THURSDAY, MARCH 31, 1898.

CÆNOGENESIS, THE EXPRESSION OF VARIOUS PHYLOGENETIC ENERGIES.

Kainogenesis als Ausdruck differenter phylogenetischer Energien. Von Dr. Ernst Mehnert, Privat-docent an der Universität Strassburg i. Elsass. Pp. 165, and plates. (Jena: Gustav Fischer, 1897.)

IT has become more and more evident, during the past twenty years, that the course of ontogeny may vary in a quite remarkable degree, even within the limits of a genus, and that the individuals of a species may present not unimportant differences in their respective ontogenies. This contradiction of the old-established belief that the type of development was similar for every considerable group of animals, has led to the abandonment of many of the older principles of embryology, and has introduced no small amount of confusion into embryological speculations. The question which confronts the investigator is this: which among the several modes of development which occur in closely allied species is to be regarded as primitive, and which secondary? In other words, what developmental features are palingenetic and what cænogenetic?

In the present work Dr. Mehnert seeks an answer to the question by a comparison of the developmental characters exhibited in homologous organs in individual embryos and in individual species with the characters exhibited by the same organs in adult individuals.

The definitive condition of an organ in an adult individual is, he says, the direct product of its phylogeny: it is therefore possible, by means of such a comparison, to recognise the characteristic correlative differences which obtain between the several ontogenies of homodynamous organs and their different degrees of phyletic perfection. He proposes to establish the principle that the law of close interdependence between phylogeny and ontogeny leads, as a consequence, to the appearance of cænogenesis; in other words, that cænogenesis is not, as is often assumed, an anomalous phenomenon, but is governed by strictly regulated principles.

In order to establish his thesis, Dr. Mehnert gives the results of his extensive researches on the fore and hind limbs of pentadactyle Vertebrates. He selected these as most appropriate to his purpose because the hand and foot are serially homologous, and because each is an organ composed of several dozen separate but approximate and partly homodynamous skeletal pieces, whose homologies can with some certainty be asserted in the whole group of pentadactyle Vertebrates. The different stages of prechondrified, chondrified, and ossified tissues also afford a series of changes whose estimation presents no difficulty.

Although he has worked over a great number of species, Dr. Mehnert confines himself to the detailed description of a few forms, selecting *Emys lutaria*, *Struthio*, some carinate birds, some Mammals, and some Amphibia.

The hand of Emys is, as is well known, typical. There are five digits, a distal row of five carpals, a proximal row of three carpals (radiale, intermedium and ulnare) and a centrale. In addition, Dr. Mehnert recognises certain "sesamoid" bones, an ulnare externum, a radiale externum, a centrale ulnare, and a centrale distale as belonging to a regressive skeletal series which was ancestrally equivalent to the other carpalia. He finds that the pendactyle arrangement is early sketched out in prechondrial tissue, and that chondrification begins in the forearm, and proceeds distally, each transverse row of carpalia, metacarpalia and phalanges chondrifying at the same time, the different rows successively in centrifugal order. This condition is compared to that of the foot of Struthio, which in the adult is two-toed, the third and fourth digits alone being developed. In young embryos, however, the foot is discovered to be pentadactyle; only three toes are visible externally, but in sections all five may be distinguished. The centres of chondrification appear successively, beginning in the proximal elements, and extending at short intervals of time to the distal elements. Of the metatarsalia, the third and fourth, corresponding to the permanent toes of the adult, are the first to be chondrified, the second and fifth are chondrified later; the first, being very rudimentary, disappears early. The conclusion is that in development permanent structures are accelerated, evanescent structures retarded. The same principle is illustrated by the development of the wing, and even more remarkably, for whereas it is usual in Vertebrata that the hind limb should lag behind the fore limb in development, in Struthio, and also in Apteryx, the adult reduction of the fore limb is foreshadowed in the embryo, since it lags behind the hind limb from the first. The same phenomenon is observed in Anura, in the adults of which the hind limbs are predominant as compared with the fore limbs. From a number of considerations, such as the limb of Baptanodon, and the embryonic condition of the limbs of Emys, Mehnert concludes that all the skeletal elements of the limb were primitively of equal size, and somewhat short and square in shape. If this were so, the long bones and the metacarpals, metatarsals and phalanges would be progressive elements, which have increased in length in the course of phylogeny, whilst the carpals or tarsals would be regressive elements, and on his principle the last-named should show evidence of retarded, the former of accelerated development. This he shows to be the case in Mammals and in carinate birds, in which the metacarpal precedes the carpal differentiation. By the comparison of a large number of forms Mehnert arrives at the general rule, that all the permanent digital rays are histologically differentiated at a very early period, and are the first to be divided into their components: in the regressive lateral digits the reverse is the case—they lag far behind the predominant digits, and they may eventually degenerate and disappear.

Mehnert claims to have shown that the ontogenetic retardation of the development of an organ is connected with a phyletic diminution of its functional importance. This he has undoubtedly done, and the special part of his work is full of interesting facts bearing upon minor anatomical problems. It is not, however, easy to follow him in his excursion into theoretical questions. Having asserted the nature of the parallelism between ontogeny and phylogeny, he proceeds to seek for a causal explanation, and finds it in the diminution and final loss of the

faculty of cell-regeneration, due to the diminution and loss of the stimulus of functional excitation. In the case of limbs, the functional excitation is supplied by the stress to which the limbs are subjected in supporting the body weight. The primitive limb consisted of many rays; eventually five only were directly used for support, the remaining rows degenerated, and are now represented only by the "sesamoids." In further development of races, groups arose in which a lesser number of digits than five were used for support: the digits which were no longer used lost the stimulus of functional excitation and became degenerate, and their degeneracy was represented in ontogeny by a retardation in histological differentiation. Dr. Mehnert is clearly a Neo-Lamarckian as well as a follower of Roux, and he speaks, as clearly as Lamarck himself might speak, of the importance of individual effort in increasing or diminishing functional excitation. But there is one thing that Dr. Mehnert does not succeed in accounting for, nor has any Neo-Lamarckian yet succeeded in accounting for it, the constitution of the germ, which is such that the pentadactyle hand is first formed, even when it is destined to be monodactyle or didactyle in the adult, and this in an embryo developing under conditions which preclude the action of functional excitation. His principle of diminished cell-regeneration following upon diminished functional excitation obliges him to reject the teachings of those authors who assert a primary blastogenic phylogenesis, but he is constrained to admit some sort of preformation in the germ cell, and falls back on the specific energy of affinity possessed by every atom according to its position in the periodic system of elements. The course of speculation which starts from such premises can hardly lead to useful conclusions. The following is an example of the author's generalisations.

"Ontogenetic evolutions are only the consequential manifestations of phyletic epigenesis, which again is in itself only a specialised evolution of the molecular energies and affinities which integrate the individual. That which in the earlier periods of the earth was epigenesis, or, as one may now say phyletic evolution, is now become ontogenetic evolution."

One can see what he wants to explain, but one cannot admit that he explains it. Towards the close of his work he states that—

"individual growth and development is a mosaic-work of cells and organs produced by mass correlation which, as a result of different phyletic functional efforts, charges the germ with different regenerative energies."

The same idea might be expressed much more simply. The problem is, how and by what mechanism are variations in adult structures able to affect the germ in such a manner that they may be reproduced in the next generation? Mehnert seeks to prove that they do affect the germ, but he has not succeeded in suggesting the manner in which they can do so. Weismann's contention that acquired characters are not inherited has yet to be shown to be untenable, and his position will hardly be shaken by an argument which invokes the individual efforts of ancestors with limbs of theoretical construction in order to explain the observed facts in the ontogenies of their presumed descendants.

RADIATION VISIBLE AND INVISIBLE.

Light Visible and Invisible. By Prof. Silvanus P. Thompson, D.Sc., F.R.S., &c., Principal of, and Professor of Physics in, the City and Guilds Technical College, Finsbury. Pp. xii + 294. (London: Macmillan and Co., Ltd., 1897.)

THIS is an age of rapid growth of scientific knowledge when the theory of to-day becomes the established fact of to-morrow, and in no province have our ideas shown a more rapid advance than on the subject of radiations in the ether. First of all, the electromagnetic theory of Maxwell upheld that light was an electrical phenomenon, and this received its confirmation by the experimental genius of Hertz, and the subject of optics thus became attached to the domain of electricity. Later came the discovery, by Röntgen, of a kind of radiation entirely different from anything before known, and this was soon after followed by a discovery of a type of invisible radiation emitted by uranium and its salts, which apparently possess properties intermediate between ultra-violet light and Röntgen rays, but the cause of whose production is at present one of the mysteries of science. Besides these, many other types of radiation, either apparent or real, have been noted, and the subject of transformation of radiations at the surface of bodies is now engaging the attention of many observers. The last few years has thus been an era of unexampled activity in the study of radiations, and there is considerable evidence that this activity will be productive of still further results in the near future.

In this little volume—"Light Visible and Invisible"—Prof. Silvanus Thompson has published in full the six lectures delivered at the Royal Institution at Christmas 1897. At the outset we feel that the title of these lectures is rather a misnomer, for even a most imaginative person would hardly have expected that the volume was to include, under the title "Light Visible and Invisible," a lecture on the subject of electromagnetic waves, as well as a discussion of the properties and production of Röntgen rays.

These lectures are of necessity popular, and, as the author has very well said in his preface,

"two things are expected of a lecturer who undertakes a course of Christmas lectures at the Royal Institution. In the first place, his discourses must be illustrated to the utmost extent by experiments. In the second, however simple the language in which scientific facts and principles are described, every discourse must sound, at least, some note of modernity, must reflect some wave of recent progress in science"

After reading the well-illustrated volume before us, no one will be disposed to deny the author has fulfilled the conditions laid down in the preface. The subject is very simply treated, and abounds with experimental illustrations; and though there is little, if anything, in the volume with which a scientific student would not be more or less acquainted, we cannot but admire the attractive way in which the information is laid before us. It came rather as a surprise to us, however, to find the "note of modernity" strongly sounded on the now well-worn subject of Röntgen rays.

The first lecture opens with a discussion of the

elementary theory of light and shadows, and closes with some interesting details of Japanese magic mirrors, which are, I believe, not generally known. We then pass on in later lectures to the consideration of the visible spectrum and the eye, and here we are given an account of some of the effects of persistence of impressions on the retina, with its modern applications in the zoetrope and animatograph. In a series of six lectures it is manifestly impossible to treat of the whole subject of light with any degree of fullness, so that no apology is needed for the absence of any account of interference, diffraction, spectrum analysis, and many other branches of the subject, which are by no means the least important. The author has, however, a chapter devoted to the polarisation of light, which he considers a subject inherently simple rendered difficult by the nomenclature applied to it. In his own words—

"Scientific men often fall into the habit of using long and difficult words to express very simple and easy ideas. The natural consequence is that people are often led to think that there is some difficulty about a really easy subject, whereas the main difficulty is to understand the meaning of the word selected to describe it. The word 'polarisation' used in optics is one of these terms. It sounds very learned and difficult, but the idea it is intended to convey is really very simple."

If this be true, the original inventor of the term must turn in his grave at the thought of the way he has unwittingly retarded the dissemination of scientific knowledge.

The elementary consideration of polarisation is admirably treated by the aid of simple mechanical analogies, and is made so ridiculously simple that no one could fail to grasp the fundamental ideas. The best and fullest part of the lectures, however, is that which deals with the ultra-violet portion of the spectrum, which is extremely well treated with a wealth of experimental illustration, and will be read with great interest by all students of physics. The discussion of the ultra-red portion of the spectrum leads up to the consideration of electromagnetic waves, of which a short account is given.

In the last chapter we reach the high-water mark of popular literature in an account of Röntgen rays, including, as it does, an interview of Prof. Röntgen by a newspaper reporter, and photographs of the hands of scientific celebrities, as well as of a cigar and spectacle case, with whose contents we are all now so familiar.

A short appendix is added to each of the lectures, treating with more completeness of one or more of the ideas which arose in the lecture. For example, we are given an account of anomalous dispersion brought up to date by the introduction of a brief account of Helmholtz's investigation of the change of refractive index with wave-length. A brief summary of the elastic solid and electromagnetic theories is appended, and also a *résumé* of recent work on invisible radiations.

The author, in his first lecture, used the conception of wave surfaces to explain the elementary theory of optics rather than the time-honoured geometrical method. Every one will agree with the author that the only true method of treatment is to disregard the source, and to consider only the march of the wave front; and the sooner it is incorporated in our elementary text-books on optics the better. In the appendix to the first lecture a method of determining the ordinary optical formulæ from the consideration of wave surfaces is shortly explained, and in the author's words, "these [formulæ] are, in fact, established much more readily on this basis than by the cumbrous methods that are consecrated by their adoption in every text-book of geometrical optics." This appendix is, however, rather out of place in a popular treatise of this kind, for it will be passed over by the ordinary reader, and it is not sufficiently complete to be of much service to the student of optics.

In the beginning of this article attention was drawn to the fact that the title of the volume hardly leads one to expect the nature of its contents. The author is apparently not quite sure whether he is justified in including an account of electromagnetic waves and Röntgen rays in a book on "Visible and Invisible Light"; at any rate, he considers it necessary to explain his nomenclature. On p. 272 (in a chapter entitled "Röntgen Light") we have the following:—

"You will have noticed that I have spoken of these rays as 'Röntgen Light.' But are we really justified in calling it light? It is invisible to our eyes; but then so also is ordinary ultra-violet light, and so is infra-red light and Hertzian light. And there are other kinds of light, too, amongst them one discovered during last year by M. Becquerel and myself, which are invisible. But if the Röntgen light can be neither reflected nor refracted, neither diffracted nor polarised, what reason have we for calling it light at all? In fact, direct proof that it consists of transverse waves is wanting. Many conjectures have been formed respecting its nature. Röntgen himself suggested that it might consist of longitudinal vibrations. Others have suggested ether streams, ether vortices, or even streams of minute corpuscles. At one time the notion that it might be simply an extreme kind of ultra-violet light of excessively minute wave-length was favoured by physicists, who were disposed to explain the absence of refraction and the high penetrative power of the rays upon von Helmholtz's theory of anomalous dispersion, according to which the ultra-violet spectrum at the extreme end ought to double back on itself. The most probable suggestion yet made, and the only one that seems to account for the strange lateral emission of the rays right up to the plane of the antikathode, is that of Sir George Stokes."

We cannot at all agree with the author in speaking of Röntgen light, as it is a very misleading term, and presupposes a knowledge which we do not at present possess. The objection to the signification lies in the fact that the underlying view of what we call light is that which gives us a sense of vision. It is quite true that we call the ultra-red and ultra-violet portions of the spectrum invisible light, but that is purely a matter of convenience, as in the spectrum these waves are merely a continuation of the visible spectrum, and are not bounded by any hard and fast line; but it is quite another matter to apply the term to Röntgen rays, and when there is a perfectly general term "radiation" ready to our hand, it is far preferable to use it. It is far more accurate, as well as more scientific, to speak of Röntgen and uranium radiation rather than Röntgen and uranium light. It is time that the term light was restricted to its original signification, and it should not be carelessly extended to forms of radiation the nature and properties of which are probably very different to ordinary light vibrations.

E. R.

PHYSICO-CHEMICAL RESEARCH.

Arbeiten des physikalisch-chemischen Instituts der Universität Leipzig aus den Jahren 1887 *bis* 1896. Collected and edited by Prof. W. Ostwald, Director of the Institute. Four vols. Pp. x + 556; iv + 496; iv + 656; iv + 550. (Leipzig: Engelmann, 1897.)

THE year 1887 may be regarded as a red-letter year in the history of physical chemistry, for it was then that the birth of the theory of electrolytic dissociation took place.

Although the osmotic theory of solutions is somewhat older, it was also in 1887 that van 't Hoff published his classical memoir on the *rôle* of osmotic pressure in the analogy between solutions and gases.

These two theories, taken in conjunction with the law of mass action, form the starting-point of a new era in physical chemistry, and have thrown an entirely new light on miscellaneous facts taken from all domains of chemistry and physics.

The correlation of apparently isolated phenomena, which was then for the first time rendered possible, has materially advanced the study of philosophical chemistry.

Concurrently with the publication of these theories, Prof. Ostwald was transferred from Riga to the University of Leipzig, where he, assisted by numerous students of all nationalities, at once began the further investigation and application of the new and powerful weapons which had just been added to the armoury of the chemist.

An idea of what Prof. Ostwald has accomplished may be gathered from a perusal of the volumes now before us, representing only a selected portion of the work which has emanated from his laboratory during the past nine or ten years.

In all, the four volumes contain reprints of 104 papers published in the *Zeitschrift für physikalische Chemie*, which, by the way, was also founded in 1887. In many respects the papers are remarkable; not only are many of them classics, but they embrace nearly every department of chemistry. We are tolerably well acquainted with the specialisation which takes place in most of the continental laboratories, and we are often wearied with a harvest of papers all dealing with minute details and with different aspects of one and the same subject. This of course is necessary and important, but it is none the less tedious.

The volumes which are now brought under our notice form, on the other hand, a refreshing change; the majority of the papers are of fundamental importance, and are an eloquent tribute to the power and versatility of the leading spirit.

The occasion for their issue was the opening, at the beginning of the present year, of the new Physico-chemical Institute at Leipzig. In collecting the pamphlets for re-issue, the chronological order of publication has wisely been departed from, in order, by arranging the articles under their appropriate headings, to produce a more or less homogeneous budget, and thus to facilitate a general survey of the gradual development of each branch.

The contents of the first volume are classified into sections headed: general, the electrical conductivity of dissolved substances, and the electrolytic dissociation of acids and bases.

The advantages of this arrangement are obvious. By bringing together closely allied investigations, a great deal of time is saved and misconceptions are often prevented. The second paper in the volume, for instance, contains the diagrammatical description of Ostwald's famous experiment which is intended to remove the last doubts as to the validity of the assumption of free electrically charged ions. This experiment, it may be remembered, consists in bringing a negatively charged body up to an insulated vessel filled with a solution of potassium chloride, and connected by means of a siphon with a similar vessel at a little distance. If the siphon be now removed and then the charged body, there will be an excess of positively charged potassium ions in the adjacent vessel and negatively charged chlorine ions in the other. By conducting away the electricity the potassium, for example, assumes the ordinary form, and acting on the water present develops hydrogen, which can be collected in suitable apparatus and tested. This experiment has, in these columns and elsewhere, given rise to a great deal of unnecessary controversy which would probably never have been printed if the critics had been aware of the existence of the next important paper in the volume, namely, that on free ions, where the imaginary experiment was actually put to the test and found to give results in harmony both qualitatively and quantitatively with what had been predicted.

The second volume contains chapters on homogeneous and heterogeneous equilibrium, velocity of reactions and the determination of molecular weights; including a great many of the original papers by Beckmann and others on the theory and practice of the ebullioscopic and cryoscopic methods now universally employed.

Volume iii. deals entirely with electro-chemistry, and contains some of the most important recent contributions to our knowledge of this interesting branch. Contact electricity, the theory of the galvanic cell, with applications, and polarisation are treated of. Nowhere, perhaps, have the modern theories led to such brilliant results as in the department of electro-chemistry. It may be somewhat invidious to mention any investigation in particular; but, now that we are accustomed to look on the galvanic battery merely as an engine driven by osmotic pressure, we cannot allow this opportunity to pass without alluding to Nernst's classical memoir on the osmotic origin of the current.

