THURSDAY, MAY 11, 1905.

## FLOW OF UNDERGROUND AND RIVER WATERS.

*Essais d'Hydraulique souterraine et fluviale.* By Edmond Maillet, Ingénieur des Ponts et Chaussées. Pp. vi+218. (Paris: Librairie scientifique, A. Hermann, 1905.) Price 11 francs.

THIS treatise, which was presented in the first instance to the Academy of Sciences of Paris in 1903, is divided into two parts, the first theoretical and the second practical, to which a paper has been appended, mainly of a practical nature, on the curves of the discharge of springs and the abatement of river floods. The book is addressed to mathematicians, physicists, geologists, geographers, meteorologists, engineers, and all who are interested in the motion and the distribution of rainfall, both on the surface of the land and underground; and its object is to investigate theoretically and practically the variations in the discharge of springs, and the low-water flow of rivers, in order to be able to foretell the amount of this minimum flow, precisely as the height of the floods of rivers is predicted, as already effected in certain cases by French hydraulicians, such as Dupuit, Belgrand, Lemoine, de Preaudeau and others, and also recently by the author with respect to two of the sources of the River Vanne.

M. Maillet believes that he is the first to have indicated a method by which exact quantitative discharges can be systematically predicted, such as a graphic curve, based upon Dausse's law concerning the permeable strata of the Seine basin, enabled him to determine the yearly minima discharges of two sources of the Vanne several months beforehand. Later on, by means of the hypothesis of a particular form of the free water-surface, he succeeded in obtaining a law which proved to be in accordance with experience, as indicated in the first half of the theoretical portion of the book. In the second half of this portion, the stability, or the nature of the motion of underground waters, under different conditions, is investigated, allowing for the increase in volume produced by rain; and assuming a simple form for the impermeable bed over which the water flows, it is shown that where the line of the bed is convex upwards the maximum height of the flood will be rapidly attained, and where concave, the flood will rise slowly, and that the influence of a part of the stream on the maximum will be greater in proportion to the fall of the bed. The connection, also, between the low-water levels, or minima discharges, at any point of a watercourse or spring and the rainfall, is considered in as general a form as possible; and it is proved that, in practice, the lowest discharge may often be regarded as a function of the combined rainfall of the preceding hot and cold seasons, and experiences very slight variations from year to year, especially in large river basins, unless the warm season is very rainy and impermeable strata intervene.

The results of the theoretical investigations comprised in the first six chapters are summed up in the three following laws:—(1) A certain number of hydrological facts, corresponding to the low stages, or minima discharges, of springs or watercourses, in many cases depend almost exclusively on the total rainfall of several preceding warm and cold seasons. It is only in the case of restricted watersheds that the rainfall of the last one or two cold seasons exercises a predominating influence, the number of preceding years on which the results depend increasing in proportion to the size of the basin. The preceding warm seasons have less influence than the following cold seasons; and they both have less influence in proportion as they date further back, though this loss of influence varies inversely with the size of the basin. The immediately preceding spring and summer rainfalls may introduce an element of disturbance if they are heavy and widespread, supposing that the permeable strata predominate in the basin; but where the basin is almost wholly permeable, the rainfall of the preceding warm seasons may often be neglected. (2) The lowest level at a given point of a watercourse in any year is approximately a function of the minimum level of the preceding year, and of the amount of rain during the preceding cold season, and some preceding months of the warm season if very wet or very dry, provided the proportion of impermeable strata in the basin is small. In the case of many watercourses, the minimum yearly level varies little from year to year; and a succession of several years, or several cold seasons, more rainy or more dry than the average, is needed to produce modifications, which, moreover, are slow and progressive with the lapse of time. (3) In the Seine basin, the low-water levels at given points of many of the watercourses draining almost wholly permeable strata, differ little from their mean secular height. These variations cannot be abrupt, except under the immediate influence of rainy summers on the impermeable strata of the basin; and in any case they would be progressive, as a result of a gradual increase in the mean rainfall for a certain number of years. Subject to these reservations, an appreciable variation in the low-water level must be due to other than meteorological causes.

The second, practical, part of the book occupies little more than a third of the space devoted to theoretical considerations, though divided into ten chapters, which are, consequently, very short for the most part. It contains some practical applications of the views and theories developed in the first part, to the prediction of various hydrological phenomena, and also some experimental verifications; and the works of Belgrand, and the observations and publications of the hydrometric service of the Seine basin, form the basis of this inquiry. After a very brief introduction, the chapters deal successively with proportion of rainfall which feeds underground waters, prediction of the drying up of the sources of the Somme from the rainfall, prediction of the discharges of Cérilly spring, a source of the Vanne, prediction of the minima discharges of the sources of the Vanne, application to the sources of the Dhuis, prediction of the low-water levels of the Marne at La Chaussée, drying up of the Laignes, remarks on springs supplying Havre, and

great floods of the Seine; and thirty-one tables are appended at the end of the volume, giving the rainfall, discharges, and water-levels at different dates in various parts of the Seine basin, and eleven sets of graphic curves indicating the decrease in the discharges of the Seine, some of its tributaries, and certain sources, at different periods. Table xxiii., giving the rainfalls of the warm seasons, and the high floods of the following cold seasons, at the Austerlitz Bridge, Paris, and at Mantes, from 1874 to 1900, shows that none of these warm seasons in which the rainfall was below the mean of 14·88 inches, was followed by floods of the Seine rising higher than 14·44 feet on the gauge at Paris, and 19·72 feet at Mantes; and the eight cold seasons in which the Seine reached or exceeded 16·40 feet at Paris, and 21·06 feet at Mantes, were all preceded by warm seasons in which the rainfall exceeded the mean. Moreover, with the exception of 1890, when the warm season came between two very dry cold seasons, all the warm seasons having a rainfall above the average have been followed by floods of the Seine, attaining at least 10·17 feet at Paris and 16·40 feet at Mantes; whereas none of the fourteen warm seasons with a rainfall below the average was succeeded by floods in the next cold season, reaching the height attained in eight of the cold seasons preceded by warm seasons in which the rainfall exceeded the average.

## *A NEW AMERICAN WORK ON THE CALCULUS.*

*Elements of the Differential and Integral Calculus.* By William Anthony Granville, Ph.D., with the editorial cooperation of Percey F. Smith, Ph.D. Pp. xiv+463. (Boston and London: Ginn and Co.) Price 10*s.* 6*d.*

THIS is a book the main object of which seems to be to enable the student to acquire a knowledge of the subject with little or no assistance from a teacher; and, after a very careful study of it, we are enabled to say that the work is admirably constructed for the purpose. There is a complete absence of the stilted formality which is usually supposed to be appropriate to a mathematical treatise. In foot-notes, and sometimes in the text, the student is given scores of useful hints and warnings against errors into which he would probably fall. Thus the work possesses a very high value for the student; and it will be found no less helpful to the teacher, for it contains a very large number of examples in every part of the subject, while it abounds in excellent diagrams.

The portion on the differential calculus occupies 285 pages, and terminates with 6 pages containing nothing but figures of all the curves more or less famous which present themselves in the subject, such as the conchoid of Nicomedes, the cycloid, the catenary, the cissoid of Diocles, the probability curve, various spirals, &c.

The work is very strictly logical in its method—here and there a little too much so, perhaps.

Thus in p. 97 the proof that the angle between the radius vector and the tangent to a curve has $rd\theta/dr$ for its tangent is quite unnecessarily accurate, and has involved an error in work, which, however, is a mere slip. The theorem of mean value is very well explained and used in the deduction of Taylor's theorem for the determination of the remainder, a little geometrical figure assisting the student to understand the nature of this remainder. (Correct, however, the errors in sign in the first equation of p. 169.)

The discussion of the convergency and divergency of series is very good, and a somewhat uninteresting subject is rendered simple and attractive. An incautious statement, however, is made with regard to an alternating series, p. 241, according to which if we stop at the $n$th term of such a series the error made is numerically less than the value of the $(n+1)$th term. Clearly this is not in general true if the alternating series is one in which the numerical values of the terms increase for a while and then diminish. For example, the series for $\sin x$ is an alternating one of this kind. If $x=5$, the numerical values do not begin to diminish until after the third term. The property asserted, and the proof in p. 226, must be applied to cases in which we stop after the greatest numerical term has been passed.

The theory of maxima and minima is well illustrated by examples taken from various branches of physics. Even at the risk of being a little hypercritical, we must, however, point out that the time taken by a ball to roll down a plane the base of which is of length $a$ and the inclination of which is $\phi$ is not $2\sqrt{a/g}\sin 2\phi$, as it is said to be in p. 128, for the simple reason that the acceleration of the centre of the ball (if the ball is solid and homogeneous) is not $g\sin\phi$, but $5/7\ g\sin\phi$. This fact is of importance in dynamics, and the matter should be set right.

The part of the book dealing with curves is very good, and, in particular, we would commend the systematic manner in which (pp. 267, 268) the student is taught to trace a curve from its equation.

In the portion dealing with the integral calculus an exhaustive exposition of all the devices used in integrating functions is given. The reduction formulas to be applied to the binomial integral $\int x^m(a+bx^n)^p dx$ are given in tabular form on p. 345, and the student is told very properly that he should not memorise them. Instead of memorising them, he should apply a single simple rule which was given long ago by Hymers in his "Integral Calculus." This rule enables us to obtain, without an effort of memory, the exact formula appropriate to the reduction of any given binomial integral.

Besides areas and volumes (accompanied by excellent figures), polar moments of inertia of plane areas are dealt with. The author speaks of these as moments of inertia about "a point"—an expression which leaves something to be desired, since it is always an *axis* that is involved. What we always require in this connection in dynamics is the *mean square of distance of a body from an axis,* and we should look to writers on the calculus to emphasise this notion of a mean square of distance, instead of the "square of the radius of gyration," $k^2$. The

student might easily learn to regard $k$ as the *distance of mean square*, just as we speak of the *velocity of mean square* in a gas.

The book has a useful chapter on the simpler forms of differential equations, and concludes with a figure and description of the integraph for finding the area of a curve. It might well include a description of Amsler's planimeter, and show how it finds areas, positions of centres of gravity, and moments of inertia of plane figures; and, as to the proof of the theory of Amsler's planimeter, it need occupy no larger space than the area of a shilling, notwithstanding the length and complication of proofs which are usually given.

The author's attention may be directed to the following misprints:—p. 44, note, Leibnitz was Gottfried, not Gottfreid; p. 206 (A), read $f'_x$ for $f_x$; p. 216, ex. 15, read $v_0^2$ for $v_0$; p. 225, line 5, read 223 for 225; p. 275, line 6, read P′ for P; p. 374, line 1, read $y$ for $dy$.

GEORGE M. MINCHIN.

## SERUM DIAGNOSIS.

*Manual of Serum Diagnosis.* By O. Rostoski. Authorised translation by Charles Bolduan. Pp. vi+96. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 1 dollar.

THIS small work forms a companion volume to that by Wasserman on "Hæmolysins and Cytotoxins," which has already been noticed in these columns. Each volume forms a monograph on some part of those newer developments of bacteriology which concern immunity and kindred subjects. The aim of the series is to provide simple yet comprehensive accounts of our present knowledge suitable for those who do not make a special study of the laboratory aspects of disease rather than exhaustive treatises adapted for special students. That the information is authoritative and trustworthy is vouched for by the list of authors, which includes some of the most distinguished names in contemporary bacteriology. Each volume is the work of one who has himself made important contributions to the study of the subject.

The present volume deals with the practical use of agglutinins, bacteriolysins, and precipitins in diagnosis. More than two-fifths of the whole is devoted to an account of the Widal reaction in enteric fever. This section is extremely good, and for it alone the book is well worth reading. The author points out very clearly that the "test" is not to be regarded as more than the "first of the cardinal symptoms of typhoid." Some discredit has been cast on the value of the reaction, because clinicians have not always found that infallibility which is so often expected of the laboratory, but which can never be present in dealing with so variable a complex as living matter. Removed from the pedestal of a "test" to the common ground of a "symptom," the phenomenon seems to have a better chance of receiving the appreciation which it deserves. There is an admirable account of the mixed and "group" agglutinations in typhoid and paratyphoid infections, and due notice is taken of the use of typhoid cultures which have been killed by the addition of formalin. These react practically as well as living cultures; and, though the increased time required to obtain a result and the slight loss of delicacy render the use of living cultures still desirable in the laboratory, the safety and convenience of the dead cultures place the "test" within the personal practice of every not-too-busy practitioner. It is, however, strange to read (p. 13) that the use of an oil-immersion objective is necessary.

The author then considers briefly the agglutination phenomena found in tuberculosis, dysentery, and other diseases. Serum diagnosis of tubercle is considered to be of very doubtful value. Appropriate stress is laid on the fact that in many diseases (especially plague and cholera) agglutination, in comparison with other symptoms, is of very little use for the direct diagnosis of the disease, though of the greatest value in the identification of the isolated organism. This part of the book is, however, less satisfactory than the earlier sections. Indeed, the serum diagnosis of Malta fever is not mentioned, though the practical value of the phenomenon in the diagnosis of this variable and often very obscure disease has been demonstrated beyond question.

The book concludes with an account of the identification of blood stains by the precipitin test. Readers will find here a wise injunction to make sure that any given stain is blood before deciding whether it is of human or animal origin; the precipitin will not distinguish between the different tissues of the same species of animal in the same way as it will separate the same tissue from different species.

