comprising several interesting points of construction and detail, is at work at the Paris Exhibition.

Mr. Debouttéville, in his paper, first reviews the gas-engines hitherto proposed or employed. He carries back his researches nearly a century, when the first gas-engine was proposed by Barber, and completes them with a description of the Simplex engine, which he brought out with Mr. Malandin in 1884. This engine is founded on principles laid down by Mr. Beau de Rochas—that, to realize the best results from the elastic force of gas, the cylinders should have the greatest capacity with the smallest circumferential surface, the speed should be as high as possible, the cut-off should be as early and the initial pressure as high as possible. In the author's engine the ignition is effected by a practically continuous electrical spark; the air and gas are mixed in an external receptacle fixed on the cover of the slide, and are drawn in through channels of varied forms so as intimately to mix them. The governors described act on the principle of totally cutting off the supply of gas for one or more strokes whenever an increase of speed occurs. From the tests made with this engine the consumption of gas is low, and it appears to compare favourably with good steam-engines as regards economy of application.

Besides the reading and discussion of papers, the members of the Institution visited the Exhibition, and various works which were opened for this purpose.

SCIENTIFIC SERIALS.

THE numbers of the *Journal of Botany* for June and July are chiefly devoted to articles interesting to students of systematic or geographical botany, especially that of our own islands; the latter number contains a biographical sketch of the late Prof. Reichenbach, by the editor.

THE most interesting article in the *Botanical Gazette* for May is the commencement of a detailed paper by Mr. C. Robertson, on the relations between insects and flowers in regard to American plants. The number for June contains original articles by Mr. H. L. Bolley, on sub-epidermal rusts, and by Mr. J. N. Rose, on the Achenia of *Coreopsis*.

THE *American Meteorological Journal* for May contains abstracts of the papers read at the meeting of the New England Meteorological Society on April 16:—In a paper on lightning and the electricity of the atmosphere, Mr. McAdie gave an account of some kite experiments at the Blue Hill Observatory, near Boston, in which the potential was determined at various heights. He also referred to the observations on the character of lightning at the top of Mount Washington during thunder-storms, and to the effect of the electrification of the air upon water, dust, and other particles in it, and to the possibility of foretelling the moment of a flash of lightning.—Prof. W. M. Davis made a report upon the investigation of the sea-breeze, undertaken in 1887, from observations at 100 stations. One fact shown was that the diurnal range of temperature, which is diminished on the coast by the action of the sea-breeze, is not lessened at the inland stations.—Mr. E. B. Weston read a paper on the practical value of self-recording rain-gauges, referring to the importance of knowing the hourly falls when constructing drainage systems.—Prof. H. A. Hazen continues the discussion upon anemometer comparisons, and upon the question of the probable effect of the momentum of heavy cups, when placed on a whirling machine. He considers that the Robinson anemometer is by far the best instrument ever devised for variable winds.—Lieut. Finley discusses the frequency of tornadoes in Illinois for fifty-four years, ending with 1888. The total number of storms was 141. The month of greatest frequency was May, no month being free from storms. The prevailing direction of movement was north-east.—Prof. Harrington communicates the instructions issued by the Chief Signal Officer for the preparation of forecasts and for their verification. The instructions contain nearly 200 regulations, and are very interesting to those who study weather predictions.

