The first Harkness Scholarship for Geology and Palæontology is to be awarded in June next; names of candidates are to be sent in by May 31 next. Candidates must be Bachelors of Arts of not more than two-and-a-half years' standing.

The Sheepshanks Astronomical Exhibition will be awarded next December, at Trinity College. It is open to all undergraduates of the University, but the person elected must become a member of Trinity College. The conditions may be learnt from Dr. Glaisher, Trinity College.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 26.—"On the Development of the Electric Organ of *Raia batis*." By J. C. Ewart, M.D., Regius Professor of Natural History, University of Edinburgh. Communicated by J. Burdon Sanderson, F.R.S.

The paper consists of a short description of the electric organs found in the skate genus, and of an account of the development of the electric organ of the common grey skate (*Raia batis*).

It is shown that while in some skates (*e.g.*, *Raia batis*) the organ is made up of disk-shaped bodies, in others (*e.g.*, *Raia fullonica*) it consists of numerous cup-shaped structures provided with long or short stems.

The disks (with the development of which the paper chiefly deals) consist essentially of three layers, viz. (1) an electric plate in front in which the nerves end; (2) a striated layer which supports the electric plate; and (3) an alveolar layer, posterior to which is a thick cushion of gelatinous tissue. Each disk is formed in connection with a muscular fibre. In young embryos there is no indication of an electric organ, but in an embryo 6 or 7 cm. in length, some of the muscular fibres at each side of the notochord are found in process of conversion into long slender clubs having their heads nearest the root of the tail.

The club-stage having been reached, the muscular fibre next assumes the form of a mace, and, later, the anterior end further expands to form a relatively large disk, while the remainder of the original fibre persists as a slender ribbon-shaped appendage. As the head of the club enlarges to form a disk, it passes through an indistinct cup-stage, which somewhat resembles the cups of the adult *Raia fullonica*, hence it may be inferred that in *Raia fullonica* the organ has been arrested in its development. The conversion of the muscular fibre into a club is largely caused by the increase, at its anterior end, of muscle-corpuscles. These corpuscles eventually arrange themselves, either in front of the head of the club, to give rise to the electric plate, or they migrate backwards to form at the junction of the head of the club with its stem the alveolar layer. The striated layer, which is from the first devoid of nuclei, seems to be derived from the anterior striated portion of the club.

The gelatinous tissue between the disks, and the connective tissue investing them, are derived from the embryonic connective tissue corpuscles, which exist in great numbers around the clubs and developing disks.

May 3.—"On the Relations of the Diurnal Barometric Maxima to certain Critical Conditions of Temperature, Cloud, and Rainfall." By Henry F. Blanford, F.R.S.

The author refers to an observation of Lamont's that the diurnal barometric variation appears to be compounded of two distinct elements, viz. a wave of diurnal period, which is very variable in different places, and which appears to depend on the horizontal and vertical movements of the atmosphere and changes in the distribution of its mass, and a semi-diurnal element which is remarkably constant and seems to depend more immediately on the action of the sun. Then, referring to the theory of the semi-diurnal variation, originally put forward by Espy, and subsequently by Davies and Kreil, the author points out that the morning maximum of pressure approximately coincides with the instant when the temperature is rising most rapidly. This is almost exactly true at Prague, Yarkand, both in winter and summer, and in winter months at Melbourne. At the tropical stations, Bombay, Calcutta, and Batavia, and at Melbourne in the summer, the barometric maximum follows the instant of most rapid heating by a shorter or longer interval; and the author remarks that this may probably be attributed to the action of convection, which must accelerate the time of most rapid heating near the ground surface; while the barometric effect, if real, must be determined by the condition of the atmosphere up to a great height. With reference to Lamont's demonstration of the failure of Espy's theory, a condition is pointed out which alters the data of the problem, viz. the resistance that must be offered to the passage of the pressure-wave through the extremely cold and highly attenuated atmospheric strata, whose existence is proved by the phenomena of luminous meteors.

With respect to the evening maximum of pressure, it is pointed out that very generally, and especially in India, and also at Melbourne, there is a strongly-marked minimum in the diurnal variation of cloud between sunset and midnight, which, on an average, as at Allahabad and Melbourne, coincides with the evening maximum of the barometer. A similar coincident minimum, even more strongly marked, characterizes the diurnal variation of the rainfall at Calcutta and Batavia in their respective rainy seasons. In the author's opinion these facts seem to point to a compression and dynamic heating of the cloud-forming strata, and he points to the existence of a small irregularity in the diurnal temperature curves of Prague, Calcutta, and Batavia, which may possibly be due to such action. It is further remarked that the evening maximum about coincides with the time when the evening fall of temperature, after a rapid reduction between 6 or 7 and 10 p.m., becomes nearly uniform in rate, and it is suggested that the former may possibly be determined by the check of the rate of collapse of the cooling atmosphere. But it is observed that both the morning and evening waves of pressure probably involve other elements than the forced waves, and are in part rhythmic repetitions of previous waves.

