supplies a bond something like that which in America is felt by people who attend the same meeting-house or chapel; and it discharges many of the functions of the mediæval guilds of Europe, together with others which are effected less smoothly by modern Trades' unions. It has its disadvantages—some of them very serious ones; but it curiously resembles, in several of its judicial, social, and charitable aspects, the ekklesia of the early Christians.

INDEX

AACH, the, and the Danube, 233
Abercromby (Hon. Ralph), the *Eurydice* Squall, 466
Abney (W. de W., F.R.S.), "A Treatise on Photography," 378; the Acceleration of Oxidation caused by the Least Refrangible End of the Spectrum, 518
Absolute Pitch, Lord Rayleigh, F.R.S., 12
Ackroyd (W.), on the Telephone, 330
Acoustic Repulsion, 515
Acoustical Effects of Atmospheric Pressure, G. Rayleigh Vicars, 244
Adulteration: in Berlin, 91; Anti-Adulteration Society at Leipzig, 91
Æolian Harps, 33
Africa: H. M. Stanley's Exploration of, 17, 49, 90, 193, 270, 297; International African Exploration Society, 71, 346; French Exploration of, 91; Italian Expedition to, 132; Exploration of Lake Albert Nyanza, 192, 364; the Belgian Expedition to, 193, 346, 467; Dr. Hildebrandt's Expedition, 194; Herr Gerhard Rohlf's Expedition to the Sahara, 211; the Marquis Antinori's Expedition, 211, 249; an Early African Explorer, 270; Mr. Stanley in England, 270; D'Anvers' History of North African Discovery, 280; Proposed Language Map of, 293; Herr Schütt's Expedition, 308; Prof. Oliver's "Flora of Tropical Africa," 319; German Exploration of, 324; Mr. Stanley's New Work on, 364; Exploration of South-West Africa, 364; African Dwarfs, 364; Proposed New Expedition, 383; Ancient Maps of Central Africa, 383; Dr. Effendi's Expedition, 408; the Lake Nyassa Region, 435; Exploration of Angola, 453; Dr. Bastian on African Weapons, 455; Trollope's "South Africa," 463; Church Missionary Society Expedition, 467; Exploration of, 279, 383, 468; Geographical Notes, 489; New Map of, 489; French Expedition to, 508
Agassiz (Alex.), North American Starfishes, 98; Cruise in the Gulf of Mexico, 151, 192, 454
Agriculture, Henderson's Manual of, 280
Agricultural Society, the Royal, 301
Air-Pump, Improvement of the, 310
Aitken (John), on a Means for Converting the Heat Motion possessed by Matter at Normal Temperature into Work, 260
Aix-la-Chapelle, the Polytechnic at 335
Albert (Herr Josef), Photography of Natural Colours, 92
Albert Nyanza, Exploration of, 364
Aldebaran, New Companion to, 488
Algæ, Green, 289
Algæ of the White Sea, 345
Algebra and Chemistry, Prof. J. J. Sylvester, F.R.S., 284, 309
Algeria, Proposed Schools in, 393
Allen (J. A.), on the American Bison, 127
Alloys of Tin, &c., Hardening of, 311
Alluard's New Condensing Hygrometer, 14, 28
Alpine Club, German, 468
Amber, Production of, 132
Amblyornis inornata, 110
America: American Journal of Science and Art, 18, 293; American Science, 18, 39, 113, 213, 293, 438, 497; American Association for the Advancement of Science, 37; American Bison, 127; American Philosophical Society, Proceedings of, 199; Entomology in, 222; American Naturalist, 232, 293; American Journal of Mathematics, 293; American Geographical Society, 346, 409; the Inland Fisheries, 382; American Longitudes, 408; American Geological Surveys, Prof. A. Geikie, F.R.S., 431; Bibliographical Index of North American Plants, 514. *See also* United States, New York, Philadelphia, &c.
Amines, Halogen, Derivatives of, 151
Amsterdam and St. Paul, the Islands of, Prof. E. Perceval Wright, 326
Analogies of Plant and Animal Life, Francis Darwin, 388, 411
Ancient History from the Monuments, George Smith, 119
Angara, Exploration of the, 308
Angola, Exploration of, 453
Animal and Plant Life, Analogies of, Francis Darwin, 388, 411
Animal Eggs, the Earliest Changes in, 509
Annalen der Physik und Chemie, 39, 214, 254, 294, 394
Annuaire Bureau des Longitudes of France, 211
Anthony (John G.), Death of, 39, 133
Anthropology: Anthropological Exhibition in Moscow, 16; Anthropological Institute, 76, 171, 176, 215, 315, 355, 415, 470, 499; Anthropological Literature, 1876, 133; Anthropologische Gesellschaft of Berlin, 438; Anthropology in Moscow, 171; of Central Asia, 172; Russian Collection at the Paris Exhibition, 350
Antibes, Thuret's Garden at, 351
Antimony, Atomic Weight of, 293, 439
Antinori (Marquis), Supposed Death of, 71, 110; his African Expedition, 110, 211, 249
Antiquity of Man, 315
Antiseptic Vapours, the Action of Certain, on the Ripening of Fruits, 150
Ants, the Habits of, Sir John Lubbock, F.R.S., 355; the Agricultural Ants of Texas, 433
Apiculture at the Paris Exhibition, 309
Apothecaries, Society of, Prizes in Botany, 109
Appunn and Kœnig—Beats in Confined Air, Alex. J. Ellis, F.R.S., 26
Aquatic Respiration, 290
Ararat, Prof. Bryce's, Prof. A. Geikie, F.R.S., 205
Archibald (E. D.), Indian Rainfall, 505
Archiv for Mathematik og Naturvidenskab, 172
Arctic Auroræ, J. Rand Capron, 162
Arctic Exploration: 132, 271, 290, 324, 408, 468; Prof. Nordenskjöld's Expedition, 90; Discovery of Arctic Fossil Plants, 115; the Howgate Expedition, 153
Arctic Fauna, 155
Arctic Map, the Zenis', 71
Artesian Well at Pesth, 109
Articulate Speech, Elements of, Dr. W. H. Corfield, 447
Artificial Flowers and Insects, 133, 162
Arthropods, Sound-producing, W. Saville Kent, 11; Origin of Tracheæ in, 284, 340
Ascidians, Deep Sea, 289
Asseline (M.), Death of, 490
Astronomy: Proctor's "Myths and Marvels of Astronomy," 180; Wolf's History of Astronomy, J. R. Hind, F.R.S., 259; English Translation of, J. R. Hind, F.R.S., 359; Astronomisches Jahrbuch, Berlin, 507; Our Astronomical Column, 14, 36, 46, 63, 82, 104, 129, 149, 163, 189, 209, 231, 247, 269, 288, 306, 323, 343, 363, 381, 407, 432, 452, 418, 507; Astronomical Society, *see* Royal
Atlantic Shells, Wollaston's, 503
"Atlas Céleste," Ch. Dien, 141
Atmospheric Movements, 307
Atmospheric Pressure of Europe, 15
Atmospheric Pressure, Acoustical Effects of, G. Rayleigh Vicars, 244

Aurora Australis, Spectrum of, Commander J. P. Maclear, 11
Aurora Borealis, Extent and Principal Zone of the, 373
Australia: C. H. Eden's "Fifth Continent with the Adjacent Islands," 121; Exploration of, 271; Meteorology of Western, 363; Bees in, 372; Australian Monotremata, E. P. Ramsay, 401
Austria: the Austrian Comet Medal, 129; Education in, 155; University Libraries of, 374
Autopsy, the Society of Mutual, 490
Avalanches in Styria, 273
Aveling (E. B.), Physiological Tables, 5
Azimuth Instrument, a New, 308

Babylonia, the Primitive Culture of, 415
Bacteria: Prof. J. Burdon Sanderson, F.R.S., 84; Prof. Tyndall on, 134; in Water, G. F. Dowdeswell, 323; in Oxygen, 393
Baker (J. G.), "The Flora of Mauritius and Seychelles," 77
Balfour (Prof.) Proposed Portrait of, 393
Balloon, the Tuileries Captive, 330, 454, 491; Balloons and Arctic Exploration, 171
Ballot (Dr. Buys), on the Mean Atmospheric Pressure of Europe, 15
Baltic and German Oceans, Physiography of, 411
Baltimore, Johns Hopkins University, Anniversary of, 459; Fellowships at, 517
Barkas (T. P.), the Daylight Meteor of March 25, 1878, 467
Barnard and Mayer, the Sources and Reflection of Light, 405, 427
Barometric Oscillation, 135
Barrett (Prof. W. F.), a Cheap Telephone, 193; New Form of Gasholder, 253; Early Electric Telephony, 510
Bary (Dr. Erwin von), Death of, 71
Baryta, Lime, and Strontium, Crystallisation of, 372
Bashforth (Rev. Francis), Trajectories of Shot, 401, 506
Batchelor's Patent Working Drawings—Trunk Engine, 160
Bathing-Place at Harrow School, Arthur G. Watson, 487
Beachbury, Earthquake at, 212
Becquerel (Antoine César), Obituary Notice of, 244
Beer, Adulteration of, 251
Bees killed by Tritoma, Alfred R. Wallace, 45; Bees and Flowers, John B. Bridgman, 102; and *Gentiana asclepiadea*, F. M. Burton, 201; Apiculture at the Paris Exhibition, 309; Australian Bees, 372, 411
Beetles of St. Helena, E. C. Rye, 338
Beiblätter zu den Annalen der Physik und Chemie, 39
Belgrand (M.), Death of, 473
Bell (Prof. Graham), on the Telephone, 135
Bell (I. Lowthian, F.R.S.), Separation of Phosphorus from Pig-iron, 459
Bell (Prof. T., F.R.S.), "White's Natural History of Selborne," 399
Bentham's "Flora Australiensis," 212
Bergen, proposed University at, 95
Berlin: Death of Pongo at the Aquarium, 70; Geographical Society of, 91, 194, 271, 409, 411; New Polytechnic at, 155; University Intelligence, 175, 214, 254; the University Library, 194; the Telegraphs in, 251; Academy of Science, 252; Arms and Weapons at the Royal Museum, 330; Anthropologische Gesellschaft, 350; "Commers" at, 393; Botanical Specimens in, 454
Berliner astronomisches Jahrbuch and the Minor Planets, 507
Bermudas, the Fauna of the, 18; Bermuda Lizard, G. Brown Goode, 425
Bern, University Statistics, 374
Bernard (Claude), Obituary Notice of, 304; Funeral of, 329; Monument to, 370, 409
Bessemer (Henry), Glass for Reflectors, 241
Bettany and Parker's "Morphology of the Skull," 3
Biggs-Wither (T. P.), "Pioneering in South Brazil," 423
Binary-Star Castor, the, 105
Biological Notes, 127, 221, 289, 344, 382, 433, 508
Birchall (Edwin), the Insects of Chili and New Zealand, 221, 260
Birds: the Protection of, in Germany, 251; Mimicry in, 361, 380, 438; Poaching, 509
Birkbeck Institution, 334, 393
Bismarck (Prince) and the Telephone, 91
Bison, the American, 127
Blackbirds, Exportation of, from Corsica, 309
Blakesley (J. H.), Phoneidoscopic Representation of Vowels and Dipthongs, 486
Bland (Thos.), Great Waterfalls, 361
Bleeker (Dr. P.), Obituary Notice of, 286; his "Atlas," 309
Blood Corpuscle, the Structure of, 20
Bolivia, Capt. Musters on, 90
Bonavia (Dr. E.), Contribution to the Sun-spot Theory of Rainfall, 61; Nocturnal Increase of Temperature with Elevation, 101
Bone, Transformation of Cartilage into, 345
Bonomi (Joseph), Death of, 370
Bonn, Prof. Kekulé's Address on Chemistry, 55
Booth (Rev. James, LL.D., F.R.S.), Death of, 513
Boracic Acid, Origin and Formation of, 150
Borneo, Volcanic Phenomenon in, A. H. Everett, 200
Bosanquet (J. Whatman), Death of, 212
Botanical Exchange Society at Buda-Pesth, 437
Botanical Specimens in Berlin, 454
Botany: in Germany, 158; Prizes in, for Young Women, 314
Boulders, Preservation of, in France, 391
Bournemouth, the Eocene Flora of, J. S. Gardner, 47; Fossil Hunting at, J. S. Gardner, 369; the Bournemouth Beds, 395
Brahe (Tycho), Star of 1572, 129
Brain of a Fossil Mammal, 222; Prof. O. C. Marsh on, 340
Brake, the Westinghouse, 410, 507
Brandeis (Dr. Richard C.), Philadelphia Diplomas, 221
Braun (Alex.), Sale of his Herbarium, 410
Brazil, Mr. H. H. Smith's Exploration of, 308
Brazil, Pioneering in South, T. P. Biggs-Wither, 423
Breaks, the Telephone as a Means of Measuring the Speed of High, J. E. H. Gordon, 424
Brehm (Dr. A. E.), Thierleben, "Die Säugethiere," 41
Breslau, University Statistics, 374
Bridgman (John B.), Bees and Flowers, 102
Brisbane, Hailstorm at, 455
Bristol: Museum and Library, 16; University College, 20, 134; Naturalists' Society, 193, 292, 311
British Archæological Association, 350
British Association, 1879 Meeting, 192, 232
British Channel Tunnel, 109
British Flora, the Future of our, A. Craig-Christie, 62
British Medical Association, Grants of the, 90
British Museum, the Salaries of the Officers in the, 197
Broun (J. Allan, F.R.S.), the Sun's Magnetic Action at the Present Time, 183; Sun-spots and Terrestrial Magnetism, 262, 280
Broun (Prof. W. Le Roy), Terrestrial Magnetism, 281
Browning's Absorption Bands Apparatus, 513
Brüggemann (Dr. F.), Death of, 473
Brunswick, New University Buildings at, 75
Brussels, the Royal Observatory, 288
Bryce (James, LL.D.), "Transcaucasia and Ararat," 25, 205
Bryozoa, the Shell of the, 355
Buchan (Alex.), Sun-spots and Rainfall, 505
Buda-Pesth, Centenary of the University, 195; Botanical Exchange Society at, 437
Buddhism, T. W. Rhys Davids, 239
Buchanan (J. Y.), Oxygen in Sea-Water, 162
Burbidge (F. W.), "Horticulture," 142
Burial-Ground, Discovery of a Prehistoric, near Berlin, 391
Burton (Capt.), Exploration of the Land of Midian, 53, 132
Burton (F. M.), Insects and Artificial Flowers, 162; *Gentiana asclepiadea* and Bees, 201
Bushman Drawings, Prof. G. Fritsch on, 350
Butterflies in Iceland, No, 243, 260
Byrne (Oliver), the Geometry of Compasses, 199
Byssus in the Mussel, 289