In the translation several useful additions have been made; the last chapter, which attempts an impossibly precise and entirely arbitrary definition of the Widal reaction, might, however, well have been omitted.

A. E. B.

## HISTORY OF PHARMACY.

*Geschichte der Pharmazie.* By Hermann Schelenz. Pp. ix+934. (Berlin: Julius Springer, 1904.) Price 20 marks.

THE successful practice of pharmacy implies some acquaintance with plant chemistry and with that branch of economic botany known as *materia medica*. For this reason the history of pharmacy, although it appeals particularly to the pharmacist and the physician, presents also many points of interest to the chemist and the botanist. Herr Schelenz does not consider that the classes of readers here enumerated form a sufficiently wide circle for his purpose, and he states in the preface to this volume that he hopes also to interest the legislator, the antiquarian, and the philologist.

The book begins with a description of the conditions under which pharmacy was practised among the Jews. A summary of the political history of the nation is first given, and this is followed by sections dealing with Biblical and Talmudic references to the practice of pharmacy and the social condition, &c., of the practitioners of the art. The most interesting portion of this section is that describing the drugs employed by Jewish apothecaries. It is curious that so many of these are still in use at the present day;

for example, myrrh, Indian hemp, cassia (or cinnamon), coriander, colocynth, galls, almonds, galbanum, and storax are among those mentioned by the author. The Jews also appear to have made use to some extent of natural mineral waters and various medicated baths as remedial agents.

Similar accounts of the practice of pharmacy among the Phœnicians, Assyrians, Egyptians, Hindus, Persians, Greeks, Romans, and other peoples are given, and then this racial method of treatment is interrupted, and a chapter is inserted giving an account of the methods of the professors of magic, astrology, and alchemy in the Middle Ages, and showing how the practice of these secret arts gradually led to a knowledge of natural science.

Resuming his narrative after this digression, the author deals with pharmacy among the Copts and Syrians, the Arabs, and the Teutonic races, and brings it to the close of the eighteenth century with a short account of the condition of medicine and pharmacy in Italy, when the school of Salermo exercised a paramount influence on these arts. It was at this period that a definite separation of pharmacy from medicine first took place.

Each of the succeeding chapters deals with the progress made during a particular century, an outline of the additions to physical, chemical, and botanical sciences being first given, with short biographies of the more famous exponents of these sciences. The bearing of these discoveries on pharmaceutical methods is then outlined, and finally the legislation of the periods, the social and commercial conditions, and other matters in so far as they affected the practice of medicine and pharmacy are discussed.

The book is evidently the outcome of much literary and antiquarian research on the part of its author, but it is unfortunate that more care was not exercised in selecting the material to be included. There is no reason why so much space should be taken up in recounting the political and religious histories of the various peoples. Similarly, the short and necessarily inadequate biographies of eminent men of science, which are scattered broadcast through the second half of the book, might well have been omitted, since they are already better done elsewhere. By omitting these and other not strictly relevant matters, the size of the volume could have been much reduced, and at the same time it would have been unnecessary for the author to write in the compressed, unreadable style which now characterises the book. As it is, the volume can only be regarded as a useful work of reference on the history of pharmacy and allied subjects, and to this purpose its index (26,000 entries) is well adapted.

T. A. H.

## OUR BOOK SHELF.

*Guide to the Gallery of Birds in the British Museum.* Pp. iv+228; illustrated. (London: Printed by Order of the Trustees, 1905.) Price 2*s.* 6*d.*

THIS handsome volume is a new departure in the matter of "guides," so far as the natural history branch of the museum is concerned, being larger in size, more fully illustrated, different in style, and (perhaps most important of all) higher in price than those to any of the other sections. The text is, in fact, a concise synopsis of the leading groups of birds, with special reference to the specimens exhibited in the galleries. The plan of the synopsis necessarily follows the system adopted in the museum, and it would therefore be quite out of place to criticise that system on the present occasion. A similar remark applies to the fact of the illustrations (which are admirable of their kind) being taken from the stuffed specimens in the collection instead of from living birds—the guide is to illustrate the collection, and therefore it is quite right and proper that the figures of the birds should be taken from those shown in the gallery. In addition to the general synopsis, there is a guide to the series of British nesting birds. That the general plan and execution are in the main excellent cannot be denied; whether it will suit the taste —and the purses—of the public remains, however, to be seen.

When a new edition is called for, certain emendations may with advantage be made in the text. The most serious error we have detected is the statement (p. 11) that the largest Æpyornis was probably not more than 7 feet in height, whereas there are actually limb-bones in the museum itself which are nearly of these dimensions; such an error implies a want of cooperation between the zoological and palæontological departments of the museum. Of less importance, although far more embarrassing to the public, is the discrepancy between the terminations of the "orders" of ostrich-like birds in the list on p. 8 and those in the synopsis on that and the following pages. Again, we venture to think that the public will not be likely to understand the semi-scientific jargon frequently employed in the text. The expression, for instance, on p. 106, "the remarkable Australian forms constituting this order," would have been much better had the word "birds" been used in place of "forms." Neither is the construction of the sentences in all cases so good as it might be, as witness the following (p. 64):—"The appendage opens under the tongue and is largest in the male, giving the bird a very peculiar appearance. Like its allies it is an expert diver . . ."

R. L.

*A Laboratory Manual of Organic Chemistry for Beginners.* By Dr. A. F. Holleman. Translated by A. Jamieson Walker, Ph.D. Pp. xiv+78. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 4*s.* net.

THE preparation and properties of a number of organic compounds are dealt with in short paragraphs in a manner reminding one of the text-books of qualitative analysis, which are now so universally condemned. But little attempt is made to indicate the quantities which should be used, and no emphasis whatever is laid on the importance of making organic preparations in a quantitative manner. We even doubt whether the beginner would attain the required result in performing many of the preparations described.

It will be a sad day for the future of organic chemistry if text-books such as Dr. Holleman's come into general use; it is indeed difficult to imagine anything more calculated to encourage scamping of laboratory work. A growing complaint of the chemical manufacturer abroad at the present time is that the university graduates from the large modern laboratories are ruined by the elaborate apparatus, ready-made reagents and other time-saving appliances placed at their disposal, so that they are no longer themselves capable of facing practical problems properly or of making the best use of the ordinary technical appliances. The physical chemical epoch from which chemical science is now slowly recover-

ing has caused it to be forgotten that for successful work in chemistry it is essential that the investigator be a highly skilled manipulator. It is too often found that the best student in the examination room is all but worthless when set to perform even the simplest piece of experimental work; good workers can only be trained by the most careful and thorough grounding in making pure chemical preparations and by being taught to appreciate the importance and necessity of even the minutest details in the process. As a glance at the modern chemical literature shows, it is precisely this attention to detail which is so conspicuous a feature in some of the best work.

We fear that the book under notice would not lead the student to attach importance either to accuracy of method or to thoroughness of detail; it seems a pity even that it should have been found worth while to translate it and so add another to the legion of text-books.

*Metaphysik in der Psychiatrie.* By Dr. P. Kronthal. Pp. 92. (Jena: Gustav Fischer, 1905.) Price 2.50 marks.

THIS costly little work is written to ventilate a grievance. It would appear that certain authorities on mental diseases, including Kräpelin and Binswanger, employ in their works such terms as association, apperception, power of imagination, anger, and the like. These, according to our author, are metaphysical terms, and must be carefully excluded from *Psychiatrie,* which is a purely natural science. New sciences spring up like mushrooms nowadays, and it is a misfortune that those who specialise in one, or seek to exploit it, so rarely know with precision what is being done in others, even when these are most closely akin to their own darling pursuit. We fear that this writer hardly understands that the terms which he criticises are used every day in psychology with a minimum of metaphysical reference, and that he is almost bound, before he proceeds a step, to show due cause why the terminology of *Psychiatrie* should differ seriously from that accepted by ordinary psychology. In spite of his parade of footnotes and his references to such grand conceptions as that of *Allbeseeltheit,* it may be doubted if this writer is competent to discuss so general a question. At any rate, his present work does not impress one as being well arranged, clear, or convincing.

*A Text-book of Physiological Chemistry.* By Charles E. Simon. Second edition. Pp. xx+500. (London: J. and A. Churchill, 1905.) Price 15*s.* net.

ALTHOUGH Dr. Simon's book has reached a second edition, it is one which has been hitherto unknown on this side of the Atlantic. Dr. Simon's name is not associated with any researches in physiological chemistry, and there is nothing strikingly new or original in his book, either as regards subject-matter or arrangement. The work has, however, many excellent features. It is clearly written, and is free from inaccuracies; the sections dealing with the proteids and their cleavage products are especially good, and fully abreast of the recent advances which have been made in this important and interesting branch of the subject.

The author is conversant with chemical technique, and his descriptions of analytical processes are specially lucid. It is evident that he is a careful student of chemico-physiological literature, and more especially with that part of it which originates in Germany. This is frequently seen in the nomenclature he adopts. Thus he speaks of casein and paracasein instead of caseinogen and casein respectively as employed in most English books. Occasionally the adherence to German terms leads to confusion; for instance, the two German words Eiweisskörper and Albumine are both translated as albumins.

The work is primarily intended for students, and therefore references to literature are omitted. A desire to keep the book within a moderate compass has no doubt induced the author to leave out a consideration of many subjects which might well have been expected to find a place in it. Thus we find no reference to the important subject of immunity and its side issues, like the precipitin test for blood. The numerous investigations now in progress on the velocity of ferment action are passed over in silence. Physical chemistry has during the last decade made great progress, and many and important are its applications to physiology. Such questions as absorption, secretion, osmosis, gaseous exchanges, and electrical conductivity have all been made clearer by the work of the physical chemist; but there is no reference to any of such investigations.

The strangest and most important omissions, however, are the absence of any account of general metabolism, animal heat, and respiration.

Turning to the title-page, one searches in vain for the words vol. i., for the omitted material would easily fill a second volume of the same size. One cannot help thinking that, interesting and instructive as the book undoubtedly is, it cannot be expected to take its place as a favourite until the deficiencies alluded to are rectified.

*Astronomy for Amateurs.* By Camille Flammarion. Translated by Frances A. Welby. Pp. 340. (London: T. Fisher Unwin, 1905.) Price 6*s.*

MUCH that is interesting to amateur astronomers may be found in this volume. The descriptions are often discursive, but the matter is there, and in a readable form providing the reader's leisure is not too limited.

After a general exhortation to his readers to study and contemplate the marvels of the sky, the author proceeds to a study of the constellations, the stars themselves, the sun, and then the planets. Next follows a chapter on comets, containing some interesting facts concerning the ancient ideas of these "glittering, swift-footed heralds of Immensity," and a brief account of comets in general and of a few in particular. Shooting stars are then dealt with, and in chapters viii., ix., and x. the earth, the moon, and eclipses are severally discussed. In chapter xi. the more elementary methods of determining stellar distances and masses are described, whilst the next, and last, chapter is devoted to a discussion of life universal and eternal. The book contains eighty-four illustrations—the relevance of some of which is open to question—and it will be read with both interest and profit by those whose previous acquaintance with astronomical truths has been slight.

## LETTERS TO THE EDITOR.

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

### Scientific Correspondence of the late Sir George Stokes.

ARRANGEMENTS are in progress for the publication of a selection from Sir George Stokes's scientific correspondence. The letters addressed to him, which are now in my custody, show that there must be many from him to others, of permanent scientific value, to which I have not access. I shall therefore be glad if owners of letters of *substantial scientific interest* will entrust them to me, to be treated with care and ultimately returned. J. LARMOR.

St. John's College, Cambridge, May 8.

## The Transposition of Zoological Names.

I WISH to say how thoroughly I agree with Mr. Lydekker in his remarks on the unwisdom of transposing zoological names, and on the confusion caused by this objectionable practice. To the instances which he has mentioned I may add the following cases relating to two well known and familiar species of animals. Linnæus called the only European hare known to him *Lepus timidus*, and for many years that name was applied to the common brown hare of Central Europe, while the northern hare, which changes to white in winter, was known by Pallas's appropriate name, *Lepus variabilis*. This was the nomenclature used by Blasius, by Bell in his "British Quadrupeds," and in all the ordinary text-books of zoology. It was, however, pointed out some years ago, first, I believe, by Lilljeborg, that the *Lepus timidus* of Linnæus had been based mainly upon the northern or variable hare, or that at all events Linnæus had confounded the two species together. In these circumstances obviously the best plan was to call the middle-European brown hare by its next given name, *Lepus europeus*, and this course has been adopted by most writers. But the advocates of unrestricted priority are not content with this, and insist upon calling the variable hare *Lepus timidus*, the consequence being that when that name is used it is impossible to know which of two perfectly distinct animals is intended by it.