THE *Meteorologische Zeitschrift* (Vienna) for June contains the first part of an epitome of Dr. von Bezold's papers on the thermodynamics of the atmosphere, which have already been summarized in our notices of Societies.—Dr. J. Hann contributes a valuable article on the results of the meteorological observations of the late Prof. A. Ackermann at Port-au-Prince, Hayti, 1854-68, being a part of the world where they are of special value. The observations were rescued from entire loss by the exertions of Dr. Hann and Prof. J. Scherer, the originals having been wilfully destroyed. The distribution of rainfall is much affected by the mountain features of the island; in the north the rainy season is from December to April, while in the south it is from May to July. The average yearly rainfall at Port-au-Prince, from the above observations, was 61 inches, on 153 days. The greatest daily fall was 5·6 inches in May 1865, the rain lasting four hours. The climate is very equable; the mean of the absolute maximum temperatures was 98°·2, and of the minimum 56°·8.—Dr. von Lepel describes his experiments in passing electric sparks through glass tubes lined with a thin coating of paraffin, and containing a small amount of moisture, and points out that during thunderstorms many similar discharges may be observed, and may find their explanation in these experiments. The sparks differ in character and in colour, and the author argues that the humidity in the tube may be compared to the particles of vapour in the thunder-clouds, and that the coating of paraffin may have the same optical effect as the translucent clouds themselves. He gives the results of his thunderstorm observations on these lines during the summer of the year 1888.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, June 22.—Prof. Reinold, F.R.S., President, in the chair.—The following communications were made:—Note on some photographs of lightning, and of "black" electric sparks, by Mr. A. W. Clayden. The lightning photographs, three in number, were obtained during the storm on June 6. Two flashes, seen on one plate, show complicated and beautiful structure: one of them is a multiple flash, and flame-like appendages point upwards from every angle; the other is a broad ribbon, and, although the plate shows signs of movement, the displacement is not in a direction such as would produce a ribbon-like effect from a linear flash. The second plate shows four flashes, none of which are ribbon-like, though the camera had moved considerably. The third plate was exposed to six flashes, one of which was believed to pass down the middle of the plate; but, on development, only a triple flash in one corner of the plate was seen. Careful search, however, revealed the central flash as a dark one with a white core, and other dark flashes were subsequently found. The plate was very much over-exposed, and this suggested that black flashes might be due to a sort of cumulative action caused by the superposition of the glare from a white cloud upon the normal image of the flash. To test this, sparks from a Wimshurst machine were photographed, and, before development, the plates were exposed to diffused gas-light for a short time. The bright sparks yielded normal images with reversed margins, and the faint ones were completely reversed. Other experiments showed the reversal to spread inwards as the time of exposure to gas-light increased. Finally, reversal was effected by placing a white screen behind the spark, to represent a white cloud, the only illumination being that of the spark itself. In the discussion which followed, Mr. W. N. Shaw exhibited a photograph taken during the same storm, which is particularly rich in dark flashes branching outwards from an intensely bright one. In some places the bright line has dark edges, and in one part a thin bright line runs along the middle of an otherwise dark portion of the flash. In answer to Mr. Inwards, Mr. Shaw said the plate was exposed about half a minute, and the former thought that, under those conditions, the appearance of the plate did not contradict Mr. Clayden's hypothesis. Speaking of the same photograph, Prof. Perry considered that Mr. Clayden's observations would explain the result, for a bright flash required more exposure to diffused light to reverse it than a faint one did. Prof. Ramsay reminded the meeting that Prof. Stokes's "oxides of nitrogen" explanation was still a possible one; and Mr. C. V. Burton asked whether they may be due to faint sparks cutting off light from brightly illuminated clouds, just as a gas-flame absorbs light from a brighter source. In reply, Mr. Clayden thought the "oxides of nitrogen" hypothesis improbable, and said his experiments did not enable him to answer Mr. Burton's question. As regards Mr. Shaw's plate, he believed the diffused light from the clouds would be sufficient to reverse the fainter tributary flashes, although it was insufficient to reverse the primary one. From data obtained when the ribbon-flash was taken, he had made some calculations which gave the height of the clouds about 1000 yards, and the ribbon-flash 1300 yards

long and 100 yards wide.—Researches on the electrical resistance of bismuth, by Dr. Ed. von Aubel. The paper, which is in French, was taken as read. A translation will appear in the Proceedings of the Society.—Expansion with rise of temperature of wires under pulling stress, by J. T. Bottomley, F.R.S. The investigation was to determine whether the coefficient of expansion of wires depends on the stress to which they are subjected, and was undertaken in connection with the secular experiments on the elasticity and ductility of wires, now being conducted at Glasgow University. Two wires, about 17 feet long, of the same material, were suspended side by side within a tube, through which steam could be passed to change the temperature. One wire was loaded to half, and the other to one-tenth its breaking weight, and, in the preliminary experiments the elongations were read by a Quincke's microscope cathetometer. About 150 heatings and coolings, extending over three months, were necessary to bring the heavily loaded wire to its permanent state, so that consecutive expansions and contractions were equal. When this stage was reached, hooks of peculiar shape were attached to the lower ends of the wire. These hooks form a relative geometrical guide, and their horizontal parts mutually support a small table which carries a plane mirror. If the wires expand or contract unequally, the mirror becomes tilted, and the relative displacement is observed by means of a telescope and scale fixed nearly vertically over the mirror. From experiments on copper wires, the coefficient of relative expansion was found to be $0{\cdot}32\times10^{-6}$ per degree Centigrade, or about 1/55 of the ordinary linear expansion of the material. The heavily loaded wire expanded most. The results for platinoid give $0{\cdot}27\times10^{-6}$ as the relative coefficient under the conditions named above; this is about 1/57 of the ordinary linear expansion, which, from separate experiments, was found to be $15{\cdot}4\times10^{-6}$. Mr. H. Tomlinson thought the probationary period for copper might be considerably shortened by repeatedly putting on and taking off the load, and by subjecting the wire to torsional oscillation. With iron wires this would not be the case, for they behave in a most peculiar manner, and require long periods of rest after each oscillation. From experiments he had conducted during the last two years, he found that the permeability of iron could be enormously reduced by repeated heatings and coolings whilst undergoing magnetic cycles of small range. Mr. Gregory said the paper threw considerable light on some experiments on the sag of stretched wires upon which he was engaged. He also suggested heating the wires by electric currents. In reply, Mr. Bottomley said he had considered it important to leave the wires untouched after being suspended, and as regards heating by electricity he thought that convection-currents would make the temperature non-uniform.—Owing to the absence of Prof. S. P. Thompson, his "Notes on Geometrical Optics" were postponed.