Cairo, Geographical Society, 468
Callao, Waterspouts in, 372
Calmy (Dr.), Eucalyptus, 283
Cambridge: University Intelligence, 39, 74, 95, 134, 154, 294, 393; Science at, 39; Philosophical Society, 96, 416; the Mathematical Tripos, 275; Science Exhibitions, 334; Woodwardian Geological Museum, 354; Report of the University Commission, 415; Report on the Teaching of the University, 497
Cameron (J.), Sound and Density, 507
Canada, Extraordinary Rain-storm in, 490
Cape of Good Hope Observatory, 269
Capello (Joas), Sun-spots and Terrestrial Magnetism, 488

Capron (J. Rand), Arctic Auroræ, 162; "Photographic Spectra," 259
Carbon of Plants, J. W. Moll's Researches on, 344
Carnac, Archæological Researches at, James Miln, 379
Carnivorous Plants, Francisco Ginez, 63
Carpenter (Dr. P. P.), his Collection of Shells, 513
Carpenter (Wm. B., F.R.S.), the Radiometer and its Lessons, 26, 61; Mr. Crookes and Eva Fay, 81, 101, 122
Carpmael (W.), Telephone Experiments, 342
Cartilage, Transformation of, into Bone, 345
Caspian, Prof. Grimm on the Fauna of the, 345
Cassell's Natural History, Vol. i, 365
Castleton, Local Museum at, 454
Castor, the Binary Star, 105
Caucasus, Prof. Abich's Work on the, 309
Causation of Sleep, 124
Cavendish (Henry), his Writings on Electricity, 75
Cazin (Prof.), Death of, 16
Cecil (Henry), Hearing and Smell in Insects, 102, 381; the Wasp and the Spider, 448
"Celestial Atlas," Dien's, 141
Cerf (Mdlle. Henrietta), Death of, 71
Cesnola (Gen. L. Palma di), "Cyprus," 397
Chadwick Museum, 272
Challenger, the, Estimates of the Volume of the Gulf Stream, T. Mellard Reade, 144; in the Atlantic, Sir Wyville Thomson's Account of, 145, 185; Laboratory Experiences on the, 394
Channel Islands, a Zoological Station for the, W. Saville Kent, 102, 475
Chappell (Wm., F.S.A.), Music a Science of Numbers, 32
Charkow, University of, 195
Charnwood Forest, the Rocks of, 294
Cheeseman (T. F.), Fertilisation of *Glossostigma*, 163
Cheijan (Omer), Translation of the Poems of, 351
Chemistry: Chemical Society, 40, 75, 134, 215, 255, 315, 394, 439, 499, 519; the Research Fund, 291, 309, 454; Anniversary Meeting of the Society, 479; a Problem in Chemical Affinity, 151; Chemical Notes, 150, 269; Die chemische Industrie, 251; Fowne's Manual of, 24; Prof. Kekulé on the Position of, 55; N. N. Lubavin on Physical Chemistry, 240; Institute of, 291, 309; Chemistry and Algebra, Prof. J. J. Sylvester, F.R.S., 284, 309; Frankland's Researches in, Prof. J. Emerson Reynolds, 318; Dictionaries of, 455, 514
Chester Society of Natural Sciences, 16
Chili: Insect-Fauna of, R. McLachlan, F.R.S., 162; A. R. Wallace, 182; the Insects of Chili and New Zealand, 221, 260
Chimpanzee at the Westminster Aquarium, 153
China: Telegraphy in, 310; Exploration of, 346; the Telephone in, 392; Mr. Baber's Report of the Grosvenor Mission, 434; Geographical Notes, 452; Chinese Remedy for *Cynanche tonsillaris*, 475; "Gray's China," 484; Chinese Plants and Animals in Paris, 513
Chloride of Silver Battery, Dr. De la Rue's Researches on the Electric Discharge with, 214
Chronometers, Trial of German and Swiss, 409
Cinchona, Cultivation of, 410
Cissbury: Exploration of the Cave-Pits, 53, 171, 215, 409
Clark (Xenos), Singing in the Ears, 342
Cleopatra's Needle, 251
Cliff-Dwellers in the United States, 409
Climatology: of the Spanish Peninsula, 248; of the Fiji Islands, 248; of India, 307; of English Sea-side Resorts, 356
Clock, a Watchman-Controlling, 292
Clusters and Nebulæ, Literature of the, 288
Cobalt and Nickel, Iodates of, 150
Cochin China, the French Colony in, 492
Coggia's Comet, 497
Cohesion Figures in Liquids, Diffusion of, 124
Cole (Alan S.), State Aid to Music, 474
"Coleoptera Sanctæ-Helenæ," Wollaston's, 338
Colley (Prof. R.), Electrical Experiment, 282
Collieries, Telegraphic Warnings in, 16
Colonies, Exploring, 290
Colorado, Atlas of, 371
Colours, Comparison of the Intensity of Light of Various, 438
Colour Sense of the Greeks, Prof. W. Robertson Smith, 100
Columbus, the Burial-place of, 17
Comets: De Vico's, 15; of Short Period of 1878, 36; of 1873, 46; the Comet of 1672, 63; the Austrian Comet-Medal, 129; Donati's Comet of 1858, 149; the Comet 1106, 189; the Comets of 1618, 247; the Periodical Comet 1873, 344; Tempel's Comet of Short Period, 408; Coggia's Comet, 497; Encke's Comet in 1878, 507
Compass Adjustment in Iron Ships, Sir William Thomson, F.R.S., 331, 352, 387
Compasses, the Geometry of, Oliver Byrne, 199
Congo, the Yallala Rapids on the, 62
Connaissance des Temps for 1879, 70
Conrad (Timothy Abbott), Death of, 39
Conservation of Energy, Lecture Experiment, W. A. Shenstone, 45
Cooke (C. J.), Landslips near Cork, 425
Cooke (Conrad W.) Cumulative Temperatures, 322, 448, 486
Cooling Powers of Various Liquids, 132
Cooper (Robt.) Mr. Crookes and Eva Fay, 183
Copeland (Ralph), Meteor, 29
Corbett (Dr. Joseph Henry), Death of, 410
Cordoba Observatory, 83, 209
Corfield (Dr. W. H.), Elements of Articulate Speech, 447
Cork, Landslip near, C. J. Cooke, 425
Corpse, Spasms in a Guillotined, 437
Corsica, Exportation of Blackbirds from, 309
Coryphodon, Brain of a Fossil Species of, 222
"Cotton Goods, the Sizing of," Thomson, 4
Cotton (Dr. R. P.), his Collection of Ilford Fossils, 231
Crabs, Horse-Shoe, 289
Craig-Christie (A.), the Future of our British Flora, 62
Crawfish, Artificial Culture of, 133
Cremmen, Discovery of a Prehistoric Burial Ground near, 391
Croll (Dr. James, F.R.S.), Age of the Sun in Relation to Evolution, 206, 321, 464
Crookes (William, F.R.S.), the Radiometer and its Lessons, 7, 43; and Eva Fay, 81, 101, 122, 183, 200
Cruelty to Animals' Act and Physiological Teaching, Frank W. Young, 45
Crustaceans, Classification of Decapod, 127
Cryptogams, Hofmeister's work on, 344; Cryptogamic Society of Scotland, 133; Cryptogamic Society of Italy, 491
Cumberland Association of Literature and Science, 133
Cumulative Temperatures, 308, 322, 448, 486
Curious Phenomenon, 10
Cyanide of Gold, Double Salts with, 151
Cycadeæ, Structure of, 222
Cyclones and Anti-Cyclones, 134
Cynanche tonsillaris, Chinese Remedy for, 475
"Cyprus," General L. Palma di Cesnola, 397

D'Albertis' and Beccari's Voyage Round the World, 53
D'Albertis' Exploration of New Guinea, 383
Danish Greenland, Dr. Henry Rink, 57
D'Anvers (N.), "History of North African Discovery," 280
Danube, the, and the Aach, 233
D'Arrest's Spectroscopical Researches, 311
Darwin (Charles, F.R.S.), Conferring an Honorary Degree on at Cambridge, 52, 64; Fritz Müller on Flowers and Insects, 78; Proposed Memorial to, 95, 350; "Different Forms of Flowers," 445
Darwin (Francis), Insectivorous Plants, 222; Analogies of Plant and Animal Life, 388, 411
Darwin (G. H.), Geological Time, 509
Davids (T. W. Rhys), Buddhism, 239
Davyum, Sergius Kern, 245, 292
Dawson (G. M.), Drowned by a Devil Fish, 282
Deaf and Dumb Language, 479
Decapod Crustaceans, Classification of, 127
Declination Ranges and Sun-spots, Prof. Balfour Stewart, F.R.S., 326
Deep-Sea Ascidians, 289
Deer, Prof. Boyd Dawkins on the, of the Miocene and Pliocene Strata, 255
De la Rue's Diaries and Calendars, 11
De la Rue (Warren, F.R.S.), Researches on the Electric Discharge with the Chloride of Silver Battery, 214
Dendritic Gold, 283
Denning (W. F.), Meteor of October 19, 1877, 10; Shooting Stars, 201
Density and Sound, J. Cameron, 507
Development in Plants, the First Stages of, 433

De Vico's Comet of Short Period, 15
Devil Fish, Drowned by a, 27, 282
Dien's "Celestial Atlas," 141
Diet, A Physician's Experiment, 305
Diffusion Figures in Liquids, 87, 102, 124
Diffusion of Gases, 92
Digital Reduction, the Laws of, 128
Digits, Hereditary Case of Six, 372
Dimetian and Pebidian Rocks of Pembrokeshire, 155
Dispersal, Means of, W. L. Distant, 124
Distant (W. L.), Means of Dispersal, 124; Oriental Affinities in the Ethiopian Insect Fauna, 282
Distillation of Organic Liquids by Means of Steam, 270
Dixon (Charles), Towering of Wounded Birds, 45
Doberck (Dr. W.), Ole Römer, 105
Dog-Fish, Capture of a, 251
Dohrn (Dr. Anton), the Zoological Station, Naples, 329, 360
Donati's Comet of 1858, 149
Donisthorpe (Wordsworth), Change of Habits in Toads, 242
Dorpat, University Intelligence, 354
Dorset, Earthquake in, 38
Double Salts with Cyanide of Gold, 151
Double Stars, 407
Dowdeswell (G. F), Bacteria in Water, 323
Downing (A. W.), Sun-spots and Terrestrial Magnetism, 242
Draper (Dr. Henry), Oxygen in the Sun, 339
Dresden, the Polytechnic, 354
Drosera rotundifolia, the Nutrition of, 222
Drought in the Southern Hemisphere, 436, 447, 454
Drury's "Chronology at a Glance," 253
Dublin, the Royal Society, 46
Dumas' Lectures on Chemical Philosophy, 193
Duncan (Dr. P. Martin), Cassell's Natural History, 365
Dundee Naturalists' Society, 54
Dun Echt Observatory Publications, 432
Dust, Explosive, 283
Dwarfs, African, 364
Dyer (Prof. W. T. Thiselton), the Rain-Tree of Moyobamba, 349

Early Man, Traces of, in Japan, 89
Ears, Singing in the, Xenos Clark, 342
Earth, Age of the, W. M. Flinders Petrie, 465
Earthquakes, 330; at Lisbon, 17; in Dorset, 38; New York, 38; at Iquique, 90; in Canada, 90, 110; in Nebraska, 110; the "Ionia Volcano," 110; at Beachburg, 212; in Jersey, 272; of January 28, 1878, 292; at Liesthal, 475; at St. Stefano, 514
Earthquakes and Seiches, Dr. F. A. Forel, 281
Earthworm in Relation to the Fertility of the Ground, 18, 28, 62
Earthworm, Supposed Gigantic, 325
Earwigs, 128
Easter, the Date of, 433
Eastern Excavations, 397
Eclipse Photography, the Use of the Reflection Grating in, J. Norman Lockyer, F.R.S., 354
Eclipses: Solar of February 2, 1878, 36; Total Solar Eclipse of A.D. 418, 163; the Total Solar Eclipse of July 29, 1878, 250, 269, 381, 452, 453; the Coming Total Solar Eclipse, J. Norman Lockyer, F.R.S., 481, 501
Eden (C. H.), "The Fifth Continent with the Adjacent Islands," 121
Edinburgh: University Buildings Extension Scheme, 95, 114; University Intelligence, 154, 294, 517; University Statistics, 214; Royal Society, 216, 276, 439, 480; University Chemical Society, 296, 500, 526; New School of Medicine at, 354; Proposed Portrait of Dr. Balfour, 393
Edison's Phonograph, 90, 190, 291, 469
Educational Travel, 324
Education, Female, in Germany, 478
Education in France, 170
Education, Technical, Prof. Huxley on, 97
Edwards (M. Milne), appointed President of the French Scientific Association, 152
Eggs, the Earliest Changes in Animal, 509
Egypt, Flint Flakes, &c., from, 215
Eidum, a Submerged Village, 232
Eimer (Prof.), on the Nervous System of Medusæ, Geo. J. Romanes, 200
Elasmobranchs, the Fins of, Prof. St. G. Mivart, F.R.S., 355
Electrical Analogies with Natural Phenomena, 226, 385; Electrical Experiments, 180, 282
Electrical Nerves, Social, 305, 346
Electric Battery, a New, 455
Electric Lighting, 156, 310, 437
Electricity, Gas Lighting by, 495; and Light, Experiment on, 233; and Railway Collisions, 371; and Railway Working, W. E. Langdon, 461
Electro-Generator, Electromotive Force of, 514
Electro-Magnets, 20, 40, 56, 76, 96
Electrometer, New Form of Absolute, 115
Electromotive Force, 252
Electrostriction, Prof. Mills, F.R.S., on, 235
Elliot (James), a Meteor, 425
Ellis (Alex. J., F.R.S.), Appunn and Kœnig—Beats in Confined Air, 26; the Phonograph, 4, 85
Elton (Capt.), Death of, 383
Encke's Comet in 1878, 507
English Lake-Dwellings and Pile Structures, Prof. T. Rupert Jones, F.R.S., 424
Entomology: Entomological Society, 75, 176, 256, 395, 459; Entomology in America, 229; Entomological Exhibition at the Westminster Aquarium, 351, 391, 402; Entomological Queries, 467
Eocene Flora of Bournemouth, J. S. Gardner, 47
Erlangen, University Statistics, 214
Esquimaux in Paris, 54, 309
Ethiopian Insect Fauna, Oriental Affinities in the, W. L. Distant, 282
Ethnography, Lectures on, in Paris, 330
Ethnological Literature of 1876, 133
Ethnology of North America, 53
Ethylen Oxide, New Modes of Forming, 150
Eucalyptus: Prince Pierre Troubitzkoy, 10; Arthur Nicols, 101, 342; used for Checking Fire, 38; Dr. Calmy, 283; as Fuel, 392; the Uses of, 514
Euplectella Sponges, 222
Euphrosyne, the Minor Planet, 36
Eurydice, the Meteorological Conditions Affecting the Wreck of the, 437, 466
Eva, the Minor Planet, 210
Everett (A. H.), Volcanic Phenomena in Borneo, 200
Everett (Prof. J. D.), "Shorthand for General Use," 17; Underground Temperature, 476
Evolution, Age of the Sun in Relation to, J. I. Plummer, 303, 360; Dr. James Croll, F.R.S., 321, 464
Evolution of Heat during Muscular Action, Prof. A. Fick, 285
Exner (Prof.), on the Diffusion of Gases, 92
Exploring Colonies, 290
Explosions in Mines, W. Galloway, 21
Explosions, A. Mackennah, 123
Explosive, Discovery of a New, 436
Explosive Dust, 283
Eyck (Jan van), Colossal Bronze Statue of, 490
Eye-brows, Supplementary, W. Ainslie Hollis, 124
Eye-motions during Sleep, &c., 371