Another still more objectionable transposition of two well known names has been lately suggested. Linnæus, in the *twelfth* edition of the "Systema Naturæ," gave the name *Turdus musicus* to the song-thrush and that of *Turdus iliacus* to the redwing, and these familiar terms have been used by all writers for these well known birds respectively ever since. But about a year ago it was discovered by an ardent member of the new school of priority that in his *tenth* edition of the "Systema" Linnæus had unfortunately (by some error in his MS. or of his printer) attached the diagnosis of *Turdus musicus* to *T. iliacus*, and that of *T. iliacus* to *T. musicus*. It was admitted that Linnæus had corrected the mistake in his later edition of 1760, but even Linnæus could not be allowed to correct his own errors in the face of the inviolable law of "priority." In future, therefore, it was maintained, the song-thrush must be called *T. iliacus* and the redwing *T. musicus*! This course has been actually adopted by a subsequent writer, but we may trust that it will not meet with general approval, and that the song-thrush and redwing will remain under the old names given to them by the father of scientific nomenclature in 1760, and used by every subsequent writer until 1904. P. L. SCLATER.

## Modern Algebra.

THE publication of Messrs. Grace and Young's treatise on algebra will direct attention to the importance and difficulty of the theory of the concomitants of ternary and quaternary quantics in connection with plane and solid geometry. There are one or two points on which I propose to make some remarks.

In the first place, canonical forms are sometimes deficient in generality, and this will be the case whenever the form is the analytical expression for some *special* property of an anautotomic curve. Of this defect the canonical form of a ternary cubic furnishes a striking example, for it is the analytical expression for the theorem that through each of the three real points of inflexion one real straight line can be drawn which passes through one pair of conjugate imaginary points of inflexion on an anautotomic cubic curve; and since autotomic cubics do not possess this property such curves cannot be represented by the canonical form.

In the next place, anautotomic curves are not by any means the most interesting species of curves, and to go through the process of calculating their concomitants, and then specialising them for some particular species of autotomic curves, is often very laborious. In the case of unicursal quartics, many interesting results might be obtained by calculating directly the concomitants of the quantic $(*\Sigma\beta\gamma, \gamma\alpha, \alpha\beta)^2$, and this would give results applicable to all unicursal quartics, except those which possess the five compound singularities called the tacnode, the rhamphoid cusp, the oscnode, the tacnode cusp, and the triple point. Also, since an evectant is the tangential equation of a curve which is related in a special manner to the original one, an examination of the evectants of the above quantic would lead to interesting results concerning conics and other curves connected with trinodal quartics.

In this subject geometrical methods are a powerful assistance to pure analysis. For example, let U be a ternary cubic in $(\alpha, \beta, \gamma)$; eliminate $\gamma$ by means of the equation $\beta = k\gamma$, and equate to zero the discriminant of the resulting cubic equation in $\alpha/\beta$. This will give a sextic equation $\Delta(k)=0$, which determines the six tangents drawn from A to the curve. The condition that the curve $U=0$ should have a node is that the equation $\Delta(k)=0$ should have a double root; hence the discriminant of this binary sextic is the discriminant of the original ternary cubic U.

Many other examples of a similar kind could be mentioned, and we may observe that from the discriminant of a binary duodecimic, all the conditions that a quartic curve should possess *point* singularities may be obtained.

April 28. A. B. BASSET.

## Current Theories of the Consolidation of the Earth.

IN Lord Kelvin's philosophical and justly celebrated paper on the secular cooling of the earth (Thomson and Tait's "Nat. Phil.," vol. i., part ii., Appendix D), the assumption is made that the earth was once a fiery molten mass, liquid throughout, or melted to a great depth all round. He cites Bischof's experiments showing that "melted granite, slate, and trachyte all contract by something about 20 per cent. in freezing," and continues:—

"Hence, if, according to any relations whatever among the complicated physical circumstances concerned, freezing did really commence at the surface, either all round or in any part, before the whole globe had become solid, the solidified superficial layer must have broken up and sunk to the bottom, or to the centre, before it could have attained a sufficient thickness to rest stably on the lighter liquid below. It is quite clear, indeed, that if at any time the earth were in the condition of a thin shell of, let us suppose, 50 feet or 100 feet thick of granite, enclosing a continuous melted mass of 20 per cent. less specific gravity in its upper parts, where the pressure is small, this condition cannot have lasted many minutes. The rigidity of a solid shell of superficial extent so vast in comparison with its thickness, must be as nothing, and the slightest disturbance would cause some part to bend down, crack, and allow the liquid to run over the whole solid. The crust itself would in consequence become shattered into fragments, which would all sink to the bottom, or meet in the centre and form a nucleus there if there is none to begin with."

In adhering to these views, Lord Kelvin has been followed by Prof. G. H. Darwin (*cf.* "Tides and Kindred Phenomena of the Solar System," p. 257) and other eminent mathematicians; so that the theory that the earth consolidated by the building up of a solid nucleus through the sinking of portions of the crust of greater specific gravity is no doubt generally accepted by geologists and others interested in the physics of the earth.

Recent researches on the pressures within the planets (*cf. Astronomische Nachrichten*, No. 3992) have thrown great doubt on this mode of consolidation of the globe. The line of argument by which we reach this conclusion is a double one:—

(1) It is shown that the effect of pressure in the highly heated fluid assumed to have constituted the molten earth would have been to dissolve the portions of the sinking crust before they attained any considerable depth.

(2) The increasing density of the fluid itself would have prevented sinking of the crust below one-tenth of the radius, so that a solid central nucleus could not have been built up in this way.

To see this clearly, let us suppose that the earth were a molten mass, and that a crust of rock several kilometres in area, and a considerable fraction of a kilometre in thickness, had formed, and begun to sink in the molten fluid

by its superior gravity. What would happen to it as it descended towards the earth's centre?

The densities and pressures in the outer layers of the earth, found by Laplace's law, are as follows:—

| Radius | Depth below the surface km. | Density | Pressure in atmospheres |
|---|---|---|---|
| 1·000 | | 2·55 | 1·000 |
| 0·995 | 31·85 | 2·608 | 8,610 |
| 0·990 | 63·70 | 2·667 | 16,470 |
| 0·985 | 95·55 | 2·725 | 25,080 |
| 0·980 | 127·40 | 2·785 | 33,690 |
| 0·97 | 191·10 | 2·904 | 51,670 |
| 0·96 | 254·80 | 3·025 | 70,410 |
| 0·95 | 318·50 | 3·144 | 89,400 |
| 0·94 | 382·20 | 3·265 | 109,860 |
| 0·93 | 445 90 | 3·386 | 130,130 |
| 0·92 | 529·60 | 3·508 | 152,940 |
| 0·91 | 593·30 | 3·629 | 175,470 |
| 0·90 | 657·00 | 3·751 | 198,760 |

The above table shows that before the mass has descended 31·85 km. (1/200th of the radius) the pressure about it would have become more than 8000 atmospheres, which would force the molten fluid deep into the heated rock. The rising temperature at that depth would also rapidly dissolve the mass, and before the solid has sunk through another equal space in the viscid liquid, and thus reached a depth of 63·7 km., it seems almost certain that it would be completely dissolved.

It must be borne in mind that the solid is not much denser than the liquid; and as the liquid is highly viscous the mass would sink slowly, while the increase of temperature and pressure would conspire together in the most powerful manner to dissolve the mass and reduce it to the same temperature and density as the enclosing liquid, which would be forced into it on all sides by a pressure vastly greater than any known in our laboratories.

Even if we make the violent assumption that the sinking mass is a kilometre, or several kilometres, thick, it is difficult to see how it could continue its downward course, undissolved by temperature and pressure, below a depth approximating one-tenth of the radius, or 637 kilometres. The sinking would be quite slow, owing to stiffness of the fluid, and could hardly be accomplished to this depth inside of several days, or more probably weeks.

Moreover, before the mass reached a depth of 260 kilometres, or less than one-twentieth of the radius, the density of the molten fluid would become 20 per cent. greater than it was at the surface, owing to pressure; and when the solid mass was no denser than the surrounding fluid it would cease to sink. Or, if it had acquired a small velocity downward in the fall from the surface against the viscous resistance of the fluid, which is enormously increased by the eddy arising from the condition of continuity, it might go down a little lower until the motion was overcome by the buoyancy of the denser fluid below. Accordingly, so far as one can see, solidified crust in sinking could by no possibility go lower than one-tenth of the radius, which would hardly accomplish the building up of a solid nucleus.

In considering the effects of pressure in forcing molten fluid into the sinking solid, we have not assumed that the density would thereby be increased; for at the great temperature of the fluid it is obvious that the solid into which the hot liquid entered would be dissolved, and heat from the fluid would be conducted rapidly through the solid mass. Thus no cause seems to be overlooked which could invalidate our conclusion.

It rests primarily upon the enormous pressures known to exist at great depths in the earth, and their undeniable effect in forcing the molten fluid into any possible solid body, so as to prevent it attaining any considerable depth without dissolving; and upon the assumption that even molten rock under such forces would take approximately the density given by Laplace's law, which hardly admits of reasonable doubt.

In considering these questions heretofore, the hypothesis of incompressibility for the molten fluid has been tacitly implied or assumed. Whether such an hypothesis is justified will appear differently to different minds, but for our part we cannot hesitate in rejecting it on account of the known porosity of all matter, and its observed yielding and condensation under great forces.

On account of the difficulty in handling liquids, especially when at high temperatures, they have not been so carefully investigated in the laboratory as solids; but there remains scarcely any doubt that under planetary pressure they would all yield like sponges.

In indicating his interest in the paper on planetary pressures (*Astronomische Nachrichten*, No. 3992), one of the most eminent British mathematical physicists has pointed out that to his mind the present writer has underestimated the probability that the earth has a metallic nucleus. I have since pointed out in a letter to the editor of NATURE (April 13, p. 559) that pressure, and not metallic constitution, is the true physical cause of the earth's rigidity; for under such pressure any kind of matter would assume a hardness greater than that of steel; and as the material is above the critical temperature of every substance it is really gaseous, and would expand with incredible violence if the pressure could only be relieved.

In the *Astronomische Nachrichten*, No. 3992, I have shown that in any mass of considerable size, so condensed that the pressure amounts to millions of atmospheres, circulation at great depth becomes practically impossible, on account of the friction due to the increasing pressure as we descend within the mass. The pressure and friction which prevent circulation also prevent separation of the elements according to their densities. While it may not be possible to say that there is not an increasing amount of metals, such as iron, towards the centre of the earth, it is, I think, clear that there is no distinctively iron nucleus; for the existence of such a nucleus would imply that the earth's mass had unimpeded circulation when in a fluid state, all of which is to the last degree improbable.

When the earth was less condensed it was at lower temperature, and the elements may not have been fused; and as condensation advanced, and the temperature rose, the friction due to pressure operated with increasing intensity to destroy circulation, which would thus be restricted to the subsidence of compact masses decidedly denser than the surrounding fluid. As the fluid was necessarily at high temperature, a compact mass would soon be dissolved, and further circulation of its elements practically cease.

It seems, therefore, very difficult to escape the conclusion that the earth's interior is a magma of all the elements, the increasing density towards the centre being due primarily to pressure. If any separation of the metals from the rocks took place, it could only be near the surface where the pressure is slight; but because the rocks predominate at the surface, we must not conclude the same material does not exist abundantly in the great central nucleus of the globe.

The difference in the point of view here adopted and that held by the older school of physicists is based primarily upon the effects of pressure. While there is a certain disappointment in negative results, they are sometimes useful in leading us to new conceptions, and perhaps we may hope that further study of these difficult questions will produce results admitting of general acceptance. It should be added that the pressures for the interior of the earth, calculated in the *Astronomische Nachrichten*, No. 3902, would not be very greatly modified by any other admissible law of density.

The researches of Radau and Darwin (*cf. Monthly Notices*, Roy. Astron. Soc., December, 1899, pp. 122–3) have shown that, so far as the mathematical conditions are concerned, the law of density within the earth might depart considerably from that of Laplace. But on *physical grounds, including the incontestably steady rise of pressure towards the earth's centre, whatever be the exact law of density, and especially the observed yielding and condensation of all matter under such forces*, I hold that the true law is essentially that of Laplace, and any departure from it in the actual arrangement of the matter of the globe is likely to be extremely small and unimportant.

T. J. J. SEE.

U.S. Naval Observatory, Mare Island, California,
March 31.

## NOTES ON STONEHENGE.[1]

### VI.—ON THE SOLAR OBSERVATIONS MADE IN BRITISH STONE CIRCLES.

IN my last notes I referred to the star observations which might be made by means of stone circles. I now pass to solar observations.

I have already pointed out that much time has been lost in the investigation of our stone circles, for the reason that in many cases the exact relations of the monuments to the chief points of the horizon, and therefore to the place of sunrise at different times of the year, have not been considered; and when they were, the observations were made only with reference to the magnetic north, which is different at different places, and besides is always varying; few indeed have tried to get at the real astronomical conditions of the problem.

The first, I think, was Mr. Jonathan Otley, who in 1849 showed the "orientation" of the Keswick circle "according to the solar meridian," giving true solar bearings throughout the year.

I wrote a good deal in NATURE[2] on sun and star temples in 1891, and Mr. Lewis the next year expressed the opinion that the British stone monuments, or some of them, were sun and star temples.

Mr. Magnus Spence, of Deerness, in Orkney, published a pamphlet, "Standing Stones and Maeshowe of Stenness,"[3] in 1894; it is a reprint of an article in the *Scottish Review*, October, 1893. Mr. Cursiter, F.S.A., of Kirkwall, in a letter to me dated March 15, 1894, a letter suggested by my "Dawn of Astronomy," which appeared in that year, and in which the articles which had been published in NATURE in 1891 had been expanded, directed my attention to the pamphlet; the observations had no pretension to scientific accuracy, and some of the alignments are wrongly stated, but a possible solar connection was pointed out.