The last volume of the series, besides several miscellaneous articles, contains an account of investigations on viscosity, diffusion, and optical and thermal phenomena.

The various pamphlets are reprinted word for word; and although the 'prentice hand is occasionally discernible, yet in many cases where corrections or additions have been rendered necessary these follow on immediately after the original article. Unfortunately some of the typographical errors present in the original have been reproduced, whilst others have here and there crept in. The equations at the top of p. 271, vol. iii., for example, are affected by both sources of error.

In conclusion, we have only to remark that if short notes giving a summary of contemporaneous work and ideas from other laboratories had been interspersed

between the different sections and individual papers, the unity of the whole would have been such as to make the four volumes of the *Arbeiten* an excellent special treatise on physical chemistry.

Although this would undoubtedly have increased the value of the work to outsiders, it is perhaps rather antagonistic to its *raison d'être*, since it is primarily the collected published papers from the physico-chemical laboratory of the University of Leipzig. As such it is not only a welcome souvenir to those who have worked in the old laboratory, but it should be in the hands of all who are interested in physical chemistry. JOHN SHIELDS.

OUR BOOK SHELF.

Archives of the Roentgen Ray. Vol. ii. No. 2. *Radiography in Marine Zoology*, being a Supplement to the *Archives of the Roentgen Ray*. The British Echinodermata. By R. Norris Wolfenden, M.D. Cantab. (London: The Rebman Publishing Company, 1897.)

To deal with the above-named publications in inverse order, it may be remarked that Dr. Wolfenden's treatise of fifteen quarto plates and six pages of letterpress is the outcome of the radiography, by means of a 10-inch spark-coil, of a collection of Echinodermata dredged in the Orkney Seas during 1896-97. The author claims that it has been his endeavour "to show that the new method of radiography may be made of considerable service in zoology, as an accessory to dissection and description." The plates are mostly inartistic and of no practical value to the zoologist—at best but poor examples of the radiographer's art. While they betoken a laudable desire on their originator's part to develop the new light of physical science, they partake of the nature of mere experimental memoranda such as are usually made a basis for fuller investigation and allowed to pass unpublished.

Of the *Archives* it may be noted that with the number under review the title is changed from that "of Skiagraphy" to that "of the Roentgen Ray." The seventeen pages before us are chiefly conspicuous as containing a full report of the inaugural meeting of the Röntgen Society of London, a combination of a conversazione, a trade exhibit, and a concert, set around a presidential address. The latter, reported *in extenso*, deals with the history, development, and application of the Röntgen discovery, to the invoking of Shakespeare. Special stress is laid upon the advantages likely to accrue to the medical profession by the employment of the X-ray tube; and since the members of that profession seem likely to profit both by its use and its user, they ought for the future to be among its foremost advocates. It is thus but appropriate that the body of the *Archives* should be devoted to a brief description of five plates mainly illustrative of the osteological phenomena of "acromegaly"—which we would remark is now more correctly known as megalacria. Beyond this there are a few desultory notes of a practical order, but we are unable to detect anything which might not have been communicated in the customary form to one or other of the established scientific societies. We fail to see the justification for the foundation of a new society, and shudder at the assertion that there are already "three journals established for the publication of observations and discoveries connected with the Roentgen rays," not to say at the suggestion of rivalry in the wording of the cover of the issue under review. Concerning the zoological departure, however, a good purpose will have been served, in the awakening of the mind of the physicist to the fact that animals exist and have a form and symmetry capable of scientific treatment.

Practical Electricity and Magnetism. By John Henderson, B.Sc. (Edin.), A.I.E.E. Pp. xv + 388. (London: Longmans, Green, and Co., 1898.)

THIS little volume, the second of a series of laboratory manuals at present being brought out by Mr. Henderson in conjunction with Mr. Joyce, has certainly many points about it which are not only original, but which should also render it of the greatest value in the physical laboratory.

It is designed "to provide a course of instruction for carrying out a progressive series of experiments in electricity and magnetism," and, though it is written, not for technical students, but for students of science, one is nevertheless struck with the author's extremely high ideal of laboratory experimental work. The student receives at the outset a preliminary admonition which cannot be described as other than most excellent and to the point. He is assumed to have plenty of time at his disposal, and not to be engaged in getting through a certain set of experiments in a given time: conditions which can hardly be expected of students preparing themselves for any practical examination, or even in every case of students engaged in original research. The writer's effort to inculcate an almost impossible ideal is none the less a most praiseworthy feature of the book.

The descriptions of recent experimental work are well up to date, though perhaps such work has received here and there an almost undue prominence. At the end of each section, a list of references to original papers bearing on the subject is given. These lists, which are carefully prepared, will recommend the book to all who are engaged in looking up in detail any particular branch of the subject.

The notation used is not always happily chosen, as, for example, the double meaning of the letter *R* on p. 108-9; and the book is by no means entirely devoid of unfortunate mistakes, as in the table on p. 378, where the mechanical equivalent of heat is given as "42400 grms. per °C" instead of "42400 grm.-cms. per °C." Such faults will, however, no doubt disappear in a second edition.

Much practical and detailed advice on the carrying out of experiments is given, which it would be hard to find in so concise a form elsewhere; and, though the manual is for this very reason not exactly readable, yet this portion of the work, together with the tables of references to original papers already alluded to, and the concluding set of numerical tables and physical constants, combine to make up a most useful work for the physical laboratory. D. K. M.

La photographie et l'étude des nuages. Par Jacques Boyer. 8vo. Pp. vi + 80. Twenty-one illustrations. (Paris: C. Mendel, 1898.)

AT the International Meteorological Conference at Munich, in 1891, a Committee was formed to consider the question of concerted observations on the direction of motion and the height of clouds, and subsequently various countries were invited to undertake special observations during a year commencing May 1, 1896, a period which was afterwards extended until August 1897. A Committee was also appointed to prepare a Cloud Atlas, based on the classification of Dr. Hildebrandsson and the late Mr. R. Abercromby, and instructions for observing and measuring the altitudes of the clouds by theodolites and photogrammeters were prepared by experts in this branch of meteorological science. The present handy little volume is the outcome of this action, and brings into a small compass a considerable amount of useful information which is spread over various publications, some of which are not easily accessible. It is divided into four parts: (1) the history of the subject from the middle of the eighteenth century; (2) classification according to the atlas above referred to, with a number of

illustrations; (3) description of the photographic apparatus employed, and (4) the method of measuring the pictures obtained. The two last chapters will be very valuable for any one proposing to undertake the difficult task of photographing the clouds, and of determining their heights and movements. In referring to the various attempts at cloud classification, we do not find any mention of "Cloudland," by the late Rev. W. C. Ley.

Proceedings of the London Mathematical Society. Vol. xxviii. Demy 8vo, pp. 594. (London: Francis Hodgson, 1897.)

THIS collection of thirty-four original papers on every branch of mathematics affords abundant evidence that English mathematicians are not behindhand in moving with the times. If proof be needed that the younger generation of mathematicians are quite following in the lines of those that have gone before them, it may be sufficient to mention that at least six of the papers are by men who have graduated at Cambridge since the year 1886. As might be expected, "Partitions" and "Groups" occupy a prominent place, seven of the papers being devoted to them. The former of these two subjects is ably introduced by Major MacMahon, F.R.S., in his address on "Combinatory Analysis," delivered on retiring from the office of president; and the publication of the outlines of seven lectures on the "Partitions of Numbers," delivered by the late Prof. Sylvester at King's College, London, in 1859, is another important feature. On the other hand, "hyper-Euclidian geometry" is conspicuous by its absence, and applied mathematics is represented by eight papers only.

During the past year the London Mathematical Society has lost two members in addition to the late Prof. Sylvester: the Rev. Alexander Freeman, who died on June 12, 1897, and Lieut.-Colonel John Robert Campbell, who died on June 23. Colonel Campbell, besides serving on the Council, was a benefactor to the Society, and we understand that had it not been for his munificence it would have been impossible for the Society to issue such large and interesting volumes of *Proceedings* as the one now before us.

First Year of Scientific Knowledge. By Paul Bert. Translated by Madame Paul Bert. Revised and partly re-written by Richard Wormell, D.Sc., M.A.; and Montagu Lubbock, M.D. Pp. vi + 417. (London: Relfe Brothers, Ltd. Paris: Armand Colin and Co.)

THIS is a revised edition of a work which has had a very successful career, but is constructed upon a plan which has little to commend it. The revision has consisted in bringing the information into line with current scientific knowledge, the plan of the book remaining as in the original. The rudiments of zoology, botany, geology, physics, chemistry, animal physiology, and vegetable physiology are all described in the four hundred pages which constitute the text, so that the book is comprehensive in its scope, if nothing else. The chief fault we have to find is that far too many technical terms are defined and used, so that the unfortunate pupils who are introduced to natural history by this book will be given the idea that science consists chiefly of words of Greek origin, and an unpronounceable terminology.

Who's Who, 1898. Edited by Douglas Sladen. Pp. xviii + 846. (London: A. and C. Black, 1898.)

THIS is undoubtedly the handiest biographical dictionary and compendium of information, referring to prominent persons and their doings, in existence. It contains nearly seven thousand biographies—mostly autobiographies—of the leading men and women of the day, and a large amount of information in addition. Among the general contents of interest to men of science is a list of Royal, National and learned societies, showing the addresses of the societies, secretaries' names, annual subscriptions and other conditions of membership. We notice also a table of university degrees, with the correct explanation of each, a list of chairs and professors in the great universities of the United Kingdom, arranged alphabetically by their chairs, and a list of Fellows of the Royal Society (most of whom appear among the biographies). The volume is one to be kept on the writing table for ready reference; and it possesses the merit of including in its pages biographical details of more men of science than usually figure in similar reference books, though even now some of the minor literary lights could be struck out with advantage to make room for well-known scientific men who have been omitted.

LETTERS TO THE EDITOR

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Mechanism of Self-fertilisation in the Banana.

I PROPOSE to describe here the mechanism of fertilisation in the banana plant.

(1) *Packing of the inflorescence.*—The inflorescence in this plant is packed air-tight in the large red-coloured bracts, whose margins are secured in place by a sort of cement. If we remove one of these bracts and examine the buds within, we find that the reproductive organs are also packed air-tight in the perianth. A closer examination of this packing is necessary to understand its efficiency.

The perianth consists of an outer whorl and an inner whorl; the outer one consists of three sepals, usually united into an elongated concave hood. (Sometimes, instead of the three being united together, only two are united and one is free, which in the bud is partially overlapped by the other. Very rarely the three are quite free. In about fifty examples I examined, I

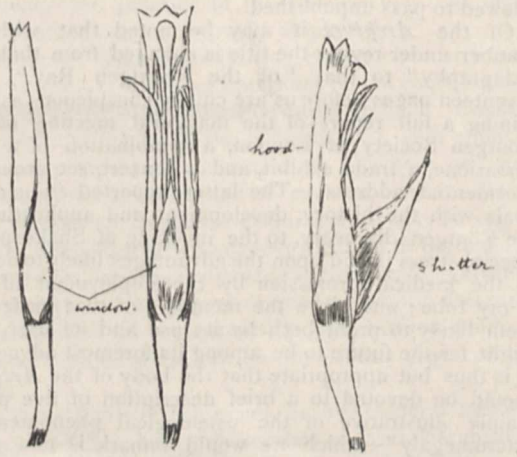

Fig. 1 Fig. 2 Fig. 3

got only one flower with all the three sepals distinct.) The margins of the hood are folded inwards, so that they overlap each other. There is no fixed rule as to which is the outer, and which the inner, sepal. Sometimes the right overlaps the left, or *vice versâ*. This overlapping is not complete throughout their length, and cannot possibly be so. For, to ensure the packing being air-tight, the pectinate inflorescence must necessarily be concavo-convex, *i.e.* convex without and concave within; and obviously any cylindrical tube bent concavo-convexly must necessarily leave a gap or a window at the bottom (see Figs. 1 and 2).

This window would be a very weak point in the packing, and hence most accessible to insects or other injurious agencies if the outer packing became loose by accident. This weak

point must, therefore, be guarded first; and we see that nature has done it by closing the window with one of the petals of the inner whorl. This petal is convex in front and concave behind, while the hood is convex behind and concave in front. This arrangement shuts off the window completely (Fig. 3). The petaloid shutter is secured in its place, on either side, by the margins of the hood to nearly an eighth of an inch. These margins are very much thinned out, and are also cemented together. The shutter, being on the concave side of the bud, comes in contact with the convex bract beneath, which thus helps to keep it in position. The top of the hood is closed similarly air-tight by its margins. The inner whorl—*i.e.* the corolla—is represented usually by the shutter alone. Sometimes, however, two petals are present, and very rarely all the three.

The male organs, thus tightly packed, can neither move from their place, nor can they be assailed by any foreign element from without.

(2) *Arrangement of the stamens.*—On removing the hood and the shutter we come to the androecium, which consists of four or five stamens. The filaments are petaloid and erect, thus embracing the pistil completely. The anthers are adnate or dorsifixed. They are also introrse, *i.e.* turned towards the stigma.

Let us now proceed to the pistil, and examine it in the different stages of its growth. In the early state—*i.e.* before it is ripe, and before the anthers are ripe also—the style and

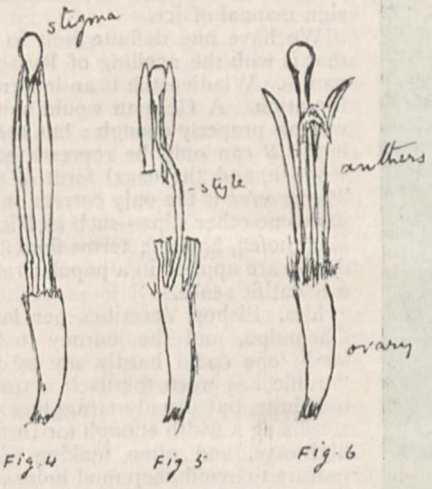

Fig. 4 Fig. 5 Fig. 6

the stigma project beyond the androecium. If this state continued, self-fertilisation would be impossible. The stamens must either overtake the stigma, or the stigma must be at the mercy of insects or the wind for pollination. The stamens are not quick enough in growth to overtake the stigma; so what happens is this. By the time the anthers are ripe, the style shortens in length by bending nearly at right angles in two places (often marked by horizontal grooves in early stages), and thus brings the stigma in contact with the pollen (see Figs. 4 and 5). After pollination is completed, the style straightens again and projects, as before, beyond the androecium (see Fig. 6). Stages intermediate between Figs. 4 and 5, may be seen if we examine the flowers from without inwards. With the straightening of the style, the anthers become free and curve outwards. The bracts fall off; the shutter drops away; the hood withers, and the style dries gradually.

Kolhapur, India, February 17. GOPAL R. TAMBE.

Stereoscopic Projection of Lantern Slides.

IN your report of the meeting of the Physical Society on February 26 (NATURE, p. 454), I notice an account of the exhibition, by Prof. T. C. Porter, of a somewhat complicated apparatus for exhibiting lantern slides in stereoscopic relief. An equally elaborate arrangement, depending on the use of polarised light, was exhibited at the British Association at Nottingham in 1893. It may possibly, therefore, be of interest to call attention to the much simpler means of accomplishing the same result, which suggested itself to me some time ago, but I subsequently found that it had been invented previously by Lieut.-Colonel Moëssard under the name of *monocular* stereoscope (*Cosmos*, May 23, 1896).

In this stereoscope one eye views one of the pictures directly, while the other eye sees the other picture after reflection at two mirrors, the angle between whose planes can be adjusted so as to bring the image into apparent coincidence with the picture seen by the first eye. In viewing distant pictures, such as lantern slides, a projecting partition, with a flange whose breadth is nearly equal to the distance between the two eyes, is all that is necessary to prevent either eye from seeing the wrong picture.

For lantern work, either two pictures could be projected side by side with separate lanterns, or two small views could be photographed side by side on the same slide, and thus enable stereoscopic effects to be shown with a single ordinary lantern.

Moreover, by turning the arrangement of mirrors through 90° it can be made to displace the image seen by one eye *vertically* instead of horizontally. This would enable the two pictures of an oblong view to be projected *one above the other*, instead of side by side, and viewed with the same apparatus as before, but differently arranged. As regards the foreshortening of the upper picture, this would be to a great extent compensated for by the fact that the lantern itself projected the picture upwards.

It is evident that two pairs of mirrors, one for each eye, could be used if desirable. G. H. BRYAN.

The Aurora of March 15.

I WAS fortunate enough to witness the display of the aurora on the night of the 15th, and think that some of the appearances may be of interest to those who did not see them, but who have recorded the accompanying magnetic disturbances.

The display began in the north-east about eight o'clock, by the appearance of a brilliant band of light, rising from behind a cloud 45° from the horizon, and extending about 30° in a south-westerly direction. This band might have been mistaken for a search-light, the edges were so sharp. The colour was the characteristic greenish hue of the aurora.

After persisting steadily for five minutes the band gradually broadened and shortened, and became a bright patch, which continued until the end. The display spread over the northern sky to the west, where another patch appeared. At nine o'clock the display was very fine, with two patches east and west, and right overhead seemed to be the apex of a parabola with beams of light streaming northwards. Looking southwards, occasional flashes of a yellowish pink colour could be seen. About ten o'clock the whole energy of the display seemed to become concentrated in the east and west patches, and great flashes of light connecting the two. After this the brightness seemed to gradually diminish.

So bright was the aurora at its height that the grey granite walls of the houses were illumined by the flashes.

Aberdeen, March 25. A. GEO. SMITH

On Phosphorescent Sap in Superior Plants.

IN answer to the question of Prof. Giglioli in NATURE of March 3 (p. 412), I beg to observe that in Meyen's "System der Pflanzen-Physiologie," which was certainly in its time a standard work, there is to be found in vol. ii. p. 203 (Berlin, 1838) a short but concise statement of the phosphorescence of the milk-juice in *Euphorbia phosphorea*, on the authority of v. Martius ("Reise in Brasilien," ii. pp. 726 and 746), as also a reference to a communication by Mornay (*Philosophical Transactions*, vol. vi. p. 279), on the phosphorescence of the milk-juice" in einem rankenden Gewächse, Cipo de Cunanam genannt, welches zwischen Monte Santo und dem Flusse Bendego wuchs und wahrscheinlich eine Asclepiadee oder ein Apocynee ist." M. W. BEIJERINCK.

Delft, Holland.

A Remarkable Case of Correlation.

A VERY interesting case of correlation is recorded in the *Bulletin* of the Botanical Department, Jamaica, for December 1897.

Particular attention has been paid lately to the selection of good Ripley pine-apples, and it is found that if there is a broad red stripe in the centre of the leaf the fruit will turn out good; in other cases the fruit goes into holes at the bottom, and is attacked by ants. S. N. C.

MRS. BISHOP'S KOREA.[1]

WHEN, after returning from the perils and hardships of her adventures in the Bakhtiari country of Persia, Mrs. Bishop announced her intention of making an extensive journey in Eastern Asia, her friends knew that she would not return without having something of interest to tell regarding her travels in little-known regions. Although unfortunately ignorant of the languages of the countries in which she was to travel, and therefore dependent on others to a large extent, Mrs. Bishop had most carefully prepared herself for making all necessary observations and records. She is particularly to be congratulated on her skill as a photographer. The points of view were very carefully chosen, and the exposures accurately calculated, while the practice of developing the plates at the time, allowed duplicates to be taken if the first negative proved defective. The result is one of the best collections of photographs which we have seen as the result of a travelling amateur. We must congratulate the publishers also on the manner of reproduction employed: the more important views are printed as separate plates by the half-tone process, the others are reproduced as line-and-stipple blocks in the text, allowing the book to be printed on unglazed paper, and giving the volumes a lightness which is as desirable as it is rare.