Falb (Dr. Rud)., his Travels in South America, 513
Faraday (Prof.), Bust of, 291
Faraday's "Experimental Researches," Sylvanus P. Thompson, 304, 361; Bernard Quaritch, 342
Faunas and Floras, the Comparative Richness of, tested Numerically, Alfred R. Wallace, 100
Fay (Eva), Mr. Crookes and Dr. W. B. Carpenter, F.R.S., 81, 122; Alfred R. Wallace, 101
Faye (A. E. A.), elected Minister of Instruction for France, 91
Female Education in Germany, 478
Ferment in Plants, 455
Ferns and Mosses, Hofmeister's work on, 344
Ferns, J. Smith's British and Foreign, 43
Fertilisation in Thyme and Marjoram, 127
Fertilisation of *Glossostigma*, J. F. Chesseman, 163
Fertilisation of Plants, 221
Fetichism in Animals, Geo. J. Romanes, 168; C. G. O'Brian, 402
Fick (Prof. A.), on the Evolution of Heat During Muscular Action, 285
Fielden (Capt.), on the Geology of the Arctic Regions, 473
Field-mice, or Rats, Plague of, in Smyrna, 437

"Fifth Continent and the Adjacent Islands," C. H. Eden, 121
Figuier's "Les Six Parties du Monde," 17
Fiji Islands, the Climatology of the, 248
Films, Experiments on Fluid, 44, 61
"Fire-Ball," Fall of a, 10
Fire-damp, Commission on Explosions from, 252
Fires, Telegraphic Warnings of, in Paris, 91
Fisheries, of the Rhine, 212; the American Inland, 382
Fishes, the Distribution of Freshwater, 128; Prof. E. Perceval Wright on Fishes' Tails, 286; Glacial and Post-glacial Fishes of Norway, 509
Fittig's "Organic Chemistry," French Translation of, 233
Fitzgerald (Geo. Fras.), the Radiometer and its Lessons, 199
Flame, Vibrations of a, Experiments on, 54
Flame Spectra, Observing the Coloured Lines of, 273
Flames, Temperature of, 269
Flammarion (M.) on Stellar Systems, 82
Floating Magnets, Alfred M. Mayer, 487
Flora, British, the Future of Our, A. Craig-Christie, 62
"Flora of Tropical Africa," Prof. D. Oliver, F.R.S., 319
Floras and Faunas, the Comparative Richness of, Tested Numerically, Alfred R. Wallace, 100
Flower (James), Death of, 37
Flower (Prof., F.R.S.), Hunterian Lectures, 350
Flowers, Darwin's Different Forms of, 445
Flowers and Bees, John B. Bridgman, 102
Flowers and Insects, 11; Fritz Müller on, 78
Fog-Signals, Dr. Tyndall, F.R.S., 456
Forbes (Henry O.), Selective Discrimination of Insects, 62
Forbes (Prof. Geo.), the Telephone as an Instrument of Precision, 343
Forel (Dr. F. A.), Seiches and Earthquakes, 281
Forests, the Air of, 515
Forficulidæ (Earwigs), 128
Fossils: Discovery of Fossil Plants in Grinnell Land, 115; Fossil Fungus, 127; the Brain of a Fossil Mammal, 222, 340; Preparing Fossils, 369; Fossil Hunting at Bournemouth, J. S. Gardner, 369; London Clay Fossils, 487; Fossil Insects, 508
Foster (Prof. G. Carey, F.R.S.), the Radiometer and its Lessons, 5, 43, 80, 142
Foucault's Pendulum Experiments, 108
Fownes' "Manual of Chemistry," 24, 46
Fox (Gen. A. Lane, F.R.S.), the Arrangement of Museums, 484
France: French Geographical Society, 17; Association Polytechnique, 54; Statistics of Suicides in, 54; Bequest to the French Institute, 70; Universities in, 114; French Acclimatisation Society, 132; Education in, 193, 214; the Scientific Association of, 232, 271; French Association for the Advancement of Science, 251, 350; French Academy of Sciences, 273; Distribution of Prizes, 271; Proposed Exploring Expeditions, 329; Agricultural Weather Warnings, 371; Statistics of Wine Production, 372; Preservation of Boulders in, 391; Drought in the South of, 475; Sociétés Savantes, 490. *See also* Paris, &c.
Frankland's Researches in Chemistry, Prof. J. Emerson Reynolds, 218, 318
Freiburg, University Statistics, 334
French Guayana, 508
French Popular Science, 120
Freshwater Fishes, the Distribution of, 128
Fries (Elias Magnus), Death of, 329; Obituary Notice of, 343
Fruit, Fungoid Disease of, 91
Fruits, the Action of Certain Antiseptic Vapours on the Ripening of, 150
Fungoid Disease of Fruit, 91
Fungus, a Fossil, 127

Gabb (W. M.), Sense in Insects—Drowned by a Devil Fish, 282
Gabriel (M. Delafosse), Illness of, 370
Galileo, was, Tortured? Sedley Taylor, 299
Galloway (W.), Explosions in Mines, 21
Gannister Beds of Northumberland, Marine Fossils in the, Prof. G. A. Lebour, 320, 352
"Gardener Bird," the, 110
Gardner (J. S.), the Eocene Flora of Bournemouth, 47; Fossil Hunting at Bournemouth, 369
Garnett (William), Leidenfrost's Phenomena, 466
Gas-Holder, New Form of, Prof. W. F. Barrett, 253
Gas-Lighting by Electricity, 495
Gases: Diffusion of, 92; the Liquefaction of the, 117, 265; the Last of the, 177; Experiments on Spread of, through Bodies, 393
Geikie (Prof. A., F.R.S.), Prof. Bryce's Ararat, 205; American Geological Surveys, 431; the Old Red Sandstone of Western Europe, 471
Gems from Russia, 72; the Production of Artificial, 55, 136, 152
Geneva, Lake of, Earthquake near, 234
Geneva Society of Physics and Natural History, 136
Gentiana asclepiadea and Bees, F. M. Burton, 201
Geography: Geographical Notes, 249, 270, 290, 308, 324, 364, 383, 408, 434, 452, 467, 489, 508; Geography at French Railway Stations, 110; Geographical Magazine, 132, 293, 468; Geographical Bibliography, 324
Geology: Geological Congress, International, 65; Hauer's "Die Geologie," 78; Geological Society, 115, 136, 155, 255, 294, 335, 374, 395, 518; Geological Work of the United States Survey under Dr. Hayden during the Summer of 1877, 129; Geological Surveys of America—Missouri, Prof. A. Geikie, F.R.S., 431; Geologists' Association, 475; Geological Time, G. H. Darwin, 509
Geometrical Teaching, the Association for the Improvement of, 89, 251
"Geometry of Compasses," Oliver Byrne, 199
Geometry of Three Dimensions, Theorems Relating to, Prof. S. Newcomb, F.R.S., 240
Germany: German Universities, Statistics of, 103; German Chemical Society, 131, 273; Botany in, 158; German Scientific Association, Report of the Munich Session, 350; University Libraries of, 374; German Polytechnic Congress, 394; German Alpine Club, 468
Ghinozzi (Dr. Carlo), Death of, 170
Gibraltar, the Geology of, Prof. A. C. Ramsay, F.R.S., and James Geikie, F.R.S., 518
Giessen, the Ph. Degree at, 75; University Statistics, 478
Gilchrist Educational Trust, 334
Gillmore (Parker), "The Great Thirst Land," 360
Ginez (Francisco), Carnivorous Plants, 63
Giraud (Dr. H.), Death of, 513
Glacial Geology of Orkney and Shetland, S. Laing, M.P., 123; Prof. M. Forster Heddle, 182
Glass for Reflectors, Henry Bessemer, 241
Glass, the Engraving of, 372; Compressed Hard, 392
Glassy Sponges, 222
Glossostigma, Fertilisation of, T. F. Cheeseman, 163
Goethe, Proposed Monument to, 211
Gold, Dendritic, 283
Gold in Teheran, 115; in New Guinea, 408
Goode (G. Brown), the Bermuda Lizard, 425
Gordon (J. E. H.), the Telephone as a Means of Measuring the Speed of High Brakes, 424
Gore (G., LL.D., F.R.S.), the Thermo-Electric Properties of Liquids, 479
Gorilla, Dissection of the Berlin, 89
Gottland, Discovery of Ancient Bronze Weights in, 351
Göttingen, Royal Academy of Sciences, 156, 296, 480; University Statistics, 214
Government Research Fund, 403
Grapes, Frost-Bitten, 132
"Gray's China," 484
Great Pyramid, J. G. Jackson, 243
"Great Thirst Land," Parker Gillmore's, 360
Greek Cities and Islands of Asia Minor, W. S. W. Vaux, 119
Greeks, the Colour Sense of the, Prof. W. Robertson Smith, 100
Green Algæ, 289
Greenland, Danish, Dr. Henry Rink, 57
Greifswald, University Statistics, 354
Greyhounds, Turkoman, 434
Grimm (Prof.), on the Fauna of the Caspian, 345
Grinnell Land, Fossil Plants found in, 115
Groshans (Dr. J. A.), Photography Foreshadowed, 202
Grove's Gas Battery, 394
Grove's Dictionary of Music, Dr. W. H. Stone, 422
Guadaloupe Island, the Birds of, 128
Guildhall, Public Standards at the, 454
Guillemard (Arthur G.), Great Waterfalls, 221, 242
Gulf Stream, the *Challenger* Estimates of the Volume of the, T. Mellard Reade, 144

Günther (Dr., F.R.S.), Gigantic Land Tortoises, 483

Hailstones, Rain-drops, and Snow-flakes, the Formation of, Prof. Osborne Reynolds, F.R.S., 207
Hailstorm at Brisbane, 455
Hair, Human, the Colouring Matter of, 355
Halle, University Intelligence, 235, 478
Haller (Albert von), 90, 223
Halogen Derivatives of Amines, 151
Handwriting, Restoration of the, of Old MSS., 351
Hanover, the Polytechnic at, 335
Harmonograph, 394
Harrison (Park), Exploration of the "Cave Pit," Cissbury, 53
Harrison (W. H.), "Lazy Lays," 38
Harrison (W. J.), Geology of Leicestershire and Rutland, 58
Harrow School Bathing-Place, Arthur G. Watson, 487
Hartlaub's "Birds of Madagascar," Prof. A. Newton, F.R.S., 9
Harvard College, U.S., Observatory, 363
Harvey (William), Notice of, by Prof. T. H. Huxley, F.R.S., 417; the Proposed Statue of, 435
Hatfield (H.), Meteor, 342
Hauer (F. R. von), "Die Geologie," 78
Hayden (Dr.) Geological Work of the U.S. Survey in 1877, 129
Head-Masters on Science Teaching, Rev. W. Tuckwell, 317
Hearing and Smell in Insects, Henry Cecil, 102, 381
Heat, B. Loewy, 43
Heat, Evolution of, during Muscular Action, Prof. A. Fick, 285
Heat-Motion, on a Means of Converting the, Possessed by Matter at Normal Temperature in Work, S. Tolver Preston, 202; John Aitken, 260
Hebrides, Low Barometric Readings in the, Nov., 1877, 307
Hecla, Mount, Eruption of, 454
Heddle (Prof. M. Forster), Glaciation of Orkney, 182
Heidelberg, University of, 195
Helmholtz (Prof. H., F.R.S.), Lord Rayleigh's "Theory of Sound," 237; Helmholtz's Vowel Theory and the Phonograph, 384, 411, 423
Henderson (Richard) Manual of Agriculture, 280
Hennessey (J. B. N., F.R.S.), Optical Spectroscopy of the Red End of the Solar Spectrum, 28
Henry Telephone, 437
Hensen (M.), the Earthworm in Relation to the Fertility of the Ground, 18
Henslow (Rev. G.), on the Self-Fertilisation of Plants, 221
Hering (M.), on the Sense of Temperature, 372
Hermann (Otto), Hungarian Spiders, 128
Herring Fisheries and the Telegraph, 351; the Swedish, 391
Herschel (Prof. A. S.), the "Phantom" Force, 302, 321, 340
Hicks (Henry), Dimetian and Pebidian Rocks of Pembrokeshire, 155
Higgins (H. H.), "Notes by a Field Naturalist in the Western Tropics," 121
High Tides, Prediction of, 38, 45, 58, 101
Hildebrandt (Dr. J. M.), Ascent of Mount Kenia, 72; Exploration of Africa, 194
Hilgard (J. E.), Transatlantic Longitudes, 244
Hind (J. R., F.R.S.), Wolf's "History of Astronomy," 259 (Translation), 359
Hinde (G. J.), Earthquake in Canada, 90
Hinduism, Buddhism, and Islam, 239
Hippopotamus, Death of, in the Zoological Gardens, 392
Hissarlik, Antiquities from, 397
Hofmann (Prof. A.), a "Commers" in Honour of, 393
Hofmeister's Cryptogamia, 344
Holden (J. Sinclair), Strychnia and its Antidote, 360
Hollis (W. Ainslie), Supplementary Eye-brows, 124
Hopkins, Johns, University, Baltimore, Anniversary, 459; Fellowships at, 517
Horology, Modern, M. Claudius Saunier, 484
Horse-Shoe Crabs, 289
"Horticulture," F. W. Burbidge, 142
Hovelacque (Abel), the Science of Language, 464
Howgate (Capt.), Arctic Expedition, 153, 171
Hubbard (E.), the Wasp and the Spider, 402
Humboldt Institution for Naturalists and Travellers, 311
Hungary: Spiders of, 128; Rotifers of, 128
Hunter (Dr. W. W.), Rainfall in the Temperate Zone in Connection with the Sun-spot Cycle, 59; Great Waterfalls, 242
Hunterian Lectures for 1878, 350
Huxley's "Physiography," 178
Hydrophobia, 117, 139
Hygrometer, a new Condensing, 14, 28; M. Alluard's, 132