I began the consideration of the Stenness circles and alignments in 1901, but other pressing calls on my time then caused me to break off the inquiry. Quite recently it occurred to me that a complete study of the Stenness circles might throw light on the question of an earlier Stonehenge, so I have gone over the old papers, plotting the results on the Ordnance map.

Now that the inquiry is as complete as I can make it without spending some time in Orkney with a theodolite, I may say that in my opinion Mr. Spence's contention in his pamphlet on Maeshowe is confirmed, although many of the alignments to which he refers in support of it prove to be very different from those he supposed and drew on the map which accompanies his paper.

The alignments on which he chiefly depended were two, one running from the stone circle past the entrance of Maeshowe to the place of sunrise at Hallowe'en (November 1), another from the same circle by the Barnhouse standing stone to the mid-winter sunrise at the solstice.

I give a copy of the Ordnance map showing the true orientation of these and of other sight lines I have made out. From this it will be seen that observations of the sun were provided for on the days in question, and that the circles and outstanding stones were undoubtedly set up to guide astronomical observations relating to the different times of the year. Of course, as I have shown elsewhere, such astronomical observations were always associated with religious celebrations of one kind or another, as the astronomer and the priest were one.

I shall not refer to all the sight lines indicated, but deal only with those, bearing upon the Stonehenge question, which I have without local knowledge been able to test and justify.

FIG. 14.—Maeshowe, in the foreground, and the Stones of Stenness. From "Notice of Runic Inscriptions," by James Farrer, M.P. (1862).

But first we must consider the astronomical differences between the rising of a star and of the sun, by which we mean that small part of the sun's limb first visible.

It is too frequently imagined that for determining the exact place of sunrise or sunset in connection with these ancient monuments we have to deal with the

[1] Continued from vol. lxxi. p. 538.
[2] See especially NATURE, July 2, 1891, p. 201.
[3] Gardner: Paisley and London.

sun's centre, as we should do with the sun half risen. As a matter of fact, we must consider that part of the sun's limb which first makes its appearance above the horizon; the first glimpse of the upper limb of the sun is in question, say, when the visible limb is 2′ high.

shown that the half-way time between an equinox and a solstice is when the sun's centre has a declination approximately 16° N. or S. In Orkney, with the latitude of 59°, assuming a sea horizon, the amplitude of sunrise or sunset is 32° 21′, the corresponding azimuth being 57° 39′.

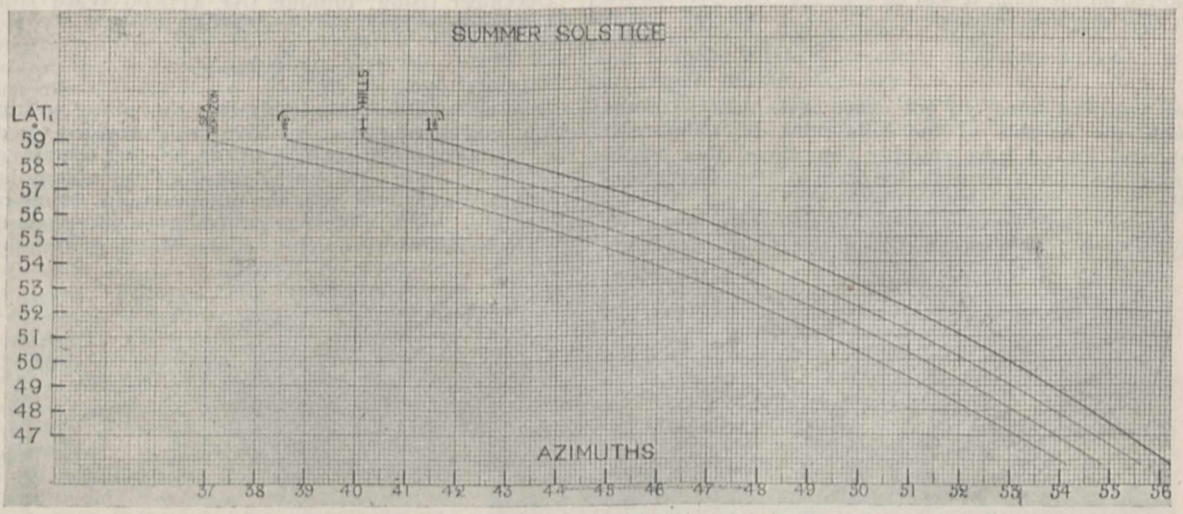


FIG. 15.—The Azimuths of the Sunrise (upper limb) at the Summer Solstice. The Values given in the table have been plotted, and the effect of the height of hills on the azimuth is shown.

To make this quite clear I give a table which has been computed by Mr. Rolston, of the Solar Physics Observatory, showing the true azimuth with hills up to 1½° high for lat. 59° N., the latitude of Stenness, and 51°, nearly the latitude of Stonehenge, of the sun's upper limb for the solstitial year.

Now the most interesting and best defined line with this azimuth on the Ordnance map is the one stretching S.E. from the centre of the Stenness circle to the Barnstone, with an azimuth of 57° 15′. The line contains between the two points I have named another stone, the Watchstone, 18½ feet high, in the

SOLAR AZIMUTHS

| | Lat. 59° Rising N. of E. or Setting N. of W. | Lat. 51° Rising N. of E. or Setting N. of W. |
|---|---|---|
| **SUMMER SOLSTICE.** | | |
| 1. Sun's centre; uncorrected | 39° 16′ | 50° 40′ |
| 2. Upper limb; corrected for semi-diameter and refraction | 37 1 | 49 20 |
| 3. ,, ,, ,, and hill ½° high | 38 34 | 50 16 |
| 4. ,, ,, ,, ,, 1° ,, | 40 8 | 51 12 |
| 5. ,, ,, ,, ,, 1½° ,, | 41 30 | 52 4 |
| **WINTER SOLSTICE.** | Rising S. of E. or Setting S. of W. | Rising S. of E. or Setting S. of W. |
| 1. Sun's centre; uncorrected | 39° 16′ | 50° 40′ |
| 2. Upper limb; corrected for semi-diameter and refraction | 41 24 | 52 0 |
| 3. ,, ,, ,, and hill ½° high | 39 54 | 51 4 |
| 4. ,, ,, ,, ,, 1° ,, | 38 23 | 50 8 |
| 5. ,, ,, ,, ,, 1½° ,, | 36 54 | 49 14 |

The first important thing we learn from the table is that although at any solstice the azimuths of the rising and setting of the sun's centre are the same, the azimuths of the upper limb at the summer and winter solstices differ in a high northern latitude by some 5°. The difference arises, of course, from the fact that the limb is some 16′ from the sun's centre, so that considering the sun's centre as a star with fixed declination, at rising the limb appears before the centre, and at setting it lags behind it.

It will also be seen that at sunrise hills increase the azimuth from N., and refraction reduces it; while at setting, hills reduce the azimuth from S. and refraction increases it.

Not only does calculation prove the worship of the May and June years, but I think the facts now before us really go to show that in Orkney the May year was the first established, and that the solstitial (June) year came afterwards, and this was the chief question I had in view.

I will begin with the May year. I have already

precise alignment; and from the statements made and measures given it is to be inferred that a still more famous and perforated stone, the "Stone of Odin," demolished seventy years since, was also in the same line within the extremities named.

If we may accept this we learn something about perforated stones, and can understand most of the folk lore associated with them, and few have more connected with them than the one at Stenness. I suggest that the perforation, which was in this case 5 feet from the ground, was used by the astronomer-priest to view the sunrise in November over the Barnhouse stone in one direction, and the sunset in May over the circle in the other.

There is another echo of this fundamental line; that joining the Ring of Bookan and the Stones of Via has the same azimuth and doubtless served the same purpose for the May year.

But this line, giving us the May sunset and November sunrise, *not* the December solstitial sunrise as Mr. Spence shows it, is not the only orienta-

tion connected with the May year at the stones of Stenness. The November sunset is provided for by a sight-line from the circle to a stone across the Loch of Stenness with an azimuth of S. 53° 30′ W.

To apply the table to the solstitial risings and settings at Stenness, and the sight-lines which I have plotted on the map, it will be seen that the table shows us that the lines marked

| | |
|---|---|
| N. 39° 30′ E. | S. 41° 0′ E. |
| N. 41° 16′ E. | S. 36° 30′ W. |

are solstitial lines; to get exact agreement with the table the heights of the hills must be found and allowed for. I have roughly determined this height from the 1-inch map in the case of the Barnstone-Maeshowe alignment.

On the N.E. horizon are the Burrien Hills, four miles away, 600 feet high at the sunrise place, gradually ascending to the E., vertical angle = 1° 36′ 30″. The near alignment is on and over the centre of Maeshowe. Colonel Johnston, the Director-general of the Ordnance Survey, has informed me that the true azimuth of this bearing is N. 41° 16′ E., and in all probability it represents the place of sunrise as seen from the Barnstone when Maeshowe was erected. What is most required in Orkney now is that some one with a good 6-inch theodolite should observe the sun's place of rising and the angular height of the hills at the next summer solstice in order to determine the date of the erection of Maeshowe. Mr. Spence and others made an attempt to determine this value with a sextant in 1899, but not from the Barnstone.

The Ordnance maps give no indication of stones, &c., by which the direction of the midsummer setting or the midwinter rising and setting might have been indicated from either the Maeshowe or the Barnstone.

To sum up the solar alignments from the circle.

We have the May sunrise marked by the top of Burrien Hill, from 600 to 700 feet high, Az. 59° 30′.

We have the November sunset marked by a standing stone on the other side of the Loch of Stenness, Az. 53° 30′.

June rising, Az. true 39°. The top of Hindera fiold, more than 500 feet high, the highest peak, triangulation station.

December rising, tumulus (Az. 41°) on Ward Hill.

December setting, tumulus Onston 36° 30′.

*General Remarks.*

It is not a little remarkable that the winter solstice rising and setting seem to have been provided for at the Stenness circle by alignment on the centres of two tumuli across the Loch, one the Onston tumulus to the S.W. (Az. 36° 30′), the other tumulus being on Ward Hill to the S.E., Az. 41° (rough measurement).

It looks also very much as if the Maeshow tumulus was an after structure to use the Barnstone for the summer solstice rising; then these two other tumuli, to deal with the winter solstice at Stenness circle, may have been added at the same time. All these provided for a new cult.

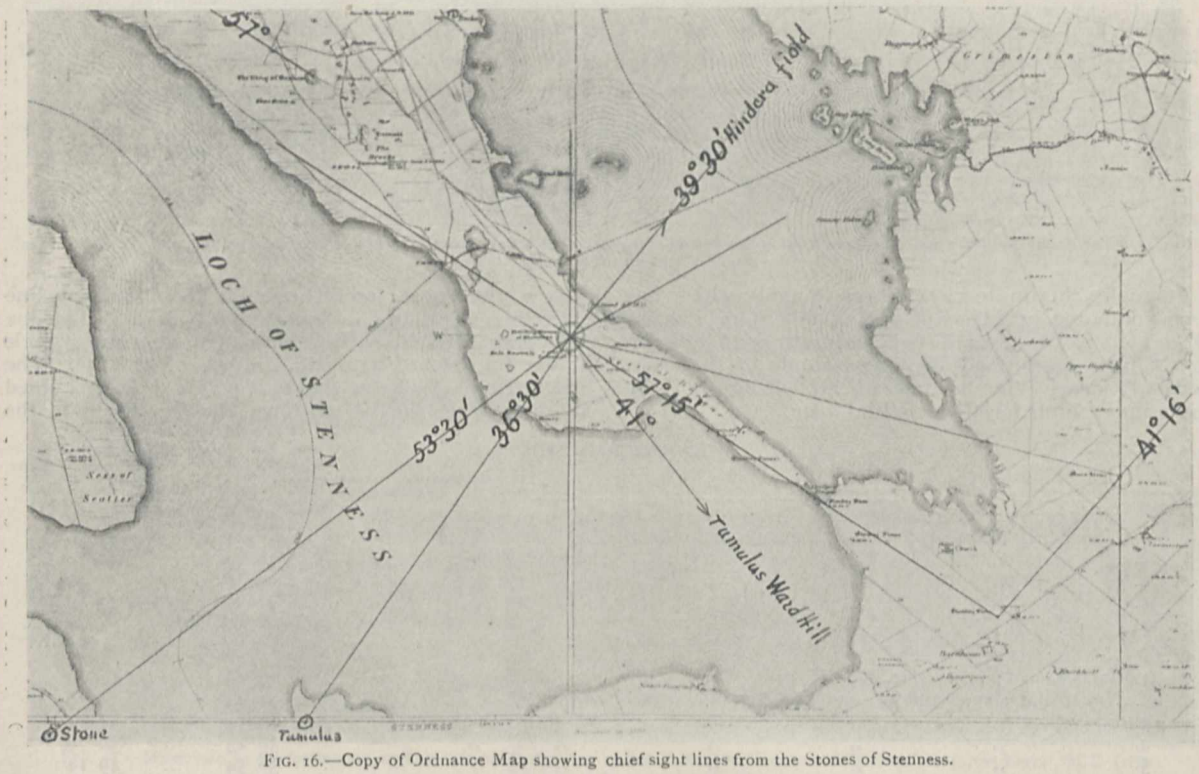


FIG. 16.—Copy of Ordnance Map showing chief sight lines from the Stones of Stenness.