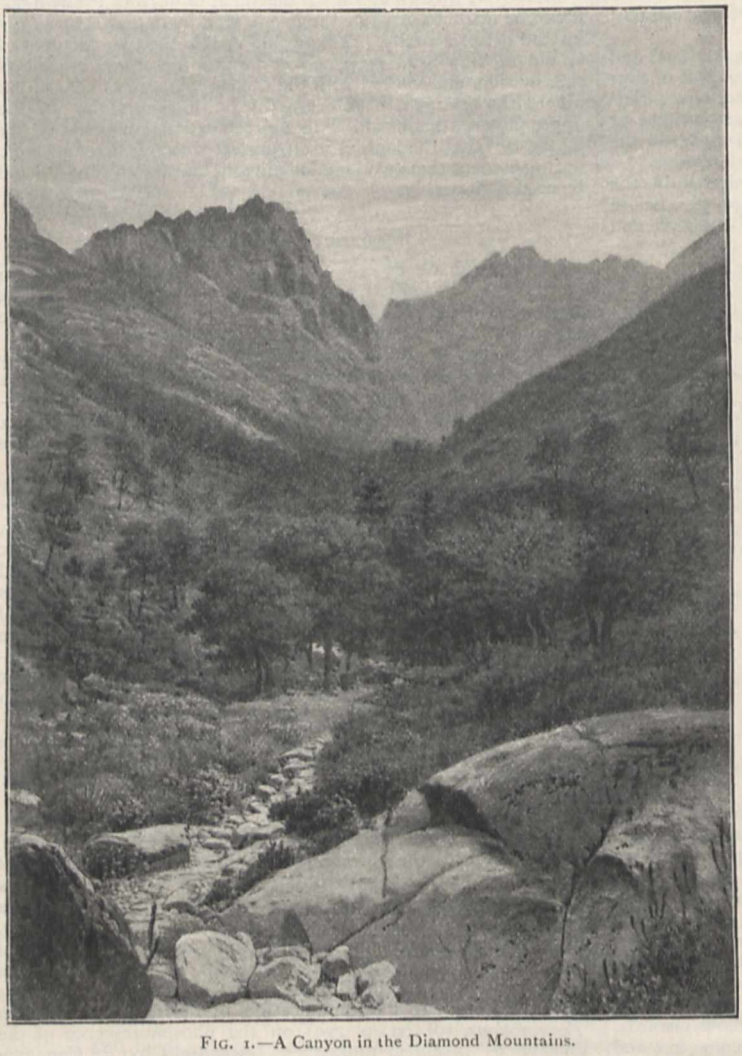

FIG. 1.—A Canyon in the Diamond Mountains.

Mrs. Bishop deals here with only a portion of her recent travels. Her important tour through Sze-chuan, on which she read a paper to the Royal Geographical Society—the first paper ever read by a lady to that Society—is not referred to, and the journey through Manchuria is but lightly touched on. Korea is the central theme; and although the interests of the authoress were obviously with the social and political aspects of the country rather than with its physical and biological conditions, she succeeds in giving an excellent general account, all the more valuable because not a little rubbish has been written by chance visitors at the treaty-ports. We may be pardoned if we feel a little regretful that—for example—the character of the interesting rock in the foreground of the photograph we reproduce (Fig. 1) is not described; but doubtless, the pioneer work having been accomplished, scientific travellers will follow, who can tell us whether the stone is merely water-worn or bears the sign-manual of ice.

We have one definite fault to find, and that is with the spelling of Russian place-names. Wladivostok is an incorrect transliteration. A German would write Wladiwostok properly enough; but the Russian letter *B* can only be represented by *v* in English, and the usual form of the name *Vladivostok* is the only correct one. There are some other slips—such as Richofen for Richthofen, and the terms flora and denudation are applied in a popular rather than a scientific sense.

Mrs. Bishop describes her landing at Chemulpo, and the journey to Seoul by land; one could hardly say by road, for "traffic has worn for itself a track, often indefinite, but usually straggling over and sterilising a width enough for three or four highways, and often making a new departure to avoid deep mud-holes." A residence in the insanitary and unsavoury Seoul followed, and then a journey by sampan up the south branch of the Han River, which was previously almost unknown to Europeans; then up the north branch of the river, and on ponies to the Diamond Mountains, and northward to Wönsun on the east coast. Returning to Chemulpo by sea, Mrs. Bishop was strongly advised by the British Consul to leave the country, and so crossed to China and made her way *viâ* Newchwang into Manchuria. It was a journey full of interest and of danger from floods, and the undisciplined Chinese armies on their way to the Korean war. Then she went *viâ* Nagasaki to Vladivostok, studied the Korean colonies in Siberia, and tried to enter Korea from the north; but the rivers were impassable, and another long sea-voyage was necessary. A second residence in Seoul led to a journey northward along the old road to China for 200 miles. A third and final visit to Seoul occupied the last few months of 1896. As Mrs. Bishop lived in the village inns when travelling, and was in constant communication with the diplomatic agents and missionaries while in the capital, her opportunities for seeing native life and learning the state of affairs in the country were exceptionally good.

Her special study was the people. In a note we learn

[1] "Korea and her Neighbours. A narrative of travel, with an account of the recent vicissitudes and present position of the country." By Mrs. Bishop (Isabella L. Bird), F.R.G.S. With a preface by Sir Walter C. Hillier, K.C.M.G., late H.B.M.'s Consul-General for Korea. With maps and illustrations. 2 vols. (London: John Murray, 1898.)

that the average size of 1060 men, measured at Seoul in January 1897, by Mr. A. B. Stripling, was height 5 ft. 11¼ in., chest-measurement 31 in., and circumference of head 21½ in. The maximum figures were respectively 5 ft. 11¼ in., 39¾ in., and 23¼ in. The physique is generally good, and the people possess many amiable qualities. The total population is estimated at from 12,000,000 to 13,000,000. Most of the people are very poor, and have no inducements to thrift; any wealth they may gather is at the mercy of the official class, who are mainly, if not entirely, responsible for the miserable condition of the country. Under the just rule of the Russians in Eastern Siberia, Mrs. Bishop found the Korean emigrants happy and enterprising, making good profits from their farms and inhabiting comfortable houses. Given good government, people and resources being as they are would ensure prosperity to Korea. Into the tangled political history of the unhappy country we cannot enter here, nor can we refer to the many curious customs, ceremonials and beliefs, which are set forth at considerable length. These, perhaps, constitute the most valuable part of the book, for Mrs. Bishop caught Korea in an interesting transition period, when the old subjugation to China was being repudiated for ever, and reforms of many kinds were being introduced. The Altar of the Spirits of the Land, at which the ceremony of repudiation was carried out, is shown in Fig. 2. Few contrasts are more striking than that presented by Seoul at her first and at her last visit; when the filthy chaos of huts surrounding the palace gave place to well-ordered streets of good houses. The problem of the fourfold influence of Russian, Chinese, Japanese and European interests is very well handled. Of the industries of Korea the most interesting is the cultivation of gin-seng, the description of the processes employed in the manufacture of the dried root being, we believe, the fullest yet published.

The future of Korea is still uncertain, but it is bound to play a prominent part in the politics of the Far East; and this book will hold a place as a valuable work of reference for many years to come.

HUGH ROBERT MILL.

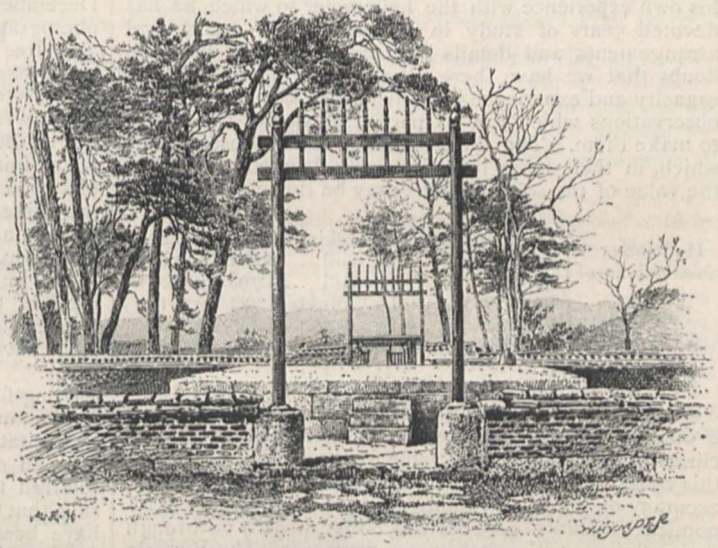

FIG. 2.—Altar of the Spirits of the Land.

ASTRONOMICAL RESULTS FROM THE CAPE OBSERVATORY.[1]

THESE three volumes, issued under the superintendence of Dr. Gill, form in some respects a very remarkable production. Not so much on account of the very numerous observations, whose discussion furnishes forth these weighty books, as by reason of the widespread assistance rendered by many astronomers, whose energies Dr. Gill has quickened, whose results he has collected, stamped with his own individuality, and incorporated in the "Annals of the Cape Observatory." There are very few instances in which the director of an observatory has been willing to take up a laborious piece of work at the suggestion of an astronomer, however eminent, go through the wearisome task of making the observations, and then be willing to hand over his results to an independent authority for final discussion or criticism. It is this quality of self-abnegation, which strikes us as so complete and worthy of imitation. We congratulate Dr. Gill on his tactful skill, by which he has emerged from his self-imposed task, without friction with his collaborators, and been able to present to the world, in a complete form, the result of a scheme which he carefully planned and carried to a successful issue. We think it an especial merit in Dr. Gill's work, that he has perceived the value of strengthening his heliometer observations by combining with them the results made with similar instruments elsewhere. It was quite within his power and instrumental means to have derived the solar parallax from observations of the asteroids made solely at the Cape Observatory. Other observers could have done the same work, but separate discussions, made at irregular intervals and under varying conditions, do not possess the proportionate authority that attaches to one discussion made with several instruments on a combined plan. Moreover, one feels that the last word has been said, for some years at least, on this subject of solar parallax, by means of heliometer observations. Every observer must feel that, singly, he cannot do more than has already been done collectively. There can be no temptation to repeat the work. Consequently the owners of this class of instruments are freed from this particular investigation, for which the heliometer seems especially well fitted, and are at liberty to pursue other inquiries with advantage. It might be worth while just to mention, that to get the full power of a heliometer a considerable number of meridian observations is necessary. In this case some thousands came under the discriminating examination of Prof. Auwers. To use this mass of observations on one series of measures would be extravagant, but when combined with all the heliometer observations in a final inquiry, this cost of time and labour is disregarded, since they contribute to the increased accuracy of so large a body of measures. It is a true economy which Dr. Gill has practised, and the success which has followed it will bear much fruit in the future.

In the inquiry from which the solar parallax is deduced, we notice that no less than six observatories have contributed heliometer measures. Besides that of the Cape, we have New Haven (Yale College), Leipzig, Göttingen, Bamberg, and the Oxford Radcliffe Observatory, all furnishing measures of some or all of the three planets, Iris, Victoria, and Sappho, from stars in a previously selected zone, through which the planets passed. Several have further assisted by making a careful triangulation of the selected stars. The position

[1] "Annals of the Cape Observatory." Vol. iii. The Cape Photographic Durchmusterung. Vol. vi. Solar Parallax from Heliometer Observations of Minor Planets. Vol. vii. Solar Parallax from Observations of Victoria and Sappho. (London: Published by order of the Lords Commissioners of the Admiralty, 1896.)

of these stars has been determined at "all the principal observatories," to use Dr. Gill's phrase, who apparently grew tired of enumerating all the institutions to which he is indebted for the completeness of this section of the work. The final value of the coordinates has been made the subject of a discussion by Prof. Auwers, which may well form a model for similar inquiries, and will be carefully studied by the professional astronomer engaged in similar work. Into minute details which arise in this section, as well as in the use and reduction of the heliometer measures themselves, it is impossible to enter here with sufficient fullness to make the involved process at all clear. The whole interest centres in the nicety with which small residuals are treated. For a similar reason it would be impertinent to offer any criticism which would imply that we have given to the volume the same anxious study and consideration which the combined authors have devoted to their subject. Dr. Gill has supported himself by the ablest authorities in meridional astronomy, his own experience with the heliometer to which he has devoted years of study in perfecting the mechanical arrangements and details is profound, and we have no doubt that we have here all that can be effected by sagacity and experience in deriving the best results from observations which are as perfect as we yet know how to make them. The final outcome of the observations which, in their main intention, were devoted to deriving the value of the solar parallax may be thus presented.

Heliometer observations of	Iris, discussed by	Dr. Elkin..	8″·8120 ± 0″·0090
	Victoria ,,	Dr. Gill ...	8·8013 ± 0·0061
	Sappho ,,	Dr. Gill ...	8·7981 ± 0·0114
Meridian observations of	Iris ,,	Dr. Auwers	8·771 ± 0·130
	Victoria ,,	Dr. Auwers	8·845 ± 0·051
	Sappho ,,	Dr. Auwers	8·626 ± 0·118

The mean value from the heliometer measures is 8″·8036 ± 0″·0046, while the meridian observations give 8″·806 ± 0″·030, but for reasons stated, Dr. Gill is inclined to adopt as a final value 8″·802 ± 0·005. Though this result of itself would be a satisfactory outcome, the accuracy of the observations permits some other astronomical constants to be derived, either directly or through their relations with other known constants. The Victoria observations give with some confidence the mass of the moon $= \frac{1}{81{\cdot}702 \pm 0{\cdot}094}$. For other constants, such as the nutation, it is necessary to assume the luni solar precession. The value adopted is 50″·367 ± 0″·004, but the source from which it is obtained is not very clearly stated, neither is the epoch to which it refers. Apparently it is taken from Newcomb's discussion in the *Astronomical Journal*, No. 359; but in that paper we have not been able to find this particular value, nor the probable error with which it is accompanied. With this value of the precession, however, and the exact amount is immaterial for this purpose, the constant of nutation is 9″·2068, and pursuing the same line of inquiry the constant, $\frac{C-A}{C}$ (employing the ordinary notation), is 0·0032825. Adopting Clark's value for the equatorial radius of the earth, the aberration constant is found to be 20″·467 ± 0″·012. Here as elsewhere the most probable value of the solar parallax is assumed 8″·802.

The remaining volume, which contains the southern "Durchmusterung," between the limits −18° to −37° declination, is in its way quite as remarkable as the two volumes which we have been considering. Herein we have the first-fruits of the application of photography to the determination of star positions on a large scale. The old and the new methods are brought sharply into contrast. One would naturally like to institute a comparison between the time necessary for the production of these zones, and that required for similar work, either at Bonn or Cordova. But such a comparison is not easy, nor probably would it be fair. The plates that were taken at the Cape were measured at Groningen. Much time must have been lost in correspondence and in settling the details of a new method. Experience had to be acquired in the most suitable methods of measuring with new and untried apparatus. Prof. Kapteyn was necessarily occupied by his University duties, and could only devote his leisure to the preparation of the catalogue—a leisure which he gave unstintingly; and Dr. Gill is to be congratulated on the good fortune that supplied him with so able and willing a coadjutor.

The plates were taken with a rapid rectilinear Dallmeyer lens of six inches aperture and fifty-four inches focus. During the course of the work this lens was repolished, and a portion of the work duplicated with a second lens; but allowing for all interruptions, the work that was begun on April 15, 1885, was finished in December 1890, with the result that the whole sky was photographed from the South Pole to −19° declination. The free area of each plate was five degrees square, more than 600 being required to cover this portion of the heavens once, without any duplication. At first, when plates were rather slow in action, an hour's exposure was given; but this time was subsequently reduced to about thirty minutes. It is instructive to notice that many plates on a first examination had to be rejected, owing to the fainter stars not having impressed themselves on the film, on account of mist, dewing of the objective, or bad definition. "The more thorough examination necessarily made by Prof. Kapteyn in course of measurement, brought to light a good many more plates which it seemed desirable to re-photograph, so that some of the areas have been photographed three, four, and even five times." Such a report will not be very satisfactory reading for those engaged on the "Carte du Ciel."

The measurement was effected in a manner that necessitated very small corrections to the original readings, in order to obtain the approximate star places, referred to the equinox of 1875; indeed, Prof. Kapteyn says that the coordinates read from the instrument might have been entered directly in the catalogue. We can form a tolerably accurate notion of the time occupied in measuring the plates, for it is stated that on good rich plates two assistants could measure 300 to 400 stars in an hour. Probably 200 would represent the average, and since this portion of the catalogue contains 152,598 stars, we have about 750 hours of actual measurement for one complete examination. Such a rapid collection of results needs no comment. The average distribution of the stars throughout the whole area is possibly of greater consequence than the actual number measured. Of course, the number to a square degree varies very much in different parts of the sky. In the sparsest parts, that is, in Galactic Latitude about −70°, this number falls to 6·28, rather less than in Argelander; but a comparison of *mean* results with other zones gives the following numbers.

Cape Photographic Survey ...	25·43	stars to square degree.
Bonn N. Durchmusterung ...	15·19	,, ,,
Schönfeld	18·21	,, ,,
Thome	56·1	,, ,,

The arrangement of the stars in the catalogue, and the degree of accuracy aimed at, is the same as in the familiar Bonn work, namely one-tenth of a second of time in R.A., and a tenth of a minute of declination. A comparison between the places here given with those of other catalogues shows that the probable error of a photographic determination contrasts most favourably with that derived from other processes. This is clearly shown by the following table.

Authority.		Prob. error in α.		Prob error in δ.
		s.		″
Argelander	− 2 to + 38	± 0·70		± 25·4
Schönfeld	− 2 to − 23	0·38		9·6
Cordova	− 22 to − 32	0·42		13·8
Cape Photog.	− 19 to − 38	0·27		2·6
Lalande (1880)	+ 1 to + 5	0·224		2·4

We do not propose in this place to follow Prof. Kapteyn in his discussion of the magnitudes assigned in the work, and his comparison with the visual magnitudes recorded by other observers. The section is very interesting and likely to lead to much discussion, owing to the curious fact disclosed, that while this catalogue is poorer in number of stars in the poor regions of the sky, it is at the same time richer in the rich regions, than is the catalogue of Schönfeld, from which fact Prof. Kapteyn concludes that the stars in the Milky Way are generally more chemically active than the stars in the other regions of the sky. W. E. P.

NOTES.

REFERRING to our inquiry (p. 488) as to disturbances of terrestrial magnetism during January and February, Dr. C. Chree writes from the Kew Observatory as follows:—"With the exception of some small movements on the 10th, our magnetic curves were very quiet from January 1 to 14; but thereafter there was a disturbed time, lasting over January 15 to 21. The disturbance was greatest from the 15th to the 18th—when it was well marked—less on the 19th and 20th, and still less on the 21st. The 22nd and 23rd were very quiet days. The rest of January was quiet generally, with a few small movements. February was quiet up to the 10th, with the exception of some slight movements on the 5th. From February 11 to 16 there was a moderately disturbed time; on the 20th and 21st there were some smaller movements. It was then quiet to the end of the month. 'Quiet' is, of course, only a relative word; there is seldom a day in which some slight movement, beyond the mere diurnal inequality, is not visible. In the case of the disturbances on January 15–21 and February 11–16, it was rather a case of numerous well-defined oscillations than of sudden comparatively isolated movements of a conspicuous character."