Ice: as an Electrolyte, 56; R. Pictet on the Formation of 154; Production of, 212
Iceland: Volcanic Eruption in, 171; no Butterflies in, 243, 260
Ilford Fossils, Dr. R. P. Cotton's Collection of, 231
Index Society, 37
India: Methods for Determining Solar Radiation in, 131; the Rainfall of, 273, 505; the Climate of, 307
Indium in British Blendes, Prof. N. S. Maskelyne, F.R.S., 5
"Inductive Metrology," Flinders Petrie, 357
Indus River, 38, 250
"Industrial Art," 272
Inflexible, the, 131, 137
Ingleby (Dr. C. M.), Philadelphia Diplomas, 183
Injurious Insects, Report on, 330
Innsbruck University Statistics, 254
Insectivorous Plants, Francis Darwin, 222
Insects: and Flowers, 11; Fritz Müller on Insects and Flowers, 78; Insects, Hearing and Smell in, Henry Cecil, 102, 381; Insects and Artificial Flowers, 133, 162; Selective Discrimination of Insects, 62, 163, 402, 425; Insect Fauna of Chili, R. McLachlan, F.R.S., 162; A. R. Wallace, 182; Insects of Chili and New Zealand, 221, 260; Sense in, W. M. Gabb, 282; Report on Injurious, 330; Digestion in, 411
Institute of Chemistry, 273, 291, 309
Institute of Civil Engineers, 54, 76, 156, 215, 276, 356, 416, 460, 500, 520
International Geological Congress, 65
International Polar Expeditions, E. J. Reed, C.B., M.P., 29
Iodates of Cobalt and Nickel, 150
Iquique, Earthquake at, 90, 272
Iron and Steel Institute, 436, 458
Iron, Red-hot and Light, 17
Iron Ships, Compass Adjustment in, Sir William Thomson, F.R.S., 331, 352, 387
Iron, the Fracture of, 491
Islam and its Founder, J. W. H. Stobart, 239
Island, a Volcanic, 194
Isomerism, Influence of, on the Formation of Ethers between Acids and Alcohols, 151
Italian Cryptogamic Society, 491
Italian Geographical Society, 37, 132

Jack (Robert L.), Research in Libraries, 486
Jackson (J. G.), the Great Pyramid, 243
Jahrbücher f. wissenschaftliche Botanik, 158
Jahresbericht für Chemie, 171
Janssen's Researches on the Sun's Photosphere, J. Norman Lockyer, F.R.S., 23
Japan: Edward S. Morse on Traces of Early Man in, 89; Exploration of, 171; Archæological Society in, 271; Geographical Work in, 290; Japanese Students in England, 491
Jena, University Statistics, 254
Jenkins (Prof. Fleeming) and J. A. Ewing on Helmholtz's Vowel Theory and the Phonograph, 384, 423
Jenkins (B. G.), Expected High Tides, 45, 101; Sun-spots and Terrestrial Magnetism, 259
Jersey, Earthquake in, 272
Jewell (Lieut. Theo. F.), Sounding Apparatus, 230
Johns Hopkins Scientific Association, 113
Joliet (M. L.), French Polyzoa, 382
Jordan (Dr. D. S.), the Distribution of Freshwater Fishes, 128
Journal de Physique, 294, 314
Journal of Forestry, 153
Judd (Prof. J. W., F.R.S.), the Strata of the Western Coast and Islands of Scotland, 335
Jupiter's Satellites, 149

"Kames" in Connecticut, 213
Kampf (Dr. Frederick), Death of, 513
Kant (Immanuel), Proposed Monument to, 391
"Katzen, Das Buch der," 351
Keane (A. H.), Translation of Hovelacque's Science of Language, 464
Kekulé (Prof.), on the Position of Chemistry, 55
Kelsief (M.), Exploration of Russia, 38
Kenia, Mount, Dr. J. M. Hildebrandt's Ascent of, 72

Kent (W. Saville), Sound-producing Arthropods, 11; a Zoological Station for the Channel Islands, 102
Kern (Sergius), Davyum, 245, 292
Key (Rev. Henry Cooper), the Earthworm in Relation to the Fertility of the Soil, 28
Kieff, University Intelligence, 374
Kirtland (Dr. J. P.), Obituary Notice of, 232
Knots, Trefoil, 421
Kœnig and Appunn—Beats in Confined Air, Alex. J. Ellis, F.R.S., 26
Königsberg, University Intelligence, 55, 478
Korostovtseff (M.), Exploration of the Northern Pamir, 249
Kosmos, 20, 254, 374
Krupp's Workshops, Statistics of, 351
Kuhlmann (Prof.), Collection of his Researches, 437
Kurz (Sulhiz), Death of, 391

Lagrange, the Statue of, 53
Laing (S. M. P.), Glacial Geology of Orkney and Shetland, 123
Lake-Dwellings, English, and Pile Structures, Prof. T. Rupert Jones, F.R.S., 424
Lakes, Depths of, 468
Lalande, the Star, 382, 488
Lamps, Lighting by Electricity, 108
Lamy (Prof. A.), Death of, 436
Landslip near Cork, C. J. Cooke, 425
Land-Tortoises, Gigantic, Dr. Günther, F.R.S., 483
Landvort (M. Schoun), Death of, 170
Langdon (W. E.), the Application of Electricity to Railway Working, 461
Language, the Science of, Abel Hovelacque, 464
L'Année Géographique, 1876, 489
Lapland, Exploration of Russian, 345
Laplanders at the Westminster Aquarium, 70
Last of the Gases, 177
Lava, Mineral Oil in, at Mount Etna, 150
Lebour (Prof. G. A.), Marine Fossils in the Gannister Beds of Northumberland, 320, 352
Leeds, Yorkshire College of Science, 175
Leicestershire and Rutland, Harrison's Geology of, 58
Leidenfrost's Phenomena, Wm. Garnett, 466
Leipzig, University Intelligence, 95
Levels, Bubbles of Air in, 233
Leverrier, the Pension to his Widow, 52; Proposed Monument to, 350, 391
Leverrier (Madame), Death of, 37
Lexington, U.S., Endowment of the University, 175
Library, Statistics of the Paris National, 92
Libraries of German and Austrian Universities, 374
Libraries, Research in, Robert L. Jack, 486
Liebig, the Proposed Monument to, at Munich, 16
Liebreich (Dr. R.), the Deterioration of Oil Paintings, 493, 515
Liesthal, Earthquake at, 475
Lighting Lamps by Electricity, 108
Light, Chemical Action of, 151, 436; the Sources and Reflection of, Mayer and Barnard, 405, 427; Action of, on a Selenium (Galvanic) Element, Robert Sabine, 512; Experiment on Light and Electricity, 233
Lime, Strontian, and Baryta, Crystallisation of, 372
Limestone Rock, the Origin of a, Prof. W. C. Williamson, F.R.S., 265
Lindsay (Lord), his Dun Echt Observatory Publications, 432
Lingula, Structure of, 383
Linne, Centenary of his Death, 210, 271
Linnean Society, 55, 155, 175, 235, 315, 355, 394, 439, 499, 519; and the Centenary of Linné, 309
Liquefaction of Air and of the so-called Permanent Gases, Prof. T. E. Thorpe, F.R.S., 384
Liquefaction of Oxygen, &c., 169, 177, 265
Liquids, Compressibility of, M. Amagat on, 91; Thermo-electric Properties of, G. Gore, F.R.S., 479; Volume of and the Absorption of Gases, 514; the Concentration of, and their Electromotive Force, 515
Lisbon, Earthquake at, 17
Littrow (Carl von), Obituary Notice of, 83
Liveing and Dewar (Profs.), on the Reversal of the Lines of Metallic Vapours, 498
Liver, the Glycogenic Function of the, 439
Liverpool Historic Society, 193
Lizard, the Bermuda, G. Brown Goode, 425
Lloyd (W. A.), the Proposed Channel Islands' Zoological Station, Aquarium, and Piscicultural Institute, 143
Lloyd (Dr.), Scientific Papers of, 272
Lob-Nor, Lake, Expedition to, 234, 434
Lockyer (J. Norman, F.R.S.), the Sun's Photosphere, 23; the Modern Telescope, 66, 125, 188, 225; the Use of the Reflection Grating in Eclipse Photography, 354; the Coming Total Solar Eclipse, 481, 501
Locomotive Engine, Quick Mounting of, 438
Locust Plague in America, Andrew Murray, 377
Loewy (B.), "Heat," 43
Lohrmann's Lunar Charts, 343
London, University of, 19
London Clay Fossils, 487
Longitudes, Transatlantic, 244, 408
Lubavin (N. N.), "Physical Chemistry," 240
Lubbock (Sir John, F.R.S.), Habits of Ants, 355
Lunar Charts, Lohrmann's, 343
Lunar Landscape, Winkler's, 469, 514
Lyons Observatory, 149

Macalister (Prof. Alex.), Royal Dublin Society, 183
McCook (H. C.), the Agricultural Ants of Texas, 433; the Aëronautic Flight of Spiders, 434
McKendrick (Prof. J. G.), Telephonic Alarum, 181
Mackennah (A.), Explosions, 123
McLachlan (R., F.R.S.), Insect Fauna of Chili, 162, 182; on some Pecular Points in the Insect Fauna of Chili, 260
Maclear (Commander J. P.), Spectrum of Aurora Australis, 11
McNab (Prof. W. R.), Baker's Flora of Mauritius and Seychelles, 77; Botany in Germany, 158; Oliver's Flora of Tropical Africa, 319
Macrosilia cluentius, Dr. Hermann Müller, 221
Madagascar, Hartlaub's Birds of, 9
Madrid, Annual Report of the Observatory of, 70
Magnet, a New, 252
Magnetical Measurements in Russia, 153
Magnets, Floating, Alfred M. Mayer, 487
Mahwa Tree, 394
Maisonneuve (M. C. Durieu de), Death of, 436
Male Nurse, a, 222
Malt, Explosion of, A. Mackennah, 123
Mammal, the Brain of a Fossil, 222
Mammoth Remains in Tomsk, 153
Mammoth, Discovery of a Fossil, in Hanover, 273
Man, Traces of Early, in Japan, 89; Antiquity of Man, 315
Manchester, Chemical Society at Owens College, 114; Literary and Philosophical Society, 96, 176, 296
Manjean (M.), Bequest to the French Institute, 70
Manfredonia, a Buried City near, 211
Manuscripts, Restoration of the Handwriting of, 351
Maps of the Balkan Peninsula, 346
Maps, Ancient, of Central Africa, 383
Marburg, University Statistics, 478
Mareotis, Lake, Proposed Draining of, 212
Marine Fossils in the Gannister Beds of Northumberland, Prof. G. A. Lebour, 320, 352
Marjoram and Thyme, Fertilisation in, 127
Marmora (Gen. La), Death of, 211
Mars, the Satellites of, 15, 190, 231, 288, 433; the Planet, and B.A.C. 8129, 105; the South Polar Spot of, 209
Marseilles, Proposed Zoological Garden at, 474
Marsh (Prof. O. C.), Brain of a Fossil Mammal, 340
Marshall (Dr. A. M.), the Development of Nerves, 382
Martini (Prof. Tito), Diffusion Figures in Liquids, 87
Maskelyne (Prof. N. S., F.R.S.), Indium in British Blendes, 5
Mathematical Society, 95, 155, 254, 336, 400, 459
Mauritius and Seychelles, the Flora of, by J. G. Baker, 77
Maxwell (Prof. Clerk, F.R.S.), an Electrical Experiment, 180; Tait's "Thermodynamics," 257, 278
Mayer (Alfred M.), Edison's Talking Machine (the Phonograph), 469; Floating Magnets, 487
Mayer and Barnard, the Sources and Reflection of Light, 405, 427
Mayer (Robert Julius v.), Death of, 435; Obituary Notice, 450
Mayer (Dr. Paul), Entomological Query, 467
Mechanical Analysis of the Trevelyan Rocker, Samuel H. Frisbee, 242
Medusæ, Prof. Eimer on the Nervous System of, George J. Romanes, 200

De Vico's Comet of Short Period, 15
Devil Fish, Drowned by a, 27, 282
Dien's "Celestial Atlas," 141
Diet, A Physician's Experiment, 305
Diffusion Figures in Liquids, 87, 102, 124
Diffusion of Gases, 92
Digital Reduction, the Laws of, 128
Digits, Hereditary Case of Six, 372
Dimetian and Pebidian Rocks of Pembrokeshire, 155
Dispersal, Means of, W. L. Distant, 124
Distant (W. L.), Means of Dispersal, 124; Oriental Affinities in the Ethiopian Insect Fauna, 282
Distillation of Organic Liquids by Means of Steam, 270
Dixon (Charles), Towering of Wounded Birds, 45
Doberck (Dr. W.), Ole Römer, 105
Dog-Fish, Capture of a, 251
Dohrn (Dr. Anton), the Zoological Station, Naples, 329, 360
Donati's Comet of 1858, 149
Donisthorpe (Wordsworth), Change of Habits in Toads, 242
Dorpat, University Intelligence, 354
Dorset, Earthquake in, 38
Double Salts with Cyanide of Gold, 151
Double Stars, 407
Dowdeswell (G. F), Bacteria in Water, 323
Downing (A. W.), Sun-spots and Terrestrial Magnetism, 242
Draper (Dr. Henry), Oxygen in the Sun, 339
Dresden, the Polytechnic, 354
Drosera rotundifolia, the Nutrition of, 222
Drought in the Southern Hemisphere, 436, 447, 454
Drury's "Chronology at a Glance," 253
Dublin, the Royal Society, 46
Dumas' Lectures on Chemical Philosophy, 193
Duncan (Dr. P. Martin), Cassell's Natural History, 365
Dundee Naturalists' Society, 54
Dun Echt Observatory Publications, 432
Dust, Explosive, 283
Dwarfs, African, 364
Dyer (Prof. W. T. Thiselton), the Rain-Tree of Moyobamba, 349

