THURSDAY, FEBRUARY 9, 1905.

SCIENTIFIC RESULTS OF THE BELGIAN ANTARCTIC EXPEDITION.

Résultats du Voyage du S.Y. Belgica en 1897, 1898, 1899, *sous le Commandemant de A. de Gerlache de Gomery.* Rapports scientifiques. (1) Zoology and Botany. (2) Astronomy and Meteorology. (Antwerp, 1902–4.)

(1) THE cruise of the steam-yacht *Belgica,* organised by the Belgian Government, may be regarded as the first of the series of expeditions fitted out during the last few years to explore the Antarctic and to collect systematically its zoological and botanical products. Consequently, it fell to the lot of this expedition to be the first to bring back specimens of certain animals previously known, more or less imperfectly, by examples obtained by the early expeditions to the South Polar regions, such as that of the *Erebus* and *Terror.* The most noticeable instance of this is afforded by the seal known as *Ommatophoca rossi,* which had been previously known only by two skulls and a skin brought home by the *Erebus* and *Terror* Expedition (1839–43). Fortunately, the fasciculus of the *Rapports* dealing with the seals (by Captain Barrett-Hamilton) was published in 1902, and ante-dates the British Museum report on the *Southern Cross* Expedition, thereby securing to the *Belgica* the full credit for having been the first to increase our knowledge of this interesting species.

The comparative slowness of the rate at which it has been found practicable to issue the result of the *Belgica's* work will, however, necessarily have discounted some of its claims to priority, seeing that the aforesaid report on the collections made by the *Southern Cross* was published in 1902, while at least one small instalment of the zoological results of the *Discovery* Expedition has already been made public. On the other hand, in many of the groups the new forms discovered by the *Belgica* expedition were described at an early date in the form of preliminary notices (in the case of the fishes as early as 1900), and as the later parts of the work before us contain reviews of the species described in the report of the *Southern Cross* Expedition, an advantage rather than a disadvantage has been gained by the delay in publication. This is particularly noticeable in the fasciculus devoted to fishes, which was published in 1904.

The characteristic of the reports on the *Belgica* collections is the wealth of detail with which the descriptions are worked out and the elaborate style in which they are issued. The entire work is, for instance, published in quarto form, in large type, with no apparent limitations to the extent of the letter-press, and a fair allowance of plates, most of which are admirably executed. Each section of the subject has been assigned to a specialist, and the mere mention of the fact that Captain Barrett-Hamilton is responsible for the seals, Mr. Racovitza (the naturalist to the expedition) for the cetaceans, Mr. Dollo for the fishes, and Dr. Pelseneer for the greater part of the molluscs, will be a sufficient indication of the care and wisdom with which the selection of these specialists has been made.

A total of more than sixty separate memoirs on the zoology of the expedition is promised, and of these no less than fourteen (ranging in their subjects from seals and cetaceans to corals and sponges) are now on the table before us. Within the limits of the space at our disposal it would obviously be impossible to attempt anything like a summary—much less a criticism—of the vast amount of work contained in this mass of literature. All that can be essayed is to record a few of the more striking results of some of these investigations, and at the same time to express our opinion, so far as we are capable of forming a judgment, of the high value and importance of the work generally.

As regards Mammalia, perhaps the most important result of the *Belgica* Expedition was a negative one, namely, the practical demonstration that no large forms of terrestrial mammalian life inhabit Antarctica. In his first expedition Mr. Borchgrevink was, indeed, inclined to attribute certain marks commonly seen on the hides of the Antarctic seals to the teeth of a land carnivore, but it is now believed, with much more probability, that they are due to sharks. Mr. Racovitza, it may be added, was the first to make us acquainted with the peculiar gular pouch and strange cry of Ross's seal.

In treating of the cetaceans, Mr. Racovitza, who (like Captain Hamilton in the case of the seals) has no new species to describe, makes some very interesting remarks with regard to the mode of life and physiology of these animals. Especially important are those relating to the depths to which whales are capable of descending. These the author believes to have been exaggerated very greatly, and he puts the extreme limit at one hundred, and the ordinary range at twenty-five metres. As he well remarks, it is practically impossible to imagine an animal the organisation of which would admit of its existence alike at the surface and under the pressure of abyssal depths. His arguments are supported by certain facts in regard to the depths at which cetaceans are captured by the Japanese.

In the bulky fasciculus on the fishes Mr. Dollo has incorporated the results of Mr. Boulenger's work on those obtained during the *Southern Cross* Expedition, and has thus been enabled to present his readers with what is practically a monograph of the Antarctic forms. The most remarkable representatives of this fauna are those constituting the family Nototheniidæ, of which the author recognises no less than eighteen generic types, three of these being named by himself. Whether he is justified in proposing the name *Cryodraco antarcticus* for the fish which he apparently admits to be identical with the one captured during the voyage of the *Erebus* and *Terror* and named Pagetodes, on account of the alleged insufficient definition of the latter, may be doubtful. In our opinion

the original sketch of Pagetodes is amply sufficient for the generic definition.

Very few words must, unfortunately, suffice for the parts devoted to invertebrates. In the fasciculus on brachiopods, Prof. Joubin directs attention to the apparently small bodily size of the Antarctic representatives of the group, a feature which is the more notable on account of the contrast they present in this respect to the forms from the Straits of Magellan. Another important fact in connection with the fauna of the southern ocean is brought out by Prof. Koehler in his description of the echinoderms obtained to the south of lat. 69°, the furthest point from which these organisms had at the time been obtained. Practically all these echinoderms have proved to be new forms, but whether they belong to the sub-Antarctic or the true Antarctic fauna has not yet been definitely ascertained.

The other fasciculi at present to hand include the following monographs:—molluscs, by Messrs. Pelseneer and Joubin; myriopods, by Mr. C. von Attems; collembola, by Mr. V. Willems; copepods, by Dr. W. Giesbrecht; nematodes, by Dr. J. G. de Man; nemertines, by Dr. O. Bürger; bryozoans, by Mr. A. W. Waters; hydroids, by Dr. C. Hartlaub; zoophytes, by Messrs. von Marenzeller and Carlgren; and sponges, by Mr. E. Topsent. The botanical memoirs include one by Dr. E. A. Wainio on lichens; a second, by Mr. J. Cardot, on mosses; and a third, by Mr. T. Stephani, on liverworts.

In concluding this too brief notice of a most valuable series of monographs, we may congratulate the Belgian Government on its wise liberality in authorising their publication, and the committee of the *Belgica* on the manner in which they have carried out their share of the task. R. L.

(2) In the department of astronomy we have the discussion of the rates of the chronometers employed and a description of the methods by which time was ascertained during the long confinement of the Antarctic winter. We may say, and it is admitted by the author, M. G. Lecomte, that the astronomical equipment was inadequate. It consisted at the outset of three marine chronometers, a sextant, two artificial horizons, an astronomical telescope, and a theodolite. The size of the telescope is not stated, but it was a relic of the old whaleship, the *Patria*, and was that which had been used by the captain to observe seals when at some distance from the ship. With this instrument, three phenomena of Jupiter's satellites were observed and one occultation. Lunar distances were also observed, but the rates of the chronometers were generally determined from local observations. The accumulated error on return is not clearly stated, but the rates and errors are worked out apparently with great care.

Meteorology naturally claims a large part in the scientific results. The observations were under the charge of M. H. Arctowski, and he has presented the details with very great clearness, and accompanied the whole with many excellent charts, showing graphically the behaviour of the barometer, the hygrometrical measurements, and the variations of temperature. The lowest temperature recorded was −43°·1 C. (−45°·6 F.) on September 8, 1898. The whole result is to exhibit the factors on which the climate depended during the sojourn of the expedition on the shifting ice. The observations do not refer to a particular spot, the ship drifting with the ice some sixteen degrees in longitude and two degrees in latitude. The observation of the clouds and the discussion of the results were entrusted to M. Dobrowolski, who had to encounter many difficulties, due to fog and darkness, which occasion lacunæ in the record. An appendix gives a description, as complete as possible, of a considerable number of cloud systems, divided into three stages of cirrus, clouds at a mean height, and of clouds at low altitudes. The greatest care seems to have been taken in the description of these systems during the twelve months of residence, but here again the expedition might have been better provided with apparatus. The observer had to trust entirely to eye and the compass; no nephoscope was provided, or photographic camera, or means for determining the height of cloud.

The same author discusses the formation of snow and hoar frost, but in this department he appears to have been hampered by the want of instrumental means. He had no microphotographic apparatus, and it has been difficult and sometimes impossible to reproduce the varied structure which he encountered. Hand drawings have been extensively used, and the general result of his work has been to confirm that of modern investigators who have recognised but two types of forms of structure.

An interesting memoir is that of M. Arctowski discussing the optical phenomena witnessed during the expedition. In this section he treats of the deformation of figure of the sun and moon crossing the horizon, illuminations of the sky at twilight, the green ray seen at the moment of the sun's setting, halos, and other phenomena, the peculiarities of which are best studied in polar regions. The author apologises for the popular character of some of his notes, but though greater detail might have been added if a spectroscope had been included in the outfit, these notes afford very interesting reading. The discussion of the auroræ forms a volume by itself, due to the same physicist. Only sixty-two times in thirteen months was this phenomenon witnessed, owing to the facts that the period of minimum auroræ occurred about the time of the expedition, and the region in which the *Belgica* was ice-bound was far from the locality in which auroræ pass through the zenith. Two excellent plates are given in this section.

Oceanography is represented by two memoirs. In the first, M. Arctowski describes the method by which observations were made on the passage across the Pacific to the Straits of Magellan to determine the density of the surface water. Later during the wintering of the expedition samples were drawn from considerable depths below the ice, and examined in the physical laboratory on board. In the second memoir M. Thoulet, professor at the University of

Nancy, gives the results of some experiments made on the density of sea water in the course of an inquiry entrusted to him by the commission in connection with the results derived by M. Arctowski.

W. E. P.

ITALIAN CHEMISTRY.

Trattato di Chimica Inorganica Generale e Applicato all' Industria. By Dr. E. Molinari. Pp. xxii+693. (Milan: Ulrico Hoepli, 1905.) Price 12.50 lire.

DURING the greater part of last century the progress of science in Italy was retarded by the political troubles of the country; even after the nation had achieved its independence and unity, scientific education was hampered by ecclesiastical controversies and by the poverty of the newly created Government. Taxation has always fallen heavily on the Italian people, and the industry and energy of the north have been taxed unduly owing to the poverty and thriftlessness of the south. In spite of these disadvantages, Italy gave to science in the last century many names which will long be remembered in its history. In particular, the hypothesis of Count Avogadro, enunciated in 1811, forms the basis of the whole of the modern development of chemistry; for nearly fifty years, however, its importance was overlooked, and it was the peculiar merit of another Italian, Cannizzaro, by reviving it, to establish a new epoch in the development of chemical science and to introduce order where all was confused and contradictory.

In the course of the past twenty-five years a school of Italian chemists has arisen the quality of whose work is on a high level of excellence. Side by side with this, an astonishingly rapid development of all branches of the industry of Italy has occurred. The rapidity of the advance may be gauged from a few facts. In the six years 1893–9, the value of the chemical manufactures of Italy exactly doubled itself, increasing from about 1,000,000*l.* to 2,000,000*l.* per annum. In the twenty-five years from 1875 to 1900 the value of the raw silk annually produced tripled itself, and that of the woven silk, which in 1890 was 600,000*l.*, rose in 1900 to 4,000,000*l.* The cotton and wool industries have developed almost as rapidly, and a similar progress is seen in the case of new manufactures, such as that of steel rails, which have only recently been introduced into the country. In some instances Italian manufacturers have begun to compete in foreign markets, and this development bids fair to become still more rapid as Italy converts more and more of her abundant store of water power into electrical energy.

The author of the present treatise, who holds the position of professor of chemistry at the Society for the Encouragement of Arts and Crafts of Milan, has endeavoured in it to initiate a reform in the teaching of chemistry in Italian universities, a reform which has also been recently urged by Profs. Cannizzaro and Ciamician. Hitherto the chemistry taught has been of too academical a character, little attention being given to practical applications. The title of the present work defines its nature, which is that of a treatise on inorganic chemistry, with especial reference to chemical industry. The commoner elements and their compounds are dealt with in detail, but instead of illustrating the text with time-honoured drawings of lecture apparatus, the actual plant used in the manufacture of these substances is depicted. All the more recent processes of manufacture are described concisely but sufficiently, but the book does not degenerate into a mere treatise of technology. The principal physical and chemical properties of the substances are clearly defined, as well as the relation existing between them; owing to conciseness and to the character of the type employed, a large amount of information is imparted which is not to be found in the usual elementary text-books. A novel feature is that the average market price of each commercial article is stated, whilst statistics are given of the cost of manufacture and profit of many of the more important substances. In many cases the development of an industry is traced through the patents referring to it, for instance, in the case of the manufacture of sulphuric acid and of alkali.

Before undertaking the systematic treatment of the elements, 114 pages are devoted to general chemical theory. It is this part that is most liable to criticism. A portion might very profitably have been omitted. The description, for instance, on pp. 37 to 40, of as many as eight different methods of determining vapour density, serves no useful purpose in a book of this kind, while it is doubtful whether the method of deducing the relationship (pp. 72 to 73) between the osmotic pressure and the freezing and boiling points of dilute solutions will be intelligible to the student in its present form. The historical treatment adopted throughout the work is the cause of a few misstatements which should have been avoided. Why, for instance, revive the story, which has no basis in fact, that Priestley, after languishing in poverty, died of poison? In discussing the history of valency, no mention is made of Frankland and Kolbe, Wurtz and Graham only being referred to. It is, moreover, so far from being the truth (p. 136) that in 1809 Gay-Lussac and Thénard admitted that chlorine was probably an element that even in 1811 they contested Davy's view of its elementary nature. Strangely enough, the part played by Cannizzaro in reviving Avogadro's theory is passed over in silence (p. 33), and the credit given to Gerhardt and Laurent alone.

Dr. Molinari's treatise is especially adapted and is likely to be very serviceable to the student who intends devoting himself to chemical industry; for a similar text-book at an equally low price the English student has long sighed in vain. With a few slight alterations the work could be made equally useful to the engineer. In particular, more space might be given to considering materials of construction, whilst the treatment of alloys is far too brief to be satisfactory, considering the important part which they now play in engineering. Several pages of part i. might well be replaced by a general discussion of the remarkable influence of impurities and of thermal

treatment on the physical properties of metals. The phase rule, which is briefly explained, could be given a practical application by referring to the nature of alloys, particularly in the case of carbon-iron mixtures.

As is the case with all the works published by the well known firm of Ulrico Hoepli, the printing and reproduction of the illustrations leave nothing to be desired. It is, however, a pity that so many proper names are wrongly spelt; thus Graham is uniformly spelt *Grahm*, and Van der Waals *Van der Vaals*. More than ten misprints of other names are observable. W. A. D.

A NEW CRYSTALLOGRAPHY.

Grundzüge der Kristallographie. By Prof. C. M. Viola. Pp. iv+389. (Leipzig: W. Engelmann, 1904.) Price 11 marks; bound, 12 marks.

THE opinion is rapidly gaining ground that the theory of crystallography based on the laws of rational indices and symmetry no longer suffices without modification for the classification and description of crystals. It is recognised on the one hand that isomorphism of kindred substances shows itself (as in the Humite group of minerals) more in similarity of crystalline habit and angles than in identity of optical and geometrical symmetry, and on the other hand that vicinal faces with high indices may play an important part in the economy of crystals. Prof. Viola is evidently of opinion that the old methods cannot be adapted to meet the situation, and his book is as revolutionary as it well could be. Crystals are here divided into 7 sygonies, 10 fundamental forms, and 29 harmonies; symmetry is but a particular case of harmony; twins are two similar crystals with two predominant elements in common; the number of space-lattices is reduced to 10, and of space-groups to 156. The basis of classification is descriptive, not geometrical; blende, felspar, and garnet belong to the same fundamental form, chalcopyrite and tetrahedrite to the same harmony.

If the author had merely attacked the existing theory and advocated a classification expressing the results of direct observation alone, independent of any hypothesis, he might have had some success. Unfortunately, he has tried to build up a mathematical theory of his own, with disastrous results. The average shape of all crystals of a substance grown under approximately the same conditions is its "habit"; the average shape of all habits is its "fundamental form." The rate of growth in any direction is proportional to the "cohesion" in that direction (measured, apparently, by the force needed to break a rod of the substance the length of which lies in the given direction), and cleavage takes place perpendicular to the lines in which minima of cohesion are well marked. It follows that the fundamental form has always a centre of symmetry. These assumptions are hardly justified by the cleavage and usual habit of many crystals, *e.g.* fluorite and tetrahedrite, but the mathematical development of these hypotheses is, if possible, still more unfortunate than the premises themselves. It is argued (p. 14, *cf.* Fig. 20) that if two faces grow outwards with velocities c_1 and c_2, (1) their intersection moves with the velocity c_3, compounded of c_1 and c_2, (2) therefore the face perpendicular to c_3 grows with velocity c_3, (3) c_3 is a maximum or a minimum when c_1 and c_2 are minima. Of these statements (1) and (3) are untrue, and (2) absolutely unproven. Thus the fundamental principles on which nearly the whole of the book is based are wrong. Much of the reasoning is of the same fallacious nature, or is, at best, only an appeal to probability; but one more example must suffice.