There are also tumuli near the line (which cannot be exactly determined because the heights of the hills are unknown) of the summer solstice setting; none was required for the sunrise at this date, as the line passes over the highest point of Hindera fiold, a natural tumulus more than 500 feet high, and on that account a triangulation station.

Another argument in favour of the tumuli being additions to the original design is that the place of the *November* setting from the Stenness circle is marked, *not* by a tumulus, but by a standing stone. As the stone near Deepdale and the tumulus at Onston are only about 1200 yards apart, the suggestion may be made that in later times tumuli in some cases replaced stones as collimation marks.

NORMAN LOCKYER.

## SOUTH AFRICAN GEOLOGY.[1]

MR. ROGERS has produced a handbook to the geology of Cape Colony which is sure to remain a standard treatise. New observations will be recorded in future editions, as the work of his survey is carried on; but results made public as recently as 1904 are included in the present volume. The book appears with especial appropriateness, now that the visit of the British Association to South Africa has been officially organised; and the included geological map, on the scale of about one inch to ninety miles, gives an admirable impression of the country. In it we see the huge Karroo synclinal, occupying almost all the colony, and lying between the pre-Devonian masses that crop out upon the north and the closely folded rocks of the Cape system along the south; while Mr. Rogers's introduction connects the scenic features with the geological structure in a manner that attracts us at the outset.

It is unfortunate that the names chosen for the colonial systems of rocks are not readily represented by adjectives. Hence such ungrammatical expressions as "pre-Cape" and "pre-Karroo" have been received indelibly into literature. Even the International Congress may hesitate to speak of an "*étage bokkeveldien*," though we have, to be sure, "purbeckien" and "bathonien" in Europe. This use of local names is, of course, greatly to be commended, in view of the scarcity of fossils in the great majority of the series.

The invasion of the old Malmesbury beds in the west of the colony by granite is concisely described on p. 38; and it is interesting to note how gneissic structures have arisen in the granite, as in so many other instances, without "evidence of a great amount of crushing or rearrangement of its component minerals after it solidified." The foliation-planes in the gneissoid granite are parallel with the strike and cleavage of the adjacent sedimentary rocks, and the whole structure seems one of subterranean flow. The granulites of the Darling area will clearly bear comparison with those that have been so much discussed in Saxony. The intercalation of orthoclase crystals from the granite in lenticular areas between laminæ of slate (p. 43) reminds us, again, of the composite rocks of Donegal.

Mr. Rogers gives an interesting account of the stages in the passage from the well known blue crocidolite to the more siliceous yellow "griqualandite" in the slates of the Griquatown series. The slates themselves are converted into jasper-rocks where the most altered amphibole occurs; and the crests and troughs of the folds have afforded hollows in which the fibres of amphibole have crystallised across from one surface to another.

The Cape system, including the Table Mountain series at its base, has been greatly contorted and overfolded in the south; but the southern edge of the Karroo beds is also involved (p. 407), and the great east-and-west ridges of the continental margin date from somewhere about Jurassic times. Flattened and striated pebbles occur in the Table Mountain beds, and are regarded as the first evidence of a neighbouring highland on which glaciers gathered. The Devonian Bokkeveld beds follow, and the still higher and famous Dwyka conglomerate is, as all geologists know, of Permo-Carboniferous age. It is somewhat fascinating to conceive the growth of glacial conditions through at least two long geological periods, until the flood of ice at last spread southward from the Transvaal territories, and scored and rounded all the preceding rock-masses down to the region of the Cape itself.

The Dwyka beds, a facies of the Kimberley-Ecca series, and long regarded as volcanic tuffs, are here very adequately described, with several effective illustrations. The glacial series at Vereeniging is associated with beds containing the Glossopteris flora, and also Sigillaria and other northern forms; and Mr. Rogers points out that the cold cannot have been responsible for preventing a more frequent mingling of these two well marked floras. The most novel portion of the account of the reptiliferous Beaufort beds of the "Karroo system" is the strong hint (p. 198) that they should be regarded as Permian rather than Triassic. This view, based on Amalitzky's work in Russia, would lead to a reconsideration of the Elgin Sandstone also, and to the acceptance of a development of reptilian life in Permian

FIG. 1.—Overfolded quartzites of the Table Mountain Series, Meiring's Poort, representative of the great upheaval, which probably took place in early Jurassic times. From Rogers's "Geology of Cape Colony."

[1] "An Introduction to the Geology of Cape Colony." By A. W. Rogers, M.A., F.G.S., Director of the Geological Survey of Cape Colony. Pp. xviii+463. (London: Longmans, Green and Co., 1905.) Price 9s. net.

times as surprising and swiftly various as that of the Eocene Mammalia. We presume that the Stormberg series must then include the whole of the Trias, and not merely the Rhætic, as Feistmantel and Seward have proposed. The consideration of this and similar questions is made far more interesting by the appearance of Dr. Corstorphine's address on the history of stratigraphical investigation in South Africa ("Report of the South African Association for the Advancement of Science," 1904, p. 145), to which is appended a table showing the classifications of various authors, starting with the brilliant and perceptive work of Bain in 1856.

Prof. R. Broom has provided Mr. Rogers with a chapter on the Karroo reptiles, in which the early carnivorous types, Ælurosaurus, Lycosuchus, &c., are separated from the Theriodonts as "Therocephalia." The pose given to the skeleton of Pareiasaurus in Fig. 18 is more erect than that at present adopted in the British Museum. The well known work of Prof. H. G. Seeley is mentioned later in the bibliographical appendix.

Mr. Rogers, quoting the view of Mr. Kitchin, who compares the fossils with those of similar beds in India, does not allow the presence of Jurassic strata in the Uitenhage series, so that the Jurassic system may be represented merely by the underlying unconformity (compare p. 408). The perforation of the Stormberg and preceding rocks by the diamantiferous volcanic pipes occurred, in all likelihood, in Lower Cretaceous times. The bending up of the strata round these vents presents us with a curious reminder of the old "crater of elevation" theory.

Denudation has attacked the surface of the interior of the colony "uninterruptedly from the close of the Stormberg period (Rhætic) to the present day," and the folded belt of the south seems to have furnished a fairly complete barrier against inroads of the Cretaceous sea (p. 414). A useful chapter on the geological features to be observed along the main lines of railway concludes this compact and highly attractive handbook. GRENVILLE A. J. COLE.

## *THE NAUMANN FESTIVAL AT CÖTHEN.*

NAUMANN is but a name to nine out of ten British ornithologists, and the proportion of them who have held in hand a volume with that name on the title-page must be smaller still. Yet it was borne by two men who, taking them all round, were the most practical ornithologists that ever lived, for their personal knowledge of the birds of Central Europe was not exceeded by that of any of their contemporaries, and it may be fairly doubted whether any of their successors, vastly improved as are the modern means of acquiring such knowledge, have attained to the like acquaintance.

The elder Naumann, Johann Andreas, seems hardly ever to have quitted the little village of Ziebigk, near Cöthen, in the duchy of Anhalt, where he was born in 1744, the son of a small landed proprietor, to whose estate he succeeded. He has left a curious autobiographical sketch, which was prefixed to the first volume of the edition of the joint work of himself and his son, Johann Friedrich, published in 1822. If ever a man devoted himself to the observation and study of birds it was this Johann Andreas, who from his boyhood passed days and nights in this sole pursuit. How he found time to take a wife—for he tells us that he often forgot his dinner—is marvellous; but marry he did, and had three sons, the eldest, Johann Friedrich, already named, born in 1780, and two others; one of them, Carl Andreas, born in 1786, became a fair assistant to his father and brother, without, however, publishing anything on his own account. The father brought up these three boys to follow his own tastes and live his own life. A gun was put into their hands as soon as they could hold it, they were made familiar with every device for catching birds, and they were also taught to draw. In this last respect the eldest attained so much proficiency that by the time he was fifteen he had executed a great number of drawings of birds, which the father proceeded to have engraved on copper and to publish in folio form. The work thus produced proves to be one of the rarest in ornithological literature, if literature it may be called, seeing that not a word of letterpress accompanied the plates. Whether a complete set of them exists anywhere is uncertain, and Dr. Leverkühn's labours seem to show that not quite a dozen more or less imperfect copies are known, though there is no room here for bibliographical details. The next thing the father did was to bring out in small octavo the first volume of what was called "A Detailed Description of the Forest-, Field-, and Water-birds of the Principality of Anhalt and the Neighbouring Districts." This appeared in 1797, and was illustrated by coloured figures by the son Johann Friedrich. Some of them are reproductions of those in the older series, but the style of drawing was manifestly improved, and, moreover, went on improving as the work itself did, for it quite outgrew the bounds of its native principality, and the fourth and last volume, published in 1803, appeared as "The Natural History of the Land- and Water-birds of Northern Germany and the Adjoining Countries." This was followed by a series of eight supplements, the last of which came out in 1817. A remarkable feature of this work is its extreme simplicity and truth, and the absence of all scientific pretence. There is not even a Latin name in it! Yet there was no attempt by "writing down" to gain popularity, and whether it became popular is doubtful. All that can be said is that copies are now not easily to be had. In England when a man tries to do a thing of this kind we know too well what is generally the lamentable result. He makes a fool of himself on almost every page; but this is just what Johann Andreas did not. He wrote with quiet dignity from his own knowledge, and his knowledge was sound. There was no need for him to borrow from anybody else.

The father's work being thus successfully concluded, the son, Johann Friedrich, lost no time in bringing out a new edition of it, and it is on this edition that the latter's fame rests, and rests securely. The preface is dated 1818, and some copies of the first volume are said to bear 1820 on the title-page. Doubtless it was then ready for publication, though for some reason it seems to have been delayed for a couple of years. Twelve volumes (parts they are called) appeared at long intervals, the last in 1844, and it may be truly averred that for completeness nothing like them exists in any language. They continue the same simple and direct style of the father's work; but the son willingly cited other authors and showed that he had read them. He also extended his area of observation, journeying to Jutland in the north and to Hungary in the south, beside voyaging to Heligoland—the ornithological peculiarities of which he was the first to detect. Moreover, he discovered that anatomy was not to be neglected, and accordingly each genus as he treated of it had prefixed to it a brief account of its internal structure, and to this end he had the good fortune to obtain the services of Christian Ludwig Nitzsch, who carried on this portion of the work until his death in 1837, when his place was taken by Rudolf Wagner. Two years after the work was ended the author began a supplement, which had not proceeded far when he died, in 1857, and this was left to be completed by two of his friends, the late Prof. J. H. Blasius and Dr. Eduard Baldamus.

Carefully elaborated as this great work had been, its information had, of course, fallen behind the times, and

a natural desire was expressed for a new edition. The first part of this appeared in 1897, under the general editorship of Dr. Carl R. Hennicke, of Gera, who has been assisted by a company of thirty-six coadjutors, comprising the chief ornithologists of Central Europe, and to celebrate the recent completion of this grand undertaking in ten folio volumes a *Naumann-Feier* is to be held at Cöthen on Sunday, May 14, under the direction of Dr. Jacobi von Wangelin, of Merseburg, and Prof. Rudolf Blasius, of Brunswick, the presidents respectively of the German Bird Protection Union and the German Ornithological Society. The business of the day is announced as of the simplest character, just as one may suppose would be consonant with the wishes of the men to be honoured—an inspection of the Naumann collections, now housed in the ducal palace, a pilgrimage to the graves of the Naumanns at Ziebigk, their old abode, on which a laurel wreath will be laid, and a visit of respect to the daughter-in-law of Johann Friedrich, a return to Cöthen for a festival dinner—that is all. Who will attend I know not, but assuredly every German ornithologist will be present in the spirit, and my chief object in writing these lines is that British ornithologists should sympathise with their German brethren on the occasion. Making every allowance for the ordinary Englishman's linguistic deficiencies, it is not to the credit of our predecessors in this country, though there are many of whom we may be justly proud, that until the year 1850 not one of them seems ever to have heard of the Naumanns and their incomparable works. It was Mr. G. R. Gray who, in a British Museum catalogue, first cited that of Johann Friedrich, and then merely on nomenclatural grounds. It was there that I first met with its title, and I lost no time in seeking the work in the library of Cambridge University. Words fail me to express the delight with which I looked into one volume after another of this huge store of information, or the admiration with which I regarded its unpretentious but exquisitely executed plates. That was nearly five-and-fifty years ago, but much as the study has since advanced, the opinion I then formed I hold now, that for fulness of treatment, perspicuity, and general accuracy, the work of Johann Friedrich Naumann has not been surpassed.

Willingly would I dwell longer on the subject, but I think I may have said enough, though I must add that for many of the details above given I am indebted to two articles by Dr. Lindner published in "Die Schwalbe" of Vienna for 1894 (Nos. 7 and 8), and still more to Dr. Paul Leverkühn's excellent biographical preface to the first volume of the recent edition already mentioned, which has been separately printed, "Biographisches über die Drei Naumanns" (Gera-Untermhaus: 1904). Later still that gentleman has come into possession of much of Johann Friedrich's correspondence, which it is sincerely to be hoped he will find the means of publishing, as it can hardly fail to be of great interest. ALFRED NEWTON.