Early Man, Traces of, in Japan, 89
Ears, Singing in the, Xenos Clark, 342
Earth, Age of the, W. M. Flinders Petrie, 465
Earthquakes, 330; at Lisbon, 17; in Dorset, 38; New York, 38; at Iquique, 90; in Canada, 90, 110; in Nebraska, 110; the "Ionia Volcano," 110; at Beachburg, 212; in Jersey, 272; of January 28, 1878, 292; at Liesthal, 475; at St. Stefano, 514
Earthquakes and Seiches, Dr. F. A. Forel, 281
Earthworm in Relation to the Fertility of the Ground, 18, 28, 62
Earthworm, Supposed Gigantic, 325
Earwigs, 128
Easter, the Date of, 433
Eastern Excavations, 397
Eclipse Photography, the Use of the Reflection Grating in, J. Norman Lockyer, F.R.S., 354
Eclipses: Solar of February 2, 1878, 36; Total Solar Eclipse of A.D. 418, 163; the Total Solar Eclipse of July 29, 1878, 250, 269, 381, 452, 453; the Coming Total Solar Eclipse, J. Norman Lockyer, F.R.S., 481, 501
Eden (C. H.), "The Fifth Continent with the Adjacent Islands," 121
Edinburgh: University Buildings Extension Scheme, 95, 114; University Intelligence, 154, 294, 517; University Statistics, 214; Royal Society, 216, 276, 439, 480; University Chemical Society, 296, 500, 526; New School of Medicine at, 354; Proposed Portrait of Dr. Balfour, 393
Edison's Phonograph, 90, 190, 291, 469
Educational Travel, 324
Education, Female, in Germany, 478
Education in France, 170
Education, Technical, Prof. Huxley on, 97
Edwards (M. Milne), appointed President of the French Scientific Association, 152
Eggs, the Earliest Changes in Animal, 509
Egypt, Flint Flakes, &c., from, 215
Eidum, a Submerged Village, 232
Eimer (Prof.), on the Nervous System of Medusæ, Geo. J. Romanes, 200
Elasmobranchs, the Fins of, Prof. St. G. Mivart, F.R.S., 355
Electrical Analogies with Natural Phenomena, 226, 385; Electrical Experiments, 180, 282
Electrical Nerves, Social, 305, 346
Electric Battery, a New, 455
Electric Lighting, 156, 310, 437
Electricity, Gas Lighting by, 495; and Light, Experiment on, 233; and Railway Collisions, 371; and Railway Working, W. E. Langdon, 461
Electro-Generator, Electromotive Force of, 514
Electro-Magnets, 20, 40, 56, 76, 96
Electrometer, New Form of Absolute, 115
Electromotive Force, 252
Electrostriction, Prof. Mills, F.R.S., on, 235
Elliot (James), a Meteor, 425
Ellis (Alex. J., F.R.S.), Appunn and Kœnig—Beats in Confined Air, 26; the Phonograph, 4, 85
Elton (Capt.), Death of, 383
Encke's Comet in 1878, 507
English Lake-Dwellings and Pile Structures, Prof. T. Rupert Jones, F.R.S., 424
Entomology: Entomological Society, 75, 176, 256, 395, 459; Entomology in America, 229; Entomological Exhibition at the Westminster Aquarium, 351, 391, 402; Entomological Queries, 467
Eocene Flora of Bournemouth, J. S. Gardner, 47
Erlangen, University Statistics, 214
Esquimaux in Paris, 54, 309
Ethiopian Insect Fauna, Oriental Affinities in the, W. L. Distant, 282
Ethnography, Lectures on, in Paris, 330
Ethnological Literature of 1876, 133
Ethnology of North America, 53
Ethylen Oxide, New Modes of Forming, 150
Eucalyptus: Prince Pierre Troubitzkoy, 10; Arthur Nicols, 101, 342; used for Checking Fire, 38; Dr. Calmy, 283; as Fuel, 392; the Uses of, 514
Euplectella Sponges, 222
Euphrosyne, the Minor Planet, 36
Eurydice, the Meteorological Conditions Affecting the Wreck of the, 437, 466
Eva, the Minor Planet, 210
Everett (A. H.), Volcanic Phenomena in Borneo, 200
Everett (Prof. J. D.), "Shorthand for General Use," 17; Underground Temperature, 476
Evolution, Age of the Sun in Relation to, J. I. Plummer, 303, 360; Dr. James Croll, F.R.S., 321, 464
Evolution of Heat during Muscular Action, Prof. A. Fick, 285
Exner (Prof.), on the Diffusion of Gases, 92
Exploring Colonies, 290
Explosions in Mines, W. Galloway, 21
Explosions, A. Mackennah, 123
Explosive, Discovery of a New, 436
Explosive Dust, 283
Eyck (Jan van), Colossal Bronze Statue of, 490
Eye-brows, Supplementary, W. Ainslie Hollis, 124
Eye-motions during Sleep, &c., 371

Falb (Dr. Rud)., his Travels in South America, 513
Faraday (Prof.), Bust of, 291
Faraday's "Experimental Researches," Sylvanus P. Thompson, 304, 361; Bernard Quaritch, 342
Faunas and Floras, the Comparative Richness of, tested Numerically, Alfred R. Wallace, 100
Fay (Eva), Mr. Crookes and Dr. W. B. Carpenter, F.R.S., 81, 122; Alfred R. Wallace, 101
Faye (A. E. A.), elected Minister of Instruction for France, 91
Female Education in Germany, 478
Ferment in Plants, 455
Ferns and Mosses, Hofmeister's work on, 344
Ferns, J. Smith's British and Foreign, 43
Fertilisation in Thyme and Marjoram, 127
Fertilisation of *Glossostigma*, J. F. Chesseman, 163
Fertilisation of Plants, 221
Fetichism in Animals, Geo. J. Romanes, 168; C. G. O'Brian, 402
Fick (Prof. A.), on the Evolution of Heat During Muscular Action, 285
Fielden (Capt.), on the Geology of the Arctic Regions, 473
Field-mice, or Rats, Plague of, in Smyrna, 437

"Fifth Continent and the Adjacent Islands," C. H. Eden, 121
Figuier's "Les Six Parties du Monde," 17
Fiji Islands, the Climatology of the, 248
Films, Experiments on Fluid, 44, 61
"Fire-Ball," Fall of a, 10
Fire-damp, Commission on Explosions from, 252
Fires, Telegraphic Warnings of, in Paris, 91
Fisheries, of the Rhine, 212; the American Inland, 382
Fishes, the Distribution of Freshwater, 128; Prof. E. Perceval Wright on Fishes' Tails, 286; Glacial and Post-glacial Fishes of Norway, 509
Fittig's "Organic Chemistry," French Translation of, 233
Fitzgerald (Geo. Fras.), the Radiometer and its Lessons, 199
Flame, Vibrations of a, Experiments on, 54
Flame Spectra, Observing the Coloured Lines of, 273
Flames, Temperature of, 269
Flammarion (M.) on Stellar Systems, 82
Floating Magnets, Alfred M. Mayer, 487
Flora, British, the Future of Our, A. Craig-Christie, 62
"Flora of Tropical Africa," Prof. D. Oliver, F.R.S., 319
Floras and Faunas, the Comparative Richness of, Tested Numerically, Alfred R. Wallace, 100
Flower (James), Death of, 37
Flower (Prof., F.R.S.), Hunterian Lectures, 350
Flowers, Darwin's Different Forms of, 445
Flowers and Bees, John B. Bridgman, 102
Flowers and Insects, 11; Fritz Müller on, 78
Fog-Signals, Dr. Tyndall, F.R.S., 456
Forbes (Henry O.), Selective Discrimination of Insects, 62
Forbes (Prof. Geo.), the Telephone as an Instrument of Precision, 343
Forel (Dr. F. A.), Seiches and Earthquakes, 281
Forests, the Air of, 515
Forficulidæ (Earwigs), 128
Fossils: Discovery of Fossil Plants in Grinnell Land, 115; Fossil Fungus, 127; the Brain of a Fossil Mammal, 222, 340; Preparing Fossils, 369; Fossil Hunting at Bournemouth, J. S. Gardner, 369; London Clay Fossils, 487; Fossil Insects, 508
Foster (Prof. G. Carey, F.R.S.), the Radiometer and its Lessons, 5, 43, 80, 142
Foucault's Pendulum Experiments, 108
Fownes' "Manual of Chemistry," 24, 46
Fox (Gen. A. Lane, F.R.S.), the Arrangement of Museums, 484
France: French Geographical Society, 17; Association Polytechnique, 54; Statistics of Suicides in, 54; Bequest to the French Institute, 70; Universities in, 114; French Acclimatisation Society, 132; Education in, 193, 214; the Scientific Association of, 232, 271; French Association for the Advancement of Science, 251, 350; French Academy of Sciences, 273; Distribution of Prizes, 271; Proposed Exploring Expeditions, 329; Agricultural Weather Warnings, 371; Statistics of Wine Production, 372; Preservation of Boulders in, 391; Drought in the South of, 475; Sociétés Savantes, 490. *See also* Paris, &c.
Frankland's Researches in Chemistry, Prof. J. Emerson Reynolds, 218, 318
Freiburg, University Statistics, 334
French Guayana, 508
French Popular Science, 120
Freshwater Fishes, the Distribution of, 128
Fries (Elias Magnus), Death of, 329; Obituary Notice of, 343
Fruit, Fungoid Disease of, 91
Fruits, the Action of Certain Antiseptic Vapours on the Ripening of, 150
Fungoid Disease of Fruit, 91
Fungus, a Fossil, 127

Gabb (W. M.), Sense in Insects—Drowned by a Devil Fish, 282
Gabriel (M. Delafosse), Illness of, 370
Galileo, was, Tortured? Sedley Taylor, 299
Galloway (W.), Explosions in Mines, 21
Gannister Beds of Northumberland, Marine Fossils in the, Prof. G. A. Lebour, 320, 352
"Gardener Bird," the, 110
Gardner (J. S.), the Eocene Flora of Bournemouth, 47; Fossil Hunting at Bournemouth, 369
Garnett (William), Leidenfrost's Phenomena, 466
Gas-Holder, New Form of, Prof. W. F. Barrett, 253
Gas-Lighting by Electricity, 495
Gases: Diffusion of, 92; the Liquefaction of the, 117, 265; the Last of the, 177; Experiments on Spread of, through Bodies, 393
Geikie (Prof. A., F.R.S.), Prof. Bryce's Ararat, 205; American Geological Surveys, 431; the Old Red Sandstone of Western Europe, 471
Gems from Russia, 72; the Production of Artificial, 55, 136, 152
Geneva, Lake of, Earthquake near, 234
Geneva Society of Physics and Natural History, 136
Gentiana asclepiadea and Bees, F. M. Burton, 201
Geography: Geographical Notes, 249, 270, 290, 308, 324, 364, 383, 408, 434, 452, 467, 489, 508; Geography at French Railway Stations, 110; Geographical Magazine, 132, 293, 468; Geographical Bibliography, 324
Geology: Geological Congress, International, 65; Hauer's "Die Geologie," 78; Geological Society, 115, 136, 155, 255, 294, 335, 374, 395, 518; Geological Work of the United States Survey under Dr. Hayden during the Summer of 1877, 129; Geological Surveys of America—Missouri, Prof. A. Geikie, F.R.S., 431; Geologists' Association, 475; Geological Time, G. H. Darwin, 509
Geometrical Teaching, the Association for the Improvement of, 89, 251
"Geometry of Compasses," Oliver Byrne, 199
Geometry of Three Dimensions, Theorems Relating to, Prof. S. Newcomb, F.R.S., 240
Germany: German Universities, Statistics of, 103; German Chemical Society, 131, 273; Botany in, 158; German Scientific Association, Report of the Munich Session, 350; University Libraries of, 374; German Polytechnic Congress, 394; German Alpine Club, 468
Ghinozzi (Dr. Carlo), Death of, 170
Gibraltar, the Geology of, Prof. A. C. Ramsay, F.R.S., and James Geikie, F.R.S., 518
Giessen, the Ph. Degree at, 75; University Statistics, 478
Gilchrist Educational Trust, 334
Gillmore (Parker), "The Great Thirst Land," 360
Ginez (Francisco), Carnivorous Plants, 63
Giraud (Dr. H.), Death of, 513
Glacial Geology of Orkney and Shetland, S. Laing, M.P., 123; Prof. M. Forster Heddle, 182
Glass for Reflectors, Henry Bessemer, 241
Glass, the Engraving of, 372; Compressed Hard, 392
Glassy Sponges, 222
Glossostigma, Fertilisation of, T. F. Cheeseman, 163
Goethe, Proposed Monument to, 211
Gold, Dendritic, 283
Gold in Teheran, 115; in New Guinea, 408
Goode (G. Brown), the Bermuda Lizard, 425
Gordon (J. E. H.), the Telephone as a Means of Measuring the Speed of High Brakes, 424
Gore (G., LL.D., F.R.S.), the Thermo-Electric Properties of Liquids, 479
Gorilla, Dissection of the Berlin, 89
Gottland, Discovery of Ancient Bronze Weights in, 351
Göttingen, Royal Academy of Sciences, 156, 296, 480; University Statistics, 214
Government Research Fund, 403
Grapes, Frost-Bitten, 132
"Gray's China," 484
Great Pyramid, J. G. Jackson, 243
"Great Thirst Land," Parker Gillmore's, 360
Greek Cities and Islands of Asia Minor, W. S. W. Vaux, 119
Greeks, the Colour Sense of the, Prof. W. Robertson Smith, 100
Green Algæ, 289
Greenland, Danish, Dr. Henry Rink, 57
Greifswald, University Statistics, 354
Greyhounds, Turkoman, 434
Grimm (Prof.), on the Fauna of the Caspian, 345
Grinnell Land, Fossil Plants found in, 115
Groshans (Dr. J. A.), Photography Foreshadowed, 202
Grove's Gas Battery, 394
Grove's Dictionary of Music, Dr. W. H. Stone, 422
Guadaloupe Island, the Birds of, 128
Guildhall, Public Standards at the, 454
Guillemard (Arthur G.), Great Waterfalls, 221, 242
Gulf Stream, the *Challenger* Estimates of the Volume of the, T. Mellard Reade, 144