A CONFERENCE of the International Aeronautical Commission opens to-day at Strassburg, and will continue for several days. Among the experiments to be performed during the meeting is the graduation of thermographs down to − 200° C. by means of a jet of liquid air procured by the Linde method. Dr. Hergesell, the president of the conference, will present a report upon the thermometric experiments already referred to in NATURE (p. 470). M. Besançon will send up a balloon of twelve hundred cubic feet capacity, equipped with meteorograms, which it is estimated will attain an altitude of about twenty thousand feet. Several members of the Paris Academy of Sciences have signified their intention to attend the conference.

THE Paris correspondent of the *Times* reports that at Monday's sitting of the Academy of Sciences the question of the French national time was introduced by M. Bouquet de la Grye, the president of the Paris Geographical Society and a member of the Section of Navigation and Geography. The fact was recalled that on February 24 the Chamber of Deputies passed without discussion and on a show of hands a Bill providing that French national time should be advanced by 9 minutes 11 seconds, which was tantamount to the adoption of the meridian of Greenwich by France. The Bureau des Longitudes has, however, sent a protest to the Minister of Education, and the protest has been forwarded to the President of the Senate. M. Bouquet de la Grye asked the Academy to refer the whole question to the joint Sections of Astronomy and Navigation to be reported upon. This motion was supported by M. Janssen and adopted after some explanations from M. Berthelot and M. Bertrand, the two permanent secretaries.

IT is announced that the Russian Government has decided to adopt the metric system.

A FRENCH ironclad launched a few days ago was christened the *Lavoisier*.

PROF. J. E. KEELER has been elected director of the Lick Observatory, in succession to Prof. E. S. Holden.

THE current number of the *Proceedings of the Royal Society* contains an obituary notice of Pasteur by Prof. Percy Frankland, F.R.S.

MR. A. D. BERRINGTON is on the point of retiring from the post of chief inspector of fisheries and assistant secretary to the Board of Trade. Among the fishery inspectors who preceded Mr. Berrington were Mr. Frank Buckland and Prof. Huxley.

THE Public Buildings Expenses Bill, providing 2,250,000*l.* for new public buildings in London, passed through Committee of the House of Commons on Tuesday. Included in the expenditure authorised by the Bill is a grant of 800,000*l.* for buildings in connection with the Science and Art Museum at South Kensington.

A SWEDISH scientific expedition to Klondike, conducted by Dr. Nordenskiöld, arranged to leave Stockholm on March 23. Dr. Nordenskiöld will be accompanied by Dr. Gunnar Andersson, professor at the Stockholm High School, and four other persons. The expedition is expected to be absent about two years. Immediately after its return the expedition will make known the results, not only in Sweden, but also to scientific societies in other countries.

IT is reported that Herr J. Stadling, who accompanied Herr Andrée's expedition to Spitsbergen in 1896, has been appointed by the Swedish Anthropological and Geographical Society to undertake a search through Siberia in order to make inquiries as to the fate of Herr Andrée's balloon expedition. For this purpose Herr Stadling has received the Vega stipendium from the Society. He will start with a companion from Stockholm early in April, and the journey will last probably until January next.

A COMMITTEE has been appointed by the Home Secretary to inquire into the extent to which water gas and other gases containing a large proportion of carbon monoxide are being manufactured and used for heating, lighting and other purposes, and the dangers which may attend such manufacture and use. The committee is composed of Lord Belper (chairman), Mr. H. H. Cunynghame, Dr. Parsons, Dr. Haldane, and Prof. Ramsay; with Mr. J. Pedder, of the Home Office, as secretary.

AT the meeting of the Manchester Literary and Philosophical Society on Tuesday, the President presented the Wilde medal for 1898 to Sir Joseph Dalton Hooker, G.C.S.I., F.R.S.; the Dalton medal to Dr. Edward Schunck, F.R.S.; and the Wilde premium for 1898 to Mr. John Butterworth. The Wilde lecture, "On the Physical Basis of Psychical Events," was afterwards delivered by Prof. Michael Foster.

THE British Association Committee of the Ethnographical Survey is desirous to obtain the services of qualified observers in numerous parts of the United Kingdom, for the purpose of inquiring into all or any of the following subjects: (1) physical types of the inhabitants; (2) current traditions and beliefs; (3) peculiarities of dialect; (4) monuments and other remains of ancient culture; (5) historical evidence as to continuity of race-

Communications should be addressed to Mr. E. Sidney Hartland, hon. sec. Ethnographical Survey Committee, British Association, Burlington House, W.

PROF. N. E. HANSEN, professor of horticulture at Brookings, South Dakota, who was sent to Eastern Europe and Asia to secure new seeds and plants for the Agricultural Department of the United States, is (says *Science*) now preparing his report for publication, after an extended trip through Eastern Russia, Trans-Caucasia, Russian Turkestan, Western China, and Siberia. Many promising varieties were obtained, and about three car-loads of seed will be distributed to State experiment stations. These seeds, it is expected, will be chiefly of value in the arid regions, the purpose of Prof. Hansen's trip being to obtain such as were distinguished for resistance to drought and heat.

THE following are among the lecture arrangements at the Royal Institution after Easter:—The Right Hon. Lord Rayleigh, F.R.S., three lectures on natural philosophy; Dr. E. E. Klein, two lectures on modern methods and their achievements in bacteriology; Mr. J. A. Thomson, two lectures on the biology of Spring. The Friday evening meetings of the members will be resumed on April 22, when Mr. W. H. M. Christie, C.B., the Astronomer Royal, will deliver a discourse on the recent eclipse; succeeding discourses will probably be given by Prof. A. Gray, Mr. E. A. Minchin, Prof. W. A. Tilden, the Right Hon. D. H. Madden, Lieut.-General the Hon. Sir A. Clarke, Prof. W. M. Flinders Petrie, the Right Hon. Lord Rayleigh, and other gentlemen.

Science announces that Prof. W. A. Rogers died at Waterville, Maine, on March 1, aged sixty-one years. He was assistant professor of astronomy in the observatory of Harvard University from 1875 until 1886, when he accepted a call to the professorship of physics and astronomy at Colby University. He had expected to enter on a professorship at Alfred University, N.Y., on April 1. Prof. Rogers was a member of the United States National Academy, and a past vice-president of the American Association for the Advancement of Science. He made important contributions to astronomy and physics, especially to the technique of measurement.

STORMS of more than ordinary severity were experienced on our coasts last week, and were accompanied by a good deal of snow in many districts. A cyclonic disturbance, which arrived from the Atlantic on March 23, crossed the northern portion of Scotland, travelling in a south-easterly direction; and, after continuing its course down the east coast of England, the central area of the disturbance crossed the North Sea, and eventually passed over Germany. Owing to the prevalence of anticyclonic conditions over Scandinavia, the track followed by the storm was somewhat unusual, and its progress was very slow, while the area of high barometric pressure advancing in the rear of the disturbance gained additional energy. It was particularly to this last feature that the storm owed its chief violence; the gales experienced from the 23rd to the 27th belonged to the rear segment of the storm-area, and were wholly from the north and north-east. They have proved very disastrous on our coasts, and have also wrought considerable damage over the inland parts of the country. The general characteristics of the disturbance, both in its cause and effect, closely resembled those of the storm which occurred at the end of last November.

THE report of the Council of the Scottish Geographical Society was presented at a general meeting held on March 23. After referring to the general reports of the meteorological stations, the Council state that, as intimated in the last report, the observations at the intermediate station on Ben Nevis, at a height of 2322 feet, were resumed last summer. The observations form a very complete series, thanks to the great enthusiasm and self-denial of the observers, Mr. T. S. Muir and Mr. A. Drysdale, aided by several valuable self-recording instruments. From the varying cyclonic and anticyclonic types of weather which prevailed during the ten weeks of observation—July 19 to end of September 1897—the Society is now in possession of simultaneous hourly observations from the three observatories on Ben Nevis, which are really the indispensable data in investigating the problems relating to the vertical gradients of the temperature, pressure, and humidity of the atmosphere and its movements. The work of making daily maps showing the rainfall at 120 stations well distributed over Scotland is in progress; and to these are being added the figures showing the hours of the occurrence of fog at the Scottish lighthouses. The large series of maps, in illustration of the mean monthly and annual atmospheric pressure and temperature of the British Islands, is well in hand. The maps of isothermals are finished, and the maps of isobars will be on the stone in a few days, and no time will be lost in issuing the number to members. The Council announced a Diamond Jubilee donation of 100*l.* from one of the members, of which 50*l.* is for discussion of separate parts of the work of the Ben Nevis observatories, and 50*l.* in furtherance of the Society's work. It was also announced that the late Hon. Ralph Abercromby bequeathed a legacy of 100*l.* to the Society.

Das Wetter of February reproduces a lecture, recently delivered by Dr. G. Hellmann, on the interesting question of mild winters. The facts are based upon the temperature observations at Berlin, for which place observations are available since the early part of the previous century, and the subject is divided into three parts: (1) the frequency and succession of mild winters, (2) their general character, and (3) what kind of summer weather may be expected after a mild winter. For the purpose of this investigation, the author defines a mild winter as one in which the mean temperature of December and January is above the average, and in which the sum of the deviations in both months amounts at least to 2° C. A table giving the monthly deviations for November to August shows that since 1720 there have been forty-eight mild winters in Berlin, that they are never isolated, but occur in groups of two or three years, and especially after a long period of colder winters. The intervals between two groups of mild winters vary from nine to fourteen years. With regard to the character of mild winters, the table shows clearly that they are usually of long duration. The chances are 79 to 21 that after a mild winter, February will also have a high mean temperature. Another characteristic of mild winters is that the greatest deviations of temperature usually occur in January. Whether a mild winter will be damp or dry depends chiefly upon the distribution of atmospheric pressure; the present winter is of the mild and dry type. The general distribution of pressure between December 5, 1897, and January 29 last, is illustrated by weekly charts. With respect to the influence of mild winters upon the subsequent weather, and especially of the summer, if July and August be taken together as representing the summer, it is found that the chances are 44 per cent. that a warm summer will follow a moderately mild winter; while after a very mild winter, the chances of a warm summer amount to 68 per cent. The cases of mild *dry* winters, such as the present, are rare; if the deficient rainfall is not compensated during spring time the summer is likely to be wet, and consequently cool.

THE *British Medical Journal* for March 19 contains an important paper by Dr. Luigi Sambon, on the "Etiology of Sunstroke." Dr. Sambon adopts what at first appears a somewhat startling theory, namely, that sunstroke is not due to excessive heat or exposure to the sun, but is

an infectious disease due to a specific organism. The author's case rests on three lines of argument. He begins by showing that excessive heat does not produce the disease; stokers, oven-cleaners, miners, and iron-workers are exposed to temperatures higher than those of any known climate, without ever contracting the malady. The Assam tea-planters and the closely-shaven Chinese are constantly exposed to the hottest sun, and are equally exempt. Dr. Sambon next discusses the geographical distribution of the disease, and proves that the areas in which it is endemic are strictly defined. It is very common in the low-lying regions of the Eastern United States, between the Appalachians and the Atlantic; it is unknown in Europe; it extends along the Nile Valley, Red Sea, and Persian Gulf; it prevails in the Indo-Gangetic alluvial plain, but not on the adjacent Indian highlands. Another peculiar feature of the disease explicable on the infection theory is the occurrence of epidemics, which may decimate hospital wards and not affect men exposed to greater heat and sun. Dr. Sambon concludes that the distribution, etiology, morbid anatomy, and epidemic character of the disease together demonstrate its organic origin. The specific organism has not been detected, but the author believes it lives in the superficial layers of the soil, and is conveyed to the lungs or alimentary canal by dust.

A PRELIMINARY statement just issued by the Canadian Geological Survey, in advance of the detailed annual report, shows that the gold produced by the Dominion in 1897 amounted to a value of 1,238,000*l.* This means that the Canadian gold output increased by 122·6 per cent. in a single year. In 1896 gold only formed 12·30 per cent. of the total mineral produce of the country (reckoning by value), while coal and building material provided 31·94 per cent. and 15·72 per cent. respectively. In 1897 gold rose to the second place on the list, with a percentage of 21·50, coal and building material being credited with percentages of 25·31 and 12·50 respectively.

A SHIP model experiment tank is being built at Washington by the United States Navy, at a cost of about 100,000 dollars. From a description in the *New York Engineer*, we learn that the tank will be a concrete lined basin, surmounted by a brick building 500 feet long by 50 feet wide, the basin itself being 47 feet long by 43 feet wide by 14 feet deep. On each side of the basin, for its whole length, will be iron rails supporting the ends of a carriage spanning the basin, this carriage being propelled along the tank with the model and measuring dynamometer attached, the model being guided along while still floating freely in the water. The carriage, with all dependent on it, is driven along the tank by four electric motors, taking current from a wire by means of trolley poles. The degree of resistance encountered by the model in passing through the water, also the time taken and the distance traversed, are all recorded diagrammatically and by electrical means. Hydraulic brake cylinders on each side of the carriage provide for stopping the carriage when run at very high speeds. The models experimented with will be one-twentieth of the actual size of the vessels, the model for a 400-foot ship being thus 20 feet long. Tests will be made with models for merchant vessels as well as war-ships, and special experiments will be conducted as to the effects of propellers of different sizes and shapes, and the effects of the shape of the after-end of vessels upon the efficiency of the propeller.

MR. J. C. GOUDIE contributes the following interesting observations to the February number of the *Victorian Naturalist*, the journal and magazine of the Field Naturalists' Club of Victoria:—"A small species of ant, commonly distributed in the Mallee, has a curious habit of keeping in close confinement a rather large mealy aphis, which feeds on the stems of young eucalypts. Round and over these aphides the ants construct a domed covering of particles of bark, grass, &c., which serves the double purpose of imprisoning the aphides and excluding other ants. Some of these coverings appear to be entirely closed, while others have an opening left in the edge; this doorway is, however, constantly guarded by a pair of ants, which continually move about in the open space, and seem much impressed with the importance of the duty assigned to them. Each enclosure contains generally from three to a dozen aphides, and about the same number of ants. Upon making a breach in some of these structures, for the purpose of observation, I have noticed that many of the 'live stock' were immediately seized by the ants and forcibly removed to a place of safety. The ant under notice is about a quarter of an inch in length, and is of a uniform dark reddish-brown colour, and forms its ordinary habitation under logs, or in old rotten stumps, and sometimes in the ground. Several other species of ants are very assiduous in their attendance on the various aphides, Tetigonidæ, and coccids, but the above is the only kind I have noticed that uses such extraordinary means to secure a monopoly of the much-prized 'honey-dew.'"

THE *Journal* of the Society of Arts for March 4 contains the account of a lecture, by Captain Baden-Powell, on "Kites," in which the advantages and disadvantages of different forms and combinations of kites, as well as their various uses for lifting, traction, reconnoitring, and other practical purposes are fully discussed.

KOENIGS and Lie have proved that if the poles are taken of an arbitrary plane with respect to the conics of a Steiner's surface, their locus is another Steiner's surface. A new proof of this theorem is given by Prof. A. Brambilla, in the *Rendiconto* of the Naples Academy, who makes use of symbolic notation enabling him to introduce considerable symmetry into the equations.

SOME doubt has existed as to who was the first to discover the microscopic Foraminifera, and to apply the microscope to the investigation of rock-structure. From a communication by Prof. Giovanni Capellini to the *Rendiconto* of the Bologna Academy, it would appear that on March 3, 1711, a paper, entitled *De variis arenis*, was communicated to that Academy by Jacopo Bartolomeo Beccari, of Bologna, thus indicating that priority must be awarded to Beccari.

ACCORDING to the views communicated to the Bologna Academy by Prof. Federico Delpino, it would appear that the lesser celandine (*Ranunculus Ficaria*) of our English hedgerows is to be regarded as the dwarf form of a dimorphic plant, whose dimorphism is of the kind known as *gynodiœcism*. Prof. Delpino contends that the hermaphrodite form is the larger plant, so common on the Riviera, known as *Ficaria calthæfolia*, and that our *Ficaria ranunculoides*, Moench, is the smaller female form of the same species. This theory accounts for the facility with which the celandine is propagated agamically, and the sterility of its pollen.

A REPORT on the colour of water by M. Ad. Kemna, of the Antwerp Waterworks Company, has been recently reprinted from the *Bulletin de la Société belge de Géologie*, and is published by Polleunis and Ceuterick, of Brussels. In it the views of various writers, from Arago downwards, on the physical, chemical, and organic causes of the different colours of different waters, are summarised, M. Spring's theories being dealt with at considerable length. M. Kemna indicates the practical bearing of these investigations on the testing of water supplies of towns, and describes different methods of applying tests. Of these, the tests known as the Hazen tests, and due to Mr. Allen Hazen, of Massachusetts, find most favour with the author.

ATTENTION has several times been called in NATURE to the various optical illusions by which one of two equal straight lines can be made to look larger than the other by drawing them in particular positions, or a series of parallel lines can be made to look askew by drawing slanting lines across them. A very full and detailed account of these illusions is now given, by Herr Wilhelm Wundt, in a paper reprinted from the *Abhandlungen der k. Sächs. Gesellschaft der Wissenschaften*, and published by B. G. Teubner in Leipzig. The paper is illustrated by sixty-five woodcuts, showing all the principal and many less-known appearances of this class, and Herr Wundt discusses at considerable length the causes of these subjective phenomena, whose existence appears to have been first made known by J. Oppel in 1854.

SUNSHINE recorders and their indications are often regarded with suspicion by meteorologists; and not without cause, for it can hardly be claimed that any sunshine recorder in use is a satisfactory physical instrument. In the current number of the *Quarterly Journal* of the Royal Meteorological Society, Mr. R. H. Curtis reports the results of a comparison between the sunshine records obtained simultaneously from a Campbell-Stokes burning recorder, and from a Jordan photographic recorder. The comparison indicates that the Campbell-Stokes instrument gives records which can be measured with a fair degree of accuracy by different persons, and are not liable to as much uncertainty as the records of the Jordan instrument. Contrary to the belief of many observers the photographic records were not, upon the whole, in excess of the records obtained with the Campbell-Stokes instrument.

IN the *Free Museum of Science and Art* (Philadelphia) for December, Dr. Brinton draws attention to a discovery among the ancient marbles of the Louvre of an admirable representation of the wearing of the murmex. It is figure No. 68 in the Salle des Caryatides. The discovery, says Dr. Brinton, removes all doubt of the correctness of his identification of the so-called bow-puller with the murmex. The bow-puller is the name generally given to a bronze object found in museums. The "collections and publications" section of this very useful bulletin is exceedingly good, and we are tempted to hope that our own museums may some day call forth the interest that is evidently felt by Americans in theirs.