The author sets himself (p. 251) the impossible task of proving that a symmetry-axis of a homogeneous medium is 2-al, 3-al, 4-al, or 6-al without employing either the law of rational indices or a molecular structure. He accomplishes this by assuming that if the medium is brought to self-coincidence by a rotation through an angle 2γ about an axis C, it cannot be brought to self-coincidence by a rotation about C through any angle less than 2γ.

Prof. Viola apparently considers the space-lattice as only a convenient geometrical expression of the physical properties of a crystal, not as corresponding to any reality of crystal-structure. It is true that he proves (by assuming that the densities of the molecule and of the crystal as a whole are equal, see pp. 280, 335) that the unit of crystalline structure must be the same as the chemical molecule; but on pp. 322 and 334 he uses arguments which would prove the existence of an infinite number of such units in a finite volume.

Crystallographers owe a debt of gratitude to the author for his clear and complete lists of references to the literature of the various subjects with which he deals; the historical notes are also very valuable. The chapters on the two-circle goniometer and the stereographic projection contain much that is interesting and not in the usual text-books. The appearance of the book is attractive, but there is a large number of misprints, some of which quite obscure the author's meaning. HAROLD HILTON.

OUR BOOK SHELF.

The Arris and Gale Lectures on the Neurology of Vision. By J. Herbert Parsons, B.S., D.Sc., F.R.C.S. Pp. 70. (London: Hodder and Stoughton, 1904.) Price 2*s.* 6*d.* net.

THE two lectures delivered by Mr. Parsons in the spring of last year before the Royal College of Surgeons deal with some points on the neurology of the eye which are of extreme interest. The first lecture has for its subject the course of the afferent impulses from the retina to the central nervous system, and their final distribution in the cerebral cortex. Since the delivery of these lectures there have been several important contributions to this latter subject. The case of Dr. Beevor and Dr. Collier, reported in the summer number of *Brain*, seems to go conclusively against the more restricted visual area for which Henschen argues. In this case, despite the fact that the lingual lobe, the depths of the calcarine fissure, and the lower cuneal lobe were all affected, the restriction of the field of vision was simply quadrantic. The truth seems to be that the limits of the visual cortical area correspond to the limits of the layer of Gennari, and that this varies markedly in its relations to the surface in different cases.

The second lecture deals with an equally important

subject, the nervous control of pupillary movements. A review of the work done on the question of the course of the pupillo-dilator fibres is given. These fibres pass from the cervical sympathetic as a separate tract along the carotid towards the Gasserian ganglion, and run thence with the ophthalmic division of the trigeminal along the nasal branch to the long ciliary nerves, thus avoiding the ciliary ganglion. The final portion of the lecture is devoted to a discussion of the cortical localisation of pupillary movements. We agree with Mr. Parsons that a very critical spirit is necessary in dealing with this subject. Here, more than anywhere else, is to be found the "elusive factor" which upsets all hypotheses. The term "synkinesis" seems to have a sufficiently useful application in neurological nomenclature to justify its invention. The limits of this notice do not allow of more detailed criticism. We must, however, congratulate Mr. Parsons on the singularly lucid, though necessarily inconclusive, fashion in which he has dealt with subjects of great complexity and importance.

The Twentieth Century Atlas of Microscopical Petrography. Part ii. With four plates. (London: Thos. Murby, 1904.)

SINCE the note on this work appeared in NATURE (vol. lxxi. p. 38), we have been informed that the "editor" of it is Mr. E. Howard Adye, who is, in fact, responsible both for the text and for the very delicate plates. The second part includes two igneous rocks from Edinburgh, the Carboniferous oolite of Clifton, and the beautiful green quartzite of Ightham, described by Prof. Bonney in 1888. This last rock, we believe, usually contains altered glauconite in addition to the minerals mentioned by the author. We fancy that Mr. Adye is familiar with biological writing, which makes his descriptions rather more severely technical than is customary among English geologists. We thus read of a "dark brown fenestrated region at the periphery," "hypo-odontoid outgrowths," "biogenetic formation," and so forth. We do not know, moreover, what degree of extraordinary accuracy is suggested by the phrases "completely polarised light" and "fully-crossed Nicols." The text, however, is usually clear and graphic. The four rock-sections accompanying the part, and issued through the laboratory of Mr. J. R. Gregory, are absolutely perfect specimens of an art rarely cultivated in the British Isles. G. A. J. C.

Abbildungen der in Deutschland und den angrenzenden Gebieten vorkommenden Grundformen der Orchideen-arten. 60 Tafeln nach der Natur gemalt und in Farbendruck ausgefuhrt von Walter Müller (Gera) mit beschreiben dem Text von Dr. F. Kränzlin (Berlin). Pp. xiv+60+plates. (Berlin: R. Friedländer und Sohn, 1904.) Price 10 marks.

THIS is a series of sixty coloured plates representing the orchids which occur in Central Europe. The introduction and the text are from the pen of Dr. Kränzlin, who tells us at the outset that the book is not intended for professed botanists, but for those who take an interest in botany, or who possess a love of flowers. For this reason it is, we suppose, that the minutiæ of anatomical structure and the details of physiology are but lightly touched on. The reader, however, has put before him in a very clear way the principal points in the morphology of this most interesting group, together with an account of the conformation of each species.

A general statement is made as to the geographical distribution of the several plants, but no precise indications of particular localities are given. Most of our European orchids are terrestrial and have tuberous roots, but *Liparis Loeselii*, a species very rare in Britain, has a distinct pseudo-bulb such as characterises most of the tropical epiphytes of this order, and a similar form of stem occurs in *Microstylis monophyllos*, so that the formation of a pseudo-bulb is not correlated solely with the epiphytic habit. Both the tuber and the pseudo-bulb serve as food stores for the growing plant. In *Goodyera repens* there is a creeping underground stem which also recalls that of its tropical congeners. These points and others of a similar character are well represented in the plates. These illustrations were executed from life by Mr. Walter Müller, and they are so truthful that we may commend them to the notice of orchid lovers. Our field botanists will find all the British species represented, as well as a few others that are not members of the British Flora.

Intensification and Reduction. By Henry W. Bennett. Pp. xv+124. (London: Iliffe and Sons, Ltd., 1904.)

THIS issue, No. 15 of the *Photography* Bookshelf Series, will form a useful addition to an already valuable set of handbooks. The author has wisely restricted himself to setting forth in a clear and concise manner the better methods employed in intensification and reduction, and has not burdened the beginner with an elaborate index to all possible methods past and present. The processes dealt with are treated in some detail, so for this reason the reader should gain a good working knowledge of the manipulations he has in hand. The distinctive qualities of each method are clearly brought out, making the selection of any one for a particular negative quite an easy matter.

LETTERS TO THE EDITOR.

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

Slow Transformation Products of Radium.

IN a recent number of the *Philosophical Magazine* (November, 1904), I have shown that radium, after passing through four rapid changes, finally gives rise to two slow transformation products, which, on the scheme of changes there outlined, were called radium D and radium E.

These two products can be separated from each other by suitable physical and chemical methods. Radium D, which is the parent of E, gives out only β rays, while E gives out only α rays. It was calculated that D should be half transformed in forty years, and E in about one year. Evidence was also shown that radium D was the active constituent in the radio-active lead of Hofmann, and that radium E was the active substance present in both the polonium of Mme. Curie and the radio-tellurium of Marckwald.

Later work has confirmed these conclusions. I have examined the rates of decay of the activity of radium E and of radio-tellurium, and have found them to be identical. Each loses half its activity in about 150 days, instead of the calculated period of one year. The specimen of radio-tellurium was obtained from Sthamer, of Hamburg, in the form of a thin film deposited on a polished bismuth rod. I find that the same value for the decay and activity of radio-tellurium has recently been obtained by Meyer and Schweidler (*Akad. d. Wiss. Wien.*, December 1, 1904).

I was, unfortunately, unable at the same time to determine accurately the decay of the activity of polonium. A specimen of polonium (ratio-active bismuth) had been in my possession for three years, and had during that time lost a

large proportion of its original activity. On testing it, the activity was found to have reached a small and nearly constant value. Rough observations, however, which I had made from time to time indicated that the rate of decay of this polonium was certainly not very different from that of radium E. More accurate experiments will be required to settle the question definitely, but I think there is little doubt but that their rates of decay will be found to be the same.

Polonium, radio-tellurium, and radium E have very similar radio-active and chemical properties. Each gives out only α rays, and each is deposited on a bismuth plate placed in the active solution. The probable identity of their rates of decay, taken into conjunction with the similarity of their radiations and chemical properties, shows that the radio-active constituent present is in each case the same. We may thus conclude that the active substance present in polonium and radio-tellurium is a decomposition product of radium and is the sixth (or, as we shall see later, probably the seventh) member of the radium family.

The main objection, in the past, against the identity of polonium and radio-tellurium has rested on the statement of Marckwald that a very active preparation of his substance did not lose its activity to an appreciable extent in six months. Unless very special methods were employed, it would be difficult to determine with accuracy the variation of the activity for such very active material. The specimen of radio-tellurium obtained both by Meyer and Schweidler and by myself undoubtedly does lose its activity fairly rapidly.

I have recently examined more carefully the product radium D, and have found strong evidence that it is not a single product, but contains two distinct substances. The parent product, radium D, does not give out rays at all, but changes into a substance which gives out only β rays, and is half transformed in about six days. Unless observations are made on the product radium D shortly after its separation, this rapid change is likely to escape detection. The work on this subject is still in progress, but the evidence at present obtained indicates that the active deposit from the emanation, after passing through the three rapid stages, represented by radium A, B, and C, is transformed into a "rayless" product D, which changes extremely slowly. D continuously produces from itself another substance—which may for the time be termed D_1—which is transformed in the course of a few weeks and emits only β rays. This product D_1 gives rise to E (polonium).

Since the activity of D_1 reaches a maximum value a few weeks after the production of D, and will then decay at the same rate as D, the conclusion, previously arrived at, viz., that D is half transformed in about forty years, still holds good.

The view that radium D is the active constituent present in the so-called radio-lead of Hofmann has been very strongly supported by some experimental results recently obtained by Hofmann, Gonder and Wölfl (*Annal. der Physik*, vol. xv., 3, 1904).

They found that preparations of radio-lead continuously produced an α ray product, which could be separated on a bismuth plate. This active product is probably radium E, for they found it lost a large proportion of its activity in one year. They found, in addition, that by certain chemical methods another distinct product could be separated which gave out only β rays, and lost much of its activity in six weeks. This substance is probably the new radium product D_1 already referred to.

Debierne recently concluded that radio-lead and polonium were identical, and proposed that the name radio-lead should be dropped in favour of polonium. In the light of the above results, this position is not tenable. There is no doubt that the preparation of radio-lead in my possession, and also that experimented on by Hofmann, contains a distinct substance which, as the parent of polonium, has certainly as much right to a name as its offspring. The radio-active substance in "radio-lead" has no more connection with lead than Marckwald's active matter "radio-tellurium" has with tellurium. The names both arose because the active matter was initially found associated with these substances.

In order to avoid confusion, I have called the new radium product "radium D_1." If no further intermediate products of radium are brought to light, it would be simpler to call it radium E and to call the α ray product (polonium) radium F.

E. RUTHERFORD.

McGill University, Montreal, January 24.

Indian and South African Rainfalls, 1892-1902.

MR. J. R. SUTTON, of Kimberley, rendered a signal service to South African meteorology in his "Introduction to the Study of South African Rainfall" (*Trans.* S.A. Philosophical Soc., December, 1903), but when he states that south-east winds are rare on the south-east coast of South Africa, and that the rainfall of the greater part of the tableland and south-east coast comes from some northern direction (NATURE, November 3, 1904), it is difficult to follow his conclusions. Most, if not all, of those who have studied South African rainfall will, I think, agree with me that the facts do not bear this interpretation. Least of all is it the case that there has been nothing that can properly be called a drought, in the sense of Sir J. Eliot's address, within the past fifteen years in South Africa. In all the summer rainfall areas of South Africa, viz., over the bulk of the subcontinent, drought has prevailed during recent years, and in some localities it has been terribly severe.

During twenty years I have travelled over every part of South Africa except the desert areas, and I have resided continuously in those parts where there is most rain and forest. I have heard the rain and its mode of arrival discussed in every locality and from every point of view, and these facts have convinced me that the summer rains have their origin in the moist winds from the Indian Ocean. The precipitation of the moisture contained in these humid air currents is caused by barometric depressions with normal cyclonic wind circulation, and it is the winds proper to these depressions that give the appearance of rains coming from the north, north-west, west, &c.

The following gives a brief account of the various storm types. In Cape Colony storms travel from west to east at all times of the year. As one would expect, they are more regular and better developed in the south than in the north, and in Rhodesia than in the Northern Transvaal. In the north during summer they may be replaced by westward travelling tropical storms. Usually it is the secondary with its thunderstorms, a whirl within a whirl, which precipitates the greater amount of moisture. In the southern portion of the subcontinent these storms in most cases pass across from west to east with their centres to the south, and thus their wind circulation shows at first winds from the north and north-west, then from the west and south-west, and finally from the south and south-east. In summer, when the south-east trade blows on to the subcontinent with a monsoon effect, the wind remains longer in the south-east quarter, and heavy rains come frequently from the south-east or the south-west quarter. The portion of the barometric depression and its accompanying circulation which brings the wind will depend on the position of the locality, but I have never known the facts not to conform more or less closely to this type of wind circulation. A range of mountains across the south-east rain-producing wind will, of course, increase the precipitation, and when once rain has started in the south-east quarter it will often continue for days with a steady south-east wind blowing like a south-west monsoon wind in India. All this takes place on the eastern side of South Africa. The rain is greatest in amount where the east wind from the Indian Ocean first strikes the highest eastern land, and the rain gradually decreases in amount until the western deserts are reached. It is generally the north-west wind which starts the precipitation, but it is quite certain notwithstanding that the humid currents do not come from the north-west. If, as Mr. Sutton has suggested, the high upper current of the north-west anti-trade were the source of South African rains, then it would be natural to suppose that the rains would be best developed on the north and western sides of South Africa, which is exactly the reverse of what actually takes place.

South Africa lies on the border of the south-east trade area. In summer South Africa, from Cape Town to the Zambezi, comes entirely under the influence of the south-east trade winds; but in winter the southern portion of

Cape Colony is subject to another type of weather, due to the passage of storms from the South Atlantic, the "roaring forties" of mariners. It is necessary very carefully to distinguish between these two weather systems. In the one the storms bring winter rains to a small part of the subcontinent, *i.e.* Cape Town and the south-west; in the other the storms precipitate the abundant moisture brought by the trade winds from the Indian Ocean, more or less over the whole subcontinent.

This much of explanation is necessary in order to understand clearly the connection between the weather of India and that of South Africa. In studying this connection we have at the outset to eliminate the winter weather of the south-west with its winter rains coming from the South Atlantic.

Sir John Eliot, in his reply to Mr. Sutton, very properly excludes the area of winter rains. I go further, and exclude what Mr. Sutton has termed the area of spring and autumn rains. The latter are areas where, with the winter storms still prevailing and the summer south-easters coming in from the Indian Ocean, there is the most marked precipitation in spring and autumn. We are not in a position to say how far these rains have been produced by the tail-end of the retreating Atlantic storms or by the head of the advancing humid south-east trade currents. The fertile country watered directly by the south-east trade is comprised in sections x. to xv. of Mr. Sutton's rainfall areas, viz. the east of Cape Colony, Kaffraria, Basutoland, the Orange River Colony and Natal, and, in addition, all the Transvaal, Rhodesia, and the Portuguese territory; in fact, it is the whole of fertile South Africa with the exception of the southern and south-west coasts. In the table below I give the mean of Mr. Sutton's figures for his sections x. to xv., comprising Eastern Cape Colony, Transkei, Basutoland, Orangia, and Natal, and I add the yearly rainfall from typical stations in the Transvaal and Rhodesia, as correct general average figures for these territories are not available.

Percentages of Rainfall in the Summer Rainfall Areas, 1891 to 1902: Mean of Sutton's Sections x. to xv.

1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902
Per cent.											
136	106	132	97	103	102	74	107	89	82	98	93

And correcting Sir John Eliot's table to purely summer rainfalls it will read thus:—

Period of general excess of rain.			Period of general deficiency of rain.		
Year.	Percentage variation Summer rainfall.		Year.	Percentage variation Summer rainfall.	
	India	S. Africa.		India	S. Africa.
1892	12	+ 6	1895	− 5	+ 3
1893	22	+32	1896 (famine)	−12	+ 2
1894	16	− 3	1897	normal	−26
			1898	1	+ 7
			1899 (famine)	−27	−11
			1900	− 1	−18
			1901	−10	− 2
			1902	− 5	− 7

These figures show more strikingly than those already quoted by Sir John Eliot the intimate connection between the rainfall of India and South Africa during the period 1892 to 1902, and the connection would have shown better if seasonal instead of calendar years had been taken, since the calendar year cuts into two unequal portions the South African summer rainfall. It will be noted that each Indian famine year has been followed by one or two particularly bad years of drought in South Africa.