Meldola (R.), Oxygen in the Sun, 161
Meldrum (C., F.R.S.), Sun-spots and Rainfall, 448
Mello (Joaquim Corrêa de), Death of, 309
Melo-Piano, the, 453
Memorie della Società degli Spettroscopisti Italiani, 314
Mercury, the Transit of, on May 6, 1878, 46, 69, 363, 370, 488
Merriman (Mansfield), List of Writings on the Method of Least Squares, 219
Merten, Excavations at, 475
Metallic Vapours, the Reversal of the Lines of the, Professors Liveing and Dewar, 498
Meteorites, *see* Meteors
Meteorology: Meteorological Notes, 15, 248, 307, 362, 489; Meteorological Society, 134, 235, 295, 356, 499; Meteorology of New York, 15; Meteorology in Russia, 16; Prof. Monier Williams on Indian, 53; Meteorological Phenomena, 82; New Meteorological Observatory at Fiesole, 110; Daily Warnings in France, 133; French Meteorology, 170, 193; Climatology of the Spanish Peninsula, 248; Climatology of the Fiji Islands, 248; United States Volunteer Weather Service, 248; Rainfall of India, 273; the Progress of Meteorology, 313; Bulletin of the Montsouris Observatory, 362; Meteorology of Western Australia, 363; Agricultural Weather Warnings in France, 371; Proposed French Institute of, 391; Scottish Meteorological Society, 440; Meteorology of Stonyhurst, 489; Weekly Statistics of the Weather, 489; Missouri Weather Reports, 490; Comparative Atmospheric Pressure of New Zealand and Great Britain, 490; Popular Meteorology in Switzerland, 492
Meteors: 29, 94, 124, 221, 342, 425, 454, 467, 487; of October 19, 1877, 10; Meteorite of July 20, 1860, 104; Meteorite of June 14, 1877, 150; of December 6, 1877, 152; the Meteor of November 23, 1877, 94, 113, 183, 246; Meteor in Virginia, 214; the Daylight Meteor of March 25, 467
Method of Least Squares, Merriman's List of Writings Relating to, 219
Metrology, Flinders Petrie on Inductive, 357
Metropolitan Sewage, 157
Meudon Observatory, 392
Mexico, New, Exploration of, 489
Meyer (Dr. A. B.), Mittheilungen aus dem k. zoologischen Museum zu Dresden, 142
Mice, Singing, 11, 29
Michaud (M. Narcisse), Death of, 474
Michel (Gustav), "Die Buch der Katzen," 351
Microscopical Society, *see* Royal
Microscopical Journal, Decease of the, 152
Midian, Capt. Burton's Exploration of, 53, 132
"Midland Naturalist," 233, 438
Millar (W. J.), a Telephone without Magnetism, 242
Millepora, Effects of the Urticating Organs of, on the Tongue, L. P. Pourtales, 27
Mills (Prof., F.R.S.), Electrostriction, 235
Miln (James), Archæological Researches at Carnac, 379
Mimicry in Birds, 361, 380, 478, 486, 507
Minchin (G. M.), Potential Energy 27
Mineral Oil in a Lava of Mount Etna, 150
Mineralogical Society, 376
Mines, Telegraphic Warnings in, 16; Explosions in, W. Galloway, 21
"Minhocao," the, 325
Minor Planets, 36, 46, 63, 83, 210, 306, 344, 382, 488, 507
Missouri: Geological Survey of, Prof. Arch. Geikie, F.R.S., 431; Weather Reports, 493
Mittheilungen aus dem k. zoologischen Museum zu Dresden, Dr. A. B. Meyer, 142
Mivart (Prof. St. G., F.R.S.), on the Fins of Elasmobranchs, 355
Mohn (Dr. H.), Norwegian Deep-Sea Expeditions, 30; Meteorological Observations in the North Atlantic, 235
Moll (J. W.), Researches on the Carbon of Plants, 344
Molybdenum, 270
Mongolia and Siberia, Exploration of, 435
Monistic Philosophy, Prize for Treatise on, 70
Monotremata of Australia, E. P. Ramsay, 401
Monster, a New Underground, 325
Monteiro (Joachim John), Death of, 391; Obituary Notice of, 425
Montsouris Park and Observatory, 132; Meteorological Bulletin of, 362
Monuments, George Smith's Ancient History from the, 119
Moon, a Lunar Landscape, 469, 514
Morning Dawn, the Expedition of the, 153
Morphologische Jahrbuch, 39, 294, 478
"Morphology of the Skull," Parker and Bettany's, 3
Morse (Edward S.), Traces of Early Man in Japan, 89; the Structure of Lingula, 383
Moscow, Anthropological Exhibition in, 16, 171
Moscow and the Volga, Communication between, 91
Moseley (H. N., F.R.S.), "Drowned by a Devil Fish," 27; Oregon, 302; Origin of Tracheæ in Arthropoda, 340
Mosquitos and Filariæ, 439
Mosses and Ferns, Hofmeister's Work on, 344
Moths, Smell and Hearing in, 45, 62, 82
Mott (F. T.), Meteor, 467
Mount Etna, Mineral Oil in a Lava of, 150
Mount Tongariro, N.Z., 346
Moving Diagrams of Machinery, 158
Moyobamba, the Rain-Tree of, Prof. Thiselton-Dyer, 349
Muir (M. M. Pattison), Proctor's "Spectroscope and its Work," 360
Müller (Fritz) on Flowers and Insects, 78
Müller (Dr. Hermann), Fertilisation in Thyme and Marjoram, 127; *Macrosilia cluentius*, 221
Munich, University Statistics, 275, 478
Münster, University Intelligence, 354
Murphy (J. J.), Meteorological Phenomena, 82
Murray (Andrew), Obituary Notice of, 232; the Locust Plague in America, 377
Musaceæ, Products of Assimilation in, 127
Muscular Action, the Evolution of Heat during, Prof. A. Fick, 285
Museums, the Arrangement of, Gen. A. Lane Fox, F.R.S., 484
Music: Music a Science of Numbers, Wm. Chappell, 32; Musical Association, 331; Grove's Dictionary of Music, Dr. W. H. Stone, 422; an Organ-Piano, 453; State Aid to Music, Alan S. Cole, 474
Musk-deer, Discovery of a Skeleton of the Pre-historic, 455
Mussel, the Byssus in the, 289
Musters (Capt.) on Bolivia, 90
"Mycenæ," Dr. Schliemann's, 397
Myopia in Germany, 310
"Myths and Marvels of Astronomy," R. A. Proctor, 180

Naples, the Zoological Station at, Dr. Anton Dohrn, 329, 360
Natural History, Cassell's, vol. i., 365
Natural History Journal, 392
Natural Phenomena, Electrical Analogies with, 226, 385
Nautical Almanac for 1881
Navicula (?), Mr. W. W. Wood on a Species of, 392, 437
Neander Valley, the Collection of Remains from, 108
Nebulæ and Clusters, Literature of the, 288
Nebulæ, Variable, 306
Nemirovich-Danchenko (M.), "The Land of Cold," 211
"Nerthus," the, of Tacitus, 250
Nerves, the Development of, 382
Nettle, the Common, Experiments on the Fibre, 351
Neumagen, Excavations at, 292
Neumayer (Dr. G.), the Progress of Meteorology, 313
New Guinea, 250, 383; Gould in, 408; Exploration of, 435
New Mexico, Exploration of, 489
New South Wales, Royal Society of, *Proceedings*, 17
New York, Meteorology of, 15; Proposed Zoological Garden in, 192; Natural History Museum, 232; Survey of, 508
New Zealand, Mount Tongariro, 346; Comparative Atmospheric Pressure of, and Great Britain, 490
Newcomb (Prof. S.), elected F.R.S., 150; Lunar Researches, 209; Theorems relating to Geometry of Three Dimensions, 240
Newton (Prof. A., F.R.S.), Hartlaub's "Birds of Madagascar," 9; No Butterflies in Iceland, 260; Mimicry in Birds, 380, 507
Niagara Falls, the Horseshoe, 109; Curious Phenomenon at, 454
Nias Island, 290
Nickel, M. H. Wild's Researches on, 393
Nickel and Cobalt, Iodates of, 150
Nicols (Arthur), Eucalyptus, 10, 342
Nicotin, Physiological Action of, 222
Nightingale, the, 487
Nitrification, R. Warington, 367, 402

Nitro-benzoic Acid, the Fourth, 151
Niven (W. S.), Trajectories of Shot, 466
Nocturnal Increase of Temperature with Elevation, Dr. E. Bonavia, 101
Noeggerath (Prof. Jacob), Proposed Monument to, 170
Nordenskjöld (Prof.), Expedition to the Arctic Regions, 90
Northumberland, Marine Fossils in the Gannister Beds of, Prof. G. A. Lebour, 320, 352
Norway, Glacial and Post-Glacial Fishes of, 509
Norwegian Deep-Sea Expeditions, H. Mohn, 30
Norwegian North Sea Expedition, 253
Nova Cygni, 46
Novaya Zemlya, Colonisation of, 109
Noyé (Thos.), a Double Rainbow, 262
Nuttall Ornithological Club, Bulletin of, 498
Nyassa, the Lake of, 435

O'Brien (C. G.), Fetichism in Animals, 402; Discrimination of Insects, 402
Observatories: Paris, 69, 109, 131, 152, 193, 232, 473; Madrid, 70; the Cordoba, 83, 209; Montsouris, 131; Lyons, 149; Cape of Good Hope, 269; Brussels, 288; the Temple, 324; the Radcliffe, 363; Harvard College, 363; Meudon, 392; Dun Echt, 432
Octopus, Drowned by an, 27, 282
Oil Paintings, the Deterioration of, Dr. R. Liebreich, 493, 515
Old Red Sandstone of Western Europe, Prof. A. Geikie, F.R.S., 471
Oliver (Prof. D., F.R.S.), "Flora of Tropical Africa," Prof. W. R. McNab, 319
Olympia, the Excavations at, 330
Ontario, Report of the Registrar-General, 455
Optical Spectroscopy of the Red End of the Solar Spectrum, J. B. N. Hennessey, F.R.S., 28
Oregon, H. N. Moseley, F.R.S., 302
Organ-Piano, an, E. J. Reed, M.P., F.R.S., 453
Organic Liquids, Distillation of, by Means of Steam, 270
Oriental Affinities in the Ethiopian Insect-Fauna, W. L. Distant, 282
Orkney and Shetland, Glacial Geology of, S. Laing, M.P., 123; Prof. M. Forster Heddle, 182
Ornithuric Acid, 270
Orograph, a new Form of, 156
Orton (Prof. James), Death of, 90
"Our Native Land," 491
Owen (Prof., F.R.S.) on the Modification of a Lower Form of Life by a Higher, 375
Owens College, Chemical Society at, 114
Owls, M. A. Milne-Edwards on, 345
Oxford: University Commission, 19; proposed High School for, 19, 39; University Intelligence, 114, 194, 334, 393, 415; University Statistics, 354
Oxidation, Acceleration of, caused by the least Refrangible End of the Spectrum, Capt. Abney, F.R.S., 518
Oxygen, the Presence of, in the Sun, Dr. Arthur Schuster, F.R.S., 148; R. Meldola, 161; Dr. Henry Draper, 339; in Sea-Water, T. Y. Buchanan, 162; Liquefaction of, 169, 177, 265; the Density of Liquid, 217; the Influence of, on Respiration, 252

Page (F. J. M.), Demonstration of Currents Originated by the Voice in Bell's Telephone, 283; the Action of the Telephone on a Capillary Electrometer, 395
Palmén on the Morphology of the Tracheal System, 284, 340
Pamir, the Exploration of the, 249, 324
Paper Trade, International Exhibition of the, 371
Papuan Plants, 289
Parker and Bettany's "Morphology of the Skull," 3
Paris: Academy of Sciences, 20, 40, 56, 70, 76, 96, 116, 136, 156, 195, 216, 236, 251, 256, 276, 316, 356, 376, 396, 409, 416, 440, 460, 480, 500, 520; Vacancy in, 70; Prizes of the 294, 373; the *Éloge* on Buffon, 474. Geographical Society of Paris, 17, 346, 384, 468. Paris International Exhibition, 37; the Russian Division in, 350; Representation of Science at, 357; "Études sur l'Exposition de 1878," 371; Arabs at, 454. Congresses at Paris, 474; Paris Observatory, 69, 109, 131, 152, 193, 232, 473; the New Transit Circle at, 165. Statistics of the National Library, 92. Telegraphic Warnings of Fires in, 91. Ethnological Museum in the Palais de l'Industrie, 272. Lectures on Ethnography in, 330. Société d'Hygiene, 310. Statistics of the Press, 311. Electric Lighting in, 437. Association d'Excursions Scientifiques, 454. Museum of the Jardin des Plantes, 455. the Tuileries Captive Balloon, 454, 491. Underground Railway in, 492
Pears, Fungoid Disease of, 91
Pembrokeshire, Dimetian and Pebidian Rocks of, 155
Peronospora, the Fossil, as a Primordial Plant, Worthington G. Smith, 144
Persimmon, the Persian, 508
Pesth, Artesian Well at, 109; Centenary of the University, 134
Petermann's Mittheilungen, 17, 90, 253, 408
Petrie (W. M. Flinders), "Inductive Metrology," 357; Age of the Earth, 465
Petty (T. S.), the Meteor of November 23, 183
"Phantom" Force, the, Prof. A. S. Herschel, 302, 321, 340
Pharmaceutical Society, 410
Phenological Observations during 1877, 236
Philadelphia: Academy of Natural Science, 296; Philadelphia Diplomas, Dr. C. M. Ingleby, 183; Dr. Richard C. Brandeis, 221
Phipps (Geo. H.), the Earth-worm in Relation to the Fertility of the Soil, 62
Phoneidoscopic Representation of Vowels and Diphthongs, 447, 486
Phonograph: Edison's, 90, 190, 291, 415, 469, 485; and Helmholtz's Vowel Theory, Prof. Fleeming Jenkin and J. A. Ewing, 384, 423
Phosphides of Tin, 151
Photography: Photography of Natural Colours, 92; Photographic Society, 195, 276, 376, 479; Photography Foreshadowed, Dr. J. A. Groshans, 202; J. Rand Capron's "Photographic Spectra," 259; Abney's "Photography," 378; "Photographic Rays of Light," 438
Phylloxera in Germany, 211
"Physical Chemistry," N. N. Lubavin, 240
Physical Society, 55, 115, 135, 175, 295, 394, 415; Annual Meeting, Officers, &c., 315
Physician's Experiment, 305
"Physiography," Huxley's, 178
Physiological Tables, Dr. E. B. Aveling's, 5
Physiological Teaching and the Cruelty to Animals' Act, Frank W. Young, 45
Piano, an Organ, E. J. Reed, M.P., F.R.S., 453
Pic-du-Midi Observatory, 409
Pictet (M. Raoul), on the Liquefaction of the Gases, 292; Honorary Degree to, 436
Pidgeon (D.), the Phonograph, 415
Pig-iron, Separation of Phosphorus from, 459
Pigott's Observations of Variable Stars, 323
Pile-Dwellings, and English Lake-Dwellings, Prof. T. Rupert Jones, F.R.S., 424
"Pioneering in South Brazil," T. P. Biggs-Wither, 423
Pirani (Prof. F. J.), an Electrical Experiment, 180
Piscicultural Institute, the Proposed Channel Isles, W. A. Lloyd, 143
Pitch, Absolute, Lord Rayleigh, F.R.S., 12
Pitury, the new Stimulant, 492
Planets, Minor, 46, 63, 83, 210, 306, 344, 382, 488, 507
Plant and Animal Life, Analogies of, Francis Darwin, 388, 411
Planté (M. Gaston), Electrical Analogies with Natural Phenomena, 226, 385
Plants: Ferment in, 455; the Carbon of, 344; Self-Fertilisation of, 221; the First Stages of Development in, 433
Plateau Films, Permanent, 175
Plestiodon longirostris, 425
Plummer (J. I.), Aid of the Sun in Relation to Evolution, 303, 360
Poaching Birds, 509
Polar Expeditions, International, E. J. Reed, C.B., 29
Polyzoa, French, 382
Pongo, Death of the Gorilla, 70; Dissection of, 89
Potential Energy, 9, 27, 81
Pouchet, Monument to, 108
Pourtales (L. P.), Effects of the Urticating Organs of Millepora on the Tongue, 27
Powell (Major J. W.), Ethnology of North America, 53
Preston (S. Tolver), on a Means of Converting the Heat Motion Possessed by Matter at Normal Temperature into Work, 202; on the Diffusion of Matter in Relation to the Second Law of Thermodynamics, 31; the Age of the Sun's Heat in Relation to Geological Evidence, 423

Pringsheim (Dr. A.), Jahrbücher für wissenschaftliche Botanik, 158
Prjwalsky's Journey to Lob-Nor and Tibet, 153, 434
Proctor (R. A.), "Myths and Marvels of Astronomy," 180; "The Spectroscope and its Work," 360
Protection of Animals, Vienna Society for the, 293
Prussia, the Universities of, 55, 294
Ptolemy's Geography of English Coast, 193
Punjab, the Upper, the Geology of, 395
Purple Dyes of Antiquity, 133
Pyramid, the Great, J. G. Jackson, 243