Linnean Society, June 20.—Mr. Carruthers, F.R.S., President, in the chair.—Dr. H. Trimen exhibited specimens and drawings of the tuberculated lime of Ceylon, and made some interesting remarks thereon.—Governor Moloney, of the Colony of Lagos, West Africa, exhibited an extensive collection of butterflies and moths, the result of twelve months' collecting during the rainy season. The former, comprising representatives of 65 genera and 158 species; the latter, 78 genera and 112 species, had been named and arranged by Mr. Herbert Druce. A few Chelonians, belonging to the genera *Trionyx*, *Sternothærus*, and *Cinixys*, were also exhibited, and a remarkably large block of resinous gum, which, in the opinion of Prof. Oliver, was referable to some species of *Daniellia*, and which had been found in Ijo country. As an article of commerce, it possessed the advantage of requiring a heat of 600° F. to "run" it, so as to unite with linseed oil in the manufacture of varnish. In addition to these specimens, Governor Moloney exhibited some long bows and cross-bows obtained from chiefs of Ibadan from some battle-field in that neighbourhood, and used by natives 300 miles from the coast-line. A discussion followed, in which Dr. Anderson, Mr. D. Morris, and Mr. Harting took part.—Prof. Stewart next exhibited some skulls, adult and immature, of *Ornithorhynchus paradoxus*, and explained the very curious dentition of this animal; upon which Dr. Mivart and Prof. Howes made some critical remarks.—A paper was then read by Dr. John Anderson, F.R.S., on the mammals, reptiles, and Batrachians which he had collected in the Mergui Archipelago, and concerning which he had been enabled to make some interesting field-notes. Attention was particularly directed to a new bat (*Emballonura*), and to the occurrence, on some of the islands, of *Pteropus edulis*, besides a wild pig, musk deer, gray squirrel, and a crab-eating monkey (*Semnopithecus*), which hunts along the shore in search of Crustacea and Mollusca. Some remarks were made on rhinoceros going out to sea, and on a crocodile being found twenty miles off the coast.—A communication was read from Mr. Charles Packe, on a remarkable case of prolonged vitality in a fritillary bulb.—The meeting (the last of the session) was brought to a close by a most interesting demonstration on animal locomotion, by Mr. E. Muybridge, who illustrated his remarks with projections on the screen, by oxy-hydrogen light, of instantaneous photographs taken by him, to which motion was imparted by means of the zoopraxiscope.

SYDNEY.