THE *Reliquary and Illustrated Archæologist* for January last is almost entirely anthropological in interest. Mr. Leader Scott's account of the Gallic necropolis in Italy, discovered by Conte Giampieri Carletti on a tract of land at the foot of an indentation of Mount Montefortino, near Arcevia, is particularly interesting; while the next three articles—on some old-fashioned contrivances in Lakeland, by Mr. Swainson Cowper, on the modern use of bone skates, by Mr. Henry Balfour, and on beer and labour tallies, by Mr. Edward Lovett—lead us to the domestic antiquities of our own country, which are all too frequently neglected. The dairy appliances described, *inter alia*, by Mr. Cowper are very interesting, and we hope he will go on to give us sufficient material to work out the evolution of farm implements.

THE *American Anthropologist* for November and December last contains a specially good article on the aborigines of Formosa and the Liu-kiu islands, by Mr. Albrecht Wirth. The aborigines who cling to the savage state are short of stature, the majority being under 5 feet 6 inches. They have broad faces with low brows, straight and high noses wide at the nostrils, and lips not so thick even as those of the Malays. The subject of trephining in Mexico is dealt with by Carl Lumholtz and A. Hrdlicka, who give some valuable additional notes upon this interesting subject. Mr. Lewis W. Gunckel analyses the deities of Mayan inscriptions, an obscure subject not perhaps of sufficient interest to attract much general attention.

THE Geologists' Association have arranged an Easter excursion to Bridport and Weymouth, under the direction of Prof. J. F. Blake, Mr. W. H. Hudleston, F.R.S., and Mr. S. S. Buckman. The party will leave Paddington Station on Thursday, April 7, and will return on Tuesday, April 12.

PROF. H. G. SEELEY, F.R.S., will begin the summer course of lecture-excursions with the London Geological Field Class on Saturday, April 23. The subject of the series will be "The Physical Geography and Geology of the Thames and its Tributaries." This is the thirteenth annual course. Mr. R. H. Bentley, 43 Gloucester Road, South Hornsey, N., is the hon. secretary to this class, which provides a systematic course of geological teaching in the open country.

THE Society for the Protection of Birds has issued Part ii. of the Educational Series of leaflets, edited by Mr. H. E. Dresser. Thirteen leaflets are bound up in this part, and each contains interesting notes on the appearance, characteristics and habits of British birds. The information will induce the reader to observe bird-life with a sympathetic eye, and will thus further the Society's objects.

THE second number of the *Science Abstracts*, issued under the direction of the Institution of Electrical Engineers and the Physical Society, has just been issued. Additions have been made to the list of journals from which papers are abstracted, and it is proposed to considerably enlarge the monthly parts as time goes on. The staff of abstractors is also being increased. The value of *Science Abstracts* to the physicist and the electrical engineer is very great, and no student of physical science who wishes to keep in touch with the world of investigation can afford to neglect so serviceable a publication.

WE have received *Natural History Transactions*, vol. xiii. part 2, published by the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, an institution which has recently completed its jubilee. The Society promotes an important museum, and detailed enumeration is given of the mammals, birds, and miscellaneous objects to the collections. Prof. G. S. Brady, F.R.S., has a long paper on the British species of Entomostraca belonging to Daphnia and other allied genera. A paper on the "Life History of Coal" seems to take up a great deal of valuable space, and suggests curtailment. There is much interesting information conveyed in the reports of the committees. Lord Armstrong has apparently been a munificent supporter of the Society. We are of opinion, though of course it may not fall in with local necessities, that much of the matter contained in this and similar publications might perhaps be condensed and printed in appendix form, so as to bring the papers and record of actual scientific progress more into prominence.—The *Proceedings* of the Bristol Naturalists' Society, vol. viii. part 2, has also reached us. There are several useful contributions in this nicely-printed publication, covering many branches of science. An interesting paper appears on the "Chemistry of Colliery Explosions," by Mr. Donald Stuart, which is supplemented by a plan of Timsbury Collieries, in Somersetshire, exhibiting the workings traversed by an explosion. Noticeable also is a paper, by Mr. S. S. Buckman and Mr. E. Wilson, on the "Geological Structure of the Upper Portion of Dundry Hill."

THE additions to the Zoological Society's Gardens during the past week include a Herring Gull (*Larus argentatus*), British, presented by Mrs. Hovell; three Bactrian Camels (*Camelus bactrianus*, ♀ ♀ ♀) from Central Asia, two Yaks (*Poephagus grunniens*, ♀ and juv.) from Tibet, a Beisa Antelope (*Oryx beisa*, ♂) from North-east Africa, a Burchell's Zebra (*Equus burchelli*, ♀) from South Africa, a Weka Rail (*Ocydromus australis*) from New Zealand, four Radiated Tortoises (*Testudo radiata*) from Madagascar, a Galapagan Tortoise (*Testudo galapagensis*) from the Galapagos Islands, deposited.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN APRIL 1898:—

April 3. Pallas 15′ south of o Eridani (mag. 4·1).
5–15. Mercury well visible in the evenings near Venus.
9. Juno (mag. 8·7) in opposition to the sun.
10. 13h. Mercury at greatest elongation (19° 23′ E.).
10. 14h. 38m. to 15h. 8m. A Ophiuchi (mag. 4·7) occulted by the moon.
10. Saturn. Outer minor axis of outer ring = 18″·14.
14. 5h. 51m. to 8h. 26m. Transit of Jupiter's Sat. III.
15. Venus. Illuminated portion of disc = 0·968.
15. Mars ,, ,, ,, = 0·953.
16. 9h. 4m. Minimum of β Persei (Algol).
18. Mercury and Venus in conjunction (Mercury 3° 20′ N.).
19–20. Meteoric shower from near α Lyra (radiant 270° + 32°).
21. 9h. 11m. to 11h. 49m. Transit of Jupiter's Sat. III.
21. 15h. Mercury in conjunction with moon (Mercury 2° 2′ S.).
27. 6h. 41m. to 7h. 44m. 79 Geminorum (mag. 6·5) occulted by moon.
28. 12h. 34m. to 15h. 15m. Transit of Jupiter's Sat. III.
29. 13h. 1m. to 13h. 15h. ξ Leonis (mag. 5·2) occulted by moon.

FAVOURABLE APPARITION OF MERCURY.—The most convenient period in 1898 for observing Mercury will be during the fortnight from April 5 to 18, when the planet will become visible about an hour after sunset above the W. by N. horizon. He will reach his greatest eastern elongation on the morning of April 11, and will set on several evenings at about this time, a little more than two hours after the sun. Fortunately, at this special period, the planet will be situated within a few degrees of Venus, and the latter will form a brilliant guide to the position of Mercury. On April 5 Mercury will be apparently 6 degrees above Venus, and on ensuing nights the interval decreases until on April 18 the two objects will be in conjunction, Mercury being about 3° 20′ N. of Venus. Mercury will then appear on the north-west side of Venus, but is likely to be much fainter than before elongation, as he rapidly loses brightness owing to the crescent-phase which his disc assumes. The following are the times of setting of the sun, Mercury and Venus, and the intervals at which Mercury sets after the sun:—

Date 1898.	Sun sets.	Mercury sets.	Venus sets.	Mercury sets after sun.
	h. m.	h. m.	h. m.	h. m.
April 5	6 38	8 28	7 45	1 50
6	6 40	8 33	7 48	1 53
7	6 41	8 37	7 51	1 56
8	6 43	8 42	7 54	1 59
9	6 44	8 46	7 58	2 2
10	6 45	8 48	8 1	2 3
11	6 46	8 49	8 4	2 3
12	6 48	8 51	8 7	2 3
13	6 50	8 52	8 10	2 2
14 ...	6 51	8 53	8 14	2 2
15	6 53	8 53	8 17	2 0
16	6 55	8 52	8 20	1 57
17	6 57	8 51	8 24	1 54
18	6 59	8 48	8 27	1 49

The conjunction of Mercury and Venus on April 18, at about 5h., does not appear to be mentioned in the *Nautical Almanac*.

COMET PERRINE.—Dr. F. Ristenpart has calculated the elements and ephemeris of this comet from the observations made on March 19, 21 and 22. These, as given in Circular No. 3 from Kiel, are as follows:—

Elements.

T = 1898 March 18·501. Berlin Mean Time.

ω = 48° 47′·1
Ω = 263 16·4 } 1898·0
i = 72 44·7
log q = 0·04316

Ephemeris for 12h. Berlin Mean Time.

1898.	α h. m. s.	δ ° ′	log Δ	Br.
March 31 ...	22 3 0	+28 24·8	0·2019	1·00
April 2 ...	11 30	30 22·0		
4 ...	20 14	32 16·4	0·2054	0·99
6 ...	29 12	34 7·8		
8 ...	22 38 24	+35 55·0	0·2110	0·89

We may mention that the elements calculated by Messrs. Hussey and Perrine are almost identical with those given above.

At the time of this comet's discovery its diameter was 2′, with a strong condensation, and a tail of length equal to 1°. It was then of the 7th magnitude.

TWO NEW VARIABLE STARS OF SHORT PERIOD.—Herren G. Müller and P. Kempf contribute some interesting data to the current number (No. 3483) of the *Astronomische Nachrichten*, relative to the two new variables of short period which were originally discovered during the series of zone observations for the second part of the Potsdam Photometric Durchmusterung. These two stars are BD + 20°·4200 and BD + 28°·3460, or, as they have been named, U Vulpeculæ and ST Cygni respectively.

The first of these stars, whose position for 1900 is R.A. 19h. 32m. 15s., declination + 20° 6′·6, has a period of nearly eight days, the light curve varying from mag. 6·9 or 7·0 at maximum to 7·6 at minimum; the epoch for the calculation of the maxima being 1897 October 2·47 Greenwich mean time. The light curve shows small secondary variations both in the ascending and descending portions, the rise to maximum and fall to minimum occupying equal intervals of time.

The second variable, whose position for 1900 is R.A. 19h. 40m. 49s., declination + 29° 1′·2, has a period of 3·844 days, the magnitudes at maximum and minimum being 6·6 and 7·4 respectively. The dates of maxima can be calculated from the epoch (maximum) 1897 October 4·66 Greenwich mean time + 3·844 E. In the case of this star the curves on either side maximum are not equal, but the rise to maximum comprises less time than the fall to minimum. The former occupies only 0·9 days, while the latter takes 2·9 days. The curve is described as similar to δ Cephei. The observations suggest that on the downward side of the curve, 1·75 days after the maximum, the light becomes stationary for a short period of time, afterwards decreasing to the next minimum.

VARIABLES AND THEIR COMPARISON STARS.—Variable star observers may be glad to know that Prof. E. C. Pickering is able to furnish the photometric magnitudes of a great many comparison stars for long-period variables, and that he will communicate the information in advance of publication should any one require it (*Harvard College Observatory Circular*, No. 27). Sequences of comparison stars have been selected for about one hundred variables, stars brighter than the tenth magnitude having been measured on at least three nights with the meridian photometer, and those from the eleventh to the thirteenth magnitude on two nights with the photometer having achromatic prisms. Observations are already completed for the following stars:—T Andromedæ, T Cassiopeiæ, R Andromedæ, S Ceti, S Cassiopeiæ, R Piscium, R Arietis, T Persei, o Ceti, S Persei, R Ceti, U Ceti, R Tauri, S Tauri, R Aurigæ, U Orionis, R Lyncis, R Geminorum, S Canis Minoris, R Cancri, S Hydræ, T Hydræ, R Ursæ Majoris, X Virginis, R Comæ, T Virginis, Y Virginis, T Ursæ Majoris, R Virginis, S Ursæ Majoris, U Virginis, R Hydræ, S Böotis, R Camelopardali, U Herculis, W Herculis, R Ursæ Minoris, R Draconis, χ Cygni, S Cygni, R Delphini, U Cygni, V Cygni, T Aquarii, T Cephei, S Cephei, SS Cygni, S Aquarii, R Pegasi, S Pegasi, R Aquarii, and R Cassiopeiæ.

Prof. Pickering adds that the brightness of each of these variables is being determined monthly by Argelander's method, and it would be a good thing if other observers would reduce their observations to the same scale of magnitudes, as then the desired uniformity in results would be obtained.

The variability of the star in Aquila, R.A. 19h. 33·3m., Decl. + 11° 29′ (1900), announced recently by the Rev. T. D. Anderson, has been corroborated by an examination of the Harvard photographs. Measures of fifty-seven negatives gave the maximum brightness 9·2, and minimum less than 12·9. The variations can be closely represented by the formula J.D. 2411550 + 330 E.

CONCAVE GRATINGS FOR STELLAR PHOTOGRAPHY.—Some experiments have been carried on quite recently at the Johns Hopkins University to investigate the value of the use of concave gratings for stellar spectroscopy, and the results obtained bid fair for further trials (*Astrophysical Journal*, vol. vii. No. 3, March). The methods originally suggested by Prof. Rowland have been developed; Dr. Poor has derived the formulæ, and directed the construction of the apparatus, while Mr. Alfred Mitchell has made the experiments and photographs. The method finally adopted was the direct one, the grating being the objective and spectroscope combined; the light from the star was thus reflected directly from the grating to the photographic plate. The best position for general work was found to be that in which the centre of the photographic plate falls on the axis of the grating. From the simplified general equation

$$r = \frac{\rho}{1 + \cos \nu}$$

in which ρ is the radius of curvature of the grating, R and v the spherical coordinates of the light source, and r and μ those of the curve on which the spectra are brought to a focus (R being ∞ and $\mu = 0$), it was found that those parts of the spectra where cos μ could be assumed equal to unity, were brought to a focus on a circle whose radius is given by the above equation. The equation really represents a parabola, but within certain limits the spectrum may be considered normal. For a grating of medium dispersion, the entire spectrum will be practically normal; but with one giving larger dispersion, as a Rowland 21-foot, the scales of the middle and end differ by one and one-half parts in a thousand at a distance of 3° from the axis. It is necessary, therefore, that parabolic curved photographic plates must be used, but within certain limits they may be circular. In the experiments a small Rowland concave grating, of 15,000 lines to the inch, radius of curvature one metre, and ruled surface 1 × 2 inches, was employed, the photographic plates being bent to the proper radius. The spectra of Sirius, Capella, and Rigel obtained were 5 cm. long, and from 0·1 mm. to 1·5 mm. broad, and showed many lines.

Thus with an exposure of forty minutes, the spectrum of Sirius showed "16 hydrogen, H and K lines, and 15 other distinct fine lines." Capella, with forty minutes' exposure, gave F.G.h.H.K., and about fifty fine lines. It may be mentioned that these experiments were made on the fifth floor of the Physical Laboratory, "subject to the jar of street-cars and city traffic, as well as to dust and to the glare of electric lights," so that the results were not obtained under the *best* conditions.

A CATALOGUE OF 636 STARS.—No. 4 of the *Mittheilungen der Hamburger Sternwarte* contains a catalogue of stars observed by Herr W. Luther in the years 1885–92 with the meridian circle of the Hamburg Observatory. The observations in R.A. were made after the eye and ear method: those for declination by bringing the stars between two horizontal wires. The positions have all been reduced to the year 1885, and a comparison is made with the catalogue of the Astronomische Gesellschaft Zonen.

THE PREPARATION OF MARINE ANIMALS AND PLANTS AS TRANSPARENT LANTERN-SLIDES.

AT the request of the editor of NATURE, I give an abridged account of my essay in the volume of original researches published to commemorate the establishment of the Sheffield University College by Royal Charter in 1897. I shall confine myself mainly to the animals shown in the reproductions from four of the series of photographs taken by Mr. J. E. Atkinson, of our College, from some of my slides. Though on the whole these reproductions show the general facts fairly well, much of the minute detail is unavoidably lost, which is quite distinct when the mounted animals or photographs are somewhat magnified.

It is about eleven years ago that I first attempted to prepare lantern-slides with marine animals. At first I did not mount them in balsam, but very soon found that this is in almost every case not only desirable but even essential, since they so readily become mouldy, sometimes are attacked by mites, and are often far too opaque. Some also scale off from the glass and break to pieces, unless mounted. The success of the preparations depends almost as much on the proper mounting with balsam as on anything else, and sometimes the only way to get excellent results is to mount several, and pick out the best, which perhaps cannot be known until the specimens are finally mounted in balsam.

The methods necessary in mounting vary greatly in the case of different animals. Often little else is wanted than to arrange them properly on a lantern-glass, so that they touch it more or less completely all over their under surface, and then to drain and dry them. Many readily adhere round the drying edges, before the central parts are dry; and being thus fixed, they do not shrink laterally on further drying, but merely become thinner. On finally drying completely they may partially scale off, and it may be desirable to gum them down in one or more places, lest they should become loose when mounted in the balsam. There are a few animals that will not adhere at all to the glass, and yet shrink greatly. This circumstance has so far prevented me from making satisfactory slides of *Actiniæ*. I have succeeded with every other group.

Few animals are more easy to prepare than small flat fish like soles and dabs, 2 or 2½ inches long. These are killed by putting them into dilute alcohol, and arranged on the glass as soon as dead, whilst still limp. The chief matter is to arrange out the fins neatly. These soon dry, and adhere well; but in order that the side near the glass may keep flat, it is desirable on further drying to adopt a plan which I find most useful in many other cases. Very few, if any, animals will adhere in an objectionable manner to thin paper soaked with bees-wax, and, having laid such over the animal, pressure can be applied. What is wanted is that this pressure should be fairly uniform, and not merely on the thick parts. This is easily done by having a stout lantern-glass covered by two or three thicknesses

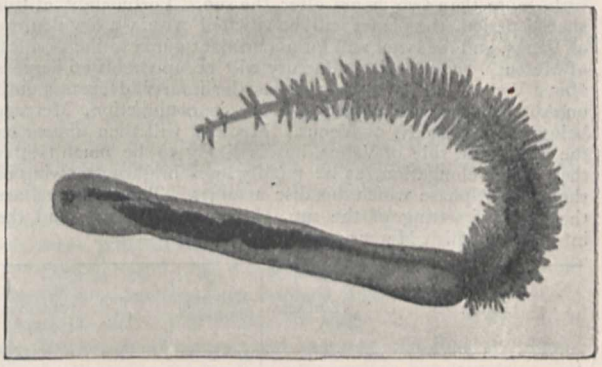

FIG. 1.—*Priapulus* in natural state.

of fine thin flannel, which is pressed down by a smaller or larger weight, so regulated as not to crush or distort the animal, but rather to retain as much as possible the natural shape and show the internal structure. The animal then dries through this flannel, and at the same time keeps sufficiently flat on the glass. Finally, any specially high parts can be pressed down by using a flat glass without flannel and a heavier weight.

A considerable variety of marine worms can be made into most excellent transparent slides, showing not only their general shape and colour, but also much of their internal structure. *Sabella* may be named as a specially good example. Such animals should be killed by keeping them for a short time in dilute alcohol. The aim should be to dry them before partial decomposition sets in and destroys the small blood-vessels. If all goes on well it is possible to dry and permanently preserve such worms as *Nereis*, so as to show not only the chief blood-vessels but even the smallest branches, and the blood may retain its red colour for years without any apparent change.

As an example of an animal mounted without staining, I give in Fig. 1 a reproduction from *Priapulus*. It should be killed by putting it into fresh water, and left in it so long that the body just begins to get limp. It can then be easily arranged on the glass, and adheres fairly well without lateral contraction. If mounted at once or previously kept in alcohol the body is too hard and will not adhere to the glass, and on drying contracts so much laterally as to become very unlike the living animal. The internal anatomy and general structure are best seen by cutting the animal open from end to end, and staining the whole with Beale's carmine or Kleinberg's hæmatoxylin. When thus

prepared, the muscular structure of the body-wall and the general internal anatomy are seen to great perfection.