Geological Society, April 25.—W. T. Blanford, F.R.S., President, in the chair.—The following communications were read:—Report on the recent work of the Geological Survey in the North-West Highlands of Scotland, based on the field-notes and maps of Messrs. Peach, Horne, Gunn, Clough, Hinxman, and Cadell. Communicated by Dr. A. Geikie. At the outset a review was given of the researches of other observers, in so far as they forestalled the conclusions to which the Geological Survey had been led. Reference was made to the observations of Macculloch, Hay Cunningham, C. W. Peach, and Salter; to the prolonged controversy between Sir Roderick Murchison and Prof. Nicol; to the contributions of Hicks, Bonney, Hudleston, Callaway, Lapworth, Teall, and others. It was shown that Nicol was undoubtedly right in maintaining that there was no conformable sequence from the fossiliferous quartzites and limestones into the eastern schists. It was also pointed out that the conclusions of Prof. Lapworth regarding the nature and origin of the eastern schists involve an important departure from Nicol's position, and are practically identical with those obtained independently by the Geological Survey. The results of the recent survey work among the Archæan rocks may be thus summarized: (1) the eruption of a series of igneous rocks of a basic type in which pegmatites were formed; (2) the development of rude foliation in these masses, probably by mechanical movement, and their arrangement in gentle anticlines and synclines, the axes of which generally run N.E. and S.W.; (3) the injection of igneous materials, mainly in the form of dykes, into the original gneisses, composed of (*a*) basalt rocks, (*b*) peridotites and palæopicrites, (*c*) microcline-mica rocks, (*d*) granites; (4) the occurrence of mechanical movements giving rise to disruption-lines trending N.W. and S.E., E. and W., N.E. and S.W.; (5) the effects of these movements on the dykes were to change the basalt-rocks into diorites and hornblende-schists, the peridotites and palæopicrites into talcose schists, the microcline-mica rocks into mica schists, and the granites into granitoid gneiss; (6) the effects on the gneiss resulted in the formation of sharp folds trending generally N.W. and S.E., the partial or complete reconstruction of the original gneiss along the old foliation-planes, and finally the development of newer schistosity more or less parallel with the prominent disruption-lines. There is an overwhelming amount of evidence to prove that all these various changes had been superinduced in the Archæan rocks in pre-Cambrian time. After reviewing the facts bearing on the denudation of the Archæan land-surface, the order of succession and thickness of the Cambrian strata were given, from which it is apparent that the deposits gradually increase in thickness as we pass southwards from Durness to Loch Broom. Prior to the deposition of the Silurian sediments the Cambrian strata were folded and extensively denuded. By these means various Cambrian outliers were formed far to the east of the present limits of the formation. The order of succession of the Silurian strata along the line of complicated structure from

Eriboll to Ullapool was described, reference being made to the further subdivision of the "Pipe-rock" and the Ghrudaidh Limestones (Group I. of Durness section). None of the richly fossiliferous zones of Durness is met with along this line, as they occupy higher horizons. An examination of the fossils recently obtained by the Geological Survey from the Durness Limestones confirms Salter's conclusions that they are distinctly of an American type, the Sutherland quartzites and limestones being represented by the Potsdam Sandstones and Calciferous Sand Group of North America. After the deposition of the limestones, the Cambrian and Silurian strata were pierced by igneous rocks, mainly in the form of sheets, producing important alterations in the sedimentary deposits by contact-metamorphism, the quartzites becoming crystalline, and the limestones being converted into marble. When this outburst of volcanic activity had ceased, terrestrial displacements ensued on a stupendous scale. By means of powerful thrusts the Silurian strata were piled on each other, and huge slices of the old Archæan platform, with the Cambrian and Silurian strata resting on it, were driven westwards for miles. With the view of illustrating the extraordinary complications produced by these movements, a series of horizontal sections was described, drawn across the line between Eriboll and Ullapool. The evidence relating to regional metamorphism was next referred to, from which it is obvious that with each successive maximum thrust there is a progressive amount of alteration in the displaced masses, as the observer passes eastwards to the higher thrust-planes. Eventually the Archæan gneiss is so deformed that the pre-Cambrian foliation disappears and is replaced by new divisional planes; the Cambrian grits and shales are converted into schists; the Silurian quartzites into quartz-schists; the limestones become crystalline; the sheets of intrusive felsite, diorite, and granitoid rock pass into sericite schist, hornblende-schist, and augen-gneiss respectively. These researches furnish a vast amount of evidence in support of the theory that regional metamorphism is due to the dynamical and chemical effects of mechanical movement acting on crystalline and clastic rocks. It is also c'ear that regional metamorphism need not be confined to any particular geological period, because in the N.W. Highlands, both in pre Cambrian time and after the deposition of the Durness Limestone (Lower Silurian), crystalline schists and gneiss were produced on a magnificent scale. After the reading of this Report, the Survey was congratulated on its work by the President, Prof. Lapworth, Prof. Judd, and other speakers.—On the horizontal movements of rocks, and the relation of these movements to the formation of dykes and faults, and to denudation and the thickening of strata, by Mr. William Barlow.—Notes on a recent discovery of *Stigmaria ficoides* at Clayton, Yorkshire, by Mr. Samuel A. Adamson.