Quaritch (Bernard), Faraday's "Experimental Researches," 342
Quarterly Journal of Microscopical Science, 37, 214, 254

Radcliffe Observatory, 363
Radiant Heat, the Thermo-electric Pile and the Radiometer, 310
Radiometer: and its Lessons, 5, 7, 26, 27, 43, 44, 61, 79, 121, 142, 143, 181, 199, 220, 261; Prof. G. G. Stokes, F.R.S., on Certain Movements of Radiometers, 172, 234; and the Thermo-electric Pile, 310
Rae (Dr. J.), Tuckey, and Stanley, the Yallala Rapids on the Congo, 62; No Butterflies in Iceland, 243, 260
Railway Brakes, 410, 507
Railway Collisions and Electricity, 371
Railway Working and Electricity, W. E. Langdon, 461
Railways, Underground, in Paris, 492
Rainbow, a Double, Thos. Noyé, 262
Raindrops, Hailstones, and Snowflakes, the Formation of, Prof. Osborne Reynolds, F.R.S., 207
Rainfall in the Temperate Zone in Connection with the Sun-spot Cycle, Dr. W. W. Hunter, 59
Rainfall, Contribution to the Sun-spot Theory of Rainfall, Dr. E. Bonavia, 61
Rainfall of India, 273, 505
Rainfall and Sun-spots, 443; C. Meldrum, F.R.S., 448; Alex. Buchan, 505
Rain-tree of Moyobamba, Prof. T. Thiselton Dyer, 349
Ralton (Dr.), "Handbook of Common Salt," 302
Ramsay (E. P.), Australian Monotremata, 401
Ramsay (Prof., F.R.S.), and James Geikie, F.R.S., on the Geology of Gibraltar, 518
Raspail (M. F. V.), Death of, 212
Ratti (Aurel de), the Telephone, 380
Rayleigh (Lord, F.R.S.), Absolute Pitch, 12; "Theory of Sound," Vol. I., Prof. H. Helmholtz, F.R.S., 237
Reade (T. Mellard), the *Challenger* Estimates of the Volume of the Gulf Stream, 144
Reale Istituto Lombardo di Scienze e Lettere, 294, 374, 478, 498
Reed (E. J., C.B., F.R.S.), International Polar Expeditions, 29; an Organ Piano, 453
Reflection Grating, the Use of, in Eclipse Photography, J. Norman Lockyer, F.R.S., 354
Reflectors, Glass for, Henry Bessemer, 241
Regnault (M. Victor), Death of, 250; Obituary Notice of, 263
Reichenbach's Odyle and Mr. Wallace, 8; Wm. B. Carpenter, F.R.S., 8, 44
Reilly (P. W.), a Meteor, 221
Research Fund, the Government, 403
Research in Libraries, Robert L. Jack, 486
Respiration, Aquatic, 290
Revue Internationale des Sciences, 152, 212
Reynolds (Prof. J. Emerson), Frankland's Researches in Chemistry, 218, 318; Discovery of a New Explosive, 436
Reynolds (Prof. Osborne, F.R.S.), the Radiometer and its Lessons, 27, 61, 121, 220; on the Formation of Hailstones, Raindrops, and Snowflakes, 207
Rheostatic Machine, 40
Rhine, the Fisheries of the, 212; Method for Determining the Impurities of, 131
Rhinoderma darwinii, 222
Rhizopods in an Apple Tree, 434
"Rider," the, in Egyptian Balances, 455
Riley (Charles V.), the Locust Plague in America, 377
Rink (Dr. Henry), Danish Greenland, 57
Roads, Machine for Levelling, 392
Roberts (Edward), Expected High Tides, 58
Rocky Mountains, Geology of the, 39
Rohlfs (Herr G.), Expedition to the Libyan Desert, 290
Romanes (G. J.), Singing Mice, 29; Smell and Hearing in Moths, 82; Fetichism in Animals, 168; Prof. Eimer on the Nervous System of Medusæ, 200
Romanis (James M.), on a New Form of Telephone, 201
Römer (Ole), Dr. Doberck, 105
Röntgen (Dr. W. C.), a Telephonic Alarum, 164
Rosthorn (Francis von), Obituary Notice of, 11
Rotifers or Wheel-Animalcules of Hungary, 128
Royal Astronomical Society, 76, 195, 275, 309, 459
Royal Dublin Society, 46, 183
Royal Geographical Society: and the Public, 381; Medals of the, 467; School Prize Medals, 497
Royal Institution, 170, 291, 371
Royal Microscopical Society, 56, 156, 236, 336, 416
Royal Society: 37, 134, 214, 235, 314, 335, 354, 415, 479, 498, 518; Council of, 37; Medals of the, 69; the *Times* on the, 108; Election of Foreign Members, 151; New Fellows, 513
Royal Society of Edinburgh, 153
Rubies, the Artificial Production of, 152
Rugby, the Temple Observatory, 324
Ruhmkorff (Henry David), Obituary Notice of, 169; Sale of his Workshop, 351
Russell (Mr., Astronomer-Royal at Sydney), Attempt on his Life, 152
Russell (Hon. Rollo), Telephonic Experiments, 292
Russia: Meteorology in, 16; Exploration of, 38; Russian Geographical Society, 53, 153, 171, 194, 213, 324; Primary Education in, 53; Gems from, 72; Magnetical Measurements in, 153; St. Petersburg Society of Naturalists, 194; University of Charkow, 195; Nemirovich-Danchenko's "The Land of Cold," 211; Russian Chemical Society's Journal, 251; Russian Anthropology at the Paris Exhibition, 350; Ethnology of, 468. *See also* St. Petersburg, Moscow, &c.
Rutland and Leicestershire, Harrison's Geology of, 58
Ryder (John A.), the Laws of Digital Reduction, 128
Rye (E. C.), Wollaston's "Coleoptera Sanctæ-Hellenæ," 338

Sabine, (Robert), the Telephone, 379; Action of Light on a Selenium (Galvanic) Element, 512
Sachs (Prof.), called to Berlin, 75
St. Andrews, University Intelligence, 95
St. Elmo's Fire, 436
St. Helena, Wollaston's "Coleoptera Sanctæ Hellenæ," 338
St. Paul and Amsterdam, the Islands of, Prof. E. Perceval Wright, 326
St. Petersburg, University Intelligence, 55; Society of Naturalists, 194; New High School for Ladies, 195; Education of Women at, 195, 334; New Archæological Institution, 329; the Central Physical Observatory, 330; New Hygienic Society, 330; University Statistics, 374
St. Stefano, Earthquake at, 514
Salmon in Germany, 392
Salt, Ratton's Handbook of Common, 302
"Salzkammergut," Snow in the, 292
Sanderson (Prof. J. Burdon, F.R.S.), Bacteria, 84
Sanitary Institute, 38
Satellites, the, 129
Saunier's "Modern Horology," 484
Saxony, Educational Statistics, 394
Schliemann (Dr. H.), Trojan Treasures, 132; "Mycenæ," 397; "Troy and its Remains," 397; "Antiquities from Hissarlik," 397
Schmidt's Lunar Chart, 408
Schoolmasters, Congress of, in Paris, 314
Schuster (Dr. Arthur, F.R.S.), Vogel's "Spectrum Analysis," 99; the Radiometer and its Lessons, 143; the Presence of Oxygen in the Sun, 148
Schwann (Theodore), Festival in Honour of, 436
Schweinfurth (Dr.), Proposed Return to Africa, 90
Science: Prof. Rudolf Virchow on the Liberty of Science in the Modern State, 72, 92, 111; Science and Art Department Examinations, 134; Science in Training Colleges, 262; the Head-Masters on Science Teaching, Rev. W. Tuckwell, 317; Science at the Paris Exhibition, 357
Scientific Research, Grants of the British Medical Association, 90
Scientific Serials, a New Catalogue of, 272
SCIENTIFIC WORTHIES, XII.—William Harvey (*With Portrait*), 417
Scotland, Prof. J. W. Judd, F.R.S., on the Strata of the Western Coast and Islands of, 335

Scottish Meteorological Society, 440
Scottish Universities Commission, 441
Sea-Sediments, Movements of, 293
Sea-Water, Oxygen in, J. Y. Buchanan, 162; as a Specific, 234
Secchi (Father), Illness of, 291; Death of, 350; Obituary Notice of, 370
Sediments in the Sea, Movements of, 293
"Seiches" on the Lake of Geneva, 234; and Earthquakes, Dr. F. A. Forel, 281; the Law of, 475
"Selborne," Prof. Bell's White's, 399
Selective Discrimination of Insects, 62, 163
Selenium, Action of Light on, Robert Sabine, 512
Semirechensk District, Exploration of, 252
Sense in Insects, W. M. Gabb, 282
Sewing Machines, Effects from Using, 71; a New, 371
Sewage, the Metropolitan, 157
Seychelles and Mauritius, the Flora of, by J. G. Baker, 77
Shadows, Observations on, 351
Shells, Atlantic, Wollaston's 503; Dr. P. P. Carpenter's Collection of, 513
Shenstone (W. A.), Conservation of Energy—Lecture Experiment, 45
Shetland and Orkney, Glacial Geology of, S. Laing, M.P., 123
Shooting Stars, 201, 212
"Shorthand for General Use," Prof. Everett, 17
Shot, Trajectories of, Rev. Francis Bashforth, 401, 506; W. D. Niven, 466
Siberia: Sea Trade with, 324; the University of, 354; and Mongolia, Exploration of, 435
Sidebotham (Joseph), Singing Mice, 29
Silesian Society, Proceedings of, 219
Silver Salts, Relations between the Volumes of, 260
Simon Testimonial Fund, 371
"Simple Lessons for Home Use," 25
Singing in the Ears, Xenos Clark, 342
Singing Mice, 11, 29
Sipylite, a New Mineral containing Niobium, 269
"Sizing of Cotton Goods," Thomson's, 4
Skin, Human, and Mineral Waters, 252
Skull, the Morphology of the, Parker and Bettany, 3
Slater (H. H.), Singing Mice, 11
Sleep, Causation of, 124
Smell and Hearing in Insects, Henry Cecil, 381
Smith (A. Percy), the Telephone, 380
Smith (George), Ancient History from the Monuments, 119
Smith (Worthington G.), a Fossil Fungus, 127; the Fossil Peronospora as a Primordial Plant, 144
Smith (Herbert H.), Exploration of Brazil, 308
Smith (J.), "Ferns, British and Foreign," 43
Smith (Prof. W. Robertson), the Colour Sense of the Greeks, 100
Smithsonian Institution: 18, 39; Annual Report, 192
Smyrna, Plague of Field-mice or Rats in, 43
Smyth (Prof. Piazzi), Sun-spots and Terrestrial Magnetism, 220
Snake Poison, 337
Snow in the "Salzkammergut," 292
Snowflakes, Hailstones, and Raindrops, the Formation of, Prof. Osborne Reynolds, F.R.S., 207
Soap-Films, the Acoustical Properties of, Prof. Silvanus P. Thompson, 486
Social Electrical Nerves, 305, 346
Société des Colons Explorateurs, 290
Société d'Hygiene of Paris, 310
Solar Corona, Early Observations of the, 14
Solar Eclipses: The Total Solar Eclipse of July 29, 1878, 36, 250, 269, 381, 452, 453; J. Norman Lockyer, F.R.S., on, 481, 501; Solar Eclipse of A.D. 418, 163
Solar Radiation in India, Methods for Determining 131
Solar Spectrum, Optical Spectroscopy of the Red End of the, J. B. N. Hennessey, F.R.S., 28
Solar, *see also* Sun
Soleil (M.), Death of, 455
Soles and Turbot, Consignment of, to America, 212, 311,
Sorby (H. C., F.R.S.), the Colouring Matter of Human Hair, 355
Sound: Experiment on Vibrations, 194; "Lord Rayleigh's Theory of Sound," Prof. H. Helmholtz, F.R.S., 237; Velocity of, 410; Sound Colour-Figures, Sedley Taylor, 426, 447; and Density, J. Cameron, 507; the Transmission of, by Wires, 519
Sounding Apparatus, Lieut. Theo. F. Jewell, 230
Spain, Science in, 91; the Telephone in, 437
Spalding, Douglas A., Obituary Notice of, 35
Spanish Peninsula, the Climatology of the, 248
Spectroscope, the, and its Work, R. A. Proctor, 360
Spectroscopical Researches of D'Arrest, 311
"Spectrum Analysis," Vogel's, 99
Spherules, Coloured, in the Retina of Birds, 473
Spiders, Hungarian, 128; the Aeronautic Flight of, 434; Spider and the Wasp, 402, 448
Spitzbergen, Maps of, 290
Sponges, Glassy, 222
Standards, Public, at the Guildhall, 454
Stanley (H. M.), Exploration of Africa, 49, 90; at the Cape, 109; his Arrival in England, 232, 249, 291; Dinner to, 270; at St. James's Hall, 297; his new Work on Africa, 364
Starch in Plants, 269
Starfishes, North American, Alex. Agassiz, 98
Stars: Tycho Brahe's, of 1572, 129; Variable, 163, 210, 231, 288; Shooting, 201, 212; ϵ Indi, 231; the Star Lalande, 19,034, 306; Double, 407
Steam-Engine, a Remarkable Small, 214
Steel Plates, Gigantic, 436
Stellar Systems, 82
Stewart (Prof. Balfour, F.R.S.), Sun-spots and Declination Ranges, 326
Stobart (J. W. H.), Islam and its Founder, 239
Stockholm, the Royal Library at, 273
Stockdale (William), the Telephone, 380
Stokes (Prof. G. G., Sec. R.S.), Certain Movements of Radiometers, 172, 234
Stone (Dr. W. H.), Grove's Dictionary of Music, 422
Stoney (G. Johnstone, F.R.S.), the Radiometer and its Lessons, 79, 181, 261
Stonyhurst, Meteorology of, 489
Strassburg, New University Buildings, 55; University Intelligence, 195; Discovery of Prehistoric Remains in, 492
Strawberries in December, 193
Strontian, Lime, and Baryta, Crystallisation of, 372
Strümpell (Dr.), Causation of Sleep, 124
Strychnia and its Antidote, J. Sinclair Holden, 360
Styria, Avalanches in, 273
Subsidence of Soil in France, 513
Suicides in France, 54
Sumatra: Death of the Leader of the Dutch Expedition to, 170; Exploration of, 290, 409
Sun: the Sun's Distance, 1; the Sun's Photosphere, J. Norman Lockyer, F.R.S., 23; Sun's Magnetic Action at the Present Time, J. Allan Broun, F.R.S., 183; Photographs of the, 195; the Presence of Oxygen in the, Dr. Arthur Schuster, F.R.S., 148; R. Meldola, 161; Dr. Henry Draper, 339; Age of the, in Relation to Evolution, 206, 303, 321, 360, 464; Age of the Sun's Heat in Relation to Geological Evidence, S. Tolver Preston, 423
Sun-spots: Rainfall in the Temperate Zone in Connection with the Sun-spot Cycle, Dr. W. W. Hunter, 59; Sun-spots and Terrestrial Magnetism, Prof. Piazzi Smyth, 220; A. W. Downing, 242; B. G. Jenkins, 259; J. Allan Broun, F.R.S. 262, 280; Joas Capello, 488; Sun-spots and Declination Ranges, Prof. Balfour Stewart, F.R.S., 326; Sun-spots and Rainfall, 61, 443, 448, 505
Supplementary Eyebrows, W. Ainslie Hollis, 124
Swinhoe (Robert, F.R.S.), Death of, 16; Obituary Notice of, 35
Sydney, International Exhibition at, 233
Sylt, the Island of, Discovery of a Submerged Village, 232
Sylvester (Prof. J. J., F.R.S.), Chemistry and Algebra, 284, 309
Symons (G. J.), Alluard's Condensing Hygrometer, 28