It is a somewhat remarkable coincidence that, while the number of NATURE containing this discussion was on the sea on its way to the Cape, I prepared my yearly forecast of South African weather, and in that took occasion to point out the very close connection of the two rainfalls during this period. I may perhaps crave your indulgence to reproduce it, since it confirms so singularly Sir John Eliot's view. Speaking of certain typical stations I said:—

"Sir John Eliot's paper shows that 1892, 1893, and 1894 were years of good rainfall in India. These were the last years of general good rainfall we had in South Africa. In 1895 the drought set in at most South African stations. Further, in this droughty period there were two years of bad famine, viz., 1896 and 1899. These two years of famine in India were the two worst years of drought at many typical South African stations. At present we are not in a position to obtain average figures for the whole of South Africa, but nearly the same purpose will be served by taking certain typical stations thus:

"At Bulawayo (Hope Fountain), in 1890–1, there was the heaviest rain on record, viz., 45 inches; all the following years have been years of drought except three years when the rainfall was barely above the average.

"At Johannesburg there were good rains in 1894, when there were good rains in India, fair rains in 1895, and then drought, when there was drought in India. 1896 (one of the Indian famine years) was the worst year of drought in Johannesburg. The great Indian famine of 1899 was represented by a bad drought 1898–9 preceding the failure of the Indian monsoon by four months. . . .

"Natal rainfalls correspond closely with the Indian rainfalls. While 1899 was the worst famine for many years in India, 1899 and 1900 were the two worst years of drought ever experienced at Durban, in Natal, since meteorological observations were begun there in 1866. In 1900, the Durban rainfall was only 27 inches against an average of 41 inches. At Maritzburg, representing the inland Natal districts, 1899 was also a year of drought, but the greatest deficiency was registered the following year (probably chiefly due to the calendar year dividing the seasonal year).

"Again, at Grahamstown, Cape Colony, in 1899 there was under 20 inches against an average of 29 inches; at King William's Town in 1899, only 16 inches against an average of 25 inches; while at Graaff-Reinet in 1899 there was only 9 inches against an average of 15 inches. At all these South African stations, 1899, the great Indian famine year, was the worst year of drought in recent times!"

The rainfall curves for Umtata, Evelyn Valley, and Katberg show similar features, viz., severe South African droughts corresponding to the years of Indian famine, and a general deficiency of rainfall corresponding with the years of general deficiency of Indian rainfall. The rainfall curve of Evelyn Valley (Fig. 1), however, is very remarkable. This is a forest station, and the observer a particularly good one. I have elsewhere compared this station to Cherapunji, in India. I founded this station in 1887, and it has since shown the heaviest rainfall on the summer register. It lies in a *cul de sac* of the mountains facing the south-east at an elevation of 4200 feet. I have long regarded it as the typical southern station for the summer rainfalls. A study of its yearly rainfall curve shows how rain failed here in the most striking manner previous to the Indian famine of 1896, and during and after the Indian famine of 1899.

With regard to Mr. Sutton's statement that there has been no severe drought during recent years in South Africa, there is abundant evidence to the contrary.

A year ago I wrote: "In the Karoo the present drought is considered the worst during the last half-century. At Hanover (Upper Karoo) during nearly a year there has fallen only three-quarters of an inch, the normal yearly rainfall being 15 inches. The drought has lasted on and off since 1896–8, and during the worst years cattle and sheep have perished in millions. In British Central Africa the drought has lasted since about 1898; it is reported that the Shiré Lake is now nearly dry. Last summer's crops in the Transvaal, so sorely needed after the war, were a complete failure, while in Natal, Rhodesia, and the country to the north there was in many places famine, and people dying in places too remote to be reached by Government aid.

"When will the drought end? is now the great question for the country.

"Good rains have fallen recently all down the eastern side and on the south coast of South Africa. This rain has come as a precious mitigation of the drought. It may be looked on as a favourable indication for a good season—perhaps more favourable if it had come later.

"The local and other indications of an early ending of

the drought are favourable. It has definitely broken up in Australia." (Weather forecast, dated November 23, 1903.)

Writing a year later, November 23rd, 1904, I said: "My weather forecast for last year (published in the *Cape Times* of November 23, 1903) indicated the expectation of a more or less complete break-up of the drought. This forecast has been fulfilled. In many parts of South Africa, particularly towards the north, the drought has broken, and good seasons were experienced last year. In other parts the rains were insufficient to really break the drought. This was the case in the fertile 'conquered territory' of Orangia, and over wide areas in Cape Colony. In the Transkei drought remains unbroken. It is described as a drought of terrible severity, and one that has stopped all ploughing and killed from 50 to 60 per cent. of the sheep in some of the districts. As was remarked by a correspondent in the *Cape Times* a few days since,

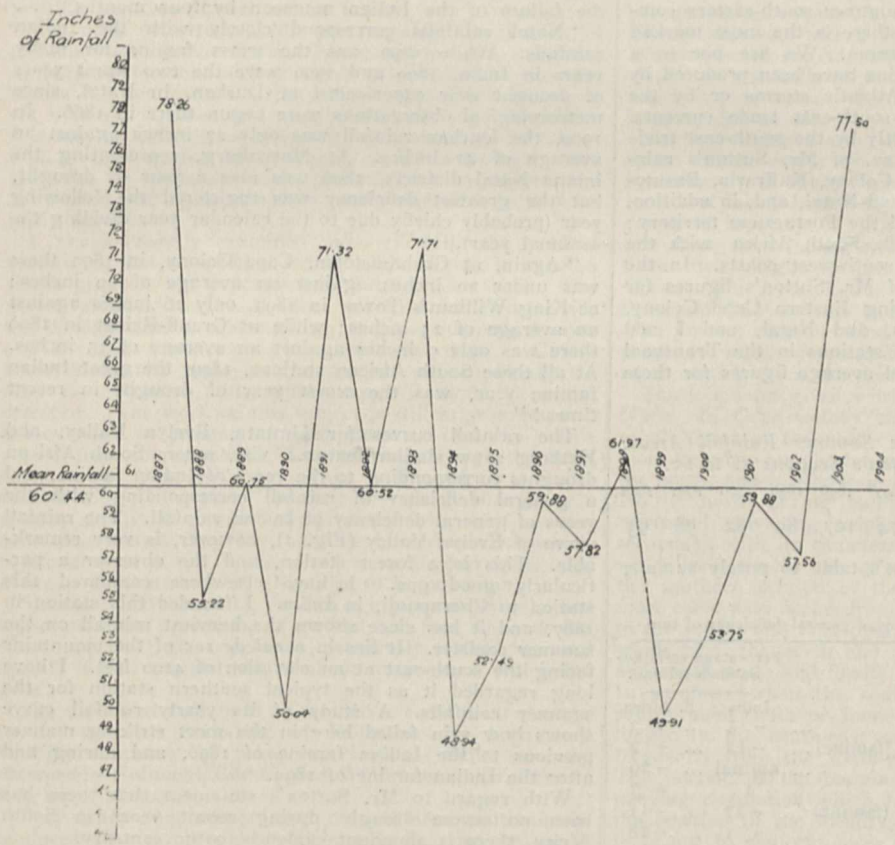

FIG. 1.—Rainfall, Evelyn Valley.

'No one not living here has any idea of the terrible condition existing in the Karoo and Eastern Province. The springs on most of the farms have utterly disappeared. On one farm in the Cradock district with large lands, orchards, and a water-mill at the junction of two kloofs in the Sneeuwberg, the river beds are as dry as a street; the farmer has sold all his stock, and I actually saw the water for household use brought some distance in a barrel. In former years the water-mill was in constant use for all the surrounding country.'"

Writing to me recently from Zomba, in British Central Africa, Mr. Clounie, the head of the scientific department, speaking of last summer's rains, says: "The wet season from November to April last has been remarkably good, and crops everywhere have been excellent. I think everything points to the end of the drought and a return to a period of good rains."

As regards the drought further north, the reader may turn to NATURE of November 3, 1904 (p. 15). I produce the extract for ready reference:—

"Appendix iii. of a report upon the basin of the Upper Nile, with proposals for the improvement of the river by Sir William Garstin, contains an interesting account of the variations of level of Lake Victoria Nyanza contributed by Captain H. G. Lyons, the director of the Survey Department of Egypt. This lake has a water surface of about 68,000 square kilometres, and is situated about 1129 metres above sea-level. It is believed to be of shallow depth, and lies for the most part of the year in the region of the equatorial rain and cloud belt, the excess water draining off at the Ripon Falls by the Victoria Nile. After reference to the geology and climate of the region, a brief historical summary is given of the early lake levels as observed by travellers and others visiting or residing by it; this is followed by a detailed study and discussion of the various gauges. Some of the results obtained are as follows:—The annual oscillation of the lake is from 0·30 metre to 0·90 metre. Between 1896 and 1902 there was a fall of 76cm. in the average level, since followed by a rise of 56cm. The epochs of high and low levels are given as:—1878, high level; 1880–90, falling level; 1892–5, temporary high level; 1896–1902, falling level; 1903, rising level."

The kernel of this quotation lies in the last six words: it shows the same correspondence with the Indian rainfall figures as the summer rainfall figures of South Africa.

D. E. HUTCHINS.

Cape Town, December 8.

Compulsory Greek at Cambridge.

SOME years ago a young lady who was studying at Girton came to Bristol to spend a part of her first vacation after passing the "Little-go." She had never learnt Greek at school, but had been coached by an elder brother, who was at that time in residence at Cambridge; in about two months she obtained a knowledge of Greek sufficient to meet the requirements of the authorities at Cambridge.

While she was with us we paid a visit to the neighbouring city of Bath, and I directed her attention to the motto which is inscribed on the Roman baths there, viz.:

ἄριστον μὲν ὕδωρ.

Remembering her recent success in the "Little-go," I jokingly asked her the meaning of this inscription—not imagining for a moment that Cambridge compulsory Greek would be unequal to such an easy task; she was, however, unable to give the meaning of the words; she did not think she had ever seen ἄριστον, but was of opinion that she had in the course of her reading met the word ὕδωρ, but did not remember what it meant.

It may be well to add that the lady in question has great linguistic ability, and in due course obtained a good place in the Modern Languages Tripos.

Do our ultra-classical friends really think that compulsory "Greek" of this type is worth preserving?

J. WERTHEIMER.

Merchant Venturers' Technical College,
Bristol, January 30.

NOTES ON STONEHENGE.[1]

II.—ARCHÆOLOGICAL OBSERVATIONS AT STONEHENGE, 1901.

SOON after Mr. Penrose and myself had made our astronomical survey of Stonehenge in 1901, some archæological results of the highest importance were obtained by Prof. Gowland. The operations which secured them were designed and carried out in order to re-erect the leaning stone which threatened to fall, a piece of work recommended to Sir Edmund Antrobus by the Society of Antiquaries and other learned bodies, and conducted at his desire and expense.

They were necessarily on a large scale, for the great monolith, "the leaning stone," is the largest in England, Cleopatra's Needle excepted. It stood behind the altar stone, over which it leant at an angle of 65 degrees, resting at one point against a small stone of syenite. Half-way up it had a fracture one-third across it; the weight of stone above this fracture was a dangerous strain on it, so that both powerful machinery and great care and precautions had to be used. Prof. Gowland was charged by the Society of Antiquaries with the conduct of the excavations necessary in the work. The engineering operations were planned by Mr. Carruthers, and Mr. Detmar Blow was responsible for the local superintendence. Mr. Blow thus describes the arrangements (*Journal* Institute of British Architects, 3rd series, ix., January, 1902):—

"A strong cradle of 12-inch square baulks of timber was bolted round the stone, with packing and felt, to prevent any marking of the stone. To the cradle were fixed two 1-inch steel eyebolts to receive the blocks for two six-folds of 6-inch ropes. These were secured and wound on to two strong winches fifty feet away, with four men at each winch. When the ropes were thoroughly tight, the first excavation was made as the stone was raised on its west side."

[1] Continued from p. 300.

The method employed by Prof. Gowland in the excavation should be a model for all future work of the kind. I have to express my thanks to the council of the Society of Antiquaries and Prof. Gowland for permission to use the accompanying illustrations showing the operations and results.

Above each space to be excavated was placed a frame of wood, bearing on its long sides the letters A to H, and on its short sides the letters R M L, each letter being on a line one foot distant from the next. By this means the area to be excavated was divided into squares, each having the dimension of a square foot. A long rod divided into 6-inch spaces, numbered from 1 to 16, was also provided for indicating the depth from the datum line of anything found. In this way a letter on the long sides of the frames, together with one on the short sides, and a number on the vertical rod, indicated the position of any object found in any part of the excavation.

FIG. 4.—The arrangements for raising the stone.

Excavations were necessary because to secure the stone for the future the whole of the adjacent soil had to be removed down to the rock level, so that it could be replaced by concrete.

All results were registered by Prof. Gowland in relation to a datum line 337·4 feet above sea level. The material was removed in buckets, and carefully sifted through a series of sieves 1-inch, ½-inch, ¼-inch, and ⅛-inch mesh, in order that the smallest object might not be overlooked.

From the exhaustive account of his work given by Prof. Gowland to the Society of Antiquaries (*Archaeologia*, lviii.), I gather three results of the highest importance from the point of view I am considering. These were, first, the finding of an enormous number of implements; secondly, the disposition and relative quantities of the chippings of the sarsen and blue stones; and thirdly, the discovery of the method by which the stones were originally erected.

I will take the implements first. This, in a con-

densed form, is what Prof. Gowland says about them :—

More than a hundred flint implements were found, and the greater number occurred in the stratum of chalk rubble which either directly overlaid or was on a level with the bed rock. They may all be arranged generally in the following classes :—

Class I.—Axes roughly chipped and of rude forms, but having well-defined, more or less sharp cutting edges.

Class II.—Hammerstones, with more or less well-chipped, sharp curved edges. Most may be correctly termed hammer-axes.

Class III.—Hammerstones, more or less rounded. Some specimens appear to have once had distinct working edges, but they are now much blunted and battered by use.

In addition to the above flint implements were found about thirty hammerstones, consisting of large pebbles or small boulders of the hard quartzite variety of sarsen. Some have been roughly broken into convenient forms for holding in the hand, whilst a few have been rudely trimmed into more regular shapes. They vary in weight from about a pound up to six and a half pounds. To these we have to add mauls, a more remarkable kind of hammerstone than those just enumerated. Their weights range from about 40 lb. to 64 lb.

How came these flints and stones where they were found? Prof. Gowland gives an answer which everybody will accept. The implements must be regarded as the discarded tools of the builders of Stonehenge, dumped down into the holes as they became unfit for use, and, in fact, used to pack the monoliths as they were erected. We read :—"Dealing with the cavity occupied by No. 55 before its fall, the mauls were found wedged in below the front of its base to act together with the large blocks of sarsen as supports (p. 54)." Nearly all bear evidence of extremely rough usage, their edges being jagged and broken, just as we should expect to find after such rough employment. We evidently have to deal with builders doing their work in the Stone and not in the Bronze age. But was the age Palæolithic or Neolithic?

Prof. Gowland writes :—

"Perhaps the most striking features of the flint implements is their extreme rudeness, and that there is not a single ground or polished specimen among them. This, at first sight and without due consideration, might be taken to indicate an extremely remote age. But in this connection it must be borne in mind that in the building of such a stupendous structure as Stonehenge, the tools required must have been numbered by thousands. The work, too, was of the roughest character, and for such only rude tools were required. The highly finished and polished implements which we are accustomed to consider, and rightly so, as characteristic of Neolithic man, would find no place in such work. They required too much labour and time for their manufacture, and, when made, could not have been more effective than the hammer-axes and hammerstones found in the excavations, which could be so easily fashioned by merely rudely shaping the natural flints, with which the district abounds, by a few well directed blows of a sarsen pebble."

FIG. 5.—Some of the flint implements.

On this ground Prof. Gowland is of opinion that, notwithstanding their rudeness, they may be legitimately ascribed to the Neolithic age, and, it may be, near its termination, that is, before the Bronze age, the commencement of which has been placed at 1400 B.C. by Sir John Evans for Britain, though he is inclined to think that estimate too low, and 2000 B.C. by Montelius for Italy.

Prof. Gowland guardedly writes :—

"In my opinion, the date when copper or bronze was first known in Britain is a very remote one, as no country in the world presented greater facilities for their discovery. The beginning of their application to practical uses should, I think, be placed at least as far back as 1800 B.C., and that date I am inclined to give, until further evidence is forthcoming, as the approximate date of the erection of Stonehenge."

Now the date arrived at by Mr. Penrose and myself on astronomical grounds was about 1700 B.C. It is not a little remarkable that independent astronomical and archæological inquiries conducted in the same year should have come so nearly to the same conclusion. If a general agreement be arrived at regarding it, we have a firm basis for the study of other similar ancient monuments in this country.