Zoological Society, April 30.—Fifty-ninth Anniversary Meeting.—Prof. Flower, F.R.S., President, in the chair.—After the Auditors' Report had been read, and some other preliminary business had been transacted, the Report of the Council on the proceedings of the Society during the year 1887 was read by Mr. P. L. Sclater, F.R.S., the Secretary of the Society. It stated that the number of Fellows on January 1, 1888, was 3104, showing a decrease of 42 as compared with the corresponding period in 1887. A large number of valuable communications received at the usual scientific meetings held during the session of 1887 had been published in the annual volume of Proceedings, which contained 730 pages, illustrated by 55 plates. Besides this; one part of the twelfth volume, viz. Part C, of the Society's quarto Transactions, illustrated by seven plates, had been issued, and several other parts of Transactions were in a forward state. The volume of the *Zoological Record* for 1886 had been sent out in the month of January of this year to about 140 subscribers. The new edition of the Library Catalogue, spoken of in the last Annual Report as ready for issue had been published last summer. Two important additions had been made to the buildings in the Society's Gardens during the past year. The first of these, the wolves' and foxes' dens, which were commenced in 1886, had been erected by the Society's staff, under the supervision of Mr. Trollope, by whom the plans were drawn, and completed in November last. The second addition was a new aviary for flying birds which had been erected on the waterfowls' lawn, opposite the eastern aviary. This aviary is 105 feet long, 62 feet broad, and 27 feet high in the centre of the roof, which is formed of galvanized wire. The visitors to the Society's Gardens during the year 1887 had been altogether 562,898; the corresponding number in 1886 was 639,674. Mr. F. E. Beddard, Prosector to the Society, had been appointed Davis Lecturer for the present year, and had commenced a course of ten lectures on "Reptiles, living and extinct." These lectures were a continuation of a series given last year in connection with the London Society for the Extension of University Teaching. The number of animals in the Society's collection on the 31st of December last was 2525, of which 735 were mammals, 1331 birds, and 459 reptiles. Amongst the additions made during the past year, 13 were specially commented upon as of remarkable interest, and in most cases representing species new to the Society's collection. About 29 species of mammals, 21 of birds, and 3 of reptiles, had bred in the Society's Gardens during the summer of 1887. The Report concluded with a long list of the donors and their various donations to the Menagerie during the past year.—A vote of thanks to the Council for their Report was then moved by Dr. David Sharp, seconded by Mr. Robert McLachlan, and carried unanimously.—The Report having been adopted, the meeting proceeded to elect the new Members of Council and the Officers for the ensuing year. The usual ballot having been taken, it was announced that Dr. John Anderson, F.R.S., F. Du Cane Godman, F.R.S., John W. Hulke, F.R.S., Osbert Salvin, F.R.S., and Lord Walsingham, F.R.S., had been elected into the Council in place of the retiring members, and that Prof. Flower, C.B., F.R.S., had been re-elected President, Mr. Charles Drummond, Treasurer, and Dr. Philip Lutley Sclater, F.R.S., Secretary to the Society, for the ensuing year.—The meeting terminated with the usual vote of thanks to the Chairman, proposed by Lord Arthur Russell, seconded by Prof. G. B. Howes, and carried unanimously.