## *DR. J. E. DUTTON.*

IT is with deep regret that we announce the sudden death of Dr. Dutton (Walter Myers Fellow) at Kosongo, in the Congo, on February 27, while actively engaged in the investigation of trypanosomiasis and tick fever.

The expedition which Dr. Dutton was leading was a very completely equipped one, and commenced work in the Congo in September, 1903. It consisted originally of Drs. Dutton, Todd, and Christy, and was subsequently joined by Dr. Inge Heiberg. The Belgian Government erected a special hospital for them, and placed every possible facility at their disposal both for investigation and travelling. Whilst conducting the investigation and mapping the distribution of sleeping sickness and tick fever, they travelled several thousand miles by river and road, and reached a station beyond Stanley Falls.

In the death of Dr. Dutton, not only have the Tropical School and the University of Liverpool lost a brilliant graduate, but medicine has lost one of its most promising men, a man who, although only twenty-nine years of age, had already won a recognised position throughout the scientific world. Educated at the King's School, Chester, Dr. Dutton proceeded to the University of Liverpool, where he rapidly made his way to the front. In 1897 he was appointed to the George Holt fellowship in pathology, a post which has had a marked effect in stimulating men to devote time to research and in supplying able investigators in tropical medicine. In 1900 he commenced the study of tropical medicine under the leadership of Dr. Annett, and together with Dr. Elliott, of Toronto University, he proceeded to Nigeria in order to study the habits of the Anopheles and the most effective measures of prevention of malaria. In 1901 he proceeded alone to the Gambia, and drew a comprehensive and useful anti-malarial report which has proved of the greatest service to the colony. It was during this expedition that he identified in the blood of the patient shown to him by Dr. Forde, of Bathurst, the trypanosome which he described and named as *Trypanosoma gambiense*.

Having established the presence of the trypanosome in man, Dr. Dutton immediately set off on another expedition to ascertain how far it was distributed in the native population. This expedition formed the basis of his first trypanosomiasis report (Senegambia, 1902).

The first progress report of the Congo expedition was published in 1904; this has been followed by others, including the description of the "Congo Floor Maggot," by Drs. Dutton, Todd, and Christy, and the "Cerebro-spinal Fluid in Trypanosomiasis," by Dr. Christy; "A Comparison of the Animal Reactions of the Trypanosomes of Uganda and Congo Free State Sleeping Sickness with that of *Trypanosoma gambiense*," by Drs. Thomas and Linton; "Two Cases of Trypanosomiasis in Europeans," by Drs. Dutton, Todd, and Christy; and "Supplementary Notes on the Tsetse-flies," by Mr. E. E. Austen. More recently Dr. Dutton wrote an interesting paper on the "Intermediary Host of the *Filaria cypseli*" (the filaria of the African swift), in which he described the intermediate host as a louse (subfamily Leiothinæ) in the abdominal cavity of which he observed the various stages of the development of the filaria. He showed that the infection was probably spread by the birds eating the infected lice.

Toward the end of 1904 the investigators had reached Stanley Falls, and quite independently Drs. Dutton and Todd verified the discovery of the cause of tick spirillum fever in man made a few weeks previously by Milne and Ross in the Uganda Protectorate; but, furthermore, they were able to transmit the disease to monkeys and rabbits by means of the bite of the infected tick. They were able to make *post mortem* examinations on cases of the fever, in the course of which Dr. Dutton contracted the disease by a *post mortem* wound and Dr. Todd an abortive attack apparently directly through a tick bite. From this fever they recovered, in Dr. Dutton's case after four typical relapses. Their researches into the relationship between the infection in man and the tick were so far advanced that they were able to prepare a report which is due by the next mail. In the meantime, they have given an account of an experiment in which tick spirillum fever has been conveyed to a monkey by the bites of young ticks during the first feed after hatching from the ova of naturally infected adults.

## NOTES.

THE gentlemen's soirée of the Royal Society will take place at Burlington House on Wednesday next, May 17.

IN a murder trial concluded last week, a finger mark left by one of the prisoners upon a cash-box tray at the shop where the crime was committed was used for purposes of identification. An inspector gave evidence that there were 80,000 or 90,000 sets of finger prints in the finger print department of Scotland Yard, and that he had never found two such impressions to correspond. The right thumb print of one of the prisoners agreed in twelve characteristics with an impression made with perspiration upon the cash-box tray, and therefore gave corroborative evidence of identity. It is probable, as Mr. Galton pointed out some years ago, that no two finger-prints in the whole world are so alike that an expert would fail to distinguish between them. The system was largely used in India by Sir William Herschel nearly fifty years ago, and was found by him to be most successful in preventing personation, and in putting an end to disputes about the authenticity of deeds. He described his methods in these pages in 1880 (vol. xxiii. p. 76); and in the previous volume (vol. xxii. p. 605) Mr. Henry Faulds referred to the use of finger-marks for the identification of criminals. There is no doubt as to the value of this system of identification, which was described in the pages of NATURE long before its practical applications had been realised, and we regret that anything should have occurred to throw discredit upon it. It appears from the reports of the trial referred to that a person who professed to be properly qualified wrote to the Director of Public Prosecutions, and also to the solicitors for the defence, offering to give evidence as an expert on the finger impressions, although he had not seen the impressions. It is not to be wondered at that Mr. Justice Channell should denounce such action in strong language, and whether the jury agreed with him or not—that the witness was "absolutely untrustworthy"—they no doubt considered that evidence which could be given on either side could not be of much importance. From the scientific point of view, we regret that a method which is associated with the names of men of such scientific eminence as Sir William Herschel and Mr. Francis Galton should be brought into disrepute. Finger prints are not only of value for personal identification, but also for hereditary investigations, and any action which produces comments like those made by Mr. Justice Channell is to be deplored, because it tends to shake the confidence of men in methods which rest on secure scientific foundations.

THE council of the Linnean Society of New South Wales has appointed Mr. Harald I. Jensen to be the first Linnean Macleay fellow.

THE *Athenaeum* announces the death of Prof. Otto Struve, who succeeded his father as director of the Nicholas Central Observatory at Pulkowa in 1861.

*Science* announces that Prof. L. Warren, for twenty-seven years professor of mathematics at Colby College, died on April 21, at the age of sixty-nine years.

THE *Times* understands that the trustees of the British Museum have expressed their willingness to receive carefully selected phonographic records of the voices of distinguished living men. The records will be for posterity only, and will in no circumstances be available for contemporary use.

PROF. E. B. FROST has been appointed director of the Yerkes Observatory by the trustees of the University of Chicago, in succession to Prof. G. E. Hale, who now gives his whole time to the establishment of the new Solar Observatory of the Carnegie Institution at Mt. Wilson, California.

A PARTY of zoological students from the Birkbeck College spent part of the Easter vacation trawling, dredging, and shore collecting at West Mersea, on the Essex coast. Although the temperature was very low for the time of year, many specimens were collected, and much experience was gained.

A REUTER correspondent at Bombay reports that a severe earthquake occurred at Bandar Abbas on April 25. Five shocks were experienced during the afternoon, and shocks have been occurring daily since. Sarn, a town west of Bandar Abbas, is reported to have suffered severely.

THE death is announced, in his eighty-eighth year, of Colonel N. Pike, known for his contributions to the natural history of birds, reptiles, and amphibia. For several years Colonel Pike held the post of American consul in the Island of Mauritius, and during this time he collected extensively the local fauna and prepared from the living specimens many coloured drawings. His most extended work was his "Sub-Tropical Rambles in the Land of the Aphanopteryx."

A REUTER telegram from Christiania reports that the *Belgica*, with the members of the Duc d'Orléans's Arctic Expedition on board, left Sandefjord on May 6 for Bergen, where the duke will embark. From Bergen the *Belgica* will go to Spitsbergen, Greenland, and Shannon Islands, where the Duc d'Orléans intends to visit the depôts of the Ziegler Expedition. His intention is to bring the members of that expedition back with him on the *Belgica*, and he hopes to return to Ostend in September.

THE Rome correspondent of the *Pall Mall Gazette* states that it is again proposed to affix a marble tablet to the Villa Medici, which is French property, to remind passers by and posterity that Galileo was kept prisoner there from June 24 to July 6, 1633. Italy has already erected a small monument to Galileo at the very door of the villa, with the following inscription:—"The neighbouring palace, which belonged to the Medici, was the prison of Galileo Galilei, guilty of having seen the earth revolving round the sun."

THE anniversary meeting of the Royal Geographical Society will be held on Monday, May 22. The annual conversazione will be held in the Natural History Museum, South Kensington, on Tuesday, June 27. In place of the annual dinner of the society this year, a banquet in honour of the retiring president, Sir Clements R. Markham, K.C.B., will be held on the evening of the anniversary meeting, May 22, at the Hotel Metropole.

THE Paris correspondent of the *Times* remarks that about 150 physicians and surgeons have arrived there from England, many of them with their wives and families, to return the visit which the French doctors paid to London last year. The formal reception took place last night at the Sorbonne. During the stay of the English medical men, besides the many attractive excursions and social entertainments arranged in their honour, every facility is to be given them for inspecting the hospitals.

IN proposing the toast of "The Japan Society" at its annual dinner on May 3, Sir Frederick Treves referred to the medical and surgical ability of the Japanese. Nothing

astounded him more, he said, in his recent visit to Japan than the way in which the Japanese have inquired into the medicine and surgery of the western world and the marvellous thing they are making out of it. It is difficult to credit the astonishing advance made by the Japanese in medical equipment in time of war. Many of the problems which have been the terror of war in European countries the Japanese are solving or have solved. British troops enter a war with many determinations—one of which is to have 10 per cent. of sick, and they get it. The Japanese are quite content with 1 per cent. of sick, and they get it. The Japanese have all the qualities of a surgeon. They have infinite patience and infinite tenderness. Sir F. Treves is confident that not many years hence there will be seen in Japan one of the most progressive schools of medicine the world has ever known.

THE annual congress of the South-eastern Union of Scientific Societies will be held at Reigate on June 7–10 inclusive, under the presidency of Prof. Flinders Petrie, F.R.S. Among the papers to be contributed are the following:—"Mendel's Law," Miss Saunders; "Botany of Reigate District," Messrs. R. H. Welchman and C. E. Salmon; "Local Orchids," Dr. Hodgson; "Eggs of Lepidoptera," Mr. Tonge; "The Law of Treasure Trove in Relation to Archæological Research," Dr. William Martin; "The Land and Fresh-water Shells of S.E. England," Mr. A. Santer Kennard. There will be excursions to Worth Church; Gatton; Mr. Maw's observatory, Outwood; Reigate Castle; Mr. Brown's Atherfield clay pit, &c. The Mayor of Reigate will give a reception on Friday, June 9. The congress secretaries are Mr. G. E. Frisby, Redhill, and Mrs. Taylor, Clear's Corner, Reigate, from whom all information can be obtained.

DURING the forthcoming eclipse of the sun, on August 30, aëronautical ascents will be made at Paris, Burgos, Prague, and very likely in Algeria. It is intended to study the variations, not only of the temperature of the air in the shade and in the sun, but also the solar radiation at several altitudes. If it is possible to take aërial photographs of the corona from the balloons it will be done at Burgos, and possibly at Wargia. M. Trépied, director of the Algiers Observatory, has left for Guelma, on a railway 36 miles south-west of Bona, and really a desert oasis. The sky is anticipated to be quite clear at that place, as at the end of August northerly breezes, which are very frequent on the coast, are hardly to be felt in the Sahara. The Algerian eclipse observatory will be housed in the French public school. For the last twenty years a weather bureau has been established in Algeria, and is situated on the terrace of the City Hall. The establishment is connected by telegraph with forty stations, which are sending regularly each morning observations used in the reduction of the warnings and forecasts.

LORD AVEBURY delivered his presidential address at the soirée of the Selborne Society on May 3. In the course of his remarks he referred to the animated discussion which took place recently in the newspapers as to whether Greek should be a compulsory subject in university examinations—which is euphemistically termed "maintaining the Greek basis of education against the material tendencies of the present day." It is not we, he continued, who wish to pit Greek grammar against nature-study. Greek—even a little Greek—is very useful. But nothing was said, Lord Avebury contended, about science being a compulsory subject—which alike from a practical and an educational point of view is even more important. Education without science is incomplete and one-sided, and the greatest classical scholar, if he know nothing of the world we live in, is but a half-educated man after all. Sir James Crichton Browne spoke of the value of the society's work from the point of view of mental health, while Sir John Cockburn urged the usefulness of that study of nature which is not rigidly scientific. Among the many exhibits of natural history and antiquarian interest was some honey gathered by bees in the "East End." This was shown by the Stepney Borough Museum, and it is practically certain that it was derived from sugar on the ships in the London Docks, a mile from the hive.