I have previously in these "Notes" referred to the fact that the trilithons of the naos and of the outer circle are all built up of so-called "sarsen" stones. To describe their geological character, I cannot do better than quote, from Mr. Cunnington's "Geology of Stonehenge,"[1] their origin according to Prestwich :—

"Among the *Lower Tertiaries* (the Eocene of Sir Charles Lyell), are certain sands and mottled clays, named by Mr. Prestwich the Woolwich and Reading beds, from their being largely developed at these places, and from these he proves the sarsens to have been derived; although they are seldom found *in situ*, owing to the destruction of the stratum to which they belonged.

"The abundance of these remains, especially in some of the valleys of North Wilts, is very remarkable. Few persons who have not seen them can form an adequate idea of the extraordinary scene presented to the eye of the spectator, who, standing on the brow of one of the hills near Clatford, sees stretching for miles before him, countless numbers of these enormous stones, occupying the middle of the valley, and winding like a mighty stream towards the south."

These stones, then, may be regarded as closely associated with the local geology.

The exact nature of the stones, called "blue stones," can best be gathered from a valuable "Note" by Prof. Judd which accompanies Prof. Gowland's paper. These blue stones are entirely unconnected with the local geology ; they must, therefore, represent boulders of the Glacial drift, or they must have been brought by man, from distant localities. Prof. Judd inclines to the first opinion.

The distinctions between these two kinds of stone are well shown by Prof. Gowland :—

"The large monoliths of the outer circle, and the trilithons of the horse-shoe are all sarsens—sandstones, consisting of quartz-sand, either fine or coarse, occasionally mixed with pebbles and angular bits of flint, all more or less firmly cemented together with silica. They range in structure from a granular rock resembling loaf sugar in internal appearance to one of great compactness similar to quartzite."

"The monoliths and trilithons all consist of the granular rock. The examples of the compact quartzite variety were, almost without exception, either hammerstones that had been used in shaping and dressing the monoliths, or fragments which had been broken from off them."

"The small monoliths, the so-called 'blue stones,' which form the inner circle and the inner horseshoe, are, with the undermentioned exceptions, all of diabase more or less porphyritic. Two are porphyrite (formerly known as felstone or hornstone). Two are argillaceous sandstone."

"Mr. William Cunnington, in his valuable paper, 'Stonehenge Notes,' records the discovery of two stumps of 'blue stones' now covered by the turf. One of these lies in the inner horseshoe between Nos. 61 and 62, and 9 feet distant from the latter. It is diabase. The other is in the inner circle between Nos. 32 and 33, 10 feet from the former, and consists of a soft calcareous altered tuff, afterwards designated for the sake of brevity fissile rock.

The altar stone is of micaceous sandstone."

I now come to the second point, to which I shall return in subsequent "Notes."

In studying the material obtained from the excavations, it was found in almost every case that the number of chippings and fragments of blue stone largely exceeded that of the sarsens; more than this, diabase (blue stone) and sarsen were found together in the layer overlying the solid chalk (p. 15). Chippings of diabase were the most abundant, but there were few large pieces of it. Sarsen, on the other hand, occurred most abundantly in lumps (p. 20); very few small chips of sarsen were found (p. 42). Hence Prof. Gowland is of opinion that the sarsen blocks were roughly hewn where they were found (p. 40); the local tooling, executed with the small quartzite hammers and mauls, would produce dust.

Finally, I reach the third point of importance from the present standpoint; the excavations produced clear evidence touching the mode of erection. Prof. Gowland's memoir deals only with the leaning stone, but I take it for granted that the same method was employed throughout. This method was this :—

(1) The ground on the site it was to occupy was removed, the chalk rock being cut into in such a

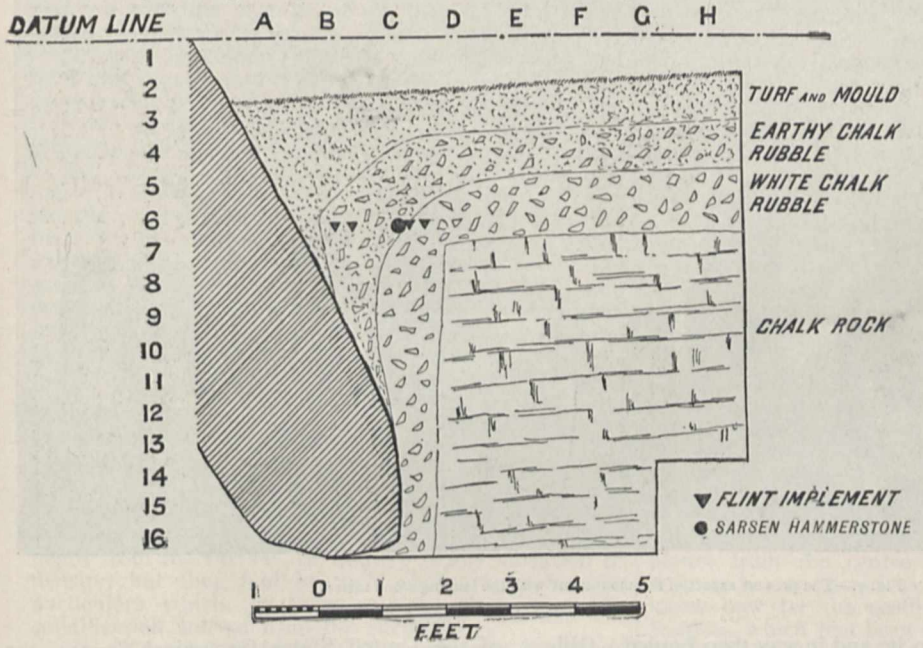

FIG. 6.—Face of rock against which a stone was made to rest.

[1] *Wilts Archæological and Natural History Magazine*, xxi. pp. 141–149.

manner as to leave a ledge, on which the base of the stone was to rest, *and a perpendicular face rising from it, against which as a buttress* one side would bear when set up. From the bottom of this hole an inclined plane was cut to the surface, down which the monolith which had already been dressed was slid until its base rested on the ledge.

(2) It was then gradually raised into a vertical position by means first of levers and afterwards of a ropes. The levers would be long trunks of trees, to one end of which a number of ropes were attached (this method is still employed in Japan), so that the weights and pulling force of many men might be exerted on them. The stronger ropes were probably of hide or hair, but others of straw, or of withes of hazel or willow, may have been in use for minor purposes.

(3) As the stone was raised, it was packed up with logs of timber and probably also with blocks of stone placed beneath it.

(4) After its upper end had reached a certain elevation, ropes were attached to it, and it was then hauled by numerous men into a vertical position, *so that its back rested against the perpendicular face of the chalk which had been prepared for it.* During this part of the operation, struts of timber would probably be placed against its sides to guard against slip.

FIG. 7.—The present aspect of the monument with the leaning stone raised.

As regards the raising of the lintels, and imposts, and the placing of them on the tops of the uprights, there would be even less difficulty than in the erection of the uprights themselves.

It could be easily effected by the simple method practised in Japan for placing heavy blocks of stone in position. The stone, when lying on the ground, would be raised a little at one end by means of long wooden levers. A packing of logs would then be placed under the end so raised, the other extremity of the stone would be similarly raised and packed, and the raising and packing at alternate ends would be continued until the block had gradually reached the height of the uprights. It would then be simply pushed forward by levers until it rested upon them.

I shall deal later on with several interesting conclusions to which these investigations lead.

NORMAN LOCKYER.

GEOLOGY OF THE MOON.

FOR many years past geologists have turned wistfully to the moon in the hope of gaining from a study of its surface some insight into planetary evolution, and more especially into some of the stages in the history of our own globe. It must be confessed, however, that as yet few satisfactory data have been obtained, either in the facts observed or in the deductions drawn from them. The great majority of those who have studied the subject have formed the opinion that our satellite was once a liquid mass, such as we believe the earth itself to have also been, and that its so-called "craters" represent extensive and prolonged volcanic activity, when the gases and lava of the heated interior escaped to the surface, probably on a scale of magnitude greatly surpassing that on which subterranean energy has ever been manifested in the geological history of our planet. But another explanation has been proposed for these lunar features, according to which, as worked out by Mr. G. K. Gilbert, of the United States Geological Survey, the moon was formed by the aggregation of a ring of meteorites which once encircled the earth, and the "craters," instead of arising from the escape of volcanic energy from within, were produced by the impact of the last meteoric bodies that fell from without. These bodies, arriving with planetary velocity, would be melted or reduced to gas, while a portion of the lunar surface around them would also be liquefied. Mr. Gilbert believes that the lunar topography bears witness to such a meteoritic bombardment rather than to gigantic volcanic explosions.

The latest contribution to the discussion was recently presented to the Academy of Sciences of Paris by MM. Lœwy and Puiseux. These eminent astronomers direct attention to the evidence furnished by the latest photographic charts of the "Atlas Lunaire" in regard to the conditions in which a planetary body passes from the liquid to the solid state, and to the stage in this transformation which has been reached respectively by the earth and the moon.

With respect to the evolution of the earth two opposite theories have been propounded. The great body of geologists have maintained that the interior

of the planet is an incandescent mass which is slowly cooling and consolidating from the surface inward, and is enclosed within a comparatively thin solid crust. Some distinguished physicists, however, have contended that the first formed crust would break up, sink down, and be re-melted; and thus that permanent consolidation would begin at the centre, and would gradually extend outwards, until eventually the whole globe became practically solid, with only here and there large vesicular spaces whence active volcanoes are supplied. The densest and least fusible materials would thus tend to accumulate towards the centre, and the lightest and most fusible towards the outside. The geological belief rests upon a large body of evidence from the structure of the terrestrial crust, which it is difficult or impossible to explain except on the supposition of an internal mass which at least in its outer parts is sufficiently liquid to emerge at the surface as molten lava. The physical argument rests on certain mathematical assumptions the validity of which has been contested. One of these assumptions is that if the interior were liquid, tides would be set up in its mass, and the crust would rise and fall with the passage of the internal tidal wave. Another objection is based on the supposition that huge mountain-chains could not possibly be supported by a thin crust, but would sink down into the interior. More recently the idea has been suggested that the internal core of the earth is gaseous. At the high temperatures and enormous pressures in the interior of the planet, gaseous iron or lava must be more incompressible than steel is at the surface. On the outside of this gaseous mass it is believed that the materials pass into the liquid form or magma which extends as a comparatively thin envelope round the gaseous core, and shades off outward into a solid crust which may not be more than twenty-five or thirty miles in thickness. The most recent earthquake observations have been quoted in support of this view.

Messrs. Lœwy and Puiseux approach the subject impartially from a study of the phenomena presented by the surface of the moon as recorded in a series of photographs. They accept the general belief that our satellite was once a liquid globe, and that traces of its passage from that condition to its present state of consolidation can be clearly recognised. They cannot say whether its temperature increases with depth from the surface, or if there is any variation in density, but they find in their photographs various particulars which, in their opinion, show that the solidification started from the surface.

The differences of level on the surface of the moon are relatively greater and more abrupt than those on the surface of the earth, and they display in many ways the dynamic effects which a liquid when in movement exerts on its solid containing walls, such as the superficial outpourings which have covered two-fifths of the visible lunar surface and have turned these tracts into continuous plains, round the margins of which numerous remains of the previous relief have been left. Other effects are seen in the traces of instability in the mountain ranges, the fractures, sharply-defined terraces and marginal fissures so often observable. The neighbourhood of a great sheet of liquid material is required to account for the undulations and horizontal displacements which have affected large tracts of the surface, such as the breaking down of the crest of the Apennines, the separation of the rectangular blocks of the Caucasus, and the formation of the rectilinear valleys of Rheita, the Alps, and Ariadæus.

The most decisive argument in favour of the gradual cooling of the moon from the outside towards the interior appears to be furnished by some facts which are brought out with great clearness by the recent photographs. Thus the two French astronomers have satisfied themselves that after the first establishment of a thin crust the inward retreat of the liquid took place gradually, until the fatal moment arrived when it partly lost connection with the overlying solidified crust, so that an intermediate vacant space was left between them. This temporary interval, being filled with gas at a high pressure, formed a cushion which was sufficiently elastic to prevent any falling-in, but was too limited in extent to affect isostatic compensations, so that the internal tides might be developed without endangering the external figure of the moon. When, for some unknown reason, as happens also on our globe, the lunar eruptive forces assumed special vigour, the crust, yielding to the pressures along its least resisting parts, was overflowed by the liquid interior. Such local subsidences gave rise to the great cirques and various other features in the polar region, where the cooling was most rapid, and where, for easily intelligible reasons, the crust reached a considerably greater thickness. But in the equatorial zone, where the tides and the centrifugal force are most powerful, these violent perturbations led to vast subsidences which now form the lunar "seas." The survival of remains of the earlier topographical relief, still visible along the borders of these tracts, bears witness to the nature of the gigantic changes. Each eruptive movement has marked, by the level bottom of the formations, the height of the level of the subjacent liquid. Five such stages in the subsidence of the molten matter are displayed in the photographs. We can understand that the process would be repeated with diminishing energy until the gradually thickening crust presented too great an obstacle to the eruptive action. Various striking examples are cited by the authors; in particular one where the five platforms are separated from each other by a step-like interval of several thousand metres. Had the consolidation begun at the centre of the moon, it is contended, the result would have been altogether different, for then only the latest level should have been seen, and the eruptive forces would have had neither an opportunity of manifesting themselves nor the means of leaving permanent traces at very different stages.

MM. Lœwy and Puiseux examine the argument from the tides in favour of the consolidation of a planet from the centre outwards, and remark that it must be considered as doubtful, because we do not know how far the coefficient of viscosity or internal friction, which has been employed in the calculations, agrees with the reality. They suggest that as the materials in the interior are under enormous pressure they may quite possibly have such viscosity, and yield so slowly to planetary influences, which are continually changing in direction in consequence of the diurnal movement, that no appreciable tidal deformation may result. In the case of the moon it is admitted that the tides in the still liquid mass would for a long time delay the formation of an outer crust, which before its final establishment must have undergone many violent disruptions, when its broken-up sheets were overflowed by the molten matter from within. But in the course of time it has ended by attaining a great thickness in consequence of continual cooling and the contraction of the outer layers.

The argument that on the supposition of a comparatively thin crust the existence of mountainous masses would be impossible is less applicable to the moon, where the force of gravity is six times less than on the earth. But in the opinion of the two French astronomers the argument need not be seriously considered, either for our planet or for our satellite, inasmuch as it depends on a problematic theory which is entirely based on an inaccurate

hypothesis of homogeneity. Mountainous excrescences, so far from weakening the general stability, really conduce to it; they are not only held up by the tenacity of the neighbouring parts, but, as Airy suggested, they probably have roots which plunge down into material of greater density and permit them to float.

The authors affirm, in conclusion, that their detailed study of the moon appears to them to confirm geologists in their preference for the theory of a thin crust and to indicate that the transition to solidity, still incomplete for the moon, is far from having reached its end upon the earth. ARCH. GEIKIE.

NOTES.

WE regret to announce that Prof. G. B. Howes, F.R.S., died on Saturday last, February 4, at fifty-one years of age.

IT is proposed to erect a monument at Laibach, in Austria, to the memory of Vega, author of the well-known table of logarithms, which is now in its eightieth edition.

FROM the American Mathematical *Bulletin* for January we learn of the death of Dr. Francesco Chizzoni, professor of geometry at Modena, and of Prof. Achsah M. Ely (Miss Ely), head of the department of mathematics at Vassar College, U.S.A.

THE Wilde medal of the Manchester Literary and Philosophical Society has been awarded to Prof. C. Lapworth, F.R.S. The medal will be presented on February 28, when the Wilde lecture of the society will be delivered by Dr. D. H. Scott, F.R.S., on "The Early History of Seed-bearing Plants, as recorded in the Carboniferous Flora."

FOR the past year, a station for solar research has been maintained on Mount Wilson, California, by the Yerkes Observatory, with the aid of a grant from the Carnegie Institution of Washington. This station has now been replaced by a new solar observatory which has been established by the Carnegie Institution, and the following staff, formerly of the Yerkes Observatory, has been appointed:—Prof. G. E. Hale (director), Prof. G. W. Ritchey, Mr. F. Ellerman, and Mr. W. S. Adams.

PROF. VALDEMAR STEIN, leader of a well known Copenhagen analytical and chemical laboratory, where for a number of years official and private tests and investigations in Denmark have taken place, died on February 1, aged 69 years. He took over in 1863 the laboratory founded by H. C. Örsted and altered it to its present shape, making it a valuable public institution. Beside his work there Stein was Government adviser in chemical agriculture, and wrote many scientific articles on chemical and agricultural subjects.