Royal Society of New South Wales, May 1.—Annual Meeting.—Sir Alfred Roberts in the chair.—The report stated that twenty new members had been elected during the year, and the total number on the roll, April 30, was 474. During the year the Society held seven meetings, at which the following papers were read:—Presidential address, by C. S. Wilkinson.—Forest destruction in New South Wales, and its effects on the flow of water in water-courses and on the rainfall, by W. E. Abbott.—On the increasing magnitude of η Argûs; on an improvement in anemometers; on the storm of September 21, 1888; on a new self-recording thermometer; and on the thunderstorm of October 26, 1888, by H. C. Russell, F.R.S.—Notes on some minerals and mineral localities in the northern districts of New South Wales, by D. A. Porter.—On a simple plan of easing railway curves, by W. Shellshear.—On the anatomy and life-history of Mollusca peculiar to Australia; and on the desert sandstone, by the Rev. J. E. Tenison-Woods.—Description of an autographic stress-strain apparatus, by Prof. Warren.—Considerations of phytographic expressions and arrangements, by Baron Ferd. von Mueller, K.C.M.G., F.R.S.—Indigenous Australian forage plants (non-grasses), including plants injurious to stock; some New South Wales tan substances, Part 5, by J. N. Maiden.—Census of the fauna of the older Tertiary of Australia, by Prof. Ralph Tate.—Results of observations of comets I. and II., 1888, at Windsor, New South Wales, by John Tebbutt.—The Latin verb *jubere*, a linguistic study, by Dr. John Fraser.—Notes on some New South Wales minerals (Note No. 5), by Prof. Liversidge, F.R.S.—The Medical Section held seven meetings, at which the attendance was far above the average; the papers read and specimens exhibited were interesting and valuable. The Microscopical Section held seven meetings. The Clarke Medal for the year 1889 had been awarded to R. L. J. Ellery, F.R.S., Government Astronomer for Victoria. The Society's bronze medal and money prize of £25 had been awarded to the Rev. J. E. Tenison-Woods for his paper on the anatomy and life-history of Mollusca peculiar to Australia, and the Council has since issued the following list of subjects with the offer of the medal and a prize of £25 for each of the best researches if of sufficient merit:—(To be sent in not later than May 1, 1890): The influence of the Australian climate (general and local) in the development and modification of disease; On the silver ore deposits of New South Wales; On the occurrence of precious stones in New South Wales, with a description of the deposits in which they are found. (To be sent in not later than May 1, 1891): The meteorology of Australia, New Zealand, and Tasmania; Anatomy and life history of the Echidna and Platypus; The microscopic structure of Australian rocks.—The Chairman read the Presidential address, and the officers and Council were elected for the ensuing year. Prof. Liversidge, F.R.S., was elected President.

PARIS.

Academy of Sciences, July 1.—M. Des Cloizeaux, President, in the chair.—On a flow of molten glass occasioned by the accidental piercing of a glass furnace, by M. F. Fouqué. An account is given of the sudden escape of about 400,000 kilogrammes of molten glass from the Clichy-la-Garenne Works, and a comparison is drawn between the action of the discharge and that of volcanic lavas. The absence of bubbles near the surface of the former, and the other differences noticed between the two streams, are attributed mainly to the different chemical composition of the initial magma of each substance. The wollastonite peculiar to the vitreous flow solidifies under very different conditions from those of the feldspars and ferro-magnesian bisilicates occurring in the molten lavas.—The thermo-chemical compared with the surgical method in the study of the animal organism, by M. Sappey. In continuation of his recent communication on

this subject, the author here contrasts the advantages and defects of the old and new processes, showing how they are complementary one of the other, and should consequently be associated in all important anatomical researches.—On the duration of lightning, by M. Daniel Colladon. In connection with M. Trouvelot's recent note, the author claims priority of discovery, having shown nine years ago that in thunderstorms the flash cannot always be instantaneous, and must last perceptibly longer than the thousandth part of a second assigned to it by Wheatstone.—Presentation of a volume of the "Annales de l'Observatoire de Paris: Observations de 1883," by M. Mouchez. The delay in issuing this volume is mainly due to the greatly increased number of meridian observations which were required to complete the revision of Lalande's Catalogue. The volume for 1884 is already half printed.—Note accompanying the presentation of M. Ch. Ed. Guillaume's work entitled "Traité Pratique de la Thermométrie de Précision," by M. Cornu. In this work is embodied a summary account of the researches that have been undertaken by the International Bureau of Weights and Measures for the purpose of removing the defects in the mercury thermometer, and giving the required degree of accuracy to that instrument.—On a new apparatus for zoological and biological research at determined marine depths, by Prince Albert of Monaco. With a view to remedying the defects of the instruments used in the expeditions of the *Challenger*, the *Blake*, and the *Vettor Pisani*, the author has prepared the instrument here described and illustrated. It is constructed on entirely new principles, and may be let down closed to any desired depth, then opened for purposes of observation, and re-closed before being brought to the surface. With this appliance Prince Albert has operated with satisfactory results to a depth of 500 metres in the Madeira waters.—Influence of temperature on the mechanical properties of metals, by M. André Le Chatelier. The mechanical properties of the metals at the different temperatures to which they are exposed in the various industrial processes have hitherto been little studied. The author here describes a series of researches that he has undertaken chiefly for iron and steel, but also for copper, zinc, aluminium, silver, nickel, and sundry alloys of copper, iron, and nickel. The results of these researches show generally that the mechanical properties of these metals are gradually modified with increased temperature. The detailed results obtained for iron and steel are reserved for a future communication.—On the malonates of barium, by M. Massol. The neutral malonates $CH_2(COO)_2Ba.2H_2O$ and H_2O, with their respective heats of solution and heats of formation, are described.—On the sardine fisheries on the coast of Brittany in 1888, by M. Georges Pouchet. The shoals were fully as abundant as in 1887; but for some unexplained reason there was a total suspension of the fisheries from about June 28 to July 20, during which period the sardines everywhere disappeared from the seaboard.—On the scales and calcareous epidermic glands of Globularia and Selago, by M. Edouard Heckel. During his general anatomical researches undertaken to establish a histotaxic classification of the Globularieæ, the author has detected in some species certain prominent anatomical characters, which appear to have escaped the notice of the numerous botanists who have occupied themselves with this family. They are described as calcareous epidermic glands of a scaly type, and are regarded by M. Heckel as condensed hairs clothing the outer surface with granular and crystalline calcareous concretions, instead of secreting an internal cystolith and localizing it in their unicellular chamber, as is the case with the Urticeæ, Verbenaceæ, and some other families.—On the occurrence of a granulite with riebeckite characters in Corsica, by M. Urbain Le Verrier. A microscopic study of this rock, which occurs in large masses about the middle of the west coast, shows that it is a hornblende of a special type, presenting the characters of the riebeckite recently described by M. Sauer.—On the leaves of Lepidodendron, by M. B. Renault. Since his last communication on this subject (*Comptes rendus*, November 28, 1887), the author has found a considerable number of leaves of Lepidodendron in the fossiliferous quartzes of Combres, de Lay, and Esnost near Autun. Some were still attached to the branches of *L. rhodumnense* and *L. esnostense*, and the present paper is restricted to a description of the former species.—The Quaternary stations in the neighbourhood of Lorrez-le-Bocage, Seine-et-Marne, by M. Armand Viré. In these stations, numbering about ten, and distant 25 leagues from Paris, M. Viré has collected several thousand flint instruments and weapons of different types, besides a few fragments of a blackish unornamented pottery.