I have not yet succeeded in preparing specimens of *Arenicola* when in their natural condition, so as to show their internal structure well, but have made some most excellent preparations by carefully cutting the animal open from end to end, spreading it out on the glass, and displacing the intestine and its appendages so as to be quite clear of the body, but yet to show the numerous blood-vessels passing to the lateral branchiæ from the main trunks along the intestine, which, however, are imperfectly seen in Fig. 2, which I give as an illustration of what may be done by partial dissection. Of their kind no preparations could be more satisfactory than some thus made, since the general anatomy is seen to great perfection, and the colour of the blood has remained unchanged for years, though in other cases, from some unexplained cause, it quickly turned brown.

It was the desire to preserve some of the beautiful Nudibranchs that led me to mount animals on slides. The lovely purple *Æolis* quickly loses its colour in alcohol. It should be killed in dilute alcohol, but kept in it a very short time, and then arranged on the glass and nearly dried. A strong solution of gum should then be placed over it, and the whole kept damp over diluted alcohol, to enable the gum to soak well into the animal, so as to protect the pigment from the balsam, in which it is soluble. I have specimens which have been mounted for more than seven years without showing any further change than the loss of a bluish tint, which occurs almost at once.

Most excellent transparent slides may be made with the so-called spider crabs, and these sometimes show well the

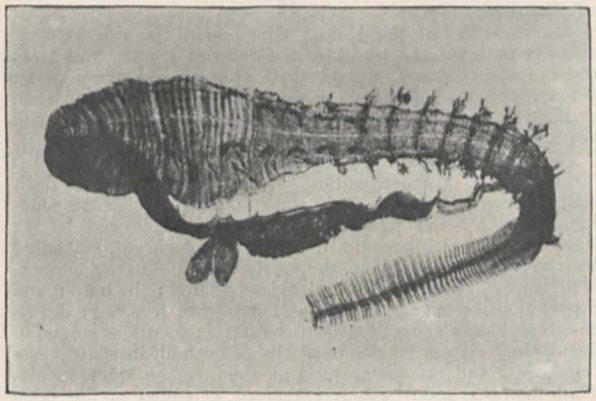

FIG. 2.—*Arenicola* partly dissected.

manner in which they are covered with a growth of sertularians, sponges, ascidians, &c. The animal is properly arranged on the glass, and at first gentle, and afterwards stronger, pressure applied, using waxed paper and glass covered with flannel; by which means the whole may be pressed flat without material distortion. The body and legs may indeed be made a little wider than natural, but this is to a great extent counteracted by lateral shrinking. At all events the general results are extremely good, and the muscles in the legs well seen.

Various species of Mollusca can be prepared so as to show their general anatomy by dissolving away the shell with hydrochloric acid in diluted alcohol. The organic matter of the shell retains the natural form, and shows the attachment of the various parts of the animal, which may be stained or not according to circumstances. Judging from what I have done, it will be possible to prepare instructive slides from the shells alone of some species, by dissolving away the carbonate of lime and mounting the membranous residue, which retains the natural form and much of the colour.

When first I attempted to mount Medusæ as lantern-slides, I looked upon them as most unpromising, and never imagined that it would be possible to prepare such specimens as I now possess. The first step must be to dissolve out all the included salt. For some years I used to put the newly caught specimens of *Aurelia* into methylic alcohol, diluted with half its bulk of fresh water, and after leaving them in for some hours, with occasional movement so as to prevent adhesion to the glass, they were digested over and over again with fresh diluted alcohol. Specimens so prepared are so colourless and transparent that little of the general structure can be seen, but if kept many months in alcohol they turn somewhat brown-yellow and show their structure moderately well. On the whole it is, however, better to stain them. I have experimented with a great variety of colouring-matters, but find that the best are tincture of madder, Beale's carmine, methylene-blue, port wine, and tincture of galls. The canal-system and the general structure are well seen when Beale's carmine is used, but the colour is unnaturally bright, whereas the colour of madder is more in harmony with nature. Methylene-blue gives good results with fresh specimens, but does not stain those which have been kept long in alcohol.

Though I have many splendid specimens prepared as described, my last year's experience shows that, at all events for some Medusæ, a 4 per cent. solution of formic aldehyde is far better than alcohol. Into this the newly-caught animals were at once put, and it was subsequently used to dissolve out the salt. The superiority of this over alcohol is that Medusæ retain their form almost unaltered, and the most delicate parts can be moved about and arranged without fear of tearing. The only serious objection is that the very delicate fringe of *Aurelia* may be too rigid to be properly extended. No such objection exists in the case of *Cyanæa* or *Chrysaora*; and *Cyanæa* may be stained so as to be of nearly the natural colour, which is otherwise lost. In Fig. 3, I give an illustration of an *Aurelia* stained with carmine when in a 4 per cent. solution of formalin to which a little sulphurous acid was added.

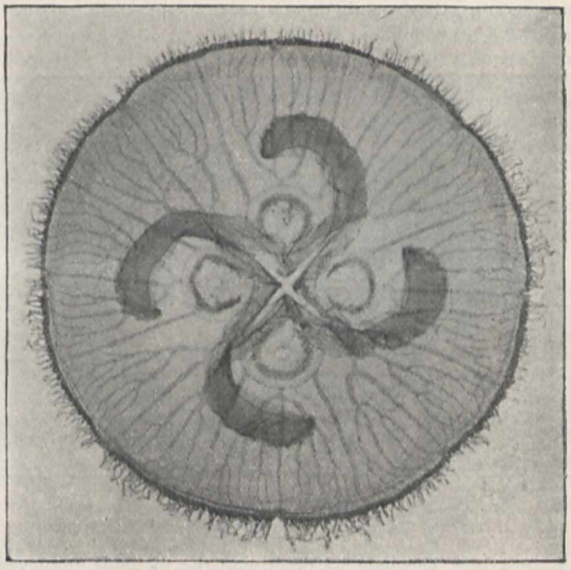

FIG. 3.—*Aurelia* stained with carmine.

In mounting Medusæ some special methods are necessary. Having removed the salt and stained the specimen as thought desirable, the lantern-slide glass is put into one of the usual developing dishes, and the animal floated out, and to some extent properly arranged, when under the liquid. The specimen may then be half an inch thick in the centre. No attempt should be made to dry it at once, since the greater part of the included liquid usually diffuses out, and nearly the whole can be drained off by keeping the slide inclined and covered up so as not to dry. In some cases the liquid passes off badly, but comes off rapidly, if a solution of gum is spread over the animal. As the edge dries, it should be covered with a strong clear solution of gum to which a little glycerine has been added to make it less brittle when dry, and this process continued until the whole specimen has been covered with gum. It should then be kept for some days in a wet state, so that the gum may soak well in, and any small bubbles not easily removed mechanically may disappear by absorption. At first I used to keep the specimens in a developing dish over a little water, covered up with a closely-fitting plate of glass, but sometimes in the course of a single day they became coated with a long growth of mould.

If, however, instead of water they are kept over alcohol diluted with an equal volume of water, they may remain wet for weeks, without any such growth of mould or such alteration in the gum as is produced by the action of stronger alcohol. It is very desirable not to finally dry too quickly, but, as it were, to anneal the specimens; since contraction may give rise to sufficient tension to cause them to crack and scale off from the glass.

I must now consider cases in which it is desirable to get rid of part of the colouring-matter, either natural or developed on keeping. Diluted sulphurous acid is very useful for this purpose, and remarkable results can be obtained with small fishes. If plaice about 2¼ inches long are kept in alcohol and then for a few weeks in diluted sulphurous acid, the earthy matter of the bones is dissolved out and only cartilage left; the general colour is reduced, and the thickness diminished; but strange to say, the arteries and enclosed blood are so little altered that when the specimens are mounted the aorta and branching arteries are well seen over the whole animal, as shown in Fig. 4, which, however, fails to show the more minute arteries, quite visible in the original.

Having duly prepared the dried animals, it may not be convenient to mount them at once in Canada balsam, especially when living on a yacht. They may then be kept in tin boxes with flannel which has been well dried at a fire, so as to absorb any moisture that may be in the air. When thus kept, even for many months, they usually do not undergo any sensible changes and do not go mouldy.

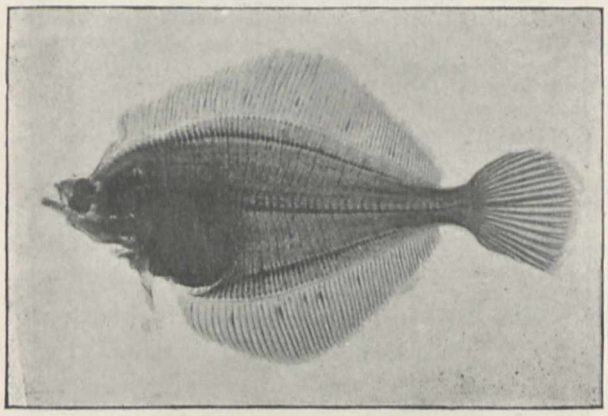

FIG. 4.—Plaice treated with sulphurous acid.

I must now conclude by describing the methods employed when finally mounting the specimens in Canada balsam. At the four corners of the glass should be gummed small pieces of blackened cardboard, of such a thickness that the cover-glass will just clear the object and not rock. The glass with the animal should be kept for a short or longer time in benzole; and, in the meanwhile, the cover-glass should be warmed on a suitable stand over a small burner, and a fair quantity of liquid balsam placed in the centre. The glass with the animal is then taken out of the benzole, and carefully placed over the balsam, so as to catch up as few bubbles as possible, the benzole causing the greater part to burst and disappear. If too little balsam has been used, more is easily run in between the glasses; and if only a few bubbles have been caught up, they soon disappear. If there are more than desirable, they can be got rid of by keeping the slide slightly inclined until they rise to one edge and can be removed. After keeping cold for a few days, for the balsam to harden the edges, it should be bound round with thin paper of the best quality, made thoroughly wet with gum. When this dries, contraction may squeeze out some superfluous balsam. This paper should then be varnished, and finally strips of good black paper should be *glued* well round the whole. All possible care should be used to enclose the balsam thoroughly, so as to avoid its turning yellow, and to prevent leakage, when the slide becomes warm in the lantern.

I have, however, had scarcely any trouble from this cause, since I have so completely fastened it in that the glasses or binding yield sufficiently. I may also say that though many of my slides have now been made for more than seven years, I have not observed any deterioration, but, on the contrary, many have greatly improved owing to the balsam having more completely penetrated into the tissues, and the included air disappeared. When this has taken place, the specimens are far more transparent and show their structure far better than the living or dead animals. Nearly all my slides have been kept in the dark, but some have been kept about the same time in a strong light at the Sheffield Public Museum, Weston Park, and, as far as can be judged, have not faded, even when imperfectly mounted.

H. C. SORBY.

OUR MINERAL WEALTH.

IT would be difficult to conceive of a more concise and clearly expounded compilation of statistics and general information regarding mines and mining than that presented in the Third Annual Report upon the Mineral Industry of the United Kingdom of Great Britain and Ireland, which has been issued by the Home Office in the form of a Blue Book for the year 1896. The volume before us is a synoptical review of the condition of our own mineral industry, as well as that of other countries, which reflects unbounded credit upon its author, Dr. Le Neve Foster, and those who have assisted him in the work. It is divided into six parts, under the respective titles of persons employed, output, accidents, prosecutions, general remarks, and mineral statistics of the Colonies and foreign countries. It contains, in addition, nineteen appendices, and concludes with an exhaustive index.

The statistics for the United Kingdom distinguish between mines or underground workings and quarries or open workings; and the same figures are marshalled again and again under different aspects, so as to show their varying significance when coalfield is compared with coalfield, inspection district with inspection district, and county with county.

The first four parts include sixty-nine tables, in which the various classes of information susceptible of being so dealt with are compared with each other and with the corresponding figures for the year 1895. These are followed by six diagrams, on which are shown by means of curves, extending from 1851 to 1896 inclusive, the yearly variations in the numbers of persons employed above and below ground; the output and export of coal; output, export, and import of iron ore; deaths due to accidents generally; deaths from accidents, arranged in five distinct classes (explosions, falls of ground, in shafts, miscellaneous, and on surface); and the average quinquennial death-rate per 1000 persons employed, classified in the same way as in the last case. In Part iii. short descriptions are given of the circumstances under which the most important accidents of the year occurred; and throughout the volume many pertinent remarks are made, which serve to throw light upon the construction and meaning of the tables, point to the conclusions which they justify, and infer the lessons that are to be learnt from their perusal.

Turning now to a consideration of the subject-matter, we find that, taken altogether, there were 725,803 persons employed in or about mines during the year under review—576,325 working in the mines, and 194,478, including 5114 females, working on the surface. Of these numbers 678,690 were employed at 3260 coal mines, 16,819 at 136 iron mines, and 30,294 at 720 other mines. In addition to this there were 112,829 persons employed at 7758 quarries.

The quantity and value of the principal classes of minerals mined and quarried were as follows:—

Name of mineral.	Quantity.	Value at the mines or quarries.
	Tons.	£
Clays	11,341,782	1,442,069
Coal	195,361,260	57,190,147
Iron ore	13,700,764	3,150,424
Limestone ...	11,011,350	1,215,604
Sandstone ...	4,507,745	1,417,985
Slates and slabs ...	586,933	1,338,256

The total value of all the minerals worked in the kingdom was 69,088,366*l.*, from which it will be seen that the value of the coal alone was practically five-sixths of the whole amount.

The number of separate accidents in mines was 886, involving the loss of 1065 lives, of which 147 were the victims of four explosions of fire-damp or coal-dust. The number of separate accidents in quarries was 117, in which 124 lives were lost.

A comparative table showing the death-rates from mining and quarrying accidents in different countries per 1000 persons employed, brings out some remarkable facts. Taking the column which represents the total for underground and surface for the year 1896, or in the absence of the figures for 1896 those of 1895, we find the following rates for the coal mines in some of the principal coal-producing countries of the world :—

Belgium	1·14
France (1895)	1·19
German Empire	2·57
Russia (1894)	1·29
United Kingdom	1·48
United States (1895) :—	
Colorado	3·75
Illinois	1·94
Indiana	2·70
Indian Territory	1·64
Kentucky	1·02
Missouri	2·07
New Mexico	16·88
Ohio	2·11
Pennsylvania :—	
Anthracite	2·924
Bituminous	1·825
Utah	1·50

According to M. Louis Lacombe, who compared the death-rates from accidents in mines in quinquennial periods, the last of which was 1890 to 1895, the ratios are as follows :—

Russia 2·90, Belgium 2·38, England 2·18, France 1·37.

The death-rate from accidents to railway servants in the United Kingdom for the year 1896 is given as 1·01 per 1000. The category includes such classes as carmen 0·47, clerks 0·17, mechanics 0·33, and signalmen 0·55, whose occupations are not by any means dangerous. On the other hand, the death-rate amongst those who have to do with coupling and uncoupling and making up the trains is infinitely more serious, such as shunters 4·94, yardsmen, 3·27, guards and brakesmen of goods trains 3·03. The highest of these figures pales before those applicable to sailing ships, amongst which we find :—

British sailing ships (1896)	12·9
German ,, ,, (1893)	15·8

These figures prove conclusively that the miner's calling, when brought into comparison with some other kinds of employment, is not of such a dangerous nature as is generally supposed. As having a bearing upon this question, however, it may be stated that one of the most gratifying features of the report is the curve given on Plate 4, which shows the death-rate per 1000 persons employed underground in coal-mines to have been reduced from the appalling figure of 5·5 in 1851 to 1·62 in 1896. This result—upon the attainment of which the Home Office, the Inspectors of Mines, and the mining community generally may well be congratulated—is undoubtedly due to the efforts that have been made by means of legislation and inspection to remove the causes which formerly led to such a lamentable loss of life. The loss of 147 lives in four great explosions in the year 1896 is a black spot in the record which ought never to have been there. I am glad to observe that the year 1897 has been entirely free from anything of the same kind, and I feel confident that if the new regulations regarding the watering of dusty places, and the use of explosives are attended to, or enforced with unflinching severity, we shall have seen the very last of such affronts to humanity and common sense.

The fines imposed upon owners and managers of mines for contraventions of the Mines Acts amounted to the insignificant sum of 258*l.* 13*s.* 9*d.*, while the workmen for similar offences paid 459*l.* 6*s.* 8*d.*

The outputs of coal from a few of the principal coal-producing countries were as follows :—

			Metric tons.
1895	...	Austria, brown coal	18,389,147
		,, coal	9,722,679
1896	...	Belgium	21,252,370
1895	...	France, brown coal	437,000
		,, coal	26,109,893
1896	...	German Empire, brown coal ...	26,797,880
		,, ,, coal	85,639,861
1896	...	Great Britain	198,496,339
1895	...	Russia, anthracite	709,718
		,, coal	8,369,420
1895	...	United States, anthracite... ...	52,616,149
		,, ,, coal	122,577,246

From these figures, with which I propose to bring this short and necessarily fragmentary notice to a close, it will be seen that this country still heads the list; but the United States are quickly overtaking us, and will, no doubt, come into the first position in the course of the next few years.

W. GALLOWAY.

CALCIUM CARBIDE AND ACETYLENE.

AT the meeting of Institution of Civil Engineers on March 15, a paper on "Calcium Carbide and Acetylene" was read by Mr. Henry Fowler, and is here abstracted.

Acetylene was first isolated by E. Davy in 1837 from potassium carbide, a by-product of Sir H. Davy's method of manufacturing potassium. In the middle of the century Berthelot investigated its properties, and Wöhler produced it from calcium carbide. During the past few years it has assumed commercial importance owing to the development of the electric furnace, in which calcium carbide can be readily produced from lime and carbon. The furnaces used consist essentially of crucibles with carbon rods forming the positive electrode and a bottom plate lined with carbon for the negative. In the more recent furnaces these crucibles are mounted on small trollies so that they may be run out of the furnace when ready and a fresh one inserted without loss of time. The carbide formed is a hard, dense substance of reddish colour, unacted upon by most of the ordinary reagents. It is, however, rapidly decomposed by water into acetylene and lime, giving 5·9 cubic feet of acetylene, at a temperature of 60° F. and a pressure of 30 inches of mercury, per 1 lb. of carbide. As the power required theoretically to produce 1 lb. of calcium carbide in an electric furnace is more than 2 H.P. hours, its manufacture is at present restricted to localities where power is cheap, as for instance where water-power is available.

Acetylene is a colourless gas with an intensely penetrating odour, and is slightly soluble in water, and extremely so in some other fluids. It is endothermic, giving 407 calories per cubic foot, whereas theoretically its value is 336·5 calories. As an illuminant it gives the most brilliant light of all gases, 5 cubic feet per hour under suitable conditions giving 240 candle-power. For small consumptions, however, this value is not obtained, and ordinary burners after a short time became clogged with soot. The latter defect can be overcome by the use of an injector burner, which, however, requires a higher pressure. Various diluents have been suggested, but have not been tried on a practical scale. The flame has a high actinic value, and causes light colours to appear lighter, and dark colours darker than when exposed to sunlight. The gas, when inhaled, combines with the hæmoglobin and renders the blood incapable of taking up oxygen, and thus causing suffocation. It has, however, been shown that it is no more dangerous in this respect than coal gas.