THE Imperial Academy of Sciences, St. Petersburg, at the last annual meeting, awarded the Lomonosoff prize of 100*l.* to Prof. N. A. Menschutkin for his well-known and extensive researches in the domain of theoretical chemistry. The Ivanoff prize was awarded to Prof. P. N. Lebedeff, of Moscow, for his remarkable experimental researches on the pressure of light. At the same meeting, Prof. S. Th. Oldenburg declared, in his yearly review of the work of the academy, that the Polar Committee had given up all hope of the return of Baron Edward Toll, F. G. Seeberg, and their two companions. The party was probably lost during the Arctic night while trying to cross the ice-fields lying between Bennett Island and the New Siberian archipelago.

A NATIONAL exhibition of brewing materials and products will be held in Paris during March, 1906.

AT the meeting of the French Physical Society on January 20, under the presidency of M. d'Arsonval, the following officers were elected:—Vice-president, M. Amagat; general secretary, M. Henri Abraham; treasurer, M. de la Touanne. The office of president falls on M. Dufet.

THE *Times* correspondent at Colombo states that Sir H. A. Blake, Governor of Ceylon, announced at the last meeting of the Asiatic Society that Sinhalese medical books of the sixth century described 67 varieties of mosquitoes and 424 kinds of malarial fever caused by mosquitoes.

AT the meeting of the Anthropological Institute to be held on Tuesday next, February 14, Dr. A. C. Haddon, F.R.S., will exhibit a series of kinematograph pictures of native dances from the Torres Straits, taken by him when in New Guinea. Applications for admission should be addressed to the Secretary of the Institute at 3 Hanover-square, W.

A LARGE and influential international committee has been formed in Heidelberg, under the presidency of His Excellency Dr. A. Freiherr von Dusch, Minister of Education, &c., of the Grand Duchy of Baden, with the object of honouring the memory of the late Prof. Carl Gegenbaur, who for nearly thirty years was the director of the Anatomical Institute of Heidelberg. The committee has decided upon a life-size bust of Gegenbaur, to be executed in marble by Prof. C. Seffner, Leipzig. The bust will be placed in the vestibule of the Anatomical Institute, probably in the early summer, at a date not yet fixed. The committee invites former pupils of the deceased master, and all those who have benefited from his epoch-making works on human and comparative anatomy, to send monetary contributions, with their addresses and titles, to Prof. M. Fuerbringer, or to Prof. E. Goeppert, both in Heidelberg. Every contributor will receive a picture of the bust, and casts may be obtained, on special application, from Prof. C. Seffner.

AFTER an interval of two years the fifth conference of West Indian agriculturists was held at Port-of-Spain, Trinidad, from January 4 to 13. It was attended by official, scientific, commercial, and practical representatives from all parts. In his presidential address, Sir Daniel Morris gave an interesting survey of the great economic change which is in progress. Taken in the aggregate, sugar cultivation must still be regarded as the backbone of the colonial industries, but in some of the islands it has already become of comparatively little or no importance. Trinidad is now a cacao-producing island, its exports of this commodity having risen to the value of a million sterling per annum. Grenada's cacao exports are valued at 250,000*l.*, and Jamaica's at 80,000*l.* Cotton growing, too, has been successfully re-established in several islands, and remunerative prices for the raw cotton are being obtained from Lancashire merchants. The exportations of fruit far exceed in value those of the staple industry. The development of the tobacco, rubber, sisal hemp, fish-curing, and other industries also came under review, and Sir Daniel dwelt upon the importance of agricultural shows and on the provision made by his department for teaching elementary science and the principles of agriculture in the various colleges and elementary schools. Numerous papers were read and discussed, Prof. d'Albuquerque, Dr. Watts, Prof. Harrison, and others supplying valuable information relating to sugar; Mr. Hart, Mr. de Gannes, &c., on cacao; Mr. Bovell, Mr. Sands, &c., on cotton; and so on.

For practical purposes visits were paid to several cacao and sugar estates. Owing to its more than usually representative character the conference is declared to have been the most successful of the series.

THE very high barometric readings over the British Isles during the latter part of January last are noteworthy. The weather report for the week ending January 28 issued by the Meteorological Office stated that on Wednesday (25) the eastern edge of an anticyclone had appeared over the west of Ireland; this system, moving slowly eastward, and continually increasing in intensity, covered the whole kingdom by Thursday, its maximum pressure being about 30·7 inches. It subsequently moved southward and south-westward, and continued to increase in energy until Saturday (28), when the barometer rose to 31 inches or more over the south-western parts of the United Kingdom. The highest reading was reported from Scilly, at 2h. p.m. on January 28, 31·06 inches, and appears to have been the highest on record for that part of the kingdom. Very high readings also occurred over the eastern portion of the North Atlantic. Recent cases of very high readings occurred in January, 1902, January, 1896, and January, 1882. The highest reading on record in the British Isles is 31·11 inches at Ochtertyne (Scotland), in January, 1896, and the lowest 27·33 inches at the same place, in January, 1887. It will be observed that all these extreme readings have occurred in the month of January.

WE have to acknowledge the receipt of a copy of the *Transactions* of the Hull Scientific and Field Naturalists' Club for 1904 (vol. iii. part ii.). The most important item in its contents is a list, with references, of the land and freshwater molluscs of the East Riding, drawn up by Mr. T. Petch, occupying fifty-two pages.

THE salmon and trout of Japan form the subject of an article by Mr. T. Kitahara in vol. v. part iii. of *Annotationes Zoologicae Japonensis*. In place of the nine species of these fishes admitted by Messrs. Jordan and Evermann, the author recognises only seven from Japanese waters, of which the majority belong to Oncorhynchus.

THE contents of the *Biologisches Centralblatt* for January 15 include an article on the structure of certain ants' nests, by Mr. C. Ernst, and a criticism, by Dr. C. Schröder, of Mr. C. Schaposchnikow's theory of the colouring of the hind-wing of the butterflies of the genus Catocala, to which allusion has been already made in our columns.

THE *Zoologist* commences the year well with an excellent article on budding in animals by Prof. McIntosh, of St. Andrews, in which the various forms of propagation by gemmation are described in a clear and popular manner. In the same issue appears Mr. Southwell's account of sealing and whaling for 1904. Eleven right whales were captured during the season by British vessels and at British stations; but the Americans are reported to have taken no less than forty-nine. The price demanded for sizable whalebone is 250*l.* per ton. Fin-whale hunting is being pursued with great energy, and as the demand for the products of these whales is limited, the author suggests that the market may be glutted.

THE *Nature Study Review* is the title of a journal published in New York of which the first volume is before us. "The aims and plans of the editorial committee," it is stated in the introduction, "are based upon an interpretation of nature-study in its literal and widest sense as including all phases, physical as well as biological, of studies of natural objects and processes in elementary schools." Several eminent writers have united to give their views as to the scope and limitations of nature-study; while others have done their best to refute hostile criticism of the movement. "Faddism," the bane of the movement, is strongly deprecated. In wishing the new venture a successful career, we may take the opportunity of recording our full sympathy with the effort to make scholars actually acquainted with natural objects, instead of attempting to learn about them through books alone. But the interpretation of the movement must be a liberal one, and it must be realised that a visit to a museum is just as much nature-study as is a saunter through a country lane.

THE double number of the *American Naturalist* for November and December last contains a suggestive article by Mr. W. D. Matthew on the arboreal ancestry of mammals. Strong arguments have been brought forward during the last few years by Mr. Dollo in Belgium and by Mr. Bensley in America to show that the ancestors of marsupials were probably arboreal; and in the present communication the author seeks to show that the same holds good for mammals in general. It is urged that the mammals of the Cretaceous were all of small size and mostly of a primitive type from which both marsupials and placentals might well have been derived. These early mammals were probably arboreal; and if so, the opposable thumb and hallux of certain living types is an archaic and not an acquired feature. Support to the view as to the arboreal habits of the ancestral mammals is afforded by the Upper Cretaceous upland flora, which first permitted the existence of an extensive terrestrial land mammalian fauna. If the theory be true, it entirely upsets the old idea that arboreal mammals had taken to their distinctive mode of life to escape persecution on the ground.

WE have received a copy of an important memoir by Dr. O. Abel, published in the *Abhandlungen* of the Austrian Geological Survey (vol. xix. part ii.), on the fossil sirenians of the Mediterranean formation of Austria, into the merits of which the limitations of space do not admit of our entering so fully as we desire. The title of the memoir scarcely does justice to its contents, for although the prime object is the description of the species known as *Metaxytherium krahuletzi*, the author also describes a number of remains of the much more primitive genus Eotherium, from the Eocene of the Mokattam Range, near Cairo. The most important feature connected with the latter (if the remains be rightly identified) is the discovery that Eotherium possessed a complete pelvis, showing a well-marked obturator foramen. In this respect the genus differs from all other known members of the order, and is thus brought into connection with less specialised mammals. The three Egyptian Eocene genera Eotherium, Eosiren, and Protosiren (new) are regarded as the earliest known ancestors of the dugong group; and to these succeed Halitherium in the Oligocene, Metaxytherium in the Miocene, and Felsinotherium in the Pliocene. In seeking to illustrate the origin of the downward flexure of the muzzle of the dugong by a malformed horse skull, we think the author has been ill-advised, as there is a much simpler and more natural explanation of the feature. In connection with the memoir by Dr. Abel, we may refer to a paper on the pelvis of Steller's sea-cow (*Rhytina stelleri*) by Dr. L. von Lorenz, published in part iii. of vol. xix. of the *Abhandlungen* of the Vienna Geologisches Reichsanstalt. The description and figure of this rudimentary bone supplement Dr. Abel's account of sirenian osteology in general.

DR. STRONG, the director of the Biological Laboratory, Manila, has published a valuable experimental study of the subject of protective inoculation against Asiatic cholera (No. 16, Bureau of Government Laboratories, Manila). After detailing the various methods of producing experimentally immunity against the cholera microbe, he discusses the use of Haffkine's prophylactic, which has been extensively employed in India with encouraging results, but an objection to which is the marked reaction that follows the inoculation, causing the inoculated person to be somewhat ill for two or three days. To remove this objection, Dr. Strong has obtained a prophylactic fluid by suspending the cholera microbes obtained from agar cultures in sterile water, keeping this suspension at 60° C. for several hours, then incubating at 37° C. for three or four days, and finally filtering through a porous porcelain filter. The fluid so obtained (a product of the autolytic digestion of the cholera microbes) was found to produce a high immunity in animals against cholera, and when injected into man was found to be free from danger, and to produce practically no general or local disturbance.

IN the *Victorian Naturalist* for November, 1904, it is mentioned that, at the October meeting of the Field Naturalists' Club in Melbourne, a number of collections of wild flowers were sent from State schools in the country, including some so far away as Hawkesdale. Dimboola, and Mansfield. These were of great interest to teachers and children from the schools in Melbourne, who were allowed to take away named specimens for study. Would it not be possible to include in one of the exhibitions, such as the Grand Horticultural Exhibition held last June in the gardens of the Royal Botanic Society, similar collections from country schools for the benefit of schools in the metropolis?

IT is remarkable how many comparative experiments conducted in tropical countries, with some or all of the established rubber plants, have demonstrated the superiority of *Hevea brasiliensis*, the source of Para rubber. One of the latest accounts is that by Mr. W. H. Johnson, director of agriculture, Gold Coast, issued as one of the miscellaneous series of *Colonial Reports*. Experiments in the Botanic Gardens, Aburi, were unsuccessful with the West African vine, *Landolphia owariensis*, Ceara, *Manihot glaziovii*, Assam, *Ficus elastica*, and Central American rubber, *Castilloa elastica*; fairly satisfactory results were obtained with the indigenous *Funtumia elastica*, but Hevea excelled in quantity and quality of rubber, in its rate of growth, and has been remarkably free from insect and fungus pests.

THERE seems to be good reason to believe that exploration of the more remote parts of Eastern Asia will add very considerably to the number of botanical species already known. In vol. iv. of the *Records* of the Botanical Survey of India, Sir Joseph Hooker states that the number of species of Impatiens, the second largest genus of Indian flowering plants, recorded for India has increased from 124 to 200 in thirty years, and that many more may be expected from the less accessible districts of Burma, Nepal, and the Eastern Himalayas. In the hope of inducing forest officers or other officials in India to take up the collection, or better, the study of this genus, Sir Joseph Hooker is publishing in the *Records* an epitome of the known species, and he also directs attention to two points of interest, the anomalous structure of the flower, and the remarkable details of segregation of the species.

IT is always of interest to note a distinct novelty in the photographic line, but in the new Lambex system of daylight loading and film and plate changing, which has been introduced by Messrs. R. and J. Beck, Ltd., in a new class of cameras called the Lambex cameras, we have quite a new invention. The makers have sent us for inspection one of these cameras with the so-called Lambex skeleton and its envelope. The method of exposing is most simple and ingenious, and is one that will no doubt find considerable favour among photographers. The skeleton, less than half an inch thick, is the name of the folded strip of paper with a tag attached at each fold; in each of the folds, twelve in number, a film or plate, of any description or make, is held by a flap at the top and two corner slots at the bottom, and an opaque card is attached to the front. This skeleton is contained in a double length opaque envelope, the unexposed films remaining in the lower portion, and the exposed films being pulled one by one into the upper portion by the attached tags. The lower portion of the envelope is provided with an opening to correspond to the size of the film through which the exposure is made, and surrounding this opening is a stiff projecting edge of card into which the envelope with its skeleton is slid into a frame in the camera. The makers claim many advantages for this system, such as daylight loading, any plates or films may be used, the skeletons can be recharged, no scratching of films, no mechanism, &c. The compactness of this system renders it applicable to both folding, pocket, and box cameras, and the makers have now prepared a series of well-made Lambex cameras, constructed in several forms and sizes, and fitted with their well-known lenses. Limitations of space prevent us from entering more into detail, but the handbook of instructions in the form of a neat pocket-book contains all the necessary information.

TO the February number of the *Monthly Review*, Sir William Ramsay contributes an article having the title "What is an Element?" It contains a popular account of the changes introduced into conceptions of the nature of elements owing to the discovery of the inert gases of the atmosphere and of radium and the radio-active elements.

THE remarkable power of aluminium to absorb completely the vapour of mercury even when highly diluted with air, and at the ordinary temperature, is the subject of a paper by N. Tarugi in the *Gazzetta* for January 14. This property is made the basis of an extremely delicate test for mercury, and of a preventive measure against poisoning by mercury vapour. A species of respirator has been patented in which the air that is inhaled is made to pass through a mass of finely divided aluminium; in this passage every trace of mercury is absorbed, the action being so complete that the dense vapours evolved by heated mercuric chloride may be breathed with impunity. The respirator has already been introduced with good results into the mercury mines of Monte Amiata.

A STRIKING instance of the intimate connection existing between the configuration of chemical substances and their susceptibility to fermentation is to be found in a paper by C. Ulpiani and M. Cingolani in the *Gazzetta* for January 14. The *Bacillus acidi urici*, which has the property of decomposing uric acid into carbon dioxide and urea by a process of successive hydrolysis and oxidation, is without action on the closely allied substances α-methyluric acid, guanine, caffeine, and theobromine. On the other hand the bacillus is capable of rapidly and completely oxidising such acids as tartronic, malonic, and mesoxalic acids, which contain the same carbon chain as that constituting the

central axis of uric acid, whilst, in addition, the ureides of these acids, namely, barbituric acid, dialuric acid, and alloxan, are converted by the ferment quantitatively into urea and carbon dioxide. Moreover, just as in the case of the sugars only the hexoses are capable of undergoing fermentation, the bacillus of uric acid is indifferent to acids containing fewer or more than three carbon atoms.

THE *Psychological Bulletin* (vol. ii., No. 1) for January contains a notice of the meeting of the north central section of the American Psychological Association which was held at Chicago on November 26, under the presidency of Prof. W. D. Scott, of the North-western University. The following papers were read:—Is subjective idealism a necessary point of view for psychology? by Mr. Stephen S. Colvin; the genesis of meaning, by Mr. I. E. Miller; relation of sensation and revived mental processes, by Messrs. T. H. Haines and J. C. Williams; the vehicle of cognition, by Mr. B. H. Bode; psychological method, by Mr. C. A. Blanchard; an Iowa case of complete congenital cataracts cured after twenty-two years, by Mr. James Burt Miner; the relations of psychology to logic, by Miss Harriet S. Penfield; the functional theory in psychology and the concept of transcendence, by Mr. J. H. Farley; the psychology of linguistic development in the individual, by Mr. M. V. O'Shea; is the beauty of art a higher type than that of nature? by Mr. George Rebec; the reality and the symbol in education, by Miss Julia H. Gulliver; and a motor theory of rhythm, by Mr. R. H. Stretton

THE Walter Scott Publishing Company will shortly issue a translation of "Science and Hypothesis," by Prof. Poincaré. Prof. J. Larmor, Sec.R.S., has written a preface to this edition of Prof. Poincaré's work.

A COPY of the report of the librarian of the U.S. Congress for the fiscal year ending June 30, 1903, has been received from Washington. The report runs to 600 pp., and includes elaborate details concerning every department of the library's activities. A select list of recent purchases during 1901–1903 constitutes part ii. of the volume, and a third section is devoted to a report on copyright legislation.