STOCKHOLM.

Royal Academy of Sciences, June 5.—On the heredity of exterior lesions and of acquired characters, by Prof. G. Retzius.—Prof. A. F. Smitt reported upon a paper, by Dr. Fr. Heincke, of Oldenburg, entitled "Researches on the Stickleback."—Baron Nordenskiöld exhibited some fine specimens of minerals from Norway, sent as a gift by Dr. Jellef Dahl.—Prof. Nilson reported upon an investigation by himself and Prof. O. Petterson on the molecular weight of chlor-aluminium. They have found that it is expressed by the formula $AlCl_3$ and not by Al_2Cl_6, as given by Friedel and Craft.—On some definite integrals, by Dr. Lindman.—Observations on the tidal waters at Polhun in Spitzbergen, by Prof. Wijkander.—On the ammoniacal combinations of iridium, by Herr W. Palmar.—On amidoximes and azoximes within the triazol and tetrazol series, by Dr. Bladin.—On the action of cyanium on *a*- and *b*-naphthylamin, by Herr O. Nordenskiöld.—On *a*- and *b*-monofluornaphthalin, by Messrs. A. Ekbom and R. Manselius.—Observations on the radiation of the sun, by Dr. K. Ångström.—Ornithological observations made during the year 1887 at Sandhamn and its neighbourhood, by Herr O. Ekbohm.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Proceedings of the Society for Psychical Research, June (Trübner).—Proceedings of the Geologists' Association, November 1888 (Stanford).—Journal of the Royal Microscopical Society, June (Williams and Norgate).—Bulletin of the U.S. Geological Survey, No. 43 (Washington).—The Geological and Natural History Survey of Minnesota, Report for the Year 1887 (St. Paul).—Aus dem Archiv der Deutschen Seewarte, ix. Jahrg., 1886; x. Jahrg., 1887 (Hamburg).—Musical Instruments and their Homes; M. E. Brown and W. A. Brown (New York, Dodd).—The Second Report upon the Fauna of Liverpool Bay and the Neighbouring Seas: edited by Prof. Herdman (Liverpool).—The Chemistry of the Coal-tar Colours, 2nd edition: Dr. R. Benedikt; translated and edited by Dr. E. Knecht (Bell).—Contributions to the Tertiary Flora of Australia: Dr. Constantin (Sydney, Potter).—Hydraulic Motors: G. R. Bodmer (Whittaker).—Contributions to the Knowledge of Rhabdopleura and Amphioxus: E. Ray Lankester (Churchill).—Der Einfluss einer Schneedecke auf Boden, Klima und Wetter: A. Woeikof (Wien).—The Invertebrate Fauna of the Hawkesbury-Wianamatta Series of New South Wales: R. Etheridge, Jun. (Sydney, Potter).—Proceedings of the Geologists' Association, May (Stanford).—Mind, July (Williams and Norgate).

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