Acetylene unites with copper, in the presence of moisture and ammonia, forming copper acetylide, and this when in a dry state is violently explosive. Silver is similarly acted upon.

Owing to the difficulty of obtaining the materials used in producing calcium carbide in a pure state, phosphoretted and sulphuretted hydrogen and ammonia are often found in the gas, and these should be removed by passing the gas through water and an acidified solution of a metallic salt. Nearly all proportions of air and acetylene are explosive, the gas itself being decomposed at 780° C. At higher pressures than 2 atmospheres, if this temperature is attained by a part of the gas, it is communicated throughout the whole mass and a violent explosion occurs, which causes the pressure to rise to eleven times the initial pressure; but owing to cooling by radiation, &c., this is not reached in practice. Acetylene can be readily liquefied, having a critical temperature of 37° C. and pressure of 68

atmospheres. The resulting liquid is very light and has a high coefficient of expansion. Although this is a convenient method of storing a large quantity of gas in small bulk, it is unsafe, because of the ease and violence with which it explodes. The gas is extremely soluble in acetone; it has been suggested that this property might be used for its storage, but it has been shown that acetylene does not, even when thus dissolved, lose all its explosive properties.

Numberless devices for generating acetylene have been invented; its application, however, is more dependent upon the cost than upon the apparatus used in the manufacture. With calcium carbide at 16*l.* per ton, it can compete with coal gas at 2*s.* 6*d.* per thousand cubic feet, when flat flames are used for the latter, and a light of not less than 30 candles is required. This renders the gas peculiarly suited for buildings in which coal gas is not obtainable. It has been used for lighting a station on the Great Southern and Western Railway of Ireland, and at the Salford Docks of the Manchester Ship Canal. In the latter case, special portable generators are used which can be carried to any part of the docks, and which may be placed on the quay side and the gas led away to lamps placed in the holds of vessels. Amongst many other uses suggested are the lighting of lighthouses, lightships, buoys, military signals, &c., as a standard of light, &c. The price prevents its use for gas-engine driving. This reason also prohibits its use as an enricher of coal gas, as with low percentages the increase is not above 1 candle-power for 1 per cent. of acetylene. With "blue" water-gas it is even less applicable, as more than 10 per cent is required before any illumination is obtained. Methane and nitrogen are claimed to carry the gas without affecting its illuminating power.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. R. T. GLAZEBROOK, F.R.S., has accepted the post of Principal of University College, Liverpool.

DR. H. W. M. TIMS has been appointed professor of zoology in Bedford College, in succession to Dr. Benham.

MR. AMOS R. ENO, the New York multi-millionaire, who died a few weeks ago, left 50,000 dollars to Amherst College.

MISS CATHERINE W. BRUCE, of New York, will give to the Yerkes Observatory, Chicago University, a photographic telescope of 10 inches aperture and 60 inches focal length.

THE bequest by Catherine M. Garcelon, of California, to Bowdoin College, Maine, amounting to several hundred thousand dollars, has been confirmed by the Supreme Court of the United States.

THE proposal to establish a chair of Anthropology and Anatomy, and also a chair of Physiology, in the University of St. Andrews, has been sanctioned by the University Court, and a scheme will be prepared.

THE proposal to create a special degree of Doctor of the University of Paris (as distinct from doctor of a particular faculty) has been approved by the Superior Council of Public Instruction, and will shortly be carried into effect.

AMONG the degrees conferred at the annual graduation ceremony of the University of St. Andrews on March 25, was the honorary degree of LL.D., upon Prof. G. B. Howes, F.R.S., and the degree of D.Sc. upon Mr. A. T. Masterman.

THE recent decision of the Government, abolishing building grants from Imperial funds to schools and institutions under the Department of Science and Art, has created dissatisfaction. A joint deputation of the County Councils Association, the Association of Municipal Corporations, and the Association of Technical Institutions waited upon Sir John Gorst at the Privy Council last week to point out the inconvenience caused by the withdrawal of the grants without previous notice; and Sir John Gorst promised to bring the views of the deputation before the President of the Council.

SCIENTIFIC SERIALS.

THE *Journal of Electricity*, published in San Francisco, contains accounts of several large schemes for the electrical transmission of power in California. In one of these the water furnishing the power required for lighting Blue Lakes City, and several neighbouring townships, is conducted from the Blue Lakes, situated near the summit of the Sierra Nevada Mountains; while another installation at Bakersfield derives its power from the Kern River canyon. The "Wild West" is certainly making great strides in the practical applications of electricity.

IN the current number of the *Physical Review*, Miss Isabelle Stone writes on the electric resistance of thin films; Mr. Edward B. Rosa describes a new form of electric curve-tracer; and Mr. C. H. Wind propounds a new theory of magneto-optic phenomena, the paper being a translation of one published by the Amsterdam Academy of Science.—Prof. C. Barus describes a method of obtaining pores or capillary canals of specified diameter; and Mr. C. P. Matthews discusses the methods of measuring mean horizontal candle-power of glow lamps, considering more especially the plan of rapidly whirling the lamp.

THE latest number of the *Mathematical Gazette*, published under the auspices of the Mathematical Association, contains papers by Mr. E. Budden, on the conic through any five points; by Prof. Lloyd Tanner, on a class of algebraic functions; and a notice, by Dr. F. S. Macaulay, of an article by Miss C. A. Scott on Cayley's theory of the absolute. The functions to which Prof. Tanner's paper refers are those which involve only the differences of their arguments, and to which the same *diaphoric* was given by Cayley; and the object of the note is to suggest that an elementary discussion of these functions would be a valuable addition to the usual school course in algebra.

Symons's Monthly Meteorological Magazine, March.—West of England snowstorm, February 21. The fall commenced, roughly speaking, about 5h. p.m., and lasted until noon on the 22nd. The heaviest storms occurred in Hants, Dorset, Devon and Somerset. The fall reached, or exceeded, 12 inches over the area contained between two lines, the northern one running about E.S.E. from Watchet, through Yeovil to Lymington, and the southern one from Portlock, through Tiverton to Bridport; say about sixty by twenty miles. The greatest depth, about 24 inches, occurred nearly centrally in this belt, between Milverton and Crewkerne.—Results of meteorological observations at Camden Square for forty years (for February). It is interesting to note the exceptional temperature and rainfall of last February in connection with the mean of 1858–97, at Camden Square (N.W. London): maximum temperature in 1898, 56°·2; minimum, 24°·3. Mean of all highest maxima of previous forty years, 55°·2; mean of all lowest minima, 24°·1. Rainfall in 1898, 1·08 inches; mean of forty years, 1·61 inches.

THE *Journal de Physique* for March contains papers on the following subjects:—On the magnetic torsion of iron and steel, by M. G. Moreau, in which the following laws are established: (1) at a point of a twisted wire outside the magnetic field the magnetic torsion is proportional to the torsion of the wire, to the square of the intensity of the field if the latter is weak, and independent of the diameter of the wire; (2) for points situated on different sides of the field the magnetic torsion has equal and opposite values if the ends of the wire are symmetrically placed with regard to the field; (3) along the length of the wire the torsion increases in proportion to the distance from the nearest end; it attains a maximum at the edge of the field, and vanishes at points inside the latter. The field in question is supposed to be a uniform field bounded by two parallel planes, beyond which the magnetic force vanishes.—M. Marage contributes a paper on ear-trumpets studied by the use of Koenig's flames.—M. G. Weiss describes an ingenious method, due to Hermann, of expanding any periodic curve in Fourier's series up to the first forty terms. The curve being drawn, forty equidistant ordinates are taken and measured, and corresponding to each ordinate a series of products is obtained from a table prepared by Hermann; and these are entered in columns on *quadrillé* paper. Finally a series of perforated cards are placed on the table thus formed; and to read off any coefficient in the expansion it is only necessary to algebraically sum the numbers seen through the openings in the corresponding card.—M. G. Charpy discusses entectic alloys, his paper being illustrated by figures showing their microscopic structure.—M. Gerrit Bakker, writing on perfect gases, gives a simple mathematical proof of the theorem that of the three characteristic laws of such gases, Boyle's, Charles's, and Joule's; any one is deducible from the other two.

SOCIETIES AND ACADEMIES

LONDON.

Physical Society, March 25.—Mr. Shelford Bidwell, President, in the chair.—Mr. A. A. Campbell Swinton read a paper and showed experiments upon the circulation of gaseous matter in a Crookes' tube. The stream-lines within a Crookes' tube are investigated by observing the direction and speed of rotation of a mica radiometer-mill, mounted on a sliding-rod, so that it can be moved along a line at right angles to the line joining the electrodes. The axis of the mill is at right angles to both these lines. If the mill is adjusted to a position between the flat plate and the cup electrodes, with its axis just sufficiently low to prevent equal and opposite simultaneous actions on the top and bottom vanes, it rotates always in the direction indicating a stream from kathode to anode. The speed is greater when the flat plate is the kathode. If, however, the mill is now moved below this line, a point is reached at which rotation ceases, and below this neutral point the rotation is suddenly reversed. Reversal is only to be observed with high degrees of exhaustion; the rotation is never so rapid here as in the first position. The mill rotates, and the reversal may be observed, whether cup or plate is made kathode, and the direction of rotation below the neutral point is always opposite to that in the position above it. A small Wimshurst machine is as effective as an induction coil in producing these effects. The experiments are intended to establish the existence, at high degrees of exhaustion, of a true anode-stream, *i.e.* a stream that travels from anode to kathode just in the same manner as the kathode-stream flows from kathode to anode. This anode-stream is charged positively; it is exterior to the kathode-stream; its velocity is less than that of the kathode-stream, but its velocity increases as the vacuum is improved. It seems probable that, in high vacua, some portion of the positive electricity passing through the tube, is carried by the positively charged atoms or particles that constitute the anode-stream. At lower degrees of exhaustion, the discharge passes through the tube chiefly by interchange of charges from molecule to molecule—a Grothüs chain. At very high vacua, however, when the mean free path is considerable, there may be to some extent a regular and complete circulation of positive and negative atoms, some of which pass from anode to kathode, and *vice versâ*, and deliver up their charges, not by interchange, but by direct convection, to the electrodes of opposite sign. Prof. Boys said he did not feel altogether convinced by the experiments, that the rotation of the mill was due to simple mechanical motion of the particles of matter between the electrodes. The weight of air left in the tube at such high degrees of exhaustion was extremely small; it was difficult to realise that its impact could produce the sudden mechanical effect observed at the moment of the reversal of the rotation of the mill. Mr. Wimshurst thought it important to keep in mind the existence of mercury-vapour in the tube. He also referred to some experiments in which a bar of metal was used to explore a focus-tube, by observation of the changes of luminosity produced in different positions. Dr. Chree said that if the rotations of the mill could be shown to indicate a velocity of the particles, of the same order as that observed in Crookes' experiments, it was safe to assume the existence of a similar cause. This might be important in deciding as to the general truth of the bombardment theory of Crookes. He asked whether the rotation had been investigated within the dark space around the kathode. Mr. Appleyard suggested that in tracing the cause of the rotation it would lead to simpler results if the vanes of the mill were made of some light conducting substance. Mica introduced difficulties owing to its retention of the charges. Prof. Boys pointed out that this could be done by gilding the mica. Mr. Campbell Swinton, in reply, said that the objection raised by Prof. Boys to the mechanical theory of the rotation would apply equally to the whole theory of electro-radiometry, including the case of the mill used originally by Crookes in the direct path of the kathode-stream. But it must be remembered that although the mass of matter present within the tube was very small, its velocity was proportionately great, it was of the order of 9000 kilometres per second; hence the contained matter might be conceived as capable of producing the observed acceleration, and Crookes' bombardment theory might with safety be adopted as a good working hypothesis. In the tubes used for these experiments, the exhaustion was carried so high that the negative dark space appeared to fill the whole tube. He had, so far, only tried mica for the vanes, but he thought it would be important to observe the result with a substance that did not retain the charges.—Mr. A. Stansfield then read a paper on thermo-electric pyrometers. In obtaining photographic records of the readings of thermo-electric pyrometers, the range of measurement is limited by the size of the photographic plate. For long ranges of temperature, the sensitiveness of the galvanometer must therefore be small. When it is desired to examine the temperature changes in detail—as, for instance, at the melting-points and freezing-points of metals—it is necessary to employ some device for giving a more open scale for the short temperature ranges that include those particular points. For this purpose two galvanometers are arranged in parallel, and so that they have their deflections recorded on the same photographic plate. The less sensitive galvanometer covers the entire range of temperature throughout an observation; the other is brought into use for magnifying special portions of the range. In this latter case, part of the electromotive force of the thermo-couple is compensated by an opposing electromotive force, applied at two points of the circuit, from a battery of Clark cells in series with a high resistance. The recording apparatus consists of a photographic plate mounted on a float that rises steadily when water is admitted into a cylinder. The source of light is a glow-lamp, enclosed in a wooden box. A brass tube, with a rectangular diaphragm at the end nearest the lamp, cuts off all light except that from a selected piece of vertical filament. Light from this filament is reflected by the plane galvanometer-mirror, and is focussed upon the photographic plate by a lens in front of the galvanometer; this method was suggested by Prof. Boys. The "cold" junctions of the thermo-couple are both inserted into a hypsometer. Very serious discrepancies exist between the indications of couples having nominally the same composition; they are too great to be attributed to accidental differences in the constitution of the alloys. Although with platinum alloys, coupled with platinum, 10 per cent. of iridium gives a more powerful couple than 10 per cent. of pure rhodium, the partial substitution of iridium for rhodium very considerably lowers its thermo-electric power. This result suggests that the change in the thermo-electric power of a metal depends upon the extent to which it is saturated with the alloying metal; thus 10 per cent. either of rhodium or iridium would, *per se*, more completely saturate the platinum than would 10 per cent. of a mixture of the two metals. The author discusses a series of curves derived from his experiments. He concludes that, thermo-electrically, there may be two classes of metals: (1) the ordinary metals, for which the curve representing the first differential of electromotive force with respect to temperature is a straight line, and (2) the platinum metals, together with a few, such as nickel and cobalt, for which the curve of this differential multiplied by the absolute temperature is a straight line. Dr. Chree discussed the curves, and asked how far stirring affected the results; he was inclined to think that stirring was a mistake. Mr. A. Campbell inquired whether the galvanometer kept its zero sufficiently well throughout the tests. Mr. Stansfield, in reply, said he had also come to the conclusion that stirring was a mistake; and it was a mistake to use a large quantity of metal. The pyrometers were sensitive to about a tenth of a Centigrade degree. He had experienced great difficulty with the zero of the galvanometer.—The President proposed votes of thanks to the authors, and the meeting adjourned until April 22.

Chemical Society, March 17.—Prof. Dewar, President, in the chair.—The following papers were read:—The reduction of bromic acid and the law of mass action, by Miss W. Judson and J. W. Walker. The reduction of bromic acid by hydrobromic acid constitutes a bimolecular reaction in presence of much sulphuric acid, and a tetramolecular reaction in absence of sulphuric acid.—The action of ferric chloride on the ethereal salts of ketone acids, by R. S. Morrell and J. M. Crofts. In dry ethereal solution, ferric chloride acts on ethylic ketophenylparaconate with production of a substance, $FeCl_2C_{13}H_{11}O_5$, which is decomposed by water yielding the basic ferric salt of ethylic phenylparaconate, $Fe(OH)(C_{13}H_{11}O_5)_2$; analogous results are obtained with the ethylic salt of the lactone of oxalcitric acid.—Note on the volatility of sulphur, by T. C. Porter. Sulphur sublimes rapidly at 100° in a vacuum.—Cannabinol, by T. B. Wood, W. T. N. Spivey and T. H. Easterfield. Cannabinol, the toxic resinous constituent of Indian hemp, boils at 400°, and its vapour density points to the molecular composition $C_{18}H_{24}O_2$;

it contains one hydroxyl-group, and is converted by prolonged boiling into a hydrocarbon of the composition $C_{10}H_{16}$.—Contributions to the chemistry of thorium, by B. Brauner. The author has investigated the properties of a new salt, ammonium thoroxalate, $Th(C_2O_4)_2$, $2(NH_4)_2C_2O_4$, $7H_2O$, and has obtained a simple method of purifying thorium compounds by aid of this salt; it is shown that the tendency to form complex oxalates amongst the rare earths is inversely proportional to the basicity of the earth.—On the atomic weight of thorium, by B. Brauner. From experiments made on ammonium thoroxalate, the author deduces the atomic weight of thorium as Th = 232·44, a result agreeing with the number obtained by Krüss and Nilson.—On the compound nature of cerium, by B. Brauner. From experiments on fractional crystallisation, the author concludes that cerium is associated with an element which possibly has the atomic weight of 110; another earth of lower atomic weight is perhaps present.—On praseodidymium and neodidymium, by B. Brauner. The author contributes a quantity of experimental data concerning praseodidymium and neodidymium, and considers that the eighth series of the periodic system may assume the form

Cs	Ba	La	Ce	Pr	Nd
133	137·4	138·2	139·7	141	143·6.

—Action of ammonia and substituted ammonias on acetylurethane, by G. Young and E. Clark. Ammonia and substituted ammonias react with acetylurethane principally in accordance with the equation

$$MeCO.NH.CO_2Et + NH_2R = MeCO.NH.CONHR + EtOH,$$

but secondary reactions occur under certain conditions.—Formation of oxytriazoles from semicarbazides, by G. Young and B. M. Stockwell. This paper describes the formation of oxytriazoles according to the equation

$$NHR.NH.CO.NH_2 + PhCHO + O = RPh.C_2N_3OH + 2H_2O,$$

in which R is an aromatic radicle.—Formation of $\alpha\alpha'$-dihydroxypyridine, by S. Ruhemann. $\alpha\alpha'$-Dihydroxypyridine hydrochloride is formed on boiling ethylic $\alpha\alpha'$-dihydroxydinicotinate with concentrated hydrochloric acid.—Position-isomerism and optical activity; the comparative rotatory powers of diethylic monobenzoyl and monotoluyl tartrates, by P. Frankland and J. McCrae.—The action of di-isocyanates upon amido-compounds, by H. L. Snape.—The action of alkyl iodides on silver malate and on silver lactate, by T. Purdie and G. D. Lander. The abnormally high optical activity of the ethereal malates and lactates prepared by the silver salt method is due to the simultaneous production of ethereal salts of alkyloxysuccinic and alkyloxypropionic acids respectively.—On the optical rotations of methyl and ethyl tartrates, by J. W. Rodger and J. S. S. Brame.

Anthropological Institute, March 8.—Mr. F. W. Rudler, President, in the chair.—The Hon. David W. Carnegie exhibited and described a large collection of objects of ethnological interest, which he had recently brought from Western Australia. He gave a description of the natives met with in his remarkable journey across the great sandy desert of the interior, between Coolgardie and Kimberley. Some of the men, notwithstanding the miserable character of their surroundings, were upwards of six feet in stature.—Mr. Robert Etheridge, curator of the Australian Museum at Sydney, sent for exhibition a large series of photographs of dilly baskets from North Australia. Many of these objects were highly ornate, and offered curious illustrations of aboriginal decorative art.—A paper on the folk-lore of the native Australians, by Mr. W. Dunlop, was read by Mr. T. V. Holmes. Most of the legends cited were taken down from the lips of the natives nearly half a century ago.