MR. JOHN A. BERGSTRÖM, of Indiana, writing in the *Psychological Bulletin*, describes a spring suspension for laboratory motors used for driving colour mixing or other experimental apparatus, with the object of reducing the noise and vibration produced by motors resting on a fixed base.

THE third English edition of Prof. Mendeléeff's "Principles of Chemistry" has been published in two volumes by Messrs. Longmans, Green and Co. The new volumes are a translation from the seventh Russian edition by Mr. George Kamensky, edited by Mr. Thomas H. Pope. There are three appendices to the work. The first of these is the Royal Institution lecture delivered by Prof. Mendeléeff on May 31, 1889, entitled "An Attempt to apply to Chemistry one of the Principles of Newton's Natural Philosophy"; the second, on the "Periodic Law of the Chemical Elements," is Prof. Mendeléeff's 1899 Faraday lecture to the Chemical Society; the last is entitled "An Attempt towards a Chemical Conception of the Ether," and its contents were described in an article which appeared in NATURE on November 17, 1904 (vol. lxxi., No. 1829). The work is one of the classics of chemical science, and the new edition will be widely welcomed.

OUR ASTRONOMICAL COLUMN.

EPHEMERIS FOR COMET 1904 *e*.—Given below is an extract from a daily ephemeris computed by Dr. E. Strömgren from the elliptic elements calculated by M. Fayet for comet 1904 *e*.

12*h*. (*M.T. Berlin*).

1905	α	δ	log *r*	log Δ
	h. m. s.	° ′		
Feb. 9 ...	2 29 38 ...	+21 14 ...	0·1582 ...	0·0816
,, 11 ...	2 34 23 ...	+22 27		
,, 13 ...	2 39 14 ...	+23 38 ...	0·1613 ...	0·0940
,, 15 ...	2 44 10 ...	+24 47		
,, 17 ...	2 49 12 ...	+25 54 ...	0·1647 ...	0·1067

On February 7 the comet was very near to, but south-west of, *ν* Arietis (*Astronomische Nachrichten*, No. 3991, supplement).

EPHEMERIS FOR COMET 1904 *d*.—The following is an extract from the daily ephemeris for comet 1904 *d* published in No. 3991 of the *Astronomische Nachrichten* by Herr M. Ebell.

12*h*. (*M.T. Berlin*).

1905	α (true)	δ (true)	log *r*	log Δ	Brightness
	h. m. s.	° ′			
Feb. 9 ...	19 22 32 ...	+54 50 ...	0·3492 ...	0·3584 ...	0·82
,, 13 ...	19 41 49 ...	+56 28 ...	0·3542 ...	0·3643 ...	0·78
,, 17 ...	20 1 45 ...	+57 57 ...	0·3593 ...	0·3710 ...	0·74
,, 21 ...	20 22 13 ...	+59 17 ...	0·3645 ...	0·3784 ...	0·70

Brightness at time of discovery = 1·0.

An observation made by Herr Pechüle at 16h. 24·3m. (Copenhagen M.T.) on January 14 gave corrections to this ephemeris of −4s. and −0′·5.

On February 9 the comet will be to the north-west of, and near to, *κ* Cygni, then, travelling in a north-easterly direction, it will pass into the constellation Cepheus.

ORBIT OF COMET 1904 *e* (BORRELLY).—From the observations made at Königsberg on December 31 and at Paris on January 11, M. Fayet has made an investigation of the probable orbit of Borrelly's comet (1904 *e*). In the first place three different sets of parabolic elements were computed, but, although the arc traversed by the comet whilst under observation was very small, and the results obtained were therefore not very trustworthy, the non-agreement of the parabolic elements with the observational results was too great to be admitted. M. Fayet therefore computed a set of elements on the assumption that the orbit was elliptical, and these were much more satisfactory, indicating a short period of about six years.

The following set of elliptic elements was finally adopted as giving a fairly satisfactory agreement between the observed and computed positions:—

$$\left.\begin{array}{ll} \Omega = 76^\circ\ 6'\ 43''\cdot97 \\ i = 30^\circ\ 55'\ 21''\cdot25 \\ \omega = 351^\circ\ 35'\ 27''\cdot11 \end{array}\right\} 1905$$

T = 1905 Jan. 15·77425 (M.T. Paris)

$\log q = 0\cdot149236$

$\log e = 9\cdot818195$

These results give a value for μ of 423″·915, and therefore indicate that the comet is of the short-period type, making one revolution in its orbit in about eight years (*Comptes rendus*, No. 4, 1905).

OBSERVATIONS OF THE LEONID SHOWER OF 1904.—In a note published in No. 3989 of the *Astronomische Nachrichten*, Mr. Denning gives a few details of his observations of the late Leonid shower at Bristol.

During a watch of about one and a half hours between 13h. 30m. and 15h. 45m. on November 14, 55 meteors, of which 33 were Leonids, were seen, and Mr. Denning estimated that, at that time, the latter were appearing at the rate of about 25 per hour, for one observer, from a radiant situated at R.A. = 151°, decl. = +23°. No increase

in the horary rate was apparent at 16h., and as the fog became denser the observations were discontinued.

Two of the Leonids seen were as bright as Jupiter, whilst several others were as bright as, or brighter than, first magnitude stars. One of these flashed out in the north-west at 14h. 38m., traversed the path 315°+57° to 318°+50½°, and left a short streak which lasted for about 30 seconds.

A few slow, yellow meteors from a radiant in Aries at 43°+21°, and some swift streaking meteors from a radiant in Leo Minor at 144°+37°, were also seen.

SPECTRA OF γ CYGNI, α CANIS MINORIS AND ε LEONIS.—In part vii. vol. cxiii. of the *Sitzungsberichte der Kais. Akad. der Wissenschaften*, Herren E. Haschek and K. Kostersitz publish the results of the reductions of the spectra of γ Cygni, Procyon and ε Leonis. After discussing in detail the methods of measurement and identification employed in the reduction, and the general and specific characteristics of each spectrum studied, the authors give a table of the wave-lengths and intensities of the lines for each star. The coincidences of each line with lines in the arc and spark spectra of terrestrial elements, as determined by Exner and Haschek, are also given, and in the last column of each table the "probable origins" of many of the lines are set down. Amongst the latter may be noted the rarer elements Yb, Pr, Sa, Nd, La, Pt, Wo, Gd, Eu, &c.

About 140 lines between λ 4250 and λ 4534, 190 lines between λ 4126 and λ 4550, and about 270 lines between λ 4215 and λ 4702 are given in the spectra of γ Cygni, α Canis Minoris and ε Leonis respectively.

SYSTEMATIC SURVEY OF DOUBLE STARS.—No. 99, vol. xvi., of the *Publications* of the Astronomical Society of the Pacific is devoted to an address on double stars read before the International Congress of Arts and Sciences at St. Louis by Prof. R. G. Aitken.

After discussing the work already performed in this field, Prof. Aitken described a systematical survey undertaken by Prof. Hussey and himself. All stars down to the ninth magnitude as given in the Bonn Durchmusterung were placed on the observing list, and the sky from the North Pole to −22° declination was equally divided for observation between the two observers.

The programme arranged for the observation of each star on the list on at least one good night, and all double stars discovered with a separation of 5″ or less were to be measured on at least two nights and catalogued. On September 10, Prof. Hussey had discovered 1035 and Prof. Aitken more than 875 new pairs. Seventy-three per cent. of these are separated by 2″ or less, and 142 are very close pairs in which the separation does not exceed 0″·25. Of similar pairs to the latter the previously published catalogues do not contain 100.

Prof. Aitken has examined, during this research, more than 12,000 stars, and finds that the doubles discovered form about 3 per cent. of this total. Including those previously discovered, the ratio of double stars, with distances of less than 5″, to the whole of the stars down to the ninth magnitude is apparently 1 : 18 to 1 : 20. This ratio is not, however, the same for all parts of the sky, for whilst in some regions observed double stars are very scarce, in others the ratio increases to about 1 : 8.

Other details concerning the survey, its prosecution and the reasons for carrying it out are given in Prof. Aitken's interesting paper.

REPORT OF THE YALE OBSERVATORY, 1900–4.—Dr. Elkin's reports to the board of managers of the Yale University Observatory for the years 1900–4, inclusive, occupy eight pages, and briefly describe the large amount of work performed at the observatory during that period.

Heliometer observations are the chief feature of the work and special attention has been paid to the determination of the parallaxes of stars having large proper motions. Practically all the stars in the northern hemisphere having known motions of 0″.5, or more, have now been observed at Yale. A second triangulation of the Pleiades and determinations of the parallax of Arcturus have also been made. Another feature of the work is the photography of meteor trails, and numerous trails of meteors from the principal showers have been obtained.

PRIZE SUBJECTS OF THE BATAVIAN SOCIETY OF EXPERIMENTAL PHILOSOPHY.

AT a recent general meeting of the Batavian Society of Experimental Philosophy of Rotterdam the following subjects were proposed for competition. The gold medal of the society, of the weight of thirty ducats, or its value, will be awarded for the best answer to one or other of the suggested questions. Answers may be written in the Dutch, French, English, German, or Latin languages, in another handwriting than that of the competitor, and must reach the secretary, Dr. G. T. W. Bremer, at Rotterdam not later than February 1, 1906.

Chemistry.—An experimental investigation of the atomic weight of an element which has not yet been satisfactorily fixed; a research on the causes of departure from Ostwald's dilution law; measurements of the osmotic pressure in solutions at concentrations corresponding with deviations from the simple gas laws; a study of the origin and physiological significance of the green pigment in the body of green articulated animals; experiments elucidating the formation and transformations of the sap in india-rubber plants; a re-investigation of the variations from the laws of electrolytic dissociation observed by Kahlenberg in 1901; an explanation of the thallioquinic test for quinine.

Physics.—An investigation of the electrical properties of some metallic alloys; of the variation with temperature of the specific heat of mercury; of the specific heat of sulphur and phosphorus in their various allotropic forms; of the indices of refraction of substances showing anomalous dispersion; of the cause of phosphorescence, particularly in the case of the lower organisms.

Biology.—A description of the life-history and properties of one or several species of moulds, ferments, or bacteria which are of industrial importance; the action of sulphur and of copper salts on plant parasites, and of mineral salts on the development of fungi; the *rôle* of micro-organisms in the formation of humus in the soil.

Physiology.—An investigation of the permeability of red blood corpuscles to the ions of NaCl, $NaNO_3$, Na_2SO_4; and of the localisation of functions in the cerebellum.

Geology.—An exposition of the theory of the origin of the Netherlands; a critical investigation of the volcanoes of the East Indian Archipelago.

Civil Engineering.—Statistical investigations of the Dutch "polders"; or an investigation of one of the principal rivers of Holland.

THE PIC DU MIDI OBSERVATORY.

IN a recent number of *La Nature*, M. L. Rudaux gave an interesting account of the present condition and operations of this important mountain station. France is well provided with high level stations, and the observations from seven of them are published daily in the *Bulletin International* of the French Meteorological Office. An account of the very favourable position of the Pic du Midi station, and of the almost insuperable difficulties experienced by its original founder, General de Nansouty, was given, in considerable detail, by M. R. Radau, in his useful little work on "Mountain Observatories" (Paris, 1876), and has been summarised by Mr. A. L. Rotch in the *American Meteorological Journal*. The summit, which has an elevation of 2877 metres (the observatory being 17 metres lower), is situated on the outskirts of the Pyrenees, in lat. 42° 56′ N., and long. 2° 12′ W. of Paris, and affords one of the finest views in Europe. Towards the north an immense plain stretches as far as the eye can see, and to the north-west, on very clear days, the blue waters of the Atlantic are visible, at a distance of 160 km. It lies directly in the path of the great atmospheric disturbances which traverse the Bay of Biscay, while the summit mostly enjoys a clear and luminous atmosphere, being some 200 metres above the level at which thunderstorm clouds usually gather. These advantages early attracted the attention of astronomers and scientific men; M. F. de Plantade died in 1741 while observing at the ridge which has since taken his name.

The project of a permanent meteorological station was first mooted in 1869, and provisional observations were com-

menced by General de Nansouty and his coadjutors in 1873, at the foot of the Pic, about 2300 metres above the sea, and were continued under great hardships, and at considerable personal expense for about eight years. The present station was established in 1880, by public and private subscriptions. The accompanying illustration gives a general view of the station as it now exists. On the left the thermometer screen may be distinguished near the erection on which the anemometer and actinometer are placed; at the other end of the terrace is the equatorial building, and the apparatus for celestial photography. The magnetic instruments are placed in vaults underneath the terrace. The meteorological observations are regularly published in the annals of the Central Meteorological Office; useful predictions have been given to the inhabitants of the plains of impending thunderstorms, and of probable floods owing to the sudden melting of the snow on the mountains. Amongst the miscellaneous observations undertaken under the able direction of M. Marchand, we may specially mention those relating to the zodiacal light, to solar phenomena, and the

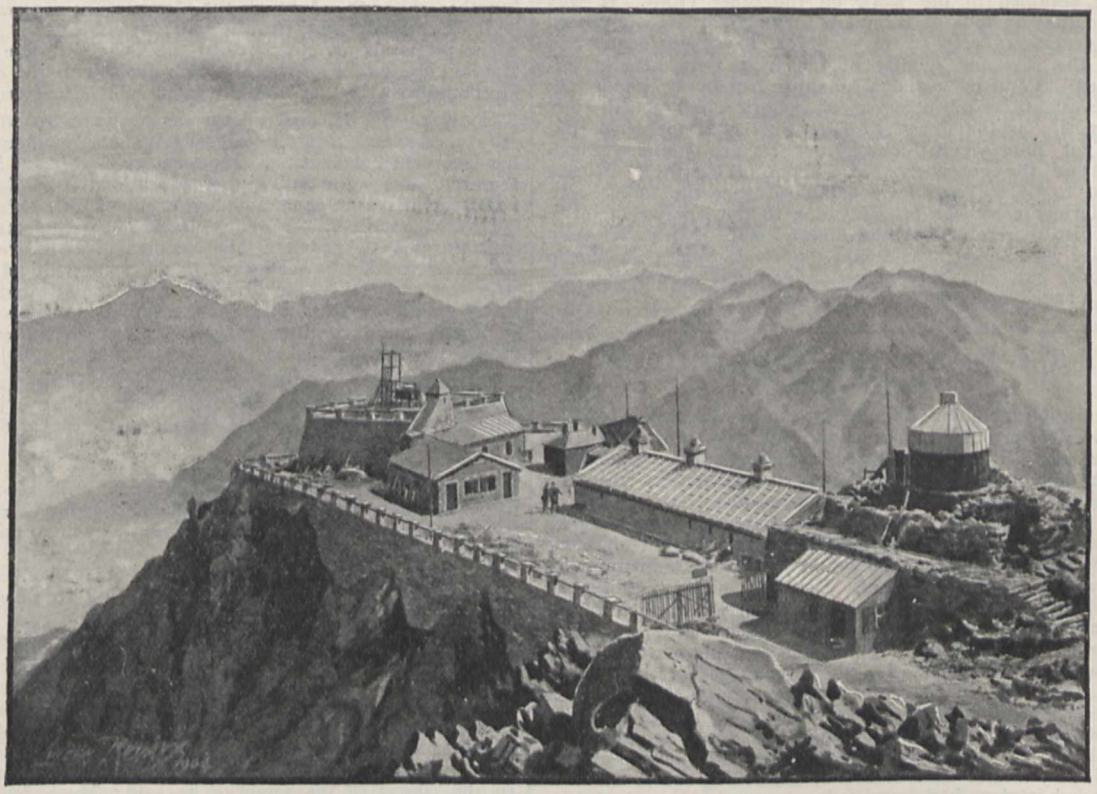

FIG. 1.—General View of the Pic du Midi Observatory in 1904.

connection of the latter with magnetic disturbances. His observations in this direction have shown that whenever a terrestrial magnetic disturbance occurs, spots or faculæ exist on the central meridian of the sun. Important spectroscopic results have also been obtained respecting the atmospheres of Venus and Mars.

AGRICULTURAL NOTES.

AN important new feature of the annual report on the distribution of grants for agricultural education and research is a return giving the character of the instruction in agriculture provided by the county councils of England and Wales. The return shows that most counties are now spending considerable sums on agricultural education—altogether 88,893*l.* in 1902–3, and to this sum 9200*l.* was added by the Board of Agriculture in the form of grants to collegiate centres. It is estimated that some 22,000 persons have attended the various local lectures provided, while 1009 students entered for the courses offered by agricultural colleges. The expenditure of the counties is given in detail, and presents some curious anomalies; thus the London County Council assigned to agricultural education 742*l.*, while the authorities of one of the most fertile divisions of Lincolnshire, in which agriculture is practically the only industry, voted 65*l.* for the purpose! Again, East Sussex, with a total income from the "Residue Grant" of 7773*l.*, spent 6116*l.* in grants to agricultural colleges or schools, while West Sussex, with an income of 4503*l.*, gave nothing for collegiate instruction, and was satisfied with an expenditure of 275*l.* upon horticulture and poultry keeping. Conditions vary from county to county, but differences in the needs of the agriculturist do not explain the widely different educational policy of the local authorities. Under the new committees, it is to be hoped that the unsystematic and spasmodic efforts that have been too common in the past may disappear, and though it is probable that in the immediate future less money will be spent on agricultural education, it is likely to be expended to greater advantage. The Board of Agriculture's report should be studied by all members of county education committees who are interested in agricultural education.