Tacitus, the "Nerthus" of, 250
Tait (Prof. P. G.), "Sketch of Thermodynamics," Prof. Clerk Maxwell, F.R.S., 257, 278; Zöllner's Scientific Papers, 420; Thermal Conductivity, 480
Talking Machine, Edison's, 469
Tanner (Prof. H. W. Lloyd), Potential Energy, 81
Taschenberg (Dr. E.), Die Insekten, 41
Tasmania, 508
Taunton College School, 16, 154, 214, 354
Taylor (Sedley), Fluid Films, 44; Was Galileo Tortured? 299; Phoneidoscopic Representation of Vowels and Diphthongs, 447; Sound Colour-Figures, 426, 447

Technical Education, Prof. Huxley on, 97
Technical University, the Proposed, 154
Teheran, Gold in, 115
Telegraphy: Telegraphic Warnings in Mines, 16; without Wires, 153; Telegraphs in Berlin, 251; the Society of Telegraphic Engineers, 277; Granfeld's Apparatus, 292; Social Electrical Nerves, 305, 346; and the Herring Fishery, 351; Telegraphic Warning Apparatus, 351
Telephone, the: 48, 135, 379; in Germany, 52, 71, 91; and the Post Office, 109; German Postal Regulations for, 131; Prof. Bell's Lecture on, 131; Telephonic Alarum, Dr. W. C. Röntgen, 164, 181; Experiments between Dublin and Holyhead, 170; Prof. Barrett on the, 193; James M. Romanis on a New Form of, 201; Telephone without Magnetism, W. J. Millar, 242; its Use in Warfare, 251; Demonstration of Currents originated by the Voice in Bell's Telephone, F. J. M. Page, 283; Experiments with the, 292, 310, 342; W. H. Preece on the, 295; W. Ackroyd on the Mechanism of, 330; the Telephone as an Instrument of Precision, Prof. Geo. Forbes, 343; Telegraphic Warning Apparatus, 351; and the Post Office, 352; and the Telegraph, 372; in China, 392; Action of the, on a Capillary Electrometer, 395; as a Means of Measuring the Speed of High Breaks, J. E. H. Gordon, 424; the Henry Telephone, 437; in Spain, 437; Application of, for Testing the Hearing, 475; Signalling by the, 491; a Mercury Telephone, 491; Early Electric Telephony, Prof. W. F. Barrett, 510
Telescope, the Modern, J. Norman Lockyer, 66, 125, 188, 225
Tempel's Comet of Short Period, 408
Temperature: Nocturnal Increase of, with Elevation, Dr. E. Bonavia, 101; Average Annual, at Earth's Surface, D. Trail, 202; of November, 1877, 249; Temperatures, Cumulative, 308, 322, 448, 486; the Sense of, 372; Underground, Prof. J. D. Everett, 476
Tenby: Mr. Smith's Collection from the Caves, 212; Local Museum at, 391
Terrestrial Globe, a Self-Moving, 71
Terrestrial Magnetism, Prof. W. Le Roy Broun, 281
Terrestrial Magnetism and Sun-spots, Prof. Piazzi Smyth, 220; A. W. Downing, 242; B. G. Jenkins, 259; J. Allan Broun, F.R.S., 262, 280; Joas Capello, 488
Texas, the Agricultural Ants of, 433
Thermal Conductivity, Prof. P. G. Tait, 480
Thermodynamics, on the Diffusion of Matter in Relation to the Second Law of, S, Tolver Preston, 31
"Thermodynamics," R. Wormell's, 25; Prof. Tait's, Prof. Clerk Maxwell, F.R.S., 257, 278
Thermopiles, Relative Value of, 437
Thierleben, Brehm's, 41
Thiers (M.), his Work on Trigonometry, 16
Thompson (Prof. Sylvanus P.), Faraday's "Experimental Researches," 304, 361; the Acoustical Properties of Soap-Films, 486
Thomson's "Sizing of Cotton Goods," 4
Thomson (J. Stuart), Mimicry in Birds, 361
Thomson (Dr. Thomas, F.R.S.), Death of, 513
Thomson (Sir William, F.R.S.), Compass Adjustment in Iron Ships, 331, 352, 387
Thomson (Sir Wyville, F.R.S.), "The Voyage of the *Challenger*"—the Atlantic, 145, 185
Thorpe (Prof. T. E., F.R.S.), Note on the Liquefaction of Air, and of the so-called Permanent Gases, 384
Thunderstorms: the Law and Origin of, 362; in Iceland, 475; Artificial, 515
Thuret's Garden at Antibes, 351
Thyme and Marjoram, Fertilisation in, 127
Tibet, Notes on, 132; M. Prshvalsky's Exploration of, 153
Tides, High, Prediction of, 38, 45, 58, 101
Titan, Transit of the Shadow of, across Saturn, 105
Toads, Change of Habits in, Wordsworth Donisthorpe, 242
Tomlinson (C., F.R.S.), Fluid Films, 61; Diffusion Figures in Liquids, 102
Tomlinson (Herbert), the Telephone, 380
Tornado in Chester County, U.S., 362
Toronto, Earthquake near, 90
Torpedo Warfare, Modern, 50
Torpedoes, 361
Tortoises, Gigantic Land, Dr. Günther, F.R.S., 483
Toucy, Belfry at, struck by Lightning, 392
Towering of Wounded Birds, Chas. Dixon, 45
Tracheal System, Palmén on the Morphology of the, 284, 340
Trail (D.), Average Annual Temperature at Earth's Surface, 202
Training Colleges, Science in, 262
Trajectories of Shot, Rev. Francis Bashforth, 401, 506; W. D. Niven, 466
Transatlantic Longitudes, J. E. Hilgard, 244
"Transcaucasia and Ararat," J. Bryce, 25
Transit Circle, the New, at the Paris Observatory, 165
Transit of Venus, English Report on, 1; French Reports of, 69; German Expedition, 392; the Transit of 1882, 507
Travel, Educational, 324
Trevelyan Rocker, Mechanical Analysis of the, Samuel H. Frisbee, 242
Tritoma, Bees Killed by, Alfred R. Wallace, 45
Trollope (Anthony), South Africa, 463
Troubitzkoy (Prince Pierre), Eucalyptus, 10
"Troy and its Remains," Dr. Schliemann's, 397
Trunk Engine, Batchelor's Patent Working Drawing of, 160
Tübingen, University Statistics, 354
Tuckey and Stanley—The Yallala Rapids on the Congo, Dr. J. Rae, 62
Tuckwell (Rev. W.), and Taunton School, 16; Presentation to, 214; the Headmasters on Science Teaching, 317
Tuning Forks, Prof. McLeod's Experiments on, 55
Tunnel, the Proposed British Channel, 109
Tupman (Capt.), on the Meteor of December 6, 1877, 152; the Great Detonating Meteor of November 23, 1877, 246
Turbot and Soles, Exportation to Massachusetts, 311
Turkoman Greyhounds, 434
Tycho Brahe's Star of 1572, 129
Tyndall (Dr., F.R.S.), Fog-signals, 456
Tyrol, Anthropology and Ethnology of South, 438

Underground Monster, a New, 325
Underground Railways in Paris, 492
Underground Temperature, Prof. J. D. Everett, 476
United States: American Science, 18, 39; the Smithsonian Institution, 18, 39; the American Association for the Advancement of Science, 37; Ethnology of the, 53; the Johns Hopkins Scientific Association, 113; Geological Work of the U.S. Survey under Prof. Hayden, during the Summer of 1877, 129; Lexington University, 175; Geological Survey of, 192; Proceedings of the American Philosophical Society, 199; Entomology in America, 229; Extension of Volunteer Weather Service in the, 248; Tornado in Chester County, Penn., 362; Atlas of Colorado, 371; Prof. Hayden's Expedition, 351; Harvard College Observatory, 363; the Geological Survey, 409; Cliff-dwellers in the, 409; American Chemical Society, 475; Survey of New York, 508; Proposed Catalogue of the Plants of North America, 514. *See also* America, New York, Philadelphia, &c.
University and Educational Intelligence, 19, 39, 55, 74, 95, 114, 134, 154, 175, 194, 214, 235, 254, 275, 294, 314, 334, 354, 374, 393, 415, 459, 478, 497, 517
University, Proposed New, 478
Upsala, University Statistics, 55, 478
Uranian Satellites, 323, 363

Variable Nebulæ, 306
Variable Stars, 163, 210, 288; R Aquarii, 231; Pigott's Observations of, 323
Valence or Atomicity, Discovery of the Law of, 309
Vaux (W. S. W.), the Greek Cities and Island of Asia Minor, 119
Venus Transit, English Report on the, 1; French Reports of, 69; German Expedition, 392; the Transit of 1882, 507
Verne (Jules), the Works of, 197
Venezuela, Dr. Sachs on, 250
Vibrations, Experiments on, 194
Vibrations of a Flame, Experiments on, 54
Vibrations of Solid Bodies, M. Dubois on, 330
Vicars (G. Rayleigh), Acoustical Effects of Atmospheric Pressure, 244
Victoria Institute, 136, 216, 296, 416, 520
Vienna: University Intelligence, 55; Academy of Sciences, 116, 176, 196, 276, 296, 376, 500; Vienna Geographical Society, 211; Temperature of, 249; Society for the Protection of Animals, 293

Vine-leaves, the Functions of, 20
Vines (S. H.), the First Stages of Development in Plants, 433
Virchow (Prof. Rudolf), the Liberty of Science in the Modern State, 72, 92, 111
Virginia Creeper, the Climbing of, 508
Viticultural Society at Cassel, 411
Vogel's "Spectrum Analysis," Dr. Arthur Schuster, 99
Vohl (Dr.), Method for Determining the Impurities of the Rhine, 131
Volcanoes: Volcanic Eruptions in Iceland, 171; Volcanic Island, 194; Volcanic Phenomena in Borneo, A. H. Everett, 200; Submarine, 372; in South America, 468
Volga and Moscow, Communication between, 191
Volta, the Statue of, 490
Volume of Liquids and Absorption of Gases, 514
Vowel Theory, Helmholtz's, 411

Wallace (A. R.), and Reichenbach's Odyle, 8; Wm. B. Carpenter, F.R.S., 8, 44; the Radiometer and its Lessons, 44; Bees Killed by Tritoma, 45; the Comparative Richness of Faunas and Floras tested Numerically, 100; Mr. Crookes and Eva Fay, 101; Northern Affinities of Chilian Insects, 182
War, New Applications of Science to, 361
Warington (R.), Nitrification, 367
Wasp and the Spider, 402, 448
Watchman-Controlling Clock, 292
Water, Specific Heat of, 252
Waterfalls, Great, 221, 242
Waterspouts in Callao, 372
Watson (Arthur G.), Harrow School Bathing-Place, 487
Waugh (Gen. Sir Andrew Scott, F.R.S.), Death of, 350
Waves, the Progression of, 95
Weather, Weekly Statistics of the, 489
Weber (Prof. Ernst Heinrich), Obituary Notice of, 286
Weights, Discovery of Ancient Bronze, 351
Wellington Philosophical Society, 296
West Indies, Higgins' "Notes on the Western Tropics," 121
Westinghouse Brake, 410, 507
Westminster Aquarium: 70, 193; Seals at the, 38; Laplanders at the, 70; Chimpanzee at, 153; Entomological Exhibition at, 351, 391, 402; American Fishes at the, 392
Whale, New Species of, 110
Wheel-Animalcules (Rotifers) of Hungary, 128
White Sea, Algæ of the, 345
"White's Selborne," Prof. Bell's, 399
Whitmee (S. J.), the Southern Drought, 447, 486
Wild (M. H.), Researches on the Magnetic Properties of Nickel, 393
Williams (Prof. Monier), on Meteorology in India, 53
Williamson (Prof. W. C.), the Origin of a Limestone Rock, 265
Willmanns (Prof. Gustav), Death of, 436
Wilson (A. Stephen), the Earthworm in Relation to the Fertility of the Soil, 28
Wine Protection of France, 372
Wines, Adulteration of, in Berlin, 91
Winkler's Lunar Landscape, 469, 514
Wires, the Transmission of Sounds by, 519
Wisby, Discovery of Ancient Bronze Weights at, 351
Wisteria, the Seeding of, 439
Wojeikoff (Dr.), Travels in Japan, 171
Wolf (M. C.), the New Paris Transit Circle, 165
Wolf's History of Astronomy, J. R. Hind, F.R.S., 259; (Translation), 359
Wollaston (Thos. Vernon), Obituary Notice of, 210; "Coleoptera Sanctæ-Helenæ," E. C. Rye, 338; Testacea Atlantica, 503
Wolves in France, 233
Women, Higher Education of, 314; Prizes in Botany for, 314
Work, Relation of, and the Decomposition of Albumen, 515
Wormell (R.), "Thermodynamics," 25
Wright (Prof. E. Perceval), About Fishes' Tails, 286; the Islands of St. Paul and Amsterdam, 326
Würzburg, University Statistics, 334

Yallala Rapids on the Congo—Tuckey and Stanley, Dr. J. Rae, 62
Yenissei, Exploration of the, 38
Yorkshire College of Science, 175
Young (E. D.), "Nyassa," 99
Young (Frank W.), Cruelty to Animals' Act and Physiological Teaching, 45
Young (J.), Mimicry in Birds, 486

Zeitschrift für wissenschaftliche Zoologie, 254, 479, 394
Zenger (Prof. Ch. V.), the Law and Origin of Thunderstorms, 362
Zeuthen (Dr. H. G.), Quatre Modèles, 240
Zöllner's Scientific Papers, Prof. P. G. Tait, 420
Zoological Gardens, 68
Zoological Gardens: Additions to the, 18, 38, 54, 72, 92, 110, 133, 154, 172, 194, 213, 234, 253, 273, 293, 311, 331, 352, 373, 411, 438, 456, 493, 515; Death of the Hippopotamus, 392
Zoological Society, 95, 115, 135, 170, 275, 355, 375, 460, 499, 520
Zoological Station, Naples, 329, 360
Zoological Station for the Channel Islands, W. Saville Kent, 102; W. A. Lloyd, 143
Zurich, University Statistics, 374