Mineralogical Society, May 8.—Prof. Bonney, F.R.S., Treasurer, in the chair.—The following papers were read:—Notes on some minerals from the Lizard, by Mr. J. J. H. Teall.—Contributions to the study of pyrargyrite and proustite, with analyses by Mr. G. T. Prior, by Mr. H. A. Miers.—On Cornish dufrenite, by Prof. E. Kinch.—On a peculiar variety of hornblende from Mynydd Mawr, Carnarvonshire; on a picrite from the Clicker Tor District, by Prof. T. G. Bonney, F.R.S.

PARIS.

Academy of Sciences, May 7.—M. Janssen, President, in the chair.—Note on the introduction of the element of mean averages in the interpretation of the results of statistical returns, by M. J. Bertrand. A demonstration is offered of the following theorem: Whatever be the number of urns (ballot-boxes and the like) and their composition, the law of discrepancies is the same for a single urn of given composition; but this urn will not yield the desired mean average. Hence in order to compare the results of statistical returns with those of abstract calculation two different urns must be assumed, the mean results being assimilated to the drawings made from the first, and the discrepancies to the results yielded by the second.—New theory of the equatorial *coudé* (continued), by MM. Lœwy and Puiseux. In this paper an explanation is given of the special processes applicable to the equatorial region, and of the physical methods employed to estimate the flexion of the axes. In a final paper the results will be given which have already been obtained in the application of this theory to the equatorial *coudé* of the Paris Observatory.—On the convergence of a continuous algebraic fraction, by M. Halphen. Three years ago the author communicated to the Academy the results of his researches concerning continuous fractions, which serve to develop the square root of a polynome of the third degree. In the present paper he extends his investigations to the case of a continuous fraction obtained by developing the function $f(x) = \frac{\sqrt{F(y)} - \sqrt{F(x)}}{y - x}$, where F indicates a polynome of the fourth or of the third degree.—On M. Massieu's characteristic functions in thermodynamics, by M. H. Le Chatelier. It is shown that these functions may be presented under a form somewhat different from that which they are usually made to assume, but which is more convenient for practical purposes.—On the variation of the specific heat of quartz with the temperature, by M. Pionchon. From the experiments the results of which are here tabulated it appears that from about 400° to 1200° C. the specific heat of quartz is constant and equal to 0·305. Thus the increase in the specific heat of this mineral is entirely confined to the interval between 0° and 400° C., a result which presents several points of interest in connection with M. Joubert's researches on the optical properties of the same substance.—On the theory of diamag-

netism, by M. R. Blondlot. The author's experiments tend completely to confirm M. Ed. Becquerel's views regarding the mutual relations of paramagnetic and diamagnetic bodies. It is shown that these views are in no way affected by Tyndall's experiment, which fails to prove the existence of diamagnetic polarity, and which is perfectly explicable by Becquerel's theory.—On the electric phenomena produced by the ultra-violet rays, by M. Auguste Righi. In connection with M. Stoletow's recent communication on this subject, the author points out that several of the results here given were previously announced by him in a note presented to the Academy dei Lincei on March 4, and printed at the time.—On the acid phosphites of the alkaline metals, by M. L. Amat. To the acid phosphite of ammonia $(PO_3HO)NH_4O,HO$, previously prepared by him, the author here adds the corresponding salts of potassa and soda $(PO_3HO)KO,HO$ and $(PO_3HO)NaO,HO$, and explains their method of preparation.—On the crystalline form of the trithionate of soda, by M. A. Villiers. The author has succeeded in obtaining crystals of this substance, the measurements of which are here given.—On terpinol, by MM. G. Bouchardat and R. Voiry. It is shown that certain derivatives of the terebenthenes generally supposed to be identical with List's terpinol are really of different composition, although presenting some marked analogies with that substance.—M. G. Demeny describes a number of instruments which he has devised for the purpose of accurately determining the exterior form of the thorax, the extent of the respiratory movements, the profiles and sections of the trunk, and the volume of air inhaled and exhaled. The last-mentioned is described as a self-registering "spirometer."

BERLIN.