A piece of work which has just been completed in the library of the U.S. Department of Agriculture has greatly enhanced the value of the leading Continental agricultural journals for English-speaking students. Complete card catalogues of "Annales de la Science agronomique," "Landwithschaftliche Jahrbücher," and "Die landwithschaftlichen Versuchs-stationen" have been prepared. Each index card gives author's name, title of article, and a brief outline of the scope of the article. The catalogues may be purchased in two series, either "author entry" sets, permitting papers to be indexed under the authors' names, or "complete" sets, furnishing two or more cards for each paper, which may then be indexed under the author's name, and also under the subject or subjects to

which the article relates. The cost of the three sets of catalogues in the latter and more useful form is about 12*l*. The sets now issued bring the indexing down to 1903, but the work will be continued, and supplementary sets will be printed from time to time. Students who do not desire references to all branches of agricultural science may obtain sets of cards dealing with special subjects, such as soils, plant diseases, or forestry. Particulars of the eighteen subject-groups under which the cards are classified are given in *Bulletin* No. 9, issued by the Catalogue Division of the Library of Congress, Washington, D.C.

In the fourth report on the Woburn fruit farm, the Duke of Bedford and Mr. Spencer Pickering, F.R.S., discuss the results of several years' experiments in the manuring of fruit crops. In an introduction the soil of the fruit station is described, and chemical and mechanical analyses are given; the report then describes experiments on strawberries, gooseberries, currants, raspberries, and apples. For various reasons the experiments on currants and raspberries were unsatisfactory, but trustworthy data were obtained in the work on the other crops. It was found that 12 tons of farmyard manure per acre increased the strawberry crop by 12 per cent. to 15 per cent., and that the size and quality of the fruit were greatly improved. A mixed artificial manure supplying about the same quantities of nitrogen, phosphoric acid, potash and magnesia as the dung similarly increased the yield, but did not improve the quality. Farmyard manure much increased the gooseberry crop, but the artificial mixture failed to do so, and it is explained that the increase in the former case was probably due to the greater quantity of moisture retained by the dunged soil. Nitrate of soda applied in summer was found to benefit apples in certain seasons, but with this exception no kind of manure had any marked effect on the apple crop.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Mr. Chamberlain, the Chancellor of the University, presided at the annual meeting of the Court of Governors held on February 6. Speaking after the adoption of the annual report, Mr. Chamberlain said that when the governors of Mason College met some five or six years ago and came to the decision that the time had come to give Birmingham its own university, it was thought that the least sum of money which would justify them in applying for a charter was 100,000*l*. But very shortly afterwards they found that there was a great opportunity, not only for themselves, but for other great provincial cities, to create a series of universities which in the first place would bring home to all the population the advantages of the highest education, and in the second place, would specialise this highest education with some more definite idea of its application to science than hitherto had been found to be possible. The moment they decided on a departure of that kind they found that it meant something quite different from what they had previously supposed. New buildings had to be specially devised, a very large and expensive equipment had to be provided, and new chairs had to be created; altogether a completely new ideal had to be developed. And then they put their demand—a demand which, indeed, they did not strictly limit themselves to, but they thought it would probably be sufficient for the present generation—they put their demand at the expenditure of one million of money. They had received at once nearly half that sum, largely from Birmingham. And he might say in passing that the liberality of the local contribution was a ground for the claim which they made for some further State support. "It is something," he said, "that we have found that the Government are becoming alive to our needs and to our deserts, and that they have been able to double the sum previously given for the university education. But we may bear in mind at the same time that the present Chancellor of the Exchequer has promised to double it again in his next Budget, and, therefore, I anticipate that from that source we shall receive a very considerable addition. I do not at all accept it as in any way a satisfaction of our demands, because it is my conviction that public opinion will soon insist upon larger sums being devoted to this purpose. When I think that we are spending 13 millions a year at least on primary education I say the sum now given for the purpose of the highest education, the most profitable of all the investments we can make in that direction, is altogether inadequate."

CAMBRIDGE.—The voting on the report of the Studies and Examinations Syndicate will take place on Friday, March 3, and on Saturday, March 4, on both days from 1–3 p.m. and from 5–7 p.m. No votes will be taken after 7 p.m. on Saturday, March 3.

In view of the discussion on the report the syndicate has issued the report in an amended form. The chief changes include as alternatives in the papers in classical languages (1) passages for translation from a selected book or books; (2) unprepared passages for translation, a vocabulary of unusual words being supplied, also the abolition of distinct grammar papers, although questions on syntax and accidence will be set in connection with the translation papers; further, one of the Synoptic Gospels is Greek, is now proposed as an alternative to one of the Synoptic Gospels, together with the Acts of the Apostles in English, and logic is included amongst the optional subjects in part iii. These proposals are embodied by the Council in five graces. It is on the second of these, which deals with the question of compulsory Greek, that attention will be centred.

LONDON.—Sir Michael Foster has consented to offer himself for re-election to the next Parliament as member for the University of London. He seeks re-election as a representative of science and higher education; if re-elected he will take his seat as a member of the Liberal Party. A committee, with Sir Thomas Barlow as chairman, has been formed to promote his election. This committee comprises graduates belonging to different political parties who are supporting Sir M. Foster on the ground of his many public services and in the belief that his special knowledge will continue to prove of great value to the House of Commons.

OXFORD.—Mr. George Longstaff, New College, has presented 50*l*. to the Hope Department of Zoology, and has offered to provide an extra assistant in the department for the years 1905 and 1906.

A SHEFFIELD gentleman, who does not wish his identity to be disclosed, has, says the *Sheffield Telegraph*, intimated in connection with the Sheffield University movement that he is prepared to subscribe 10,000*l*. towards the endowment fund, provided four other sums of 10,000*l*. are contributed. As an alternative, he is willing to give 5,000*l*. provided nine similar donations are promised. Under either condition a sum of 50,000*l*. would be raised, and, roughly, this is the amount still required to complete the fund.

AT a public meeting held under the auspices of the University of Leeds on February 6th, Mr. Alfred Mosely, C.M.G., gave an address on "Some Lessons learned by the recent Mosely Commission of Educationists to the United States." In the course of his remarks he said: Much remains in England to be done so that she may be brought into line with the United States and Germany in the matter of education. In America the people realise that if the nation is to be made and saved it must be through the medium of education. The time has come for us to reconsider our position, and above all to realise that the Board schools and the primary schools are but the prelude to secondary education, which in the United States has made such satisfactory strides—as it has also in Germany. The great difference in the education of the United States and that in our own country is the appreciation there of everybody, from the highest to the lowest, of the value of education. The Government has realised its obligations, and private citizens pour out their money like water. The University at Chicago, for instance, has been built up through the liberality of one man, who has given millions of pounds sterling. Why is there not the same spirit in England?

THE current number of the *Quarterly Review* contains an article entitled "The Direction and Method of Education." The writer passes in review many of the official publications of the English Board of Education and the

Scotch Education Department, Prof. Sadler's report on secondary education in Liverpool, and other publications. Men of science would do well to note what is given as the sum and substance of official activity in education since the passing of the recent Education Act. The writer says, "If we were asked to describe in one word the whole tendency of English education as manifested at the present time, we should speak of a humanistic renaissance." And again later, "English education, we believe, is working round to the humanistic ideal." Literary studies are included in every satisfactory scheme of elementary and secondary education, and the man of science recognises fully the value of the humanities in the work of schools and colleges. But whatever "humanistic renaissance" there may be dawning upon the world of education, it is to be hoped that the danger of a return to the conditions of fifty years ago, when instruction in the methods of science was unknown in our schools, and no opportunity to become acquainted with natural objects was offered, will be borne in mind by all education committees and other authorities.

THE Hon. Maude Lawrence has been appointed to a newly-established post of Chief Woman Inspector under the Board of Education. Miss Lawrence will direct a staff of women inspectors of special qualifications and varied experience, who will assist the Board in dealing with many questions for the treatment of which they have hitherto been somewhat imperfectly equipped. Instruction in various domestic subjects, such as needlework, cookery, laundry work, household management, and hygiene, has for some time past been given under the regulations of the Board for schools of different grades. But the report of the Inter-Departmental Committee on Physical Deterioration points to the need of a reform in the methods now commonly employed in the teaching of these subjects. It is considered that this instruction has been less effective than it should have been, because it has been too theoretical and has not been kept sufficiently in touch with the needs and habits of daily life. The new branch of the inspectorate will be employed to assist local authorities in providing, as part of their educational system, ample opportunities for girls of various ages to obtain a training for home life simple, practical, and adapted, where necessary, to the special circumstances of each locality. There are also many questions of importance involving the national physique, as affected by the studies, the life, and the treatment of children, and especially of very young children, from day to day in elementary schools, which women inspectors are specially qualified to investigate and to advise upon.

THE council of the Association of Technical Institutions has published its report of an inquiry, undertaken in May, 1904, as to the conditions of admission to evening classes in technical institutions and evening continuation schools throughout the country. The council considers that the returns and expert opinions recorded in this report justify the following conclusions:—(1) That it is undesirable to establish any general system of free admission to evening continuation schools, or of free admission or admission at specially reduced fees to evening classes in technical institutions. (2) That it is unnecessary to grant entirely free admission, to evening classes in technical institutions, to any special class or body of students or workers engaged in skilled industries, such as apprentices or persons under twenty-one years of age. (3) That there is need for the establishment in all technical institutions of sufficient "free studentships" or "scholarships" to secure the admission of all qualified and deserving students who are unable, by reason of their limited means, to pay the usual class fees without more sacrifice than should reasonably be expected of them. The plan to secure information adopted by the council was to issue a letter and form of inquiry to the education authorities and technical institutions throughout the United Kingdom asking for information as to the existence of the following conditions of admission to evening classes: (*a*) entirely free, (*b*) at less than normal fee, (*c*) by scholarships, (*d*) by arrangement with employers. Replies were received with reference to sixty evening continuation school areas and from eighty-three technical institutions. Of the technical institutions, fifty-five are not in favour of free admission, and one only in favour of it. The remaining institutions gave no definite answer. Thirty-eight education committees are against free admission to evening continuation schools, two are in favour of it, sixteen expressed no opinion, and four suggest scholarships.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 24, 1904.—"The Flow of Water through Pipes.—Experiments on Stream-line Motion and the Measurement of Critical Velocity." By Dr. H. T. **Barnes** and Dr. E. G. **Coker**. Communicated by Prof. Osborne Reynolds, F.R.S.

In a brief note published in the *Physical Review* (vol. xii. p. 372, 1901), the authors described a thermal method of observing the change from stream-line to eddy motion for water flowing through pipes of different diameters.

The impossibility of heating a column of water uniformly throughout while flowing in stream-line motion has been previously observed. It was shown that, when water is heated electrically while flowing through a tube of two or three millimetres diameter by a central wire conductor, the heat is carried off by the rapidly moving stream, which forms a cloak of hot water around the wire, and leaves the walls of the tube almost entirely unheated.

The change from stream-line to eddy motion can be very clearly observed in a tube heated on the outside, since the temperature of the emerging stream immediately increases when the flow rises above the critical point. The point of change is very sharp, and the disappearance of the stream-lines instantaneous.

It is clear from a study of the work of Osborne Reynolds that the change from stream-line to eddy motion may take place within a wide range of velocities. Critical velocity is measured in two ways: either by observing the velocity at which the stream-lines break up into eddies, or by obtaining the velocity at which the eddies from initially disturbed water do not become smoothed out into stream-lines in a long uniform pipe. The first change may be at any velocity within certain limits depending on the initial steadiness of the inflowing water, while in the second, the change can take place at only one velocity.

Osborne Reynolds's experiments were carried out by the method of colour bands in a long rectangular tank. By using a very much larger tank under a high head of water the authors were able to obtain a higher degree of steadiness than was obtained in the comparatively small tank used by Reynolds. A large number of experiments were obtained, an account of which forms the main part of the present paper.

Briefly, the result of the work may be summarised as follows:—

(1) The attainment of exceedingly high velocities of stream-line flow for certain sizes of pipes fed by perfectly quiet water under a high head.

(2) The re-formation of stream-lines in certain cases after eddies had formed, with a subsequent breaking up of the stream-lines at a very much higher velocity.

(3) A small divergence from the law of the change in viscosity with temperature for the upper-limit of stream-line flow.

(4) A verification of the viscosity temperature law for the lower-limit of stream-line flow by separate methods.

January 19.—"Further Histological Studies on the Localisation of Cerebral Function.—The Brains of Felis, Canis, and Sus compared with that of Homo." By Dr. A. W. **Campbell**. Communicated by Prof. Sherrington, F.R.S.

This addendum to a work on cerebral localisation, presented by the same author to the Royal Society in November, 1903, aims at elucidating certain obscure functional analogies and structural homologies pertaining to the brain.

The points emphasised are as follows:—Giant cells characterise the cortex of the lower mammalian cruciate zone, and this represents the motor area, as defined by Profs. Sherrington and Grünbaum in the anthropoid ape,

and by the author in man. The compensatory ansate and coronal sulci are respectively interchangeable with the upper and lower constituents of the primate fissure of Rolando. The common sensory area forms a morphological buffer behind the cruciate zone. Quite one-sixth of the lower animal's brain surface is allotted to visual cortex. The "true calcarine" fissure is the antecedent of the human anterior calcarine, the intercalary sulcus undergoes retrograde changes, and the suprasplenial sulcus is the derivative of the "sulcus intrastriatus lateralis." In the limbic region, human types of cortex are repeated, and the genual fissure is the homologue of the calloso-marginal. Parietal cortex is older, in the sense of phylogeny, than frontal. The lateral sulcus is the forerunner of the intraparietal. Out of the ectosylvian region of lower animals is developed the Sylvian region, including the insula, and much of the temporal lobe of primates.

It is concluded that the stability of the architectural plan of any given field of cortex is directly related to the phylogenic age of that cortex, and to the importance, as a means to survival, of the function it subserves; and, that while the human brain has expanded more decisively in some parts than in others, yet that expansion, if we except the visual and olfactory areas, has been general in kind.

January 26.—"On a Method of Finding the Conductivity for Heat." By Prof. C. **Niven**, F.R.S.

The first part of the paper contains a detailed account of the methods employed for finding the difference of temperature, and a description of the apparatus used. The results of some experiments made with it are also given, and compared with those found by other observers. The second part of the paper contains a solution of the mathematical problem of the diffusion of heat in an infinite solid from a line at which it is supplied at a constant rate, and the solution of some other allied questions. One result of the investigation suggests a method of finding the diffusivity directly, when the substance is of sufficiently great extent.

"The Boring of the Simplon Tunnel, and the Distribution of Temperature that was encountered." By Francis **Fox**. Communicated by C. V. Boys, F.R.S.

February 2.—"On the Compressibility of Gases between One Atmosphere and Half an Atmosphere of Pressure." By Lord **Rayleigh**, O.M., F.R.S.

The present memoir contains a detailed account of the observations referred to in the Preliminary Notice of February, 1904. In addition, results are now given for air, carbonic anhydride, and nitrous oxide. In the following table are recorded the values of B for the various gases at specified temperatures, B denoting the quotient of the value of pv at half an atmosphere by the value at the whole atmosphere:—

Gas	B.	Temperature
Oxygen	1·00038	11·2
Hydrogen	0·99974	10·7
Nitrogen	1·00015	14·9
Carbonic oxide	1·00026	13·8
Air	1·00023	11·4
Carbon dioxide	1·00279	15·0
Nitrous oxide	1·00327	11·0

By means of a formula given by D. Berthelot the compressibilities at 0° C. are inferred, and applied to deduce the ratio of densities as they would be observed at 0° C. under very low pressures. According to Avogadro's law these are the relative molecular weights. From the densities of nitrogen and oxygen we get N = 14·008, if O = 16. Again, from the densities of oxygen and nitrous oxide we find N = 13·998. The former is probably the more trustworthy.