THE Belgian Royal Academy has issued the following lists of prize subjects for 1905 and 1906:—for 1905, in mathematical and physical sciences, on the combinations formed by halogens; on physical, particularly thermal, phenomena accompanying dissolution; on linear complexes of the third order; and on the deviation of the vertical treated from the hypothesis of the non-coincidence of the centres of mass of the earth's crust and nucleus. In natural sciences, on the function of albuminoids in nutrition; on the reproduction and sexuality of Dicyemidæ; on the silicates of Belgium; on the formations of Brabant between the Bruxellian and the Tongrian; on certain Belgian deposits of sand, clay, and pebbles; on the sexuality of the individuals resulting from a single ovum in certain dicœcious plants; and on the development of Amphioxus. For 1906 the subjects in mathematical and physical sciences are:—on critical phenomena in physics; on $n$-linear forms ($n>3$); on thermal conductivity of liquids and solutions; and on the unipolar induction of Weber. In natural sciences, on the Cambrian series of Stavelot; on the effect of mineral substances on the assimilation of carbon by organisms; on the effects of osmotic pressure in animal life; on the tectonic of Brabant; on the soluble ferments of milk; and on the physiological action of histones. The essays for 1905 and 1906 are to be sent in by August 1 of the respective years, and the prizes range from 24*l.* to 40*l.* in value. In addition, prizes bequeathed by Edward Mailly and in memory of Louis Melsens are offered under the usual conditions for astronomy and applied chemistry or physics respectively.

THE codling-moth forms the subject of *Bulletin* No. 222 issued by the entomological division of the Michigan Agricultural College Experiment Station. This insect is a serious enemy to fruit-growers in the district, and the author, Mr. R. H. Pettit, has carefully worked out its life-history and devised effective means for its destruction.

AT the first congress of the Association of Economic Biologists, held in Birmingham University on April 19–20, Mr. A. E. Shipley directed attention to the circumstance that bacteriological and parasitical science is unrepresented on the committee appointed by Parliament to inquire into the nature of grouse-disease. The president, Mr. F. V. Theobald, emphasised the importance of closer study of the aphids affecting cultivated plants in this country, while parasites in the liver of swine, the porosity of wood, the injuries inflicted on plants by spring-tails, and ticks and fleas as conveyers of disease formed the subjects of other communications.

ARTICLE No. 4 of vol. xx. of the *Journal of the College of Science of Tokyo University* is devoted to the description of the spoon-worms (Gephyrea) of Japan, and is illustrated by one coloured and three black and white plates. The author, Mr. I. Ikeda, states that hitherto only four species of these worms appear to have been recorded from

Japanese waters, and of one of these no specimens have come under his notice. From a study extending over several years, he has been enabled to add 34 additional species to the fauna, thus bringing the number up to 38. Of the 34, no less than 24 appear to be new forms, all of which are provisionally referred to previously known generic types, although there are grounds for considering that some of those included in Thalassema might advantageously be assigned to a new genus.

SOME excellent photographs of Australian bird-life are reproduced in the March number of the *Victorian Naturalist*, among which may be specially mentioned a group of young diamond-birds (Pardalotes) and a nestling bronze-cuckoo in the act of ejecting the rightful occupant of the nest in which it was hatched. "When discovered, the nest contained two young birds. The cuckoo, blind, featherless, and apparently not more than a day old, struggling till it got beneath its victim, gradually lifted it to the edge of the nest, resting at intervals, all the while balancing the resisting nestling in the hollow between the wings immediately at the back of the neck. Slowly and relentlessly it pushed the unfortunate wren over the side. . . . The young wren was replaced in the nest half a dozen times, but always with a like result until the cuckoo was thoroughly exhausted."

TWO interesting Antarctic organisms obtained during the *Scotia* Expedition are described in the *Proceedings of the Royal Physical Society of Edinburgh*, vol. xvi., No. 2. In the first article, by Dr. J. Rennie, are discussed a number of isolated tentacles of a zoophyte belonging to the group Siphonophora. The specimens are barely sufficient for definite identification, but appear to indicate a type allied to the Mediterranean Apolemia, which attains a length of two or three yards. Mr. T. V. Hodgson, in the second communication, describes a five-limbed sea-spider (Pycnogonida) distinct from *Pentanymphon antarcticum* recently described on the evidence of a *Discovery* specimen. With the assistance of Dr. Calman, of the British Museum, the author has been enabled to identify the *Scotia* pycnogonid with *Decalopoda australis*, an almost forgotten generic type described so long ago as 1837. The occurrence of two five-limbed pycnogonids in the Antarctic is, in view of the absence of this type from all other seas, very remarkable.

MR. F. FLETCHER, Deputy Director of Agriculture, Bombay Presidency, is the author of a small volume, published at Bombay, entitled "Notes on some Egyptian Insect Pests." In the autumn of 1901 the author, it appears, was engaged to teach agricultural entomology to the students at the Khedivial Agricultural School, Giza, and found himself seriously hampered in his task by the fact that practically nothing was known with regard to the insects which are harmful to the Egyptian agriculturist. Accordingly, during a two years' sojourn in the country, Mr. Fletcher set himself to study such insects whenever opportunity occurred, and the present "booklet" is the result. It contains an introduction showing the position of insects in the animal kingdom, followed by a short summary of the life-history and structure of insects in general, after which comes an account of the species forming the proper subject of the "notes." The publication seems admirably adapted to the needs of those for whom it is intended.

THE catalogue forming appendix ii. to the *Kew Bulletin* of books and pamphlets added to the library of the Botanic Gardens during the past year has been received; as usual, the printing is confined to one side of the paper only, in order that, if desired, the separate titles may be cut out.

THE collection of phenological records by teachers and pupils of schools in Nova Scotia has been proceeding for some years, and the number of schools sending in lists has been increasing. The data supplied by about 300 selected schedules in 1903 have been utilised for the compilation of phenochrons or average dates for different regions of the province, and these have been tabulated in vol. x., part xvi., of the *Transactions of the Royal Society of Canada*.

SINCE the year 1900, a gooseberry mildew, *Sphaerotheca mors-uvae*, which appears to have been introduced from the United States, has been observed in Ireland and Russia. Mr. E. S. Salmon, who reported the first appearance in Ireland, and has since notified the spread of the disease, announces in the *Journal of the Royal Horticultural Society* (vol. xxix.) its continued increase in these countries. The yellow varieties seem to suffer most. Spraying checks the fungus, but the only effectual remedy is to burn all the diseased bushes. Mr. Salmon contributes also to *Annales Mycologici* an account of a disease observed on plants of *Euonymus japonicus* in the south of England and elsewhere caused by an *oidium* or conidial stage of one of the Erysiphaceæ.

HERR PAUL GROSSER has recently visited and described the site of the Tarawera eruption of 1886, in the north island of New Zealand ("Vulkanologische Streifzüge im Maoriland," *Verhandlungen des naturhistorischen Vereins der preuss. Rheinlande*, 1904, pp. 37–58). He lays stress on the linear grouping of the eruptive centres, the ash-cones of which are almost as contiguous as pearls on a string. A fine photograph is given of a crater exploded through rhyolite on Ruawahia, with basaltic ashes covering the country above. Incidentally, Herr Grosser examined the ground affected by the Port Nicholson earthquake of 1855, which is described in the later editions of Lyell's "Principles of Geology"; and he adds the interesting detail that the elevation of the floor of a lagoon by two metres enabled it to be successfully drained into the sea, a work previously attempted, but abandoned.

THE shoal-water deposits of the Bermuda banks are described by Mr. H. B. Bigelow (*Proc. Amer. Acad. Arts and Sciences*, xl., No. 15). The oceanic character of Bermuda, due to its great distance from the neighbouring continent, prevents its receiving much foreign detritus, and its submarine deposits are almost wholly local. The great bulk of these is calcareous, with some spicules of siliceous organisms. True coral sand is absent; indeed, there is a great rarity of coral fragments, for although corals flourish on the reefs, they do so in a subordinate manner. The Bermuda plateau is of interest in illustrating the growth of a limestone island where reef-building corals are of slight importance. The organisms chiefly active in the formation of the shell-sands are corallines, molluscs, tube-building worms, millepores, and foraminifera. Algæ probably form the greatest mass of the sand. White marls are described as due to the slow trituration of wind-borne material. There are also limited areas of blue mud. This seems to be of terrigenous origin, being the fine detritus washed down by rain from the calcareous hills, with vegetable matter.

TO the March number of the *American Naturalist* Dr. A. Hollick contributes a paper on the occurrence and origin of amber in the eastern United States. Although amber has for many years been known to occur in several

districts in this part of America, a discovery of the occurrence of this substance in large masses has been recently made in the Cretaceous deposits of Kreischerville, Staten Island, N.Y. The amber, which is being extensively worked for commercial purposes, occurs in a bed containing layers and masses of vegetable débris, together with lignite and pyrite. The bed appears to be lens-shaped. Some at least of the amber is presumed to be the product of sequoias, but it is possible that a species of Pinus, and perhaps a representative of the Austro-Malayan genus Dammara, may have contributed to its production. The remaining articles include one by Prof. Hallow on the structure of the vascular cylinder in hybrid catalpa trees; a second, by Messrs. Cushman and Henderson, on fresh-water rhizopods from New Hampshire; and a third, by Dr. F. W. Carpenter, on the behaviour of a fruit fly under certain stimulants.

A DESCRIPTION of the large diamond found recently in the Premier Mine, Transvaal, is given in the *Geological Magazine* (April) by Dr. F. H. Hatch and Dr. G. S. Corstorphine, with reproductions of four photographs which represent the diamond in its actual size from four

FIG. 1.—View of the Cullinan Diamond. Actual size. From a photograph by E. H. V. Melvill.

different points of view. One of these pictures is here given (Fig. 1), and it conveys a good idea of the size and shape of the crystal. The stone is bounded by eight surfaces, four of which are faces of the original crystal, and four are cleavage surfaces, which are distinguished from the original octahedral faces by greater regularity and smoothness. For a large stone the crystal is of remarkable purity, and the colour approaches that of a blue-white. The complete crystal appears to have been a distorted octahedron, with dodecahedral faces developed on the edges; and the portions missing probably amount to more than half the original crystal. The stone, which has been named the Cullinan diamond, weighs 9600·5 grains troy, or 1·37 lb. avoirdupois; this is more than three times the weight of the largest diamond previously known.

SOME account of the Mount Morgan Gold Mine, Queensland, is given by Mr. E. J. Dunn (*Proc. Royal Soc. Victoria*, vol. xvii., part ii.). The hill, which rises to a height of 580 feet, is formed mainly of igneous rocks, within which are enclosed masses of decomposed rock, made up of siliceous and ferruginous material, and overlying these is a plug of Desert Sandstone, nearly 100 feet thick in places. The sandstone occupies a hollow in loose sandy beds overlying a ferruginous layer, and these beds yielded the rich secondary ore for which Mount Morgan has been celebrated. No naturally formed gold is known that more nearly reached chemical purity. At a much lower depth, in what is known as the sulphide zone, the gold is much alloyed with silver. The silver was got rid of in the transference of the leached ore to the enriched zone. The state of subdivision of the gold in this zone was so extreme that rich samples, in some cases those carrying 50 oz. per ton, showed no traces of gold that could be detected by the naked eye. The author attributes the formation of the secondary ore to the mechanical and chemical action of sea-water on the sulphide ore, there being evidence of considerable local erosion before the horizontal beds of Desert Sandstone were laid down.

THE Canadian Department of Marine and Fisheries has published the meteorological results obtained at the magnetical observatory at Toronto for the year 1904, with remarks, in a handy and useful form. The monthly means are in most cases compared with an average of sixty-four years, and are consequently of considerable value. The mean temperature of the year 1904 was 42°·2, being 2°·2 below the average. The maximum daily mean was 78°·9, on July 18, and the coldest day −8°·5, on January 14. The rainfall measured 30·04 inches (3·05 inches above the yearly average); this amount does not include 56·5 inches of snow, which is measured quite separately from rain.

AN important step for the promotion of New South Wales meteorology is recorded in the *U.S. Monthly Weather Review* (vol. xxxii., No. 11, p. 518). It seems that the principal newspaper of the colony, the *Daily Telegraph*, has commenced the publication of a daily weather chart. The origin of this step is stated in the following brief extract from the first number of the paper which contained this new information, a more complete account of which is inserted in the *Weather Review* referred to above:—"The inclusion of meteorology in the new public schools syllabus has directed special attention to consideration of weather conditions. Correspondents, including a number of public school teachers, have applied to the *Daily Telegraph* for amplified daily information on this subject, and the meteorological branch of the Sydney Observatory also has been requested to furnish details of the weather conditions and atmospheric pressures, the information upon which the weather forecasts are made. The *Daily Telegraph* has arranged to publish daily a chart showing the principal features of weather conditions, including the high and low pressure isobars. Where possible the rainfall area will be indicated and conditions on the coast will also be given. . . . The publication of isobaric charts will enable students with their local knowledge of physical surroundings to anticipate in detail their probable weather more completely than is possible at the central

office, where precise knowledge of local peculiarities is lacking." Those acquainted with Australian meteorology will appreciate the importance of disseminating a knowledge of this valuable factor in Australian welfare. In many countries the absence of public interest in the science of the weather is due to its omission from all school instruction, and we in Great Britain are suffering from the same neglect.

THE current number of the *Fortnightly Review* contains an article by Major B. Baden-Powell, president of the Aëronautical Society, entitled "Air-ships and M. Santos Dumont." Major Baden-Powell supplements and criticises a contribution by M. Santos Dumont to an earlier number of the same review on air-ships. He also points out some of the advantages to be gained by flying machines not dependent on a light gas to lift them, and directs attention to a few of the drawbacks inherent in the large gas-bag. The attainment of human flight, he contends, apparently presents no insuperable difficulties. "All that is wanted, so far as I can see, is a few thousand pounds and a clever and energetic inventor, and there is no reason why a machine could not be constructed within a year or two capable of rising and carrying a man in safety for, at all events, a short trip through the air."