Physical Society, April 20.—Prof. du Bois-Reymond, President, in the chair.—Prof. Vogel communicated the results of his researches on the spectrum of carbon. In recent times the spectra of all the carbon compounds have been recognized as being those due to carbon itself, the sole exception being in the case of cyanogen, whose spectrum was considered to be that of the compound, not of carbon itself. The speaker had therefrom investigated the spectrum of cyanogen, with the help of photography. He obtained a spectrum which was marked, from the red to the ultra-violet, by very characteristic lines. The spectrum of a Bunsen burner was next photographed, and it was found that its first three lines coincide in all respects with those of the spectrum of cyanogen; in addition a series of lines lying between the above and also in the blue were found to be identical in both spectra. On the other hand, the two bands in the blue and ultra-violet were absent in the spectrum of the compounds of carbon and hydrogen, being replaced by a series of very characteristic double lines. Prof. Vogel next photographed the spectrum of carbonic oxide, and found that its more highly refracted portion corresponded completely with that of cyanogen. The bands in the blue and ultra-violet were particularly well marked, whereas the less highly refracted half of this spectrum did not correspond with that of cyanogen. Finally, the light emitted by the electric arc was photographed, and its spectrum resembled in all respects that of cyanogen. The speaker drew the conclusion from these observations that in all four cases he was really dealing with the spectrum of carbon. The differences in the several spectra are not dependent upon differences of temperature, inasmuch as the temperature of a Bunsen flame is higher than that of cyanogen, and notwithstanding this the latter gave a more highly developed and complicated spectrum. The speaker was much more inclined to assume the existence of modifications of carbon, of which one yields its spectrum in the Bunsen flame, the other in the flame of carbon monoxide, the two spectra being met with united in those of cyanogen and the electric arc respectively. In photographs of the solar spectrum, the dark background on which the line G is conspicuous shows such a marked correspondence with narrow bands in all the above four spectra that the existence of carbon in the sun must necessarily be assumed.—Prof. Vogel then spoke on colour-perceptions, which he explained by means of experiments. It is well known that when a colour-chart is seen illuminated by the light of a sodium flame it appears colourless: the yellow appears to be pure white, and the other colours appear gray, graduating into black. This result is not observed with other monochromatic light, such as that of thallium or strontium. The speaker was, however, able to produce the same result by means of coloured glasses, whether red, green, or blue; those colours always appeared to be white or very bright which most strongly reflected the light with which the colour-chart was illuminated, all the other colours appearing to be either gray or black. When a second monochromatic light was added to a previous one, such as blue to a yellow light, then definite colour-sensations were observed, which increased in number when a third source of monochromatic light was superadded to the other two. Prof. Vogel laid great stress on the perception of white by monochromatic illumination of a uniformly coloured field of view. He was not prepared to give any explanation of the phenomena, but simply to bring them to notice, with the intention of investigating them further.

BOOKS, PAMPHLETS, and SERIALS RECEIVED

Nature's Hygiene, 3rd edition: C. T. Kingzett (Baillière, Tindall, and Cox).—Œuvres Complètes de Christiaan Huygens; Tome Premier, Correspondance 1638–56 (Nijhoff, La Haye).—Longmans' Junior School Geography: G. G. Chisholm (Longmans).—Kurzes Handbuch der Kohlenhydrate: Dr. B. Tollens (Trewendt, Breslau).—Geology for All: J. L. Lobley (Roper and Drowley).—The Elements of Logarithms: W. Gallatly (Hodgson).—Natural Causation: C. E. Plumptre (Unwin).—Text-book of Practical Metallurgy: A. R. Gower (Chapman and Hall).—Recherches sur le Ceratium Macroceros: E. Penard (Genève).—The Old Babylonian Characters and their Chinese Derivates: Dr. T. de Lacouperie (Nutt).—The Natural History and Epidemiology of Cholera: Sir J. Fayrer (Bale).—The Study of History in American Colleges and Universities: H. B. Adams (Washington).—Tōkyō Sūgaku Butsurigaku Kwai Kiji, Maki No. III. Dai 3.—Asbestos; its Production and Use: R. H. Jones (C. Lockwood).—A Chapter in the Integral Calculus: A. G. Greenhill (Hodgson).—Journal of the Chemical Society, May (Gurney and Jackson).—Annalen der Physik und Chemie, 1888, No. 6 (Barth, Leipzig).—Bulletins de la Societé d'Anthropologie de Paris, Tome X. (3 Serie), 4e. Fasc. (Masson, Paris).—Mémoires de la Société d'Anthropologie de Paris, Tome III. (2e. Serie) Fasc. 3 and 4 (Masson, Paris).—Quarterly Journal of the Geological Society, vol. 44, part 2, No. 174 (Longmans).—Bulletin of the American Geological Society, vol. xix., Supplement 1887, vol. xx. No. 1 (New York).—Jamaica, Annual Report on the Public Gardens and Plantations for the year ended September 30, 1887 (Jamaica).

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