Chemical Society, January 18.—Prof. W. A. Tilden, F.R.S., president, in the chair.—Nitrogen halogen derivatives of the sulphonamides: F. D. **Chattaway**. A number of the nitrogen halogen derivatives of the sulphonamides, which are obtained by the action of hypochlorous acid on the suphonamides and the alkylsulphonamides, were described, and the ease with which they can be prepared and crystallised demonstrated.—Electrolytic oxidation of the aliphatic aldehydes: H. D. **Law**. The chief product of oxidation of the lower members of the saturated aliphatic aldehydes is the corresponding organic acid, but small quantities of carbon dioxide and monoxide and saturated hydrocarbons are also formed in some cases.—The diazo-derivatives of the benzenesulphonylphenylenediamines: G. T. **Morgan** and F. M. G. **Micklethwait**. A description is given of the substances produced by the interaction of nitrous acid with the benzenesulphonyl derivatives of *o*-, *m*- and *p*-phenylenediamines, illustrating the different behaviour of these isomerides with this reagent.—The molecular condition in solution of ferrous potassium oxalate: S. E. **Sheppard** and C. E. K. **Mees**. Ferrous oxalate was shown to dissolve in alkali oxalates forming double salts, such as $K_2Fe(C_2O_4)_2$, which dissociate according to the scheme $2K + Fe(C_2O_4)_2$. Spectrophotometric measurements indicated that the formation of ferrous ions at moderate dilutions was negligibly small.—A further analogy between the asymmetric nitrogen and carbon atoms: H. O. **Jones**. The author showed that, during the formation of an asymmetric nitrogen atom in a compound containing an asymmetric carbon atom, two isomerides, which are called the *α*- and *β*-compounds, are produced. For this purpose methyl-*l*-amylaniline has been combined with allyl and benzyl iodides.—The formation of magnesia from magnesium carbonate by heat and the effect of temperature on the properties of the product: W. C. **Anderson**. Experiments were made with native and artificial magnesium carbonates to ascertain (1) the lowest temperature at which the evolution of carbon dioxide could be distinctly recognised; (2) the comparative rates at which the expulsion of the gas takes place at higher temperatures under atmospheric pressure; and (3) the extent to which the magnesia obtained dissolves in water after being kept at different known temperatures for a fixed period. It is inferred from the results that polymerisation takes place when magnesia is heated, and that this goes on more quickly in the "heavy" oxide than in "light" magnesia.—Transformations of derivatives of *s*-tribromodiazobenzenes: K. J. P. **Orton**.—The addition of sodium hydrogen sulphite to ketonic compounds: A. W. **Stewart**.—The reduction products of anisic acid: J. S. **Lumsden**. When anisic acid, dissolved in amyl alcohol, is reduced by sodium, the products are hexahydrobenzoic acid and δ-keto-hexahydrobenzoic acid.—The physical properties of heptoic, hexahydrobenzoic, and benzoic acids and their derivatives: J. S. **Lumsden**.—The influence of solvents on the rotation of optically active compounds. Part vii. Solution-volume and rotation of menthol and menthyl tartrates: T. S. **Patterson** and F. **Taylor**.

Royal Microscopical Society, January 18.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—The **President** delivered his annual address, the subject of which was an inquiry as to "What were the Carboniferous Ferns?"

Geological Society, January 18.—Dr. J. E. Marr, F.R.S., president, in the chair.—On the geology of Arenig Fawr and Moel Llyfnant: W. G. **Fearnsides**. This paper contains a detailed description of the succession of beds in Sedgwick's typical area of development of his Arenig series. The author discusses the relationship of the various divisions he describes to corresponding beds of other areas. He gives a description of the intrusive igneous rocks, and some account of the structure of the district and the nature of its glaciation.

Physical Society, January 27.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—Action of a magnetic field on the discharge through a gas: Dr. R. S. **Willows**. It has been shown previously that a transverse magnetic field, if applied at the kathode, may in some cases reduce the potential difference at the terminals of the tube. It is shown in the paper that the pressure at which this decrease commences corresponds to the pressure at which the voltage required to maintain this discharge, under normal conditions, is a minimum. This is also found to be the pressure at which the positive column is first completely striated. Reasons why such action takes place are given.—Action of radium on the electric spark: Dr. R. S. **Willows** and J. **Peck**. In certain cases the authors have found that the spark from a Wimshurst machine is extinguished by the action of the radiations from radium and that the current

passing is decreased. The action is altogether different according to the direction of the discharge. Using a spark-gap longer than 2 cm. and making the larger knob, of the machine used, positive, the radiations had practically no influence. With the smaller knob positive the radium, in most cases, extinguished the spark. The phenomenon is found to be due to the action of the β rays. Röntgen rays do not produce this effect, even if their ionising power at the spark-gap is some thousands of times greater than that of the radium. Lenard rays are, however, effective.—The slow stretch in indiarubber, glass, and metal wires subjected to a constant pull: P. **Phillips.** When indiarubber is subjected to a sustained pull of constant amount it yields at quite a large rate, the stretch at any time (t), after the establishment of the pull, being given by $x=a+b$ log t, a and b being constants for the particular pull exerted. For different pulls b is proportional to the pull. When the pull is removed the indiarubber slowly returns to its original length, the extension still remaining at a time t_0 after the removal being given by

$$x=b \log (t/t_0),$$

t being the time which has elapsed since the pull was established. These two results, for the slow stretching and slow recovery of indiarubber, have also been established for glass fibres subjected to sustained pull, but the magnitude of the slow yielding is very much smaller. When annealed wires of copper, silver, gold, or platinum are subjected to a sustained pull they behave in some ways similarly to indiarubber and glass, but there are some very decided differences. If the pull is greater than a certain amount (in the actual experiments about one-third to one-quarter of the breaking weight) the stretch at any time (t) after the establishment of the pull is given by the same law $x=a+b$ log t, but below this value of the pull b is zero. This law obtains up to the breaking strain of the wire, b increasing very rapidly a little before the breaking strain is reached. When the pull is removed, there is no appreciable slow recovery like that occurring in indiarubber and glass. Iron and steel wires show themselves to be exceptions to these rules.—Determination of Young's modulus (adiabatic) for glass: C. A. **Bell,** with an appendix by Dr. C. **Chree,** F.R.S. In this paper it is shown that errors in the acoustical determination of Young's modulus for glass, due to irregularities in the rods or tubes employed, may be eliminated by applying to the measured length of each free-free rod a correction given by the formula

$$\Delta l=\int_0^l \frac{\delta S}{S_0}\cos\frac{2\pi z}{l}\,dz,$$

in which δS is the difference between the cross section at the point z and its mean value, S_0, for the whole rod.—Some methods for studying the viscosity of solids: Dr. Boris **Weinberg.** The author has been carrying out investigations similar to those described by Prof. Trouton and Mr. Andrews in their paper on the viscosity of pitch-like substances (*Proc.* Phys. Soc., 1903). The details of his experiments are, however, different. He has worked principally with lead and has employed three distinct methods for determining the coefficient of viscosity.

PARIS.

Academy of Sciences, January 30.—M. Troost in the chair.—On some new experiments relating to the preparation of the diamond: Henri **Moissan.** In connection with the study of the Cañon Diablo meteorite, it appeared desirable to repeat the experiments on the formation of diamonds in rapidly cooled cast iron, with especial reference to the effect of sulphur and silicon in the ingot. The results obtained with an ingot to which iron sulphide had been added immediately before cooling were similar to those of the earlier experiments, except that the yield of diamonds was slightly greater. The addition of silicon had the same effect, except that the formation of the dense silicon carbide rendered the separation of the microscopic diamonds rather more difficult. Drawings of four typical crystals are given.—Synthesis in the anthracene series: MM. **Haller** and A. **Guyot.** γ-hydroxy-γ-triphenyl-dihydroanthracene condenses very readily with amines and phenols, giving compounds of the type

$$(C_6H_5)_2C\begin{<}{C_6H_4}{C_6H_4}\end{>}C(C_6H_5)(C_6H_4R),$$

in which R may be $N(CH_3)_2$, $N(C_2H_5)_2$, NH_2, or OH. A description of these substances is given.—The mixed treatment of trypanosomiasis by arsenious acid and trypan-red: A. **Laveran.** The injection of these substances has caused the disappearance of the *Tr. gambiense* in certain animals, and hence the author regards this disease as curable in certain cases, the most efficacious treatment being the successive injection of arsenious acid and trypan-red. As the curative doses of these substances are not far removed from their toxic doses, this toxicity being variable with the animal species, the doses to be prescribed must be rigorously determined. This will be especially difficult for man.—On the faculty possessed by cement strengthened with iron of supporting large elongations: M. **Considère.** Some doubt having been thrown on the earlier work of the author on this subject by German and American writers, details are given of some further experiments, the results of which are in complete accordance with those of the earlier work.—On the new short period comet 1904 e (Borrelly, December 28, 1904): G. **Fayet.** Observations on this comet having now been carried on for a month, the calculation of its orbit can be made with more certainty. The results confirm those previously published, the time of revolution being now determined at about seven years.—A secondary shadow observed on the rings of Saturn in October, November, and December, 1904: M. **Amann** and Cl. **Rozet.** Between October 20 and the end of December, besides the shadow of Saturn projected on its ring a second shadow, narrower and less well marked than this, was observed. It traversed the rings throughout in the form of a curved line, and it was noted that the portion of the rings between the shadow of the planet and that now described appeared to be more brilliant than the other illuminated portions of the rings. It is not clear to what this extra shadow can be due.—Remarks on a generalisation of M. Riesz: Émile **Borel.**—On the zeros of integral functions of infinite order, not transfinite: Ed. **Maillet.**—On the precision of geographical positions obtained in the field with the prism astrolabe: M. **Driencourt.** This instrument, invented by A. Claude, has already been tested in the Observatory of Montsouris, with very satisfactory results; it remained to be seen whether the same accuracy could be maintained in field observations. Details are given of some measurements made in Madagascar showing the remarkable saving of time, without loss of precision, resulting from its use.—On the self-registration of the ions of the atmosphere: P. **Langevin** and M. **Moulin.** Owing to the existence of two kinds of ions in air differing greatly in mobility, it is not possible to register these on the same apparatus, although the same principle is applicable. The theory of the apparatus with some details of its construction are given.—On the tempering of bronzes: Léon **Guillet.** The mechanical properties of bronzes of varying content of copper, and after tempering at varying temperatures, correspond very closely with the changes of constitution brought out by the experiments of Heycock and Neville.—A brown modification of colloidal ferric oxide: P. **Nicolardot.**—On the chlorination of methyl-ethyl-ketone: André **Kling.** After trying the various methods of chlorination of ketones, the method found to give the best yield is described in detail, the action of chlorine in the presence of water and marble. The chief product was $CH_3.CHCl.CO.CH_3$, boiling at 114° to 117°, and furnishing the glycol $CH_3.CH.(OH).CH(OH).CH_3$ on reduction.—The action of dilute nitric acid upon vegetable fibres: M. **Jardin.** The use of a weak solution of nitric acid, 5 parts of acid in 1000, is suggested for bleaching flax. It presents certain advantages in regard to the time and the amount of labour required, and leaves a fibre which takes the dye in a perfectly homogeneous manner.—On fiedlerite: A. **de Schulten.** This mineral is a hydrated oxychloride of lead, of a composition corresponding to $2PbOHCl,PbCl_2$.—On the salts of the Tchad region: H. **Courtet.**—On the parasitism of *Osyris alba*: A. **Fraysse.** In a preceding note some conclusions have been given on the biology of *Osyris alba* and on the anatomy of its suckers. In the present note is an account of the general physiology of these suckers and the relations existing between the parasite and its host.—On the changes of composition of the fruit of the Cucurbitaceæ: Leclerc **du Sablon.**—On the chemical composition and the significa-

tion of the aleurone grains: S. **Posternak.** The analyses of aleurone grains obtained from four different species of plants showed practically the same composition, noteworthy points being the invariable presence of silicon and the absence of sodium and chlorine. The manganese was more variable in amount than the other elements.—The preparation of practically sterile musts from apples: G. **Perrier.**—The mode of dorsal fixation of *Lernaeenicus Sardinae* on its host: Marcel **Baudouin.**—The existence of intra-uterine rickets: MM. **Charrin** and **Le Play.**—On the folded layers near Saint-Jean-de-Buèges (Herault): René **Nicklès.**—On the ascents of captive balloons carried out on the Mediterranean and on the Atlantic Ocean from the yacht of the Prince of Monaco in 1904: H. **Hergesell.** A study of the atmospheric conditions above the ocean, measurements being taken of the temperature, relative humidity, and direction of the wind at varying heights above the sea level.—On the existence of high terraces in the North Ural: L. **Duparc** and F. **Pearce.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 9.

ROYAL SOCIETY, at 4.30.—(1) On the Conversion of Electric Oscillations into Continuous Currents by means of a Vacuum Valve: (2) On an Instrument for the Measurement of the Length of Long Electric Waves, and also small Inductances and Capacities: Prof. J. A. Fleming, F.R.S.—Report on an Area of Local Magnetic Disturbance in East Loch Roag, Lewes, Hebrides: Captain A. M. Field, R.N.—Phosphorescence caused by the Beta and Gamma Rays of Radium: G. T. Beilby.—(1) The Spectrum of Scandium and its Relation to Celestial Spectra; (2) On the Stellar Line near λ 4686; (3) Note on the Spectrum of μ Centauri: Sir Norman Lockyer, K.C.B., F.R.S., and F. E. Baxandall.—Europium and its Ultra-Violet Spectrum: Sir William Crookes, F.R.S.

ROYAL INSTITUTION, at 5.—Forestry in the British Empire: Prof. W. Schlich, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Fuel Economy in Steam Power Plants: W. H. Booth and J. B. C. Kershaw. (Conclusion of discussion.)—The Value of Overhead Mains for Electric Distribution in the United Kingdom: G. L. Addenbrooke.

MATHEMATICAL SOCIETY, at 5.30.—General Theory of Transfinite Numbers and Order-types: Dr. E. W. Hobson.—On the Reducibility of Covariants of Binary Quantics of Infinite Order. Part ii: Mr. P. W. Wood.

FRIDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 9.—The Art of the Ionian Greeks: Dr. Cecil Smith.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

MALACOLOGICAL SOCIETY.—Annual General Meeting. Address by the President, Mr. E. R. Sykes, on Variation (including Teratology) in Recent Mollusca.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Reconstruction of the Santa Lucia River Bridge, Uruguay: P. J. Risdon.

PHYSICAL SOCIETY, at 8.—Address on Radiation Pressure by the President-elect, Prof. J. H. Poynting, F.R.S.

MONDAY, FEBRUARY 13.

SOCIETY OF ARTS, at 8.—Internal Combustion Engines: Dugald Clerk.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geographical Results of the Tibet Mission: Sir Frank Younghusband, K.C.I.E.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Results of Force Measurements with Cutting Tools, and their Application to Lathe Design: Dr. J. T. Nicolson.

TUESDAY, FEBRUARY 14.

ROYAL INSTITUTION, at 5.—The Structure and Life of Animals: Prof. L. C. Miall, F.R.S.

SOCIOLOGICAL SOCIETY, at 4.—(1) Restrictions in Marriage: (2) Studies in National Eugenics: Communicated by Dr. Francis Galton, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Alfreton Second Tunnel: E. F. C. Trench.—The Reconstruction of Moncreiffe Tunnel: D. McLellan.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Kinematograph Exhibition of Native Dances from Torres Straits: Dr. A. C. Haddon, F.R.S.—The Dog-motive in Bornean Art: E. B. Haddon.

WEDNESDAY, FEBRUARY 15.

SOCIETY OF ARTS, at 8.—The Decline of the Country Town: Arthur H. Anderson.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Practical Micro-Metallography with Experimental Demonstration: J. E. Stead, F.R.S.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1904: E. Mawley.—Observations made during a Balloon Ascent at Berlin, September 1, 1904: Dr. Hermann Elias and J. H. Field.—The Winds of East London, Cape Colony: J. R. Sutton.

CHEMICAL SOCIETY, at 5.30.—The Condensation of Anilino-acetic Esters in Presence of Sodium Alcoholate: A. T. de Mouilpied.—Nitrogen Halogen Derivatives of the Aliphatic Diamines: F. D. Chattaway.—Nitration of Substituted Azophenols: J. T. Hewitt and H. V. Mitchell.

THURSDAY, FEBRUARY 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Polarised Röntgen Radiation: Dr. G. C. Barkla.—The Effects of Momentary Stresses in Metals: Prof. B. Hopkinson.—The Halogen Hydrides as Conducting Solvents. Part I. The Vapour Pressures, Densities, Surface Energies, and Viscosities of the Pure Solvents: D. McIntosh and B. D. Steele.—The Halogen Hydrides as Conducting Solvents. Part II. The Conductivity and Molecular Weights of Dissolved Substances: D. McIntosh and E. H. Archibald.—The Halogen Hydrides as Conducting Solvents. Part III. The Transport Numbers of Certain Dissolved Substances: B. D. Steele.—The Halogen Hydrides as Conducting Solvents. Part IV.: B. D. Steele, D. McIntosh, and E. H. Archibald.

ROYAL INSTITUTION, at 5.—Recent Work of the Geological Survey: Prof. J. J. H. Teall, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Indian Census of 1901: Sir Charles A. Elliott, K.C.S.I.

LINNEAN SOCIETY, at 8.—A Revised Classification of Roses: J. G. Baker, F.R.S.—The Botany of the Anglo-German Uganda Boundary Commission: E. G. Baker, Spencer Moore, and Dr. A. B. Rendle.

FRIDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 9.—High Power Microscopy: John W. Gordon.

GEOLOGICAL SOCIETY, at 8.—Anniversary Meeting.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Protozoa in Relation to Disease: Prof. E. J. McWeeney.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—Adjourned Discussion on the American Visit, 1904.—The Strength of Columns: Prof. W. E. Lilly.

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