THE water jet affords a most convenient method of applying the power carried by high-pressure water, whether for driving wheels, such as are generally known as Pelton wheels, for conveying the water itself into burning buildings, or for the destructive process of breaking down a mountain side, as practised in hydraulic mining. All this is especially the case in mountainous country where water supply with almost unlimited head is available. As it is not always necessary that the jet should work at full power, regulation becomes necessary. Merely reducing the flow of water by throttling elsewhere than at the jet would be ruinously wasteful, for half the flow would carry one-quarter the power, and a driven wheel would no longer run at the proper speed. The regulating nozzle described in a thesis entitled "An Investigation of the Doble Needle Regulating Nozzle," by H. C. Crowell and G. C. D. Lenth (printed by permission of the Civil Engineering Department of the Massachusetts Institute of Technology, Boston, and Tangential Water Wheels, Abner Doble Company), contains a spindle-shaped concentric needle which may be advanced so as to reduce the area of the orifice or withdrawn so as to enlarge it, but the form of the annular passage-way is always such as to lead the water to converge along easy stream lines, until a circular jet of corresponding size is the result. In this way a range of 10 to 1 in the area of the jet may be attained, while the full head is always available. Very beautiful photographs are given showing the jets like clear glass rods instead of the familiar opaque and spray-clothed stream of water. Efficiencies from 96·4 to 99·3 for the energy of the jet are found, which correspond to 98·2 to 99·7 for the velocity.

IN vol. vi. of the *Transactions of the American Electrochemical Society*, which has just been published, Messrs. A. G. Betts and E. F. Kern publish a paper on the "lead voltameter." Two years ago Mr. Betts found that lead could be deposited in a non-crystalline and dense form from solutions of lead fluosilicate to which had been added a small quantity of gelatin. The Canadian Smelting Company now manufactures more than twenty tons a day of refined lead from solutions of lead silicofluoride. Until Mr. Betts discovered this process it had not been found possible to refine lead electrolytically. By using the above solution the authors have constructed a voltameter which is—according to their published results—more accurate than the copper coulombmeter, and does not fall far behind the silver instrument. A glass beaker is used as the electrolysing cell, and a kathode of thin lead sheet is hung between two anodes of the same metal. The calculated value of the electro-equivalent of lead is 103·46. In this instrument, in which the electrolyte was 8·5 per cent. $PbSiF_6$, 2·5 per cent. $H_2SiF_6$, and a small quantity of gelatin, the numbers found in six experiments ranged from 103·39 to 103·49. Among other papers of interest in the same journal we note the electrolysis of fused salts, by Dr. Lorenz; the electrical extraction of nitrogen from the air, by Mr. J. S. Edström; electrolysis and catalysis, by Dr. W. Ostwald.

THE latest number of the *Journal of the Russian Physical and Chemical Society* (1904, No. 9) contains the conclusion of an interesting study, by B. N. Menshútkin, on Lomonósoff as a natural philosopher and a chemist. Lomonósoff's services in the creation of the Russian literary language and poetry are well known; but the remarkable work of this eighteenth century natural philosopher, of whom his friend and correspondent, Euler, always spoke with great respect, had hitherto found no proper appreciation in his mother country. His ideas upon the structure of matter, the atomistic theory of chemical changes, the mechanical theory of heat, his kinetic theory of gases, his views on the liquid and the solid state, and his theory of atmospheric electricity, which, he said, is always present in the atmosphere, and originates from the changes in the thermal potential of ascending and descending air currents—all these theories being based upon molecular movements within the bodies—were expressed in terms almost identical with those which are used now. "It is," he wrote, "the inner, unseen motions of the corpuscles of which all bodies are composed which are the cause of every rise of temperature in a given body. These movements are rotatory. When a cold body is brought into contact with a hot one, the latter communicates to the former the movements of its particles, which therefore are slackened in the hot body, and accelerated in the cold one. The greater these rotatory movements, the greater the repulsive forces, and the weaker the connection between them."

DR. A. C. HADDON, F.R.S., is delivering a course of lectures on Saturdays at the Horniman Museum, Forest Hill, S.E., on "Magic and Primitive Religion."

THE first volume, that for 1904, has been received of a series of yearly publications to be issued by the Chemical Society under the title "Annual Reports on the Progress of Chemistry." The object of these reports is to present an epitome of the principal definite steps in advance which have been accomplished in the preceding year. The first volume contains articles on general and physical chemistry, by Prof. James Walker, F.R.S.; on inorganic chemistry, by Dr. P. P. Bedson; on the aliphatic division of organic chemistry, by Mr. H. J. H. Fenton, F.R.S.; on the aromatic and other cyclic divisions of organic chemistry, by Prof. J. B. Cohen; on stereochemistry, by Prof. W. J. Pope, F.R.S.; on analytical chemistry, by Mr. A. C. Chapman; on physiological chemistry, by Prof. W. D. Halliburton, F.R.S.; on agricultural chemistry and vegetable physiology, by Dr. J. A. Voelcker; on mineralogical chemistry, by Dr. A. Hutchison; and on radio-activity, by Mr. F. Soddy. These summaries of the chief advances in various branches of chemical science should prove of real benefit to students, teachers of chemistry, and professional chemists.

## OUR ASTRONOMICAL COLUMN.

EPHEMERIS FOR COMET 1905 *a*.—A set of elements and a daily ephemeris for comet 1905 *a* are given in No. 4011 of the *Astronomische Nachrichten*. The ephemeris has been computed by Herr M. Ebell, and an extract is given below :—

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

| 1905 | α (true) h. m. s. | δ (true) ° ′ | log *r* | log Δ | Brightness |
|---|---|---|---|---|---|
| May 12 ... | 9 45 27 ... | +49 15·8 ... | 0·1066 ... | 9·9814 ... | 0·42 |
| 16 ... | 10 8 56 ... | +49 44·2 ... | 0·1172 ... | 0·0002 ... | 0·36 |
| 20 ... | 10 31 29 ... | +49 51·5 ... | 0·1281 ... | 0·0189 ... | 0·32 |
| 24 ... | 10 52 58 ... | +49 40·1 ... | 0·1394 ... | 0·0375 ... | 0·28 |
| 28 ... | 11 13 11 ... | +49 13·1 ... | 0·1508 ... | 0·0558 ... | 0·24 |
| June 1 ... | 11 32 9 ... | +48 32·8 ... | 0·1623 ... | 0·0740 .. | 0·21 |
| 5 ... | 11 49 51 ... | +47 41·8 ... | 0·1739 .. | 0·0919 ... | 0·18 |

COMETS 1905 II (1904 *e*) AND 1904 I.—A daily ephemeris for comet 1904 *e*, computed by Dr Strömgren, is given in No. 4011 of the *Astronomische Nachrichten*. The comet is now very faint, and as seen by Dr. Palisa at the beginning of April it was 10″ in diameter, and had a fourteenth-magnitude nucleus. During the present month it will apparently travel through the constellation Lynx in a south-easterly direction towards Leo Minor.

A bi-daily ephemeris for comet 1904 I, computed by Herren Nijland and van d Bilt, is given in the same journal. This comet is also faint, being 0·052 as bright as when first discovered, its magnitude then being about 9·0. It is likewise situated in the constellation Lynx, and is apparently travelling in a S.S.E. direction towards Cancer, although at the beginning of September it will only be about 3° south of 35 Lyncis.

OBSERVATIONS OF JUPITER.—The results of their observations of Jupiter during the 1904–5 opposition are given by MM. Flammarion and Benoit in the May number of the *Bulletin de la Société astronomique de France*. Numerous points of change in the colours and forms of the various features are noted, and some of them are illustrated on the four drawings accompanying the article. Among the other conclusions derived from these observations the writers state the following :—(1) the estimations of the coloration of the equatorial bands do not confirm Mr. Stanley Williams's views as to periodical changes therein; (2) the appearance of the Great Red Spot has not changed since the previous opposition; (3) the large variation of the longitude of this feature between March and June, 1904, was probably due to the passage alongside it of the dark region of the tropical zone; (4) a clear spot situated in longitude o° of system ii., and dividing the south equatorial band, appears to be a permanent feature which it will be well to observe assiduously. They further urge that careful attention should be paid at the end of this year to observations of the movements of the red spot, of the bright spots on the southern edge of south temperate band announced by Mr. Denning, and of the dark region situated in the south tropical zone.

THE ELECTRIC CHARGE OF THE SUN.—In No. 1, vol. x., of *Terrestrial Magnetism and Atmospheric Electricity* is reprinted the address "On the Electric Charge of the Sun" delivered by Prof. Svante Arrhenius before the International Electrical Congress held at St. Louis last September.

After briefly discussing the various theories regarding the nature of the sun's repulsive action, the author shows that the theory which explains the phenomena, by premising that the repulsion is due to radiation pressure acting on negatively charged particles, is in accordance with observational records. The particles having a specific weight of 1·0 and a radius of 0·08 $\mu$ are those which are repelled at the greatest speed, and would reach our atmosphere in about 45·9 hours, an interval of the same order as that obtained by Riccò for the time intervening between the probably correlated solar and terrestrial phenomena. These particles are negatively charged in accordance with Mr. C. T. R. Wilson's proof that such particles are more easily condensed on negative than on positive ions, the ionisation of the solar atmosphere resulting, as Lenard has shown, from the action of the sun's strong ultra-violet radiation. By a simple calculation Prof. Arrhenius shows that the remaining positive charge is balanced, and the balance maintained, by the attraction of negative electrons emitted by other celestial bodies which are negatively charged and lose their charge under the influence of their ultra-violet rays. All such rays coming within a mean distance of 0·063 light-years of the sun will be attracted thereto, and by this means the supply of negative electrons becomes just proportional to the defect thereof.

VARIABILITY OF MINOR PLANET (15), EUNOMIA.—*Circular* No. 94 of the Harvard College Observatory is devoted to an account of Prof. Wendell's observations of the minor planet Eunomia, from which he established a variation of magnitude of about 0·5. The observations were made with a photometer having achromatic prisms and attached to the 15-inch telescope. As the planet was near its stationary point it was compared with the same star, +13° 1875 (mag. 9·0), from March 15 to April 1, and the corrected differences varied from −0·77 to −1·11. The formula J.D. 2416920·116+0·1267 E. expresses the phase and period of the changes. The period is very similar to that found for minor planet (7), Iris, viz. 0·1295d., and in both cases it is still doubtful as to whether the period requires doubling or not.

FAINTNESS OF PLANETARY NEBULÆ.—Some interesting results of calculations appertaining to the luminosity of the surfaces of several planetary nebulæ, as compared with the surface luminosity of the sun or the moon, are given in a letter written by Mr. J. E. Gore to the current number of the *Observatory*.

Dealing with the nebula H, iv. 37, situated near to the pole of the ecliptic, he finds that the ratio of its surface luminosity is to that of the sun's as $1 : 43196{\cdot}7 \times 10^6$. The similar ratios for the nebulæ h 3365, Σ 5, and G.C. 7027 are $1 : 245{\cdot}3 \times 10^6$, $1 : 1095{\cdot}5 \times 10^6$, and $1 : 434 \times 10^6$ respectively; thus the brightest of them, *i.e.* h 3365, has a surface luminosity of only 1/400 that of the moon.

## THE COWTHORPE OAK.

IN the *Transactions and Proceedings of the Botanical Society of Edinburgh* (vol. xxii., part iii., 1904, p. 396) we notice a very interesting article on the Cowthorpe Oak from the pen of Mr. John Clayton. This venerable tree, which stands near the church of Cowthorpe, a small village near Wetherby, is unique among oaks in that its girth is greater than that of any other known tree of its species. Recorded measurements taken about 1700 show that it had at that time a height of 80 feet with a girth of 78 feet on the ground. Since then various observers have recorded its dimensions and noted at the same time the gradual process of decay, damage by storm, and other points likely to be of interest. The latest measurements were taken by Mr. Clayton himself, and they show that the height is now reduced to 37 feet including dead wood, while the girth on the ground has diminished to 54 feet 3 inches. In 1893 a crop of acorns was produced, from one of which a seedling was reared, and is now planted near its parent as a memorial.

The tree stands in a warm, sheltered spot in a field which has a gentle slope to the river, and near enough to get a constant supply of water. The process of decay has been going on for the last 200 years. Between 1703 and 1722 much damage was done by various storms; nevertheless, new leaves are put forth annually. The acorns produced in 1893 were on long stalks—hence the species is *Quercus pedunculata*. As regards the age of this giant opinion seems to differ. The trunk, being now hollow, precludes all possibility of ever ascertaining the number of year-rings, and no trustworthy data are available before the year 1700—hence the author has been compelled to rely upon a comparison with the age of other trees. In a tree the duration of life may be taken as composed of

three periods, one of growth, one of maturity, and lastly one of decline and decay. Between the number of years in each period a certain ratio is found to exist, and, taking this as a basis, together with what is known of the tree since 1700, Mr. Clayton arrives at the conclusion that its age is not more than 500 years—certainly much nearer the mark than the age of 1600 years assigned to it by Prof. Burnett in 1842, who based his calculation on the theory of the elder De Candolle that a tree increases by one-twelfth of an inch in diameter annually