Entomological Society, March 16.—Mr. R. McLachlan, F.R.S., Vice-President and Treasurer, in the chair.—Mr. Champion exhibited specimens of *Acanthia inodora*, A. Dugès, from Guanajuato, Mexico. This insect, a congener with the common bed-bug, was found in fowl-houses, where it attacked poultry.—Mr. Wainwright exhibited a locust found alive in broccoli at Birmingham. The insect was identified by Mr. Burr as *Acridium ægyptium*.—Mr. Tutt showed a series of captured examples of *Calligenia miniata*, varying in colour and the amount of black markings, one example being a clear yellow and another orange.—The Secretary exhibited part of a series of holograph letters, &c., which he had discovered among old papers in the Society's library, including communications from Kirby, Spence, Darwin, Hope, Yarrell, and many other entomologists.—A paper by Mr. E. E. Green, of Punduluoya, Ceylon, entitled "Further notes on *Dyscritina*, Westwood," was read, and illustrated by specimens and drawings.—The author discovered two distinct species of *Dyscritina*, which he was able to keep in captivity, and rear from the early larval stage to that of the imago.—Dr. Chapman read a paper entitled "Some remarks on *Heterogyna penella*," giving a full account of its life-history.

MANCHESTER.

Literary and Philosophical Society, March 22.—Mr. J. Cosmo Melvill, President, in the chair.—The President read a description and exhibited two specimens of *Strombus* (*Conomurex*) *belutschiensis*, just discovered by Mr. F. W. Townsend off the Mekran coast of Beluchistan, having been dredged at seven fathoms on a sandy and muddy bottom. This is a remarkable find, as it is nearly fifty years since any new species of this genus has come to light. It is most akin to *S. mauritianus*, Lam., but differs in several marked particulars.—Prof. Hickson communicated a paper by Miss E. M. Pratt, entitled "Contributions to our knowledge of the Marine Fauna of the Falkland Islands." The Manchester Museum received last summer a number of marine animals collected on the shores of one of the Falkland Islands by Miss Blake. As they were nearly all in an excellent state of preservation, the author was able to identify them, and to compare this common shore fauna, as a whole, with that of other temperate regions in the northern and southern hemispheres. The bearing of the facts of the geographical distribution of the species identified by Miss Pratt, upon Murray's theory of the bipolar distribution of marine organisms, was also indicated.

DUBLIN.

Royal Dublin Society, February 16.—Sir Howard Grubb, F.R.S., in the chair.—Prof. J. Emerson Reynolds, F.R.S., and Mr. Emil A. Werner made a communication on Goodwin's system of generating and using acetylene gas for illuminating purposes.—Prof. D. J. Cunningham, F.R.S., described the seventh cranial nerve in the orang, with illustrations by lantern projection.—Dr. W. E. Adeney and Mr. James Carson described the method they have followed in mounting the 21·5 feet concave Rowland diffraction grating, which has recently been acquired by the Royal University, Dublin.

EDINBURGH.

Mathematical Society, March 11.—Dr. Morgan, Vice-President, in the chair.—The following papers were read: An analysis of all the inconclusive votes possible with fifteen electors and three candidates, and a suggestion for a shortened table of five-figure logarithms, by Prof. Steggall; note on the centre of gravity of a circular arc, by Mr. John Dougall; on the wave surface generalised for space of n dimensions, Prof. Schoute.

PARIS.

Academy of Sciences, March 21.—M. Wolf in the chair.—Algebraic solutions of some questions concerning the indeterminate equations of the second degree of three terms, by M. de Jonquières.—Action of some reagents upon carbon monoxide, in view of its estimation in the air of towns, by M. Armand Gautier. A study of the various absorbents proposed for the estimation of carbonic oxide. Of these cuprous chloride and potassium permanganate react also with acetylene and ethylene; chromic acid is only partial in its action. A one per cent. solution of gold chloride gives an immediate precipitate with the pure gas, even in the cold, and forms a good qualitative test for CO mixed with air.—Observations of the sun, made at the Observatory of Lyons with the Brunner equatorial, during the fourth quarter of 1897, by M. J. Guillaume. Statistics referring to spots and faculæ are given.—New series of photographs of the complete chromosphere of the sun, by M. H. Deslandres.—On the singular transformations of Abelian functions, by M. G. Humbert.—On discontinuous functions capable of development in series of continuous functions, by M. R. Baire.—On the transformation of the X-rays by matter, by M. G. Sagnac. A metal upon

which X-rays from a vacuum tube are falling emits secondary radiations differing in penetrative power from the original rays, and also differing according to the nature of the reflective substance. Thus aluminium gives off secondary rays which are much more penetrating than those of zinc.—Some applications of photographic irradiation, by M. Ch. Féry. On the hypothesis that the upper portion of the sensitive plate when illuminated by a ray acts as a true secondary source for neighbouring portions of the film, the conclusion is drawn that the apparent width of the line due to halation ought to grow in arithmetical progression when the quantities of light increase in geometrical progression, and this conclusion was verified completely by experiment.—Remarks on the preceding communication, by M. A. Cornu. This research throws light upon the divergences obtained in different observatories in the measurement of stellar magnitudes by photographic observations, although part of the observed variation is probably due to aberrations of the mirror.—On a universal magnifier for use in photographic enlargements, by M. J. Carpentier.—Determination of the density of gases with very small volumes, by M. Th. Schloesing, junr. A detailed description of the apparatus used for the determination of gaseous densities by the hydrostatic method, together with the results obtained for air, nitrogen, carbon dioxide and sulphur dioxide. The results are accurate to one part in a thousand.—On neodymium, by M. O. Boudouard. Neodymium forms a double sulphate with potassium, which is more soluble than the corresponding salt of praseodymium, the difference in solubility being sufficiently great to allow of a fairly rapid separation.—On the explosion of mixtures of marsh gas and air by the electric spark, by MM. H. Couriot and J. Meunier. To avoid explosion, it is necessary to join up the two points between which the spark is produced by a secondary conductor.—On the properties of the phosphorescent sulphide of strontium, by M. José Rodriguez Mourelo.—On the oxidation of some amido- and thio-amido-compounds, by M. Œchsner de Coninck. A study of the oxidation of acetamide, thio-urea, phenyl-urea, phenyl-thiourea, sarcosine, and carbamic ether by alkaline hypochlorite solution.—On the chlorine derivatives of phenyl carbonate, by M. E. Barral. By the action of chlorine in presence of iodine upon phenyl carbonate dissolved in carbon tetrachloride, the di-chlor-derivative, $CO(O.C_6H_4.Cl)_9$ is obtained.—On the cholesterins of the lower plants, by M. E. Gérard.—Study of the anatomy and histology of the rectum and rectal glands of the Orthoptera, by M. L. Bordas.—On the reserve material in *Ficaria ranunculoides*, by M. Leclerc du Sablon. Estimations of the reducing and non-reducing sugars, dextrin and starch in the tubers of *Ficaria* were made monthly, and the results expressed in curves.—The tectonic of the secondary and mountainous region comprised between the valleys of the Ouzom and Aspe (Basse-Pyrénées), by M. J. Seunes.—On the phyllogenic classification of the Lamellibranchs, by M. H. Douvillé.—On the visibility of the X-rays to certain young blind persons, by M. Foveau de Courmelles. Only nine out of two hundred subjects examined were able to distinguish when the Crookes' tube was or was not excited. No sensation was perceived by those totally blind, only those blind by a peripheral lesion, or having a vague perception of light, being sensitive to the X-rays.—Applications of radiography to the study of digital malformations, by MM. Albert Londe and Henry Meige.—Application of radiography to the study of a case of myxœdema; development of the osseous system under the influence of the thyroid treatment, by MM. Georges Gasne and Albert Londe.—Experimental paralysis under the influences of venoms, by MM. Charrin and Claude.—On the eruptions of Vesuvius, by M. E. Semmola.—Communication from the Directeur des Services de la Compagnie des Messageries Maritimes, concerning a Dugong captured in the Red Sea, of a species supposed to be extinct.

ST. LOUIS.

Academy of Science, February 21.—Dr. R. J. Terry exhibited a specimen of a cervical rib from a human subject, and discussed the occurrence of structural anomalies of this character.

March 7.—Prof. C. M. Woodward presented a paper embodying an analytical discussion of the efficiency of gearing under friction. Few works on applied mechanics, the speaker stated, give any discussion of the matter. Only spur wheels with epicycloidal and involute teeth were considered. For the sake of comparison, a table was produced giving the efficiency for different values of the coefficient of friction f, and for equal wheels and for the same number of teeth, 12, on each wheel.

Efficiency of Spur Wheels.

	Equal wheels with 12 teeth each.				
Kind ...	f 0·03	f 0·10	f 0·15	f 0·20	f 0·25
Epicycloidal	0·9915	0·9693	0·9514	0·9318	0·9103
Involute ...	0·9923	0·9746	0·9622	0·9501	0·9381

—Dr. Amand Ravold demonstrated the method, recently introduced by Hiss, of differentiating the typhoid bacillus from bacillus coli-communis, by the use of semi-solid acidulated media, in which, at blood temperature, the round colonies of the typhoid bacillus assume a peculiar fimbriated form of growth, because of the motility of the bacteria in the slightly yielding medium, which in most cases readily distinguishes them from the more whetstone-shaped colonies of the colon bacillus, which does not produce the peculiar fimbriation in plate cultures. In tube cultures in the same general medium, but prepared with a slighter acidity and somewhat less solidity, a uniform clouding of the entire tube, due to the swarming of the bacteria, was shown to be characteristic of the typhoid bacillus, while the colon bacillus was definitely confined to the immediate vicinity of the thrust. The media in both cases are made up without peptone. The formulæ are:—

For plate cultures.		For tube cultures.	
Agar ...	10 grams.	Agar ...	5 grams.
Gelatine ...	25 ,,	Gelatine ...	80 ,,
Beef extract	5 ,,	Beef extract	5 ,,
Glucose ...	10 ,,	Glucose ...	10 ,,
Salt ...	5 ,,	Salt ...	5 ,,
Normal acid	20 cc.	Normal acid	15 cc.
The whole increased to 1000 cc.		The whole increased to 1000 cc.	

The growth of the two species in question, on potato and in milk cultures with litmus, was also demonstrated.

AMSTERDAM.

Royal Academy of Sciences, February 26.—Prof. van de Sande Bakhuyzen in the chair.—Prof. Schoute, Necrology of Dr. F. J. van den Berg (1833-1892), Professor of Mathematics at the Polytechnic School of Delft (1864-1884).—Mr. Muller, correspondent of the Academy in the Dutch East Indies, made a communication on the triangulation of Sumatra. When, on the completion of the triangulation of the "Government of the West Coast of Sumatra," the triangulation of South Sumatra was to be commenced, the intention was to start from the triangulation points, determined in 1868 and 1869 in the Lampong districts by the staff of the then Geographical Service. On inquiry being made towards the end of 1895 into the condition of the pillars erected on those points, they were all found to have disappeared, so that the staff of the Triangulation Brigade of the Topographical Service, appointed to carry out the triangulation of Sumatra, had to effect a new connection across the Strait of Sunda. The Langeiland-G. Radja Bara side of the Sumatra chain was therefore connected by means of three triangles with two sides of the Java chain, viz. G. Karang-Batoo Hideung and G. Karang-G. Gede; by means of four triangles the same side was now connected with the point G. Dempoo in the Lampong districts, which had been selected for astronomical station for the orientation of the Sumatra triangulation. In 1896 the building of pillars was commenced, and in the course of 1897 the angular measurements at the nine stations, besides the determination of the latitude and azimuth at G. Dempoo were completed. The mean error of the result of the determination of the latitude of G. Dempoo is 0″·21, and that of the result of the determination of the azimuth 0″·27. The latitude of the point G. Karang, as calculated from the Sumatra chain, differs 6″·5 from that derived from the Java chain, which difference may partly be ascribed to local declination. The azimuths at that point differ 5″·3, which is probably to a great extent due to the accumulation of errors in connection with the great distance of the point Genook in Japara, which served as starting-point for the computations of latitude and azimuth in the Java chain of triangles, and which is 540 km. from Karang. The publication of the determinations of latitude and azimuth carried out by the Geographical Service in West Java, will probably throw more light on the

cause of these differences.—Prof. Kamerlingh Onnes communicated on behalf of Mr. N. Kasterin, of Moscow, experiments on, and a theory of, the propagation of sound through a non-homogeneous medium. The solution given has been rendered general by means of spherical functions for a medium consisting of equal spheres in a state of rest and arranged parallelopipedically. Applications were made to the case when the dimensions of the spheres are small in comparison with the wave-length. Perfect analogy with the dispersion and absorption of light was found; the index of refraction, the dispersion curve, the absorption coefficient and the absorption bands in the acoustic spectrum were determined. The experiments were made with balls, arranged in tubes of quadratic cross section. Complete correspondence between observation and theory was found. The solution was also found for a medium, composed of gaseous spheres. Experiments, relative to this case, were made by placing a series of resonators in a Kundt's tube. Phase retardation on waves passing through impediments was previously observed by Kasterin in the case of capillary waves.—Prof. W. H. Julius presented a paper on a simple extension of the Gauss-Poggendorffian method of reflector reading, by which it becomes possible directly to read not only *tg* 2*a*, but also *tg* 4*a*, *tg* 6*a*, *tg* 8*a*, *tg* *a* . . . *ad lib.* This effect is produced by repeated reflections of the incident rays between the reflector and the slightly silvered back of a small glass plate, placed in front of it. A photograph of the field of vision in the telescope was added, in which the four images of the scale are seen simultaneously, the readings of which yield the various multiples of 2*a*.

DIARY OF SOCIETIES.

THURSDAY, MARCH 31.

ROYAL SOCIETY, at 4.30.—Total Eclipse of the Sun, January 1898: Preliminary Report on the Observations at Sahdol: W. H. M. Christie, C.B., F.R.S. (Astronomer Royal).—Preliminary Account of the Observations at Viziadrug: Sir J. Norman Lockyer, K.C.B., F.R.S.—Polariscopic Results at Sahdol: Prof. H. H. Turner, F.R.S.—Note on Photographs obtained at Ghoglee: Dr. R. Copeland (Astronomer Royal for Scotland).—Observations at Pulgaon: Captain E. H. Hills, R.E., and H. F. Newall.

SOCIETY OF ARTS (Indian Section), at 4.30.—The Earthquake in Assam: Henry Luttman-Johnson.

ROYAL INSTITUTION, at 3.—Recent Researches in Magnetism and Diamagnetism: Prof. J. A. Fleming, F.R.S.

CHEMICAL SOCIETY, at 3.—Annual General Meeting.

CAMERA CLUB, at 8.15.—Prof. Joly's System of Colour Photography: Captain Abney, C.B., F.R.S.

FRIDAY, APRIL 1.

ROYAL INSTITUTION, at 9.—Liquid Air as an Analytic Agent: Prof. Dewar, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—Addresses on the Excursion Programme for 1898: H. W. Monckton, Prof. J. F. Blake, and W. Whitaker, F.R.S.

MONDAY, APRIL 4.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Bacterial Treatment of Sewage containing Manufacturing Refuse: W. J. Dibdin.

VICTORIA INSTITUTE, at 4.30.—The Star-Worshippers in the East: S. M. Zwemer.

TUESDAY, APRIL 5.

SOCIETY OF ARTS, at 8.—The British Empire, its Resources and its Future: John Lowles.

ZOOLOGICAL SOCIETY, at 8.30.—On the Species of Corals of the Genus *Millepora*: Prof. Sydney J. Hickson, F.R.S.—On the Perforate Corals collected by the Author in the South Pacific: J. Stanley Gardiner.—On the Geographical Races of the Banting, *Bos sondaicus*: R. Lydekker, F.R.S.

MINERALOGICAL SOCIETY, at 8.—On Sphærostilbite: G. T. Prior.—On the Occurrence of Monasite and Niobates and Tantalates of the Rare Earths in Swaziland: G. T. Prior.—On Sennaite, a New Titanate of Iron, Lead, and Manganese from Brazil: Dr. E. Hussak and G. T. Prior.—On a Cubic Modification of Silver Iodide from Broken Hill, New South Wales: L. J. Spencer.—Crystallographic Notes on Laurionite and Phosgenite: Herbert Smith.—On Peculiar Quartz-Pseudomorphs found at the Owera Mine, Opitonui, North Island, New Zealand: Prof. G. H. F. Ulrich.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Extraordinary Floods in Southern India: their Causes and Destructive Effects on Railway Works: E. W. Stoney.—The Electricity Supply of London: A. H. Preece.

RÖNTGEN SOCIETY, at 8.—The Influence Machine and its advantages for Lighting X-Ray Tubes: James Wimshurst.

WEDNESDAY, APRIL 6.

GEOLOGICAL SOCIETY, at 8.—On some Palæolithic Implements from the Plateau-Gravels, and their evidence concerning Eolithic Man: W. Cunnington.—On the Grouping of some Divisions of Jurassic Time: S. S. Buckman.

ROYAL ASTRONOMICAL SOCIETY, at 8.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, APRIL 7.

MATHEMATICAL SOCIETY, at 8.—An Essay towards the Generating Functions of Temariants: Prof. Forsyth, F.R.S.—On Systems of Forces in Space of *n* Dimensions: W. H. Young.—Note on the Definition of a Continuum of *n* Dimensions: A. E. H. Love, F.R.S.—On the Zeroes of the Bessel Functions: H. M. Macdonald.

LINNEAN SOCIETY, at 8.—On the Brain of the Edentata, including Chlamydophorus: Dr. Elliott Smith.—Preliminary Account of some New Zealand Actiniaria: H. Farquhar.

BOOKS AND SERIALS RECEIVED.

BOOKS.—A Treatise on Magnetism and Electricity: Prof. A. Gray, Vol. 1 (Macmillan).—Comité Internationale des Poids et Mesures, Procès-Verbaux des Séances de 1897 (Paris, Gauthier-Villars).—Text-Book of Physiology: edited by Prof. E. A. Schäfer, Vol. 1 (Pentland).—Bergens Museums Aarbog, 1897 (Bergen).—Die Wettervorhersage: Prof. Dr. W. J. van Bebber, Zweite Auflage (Stuttgart, Enke).—Die Fundamentalen Physikalischen Eigenschaften der Krystale: Dr. W. Voigt (Leipzig, Veit).—Die Energetik: Dr. G. Helm (Leipzig Veit).—Statesman's Year-Book: edited by Dr. J. S. Keltie 1898 (Macmillan).—Hints on the Management of Hawks, &c: J. E. Harting, 2nd edition (H. Cox).—What is Science?: Duke of Argyll (Edinburgh, Douglas).—The Mammals, Reptiles and Fishes of Essex: H. Laver (Chelmsford, Durrant).

SERIALS.—Memoirs of the Geological Survey of India, Vol. xxvii. Part 2 (Calcutta).—Ditto, Palæontologia Indica, ser. xv. Vol. 1, Part 4; Vol. 2, Part 1; ser. xvi. Vol 1, Parts 2 and 3 (Calcutta).—Astrophysical Journal, March (Chicago).—American Naturalist, February (Ginn).—Monthly Weather Review, December (Washington).—Journal of the Anthropological Institute, February (Paul).—Journal of the Chemical Society, March (Gurney).—Economic Journal, March (Macmillan).—Humanitarian, April (Hutchinson).—Longman's Magazine, April (Longmans).—Science Abstracts, February (Taylor).—Himmel und Erde, March (Berlin, Paetel).—Chambers's Journal, April (Chambers).

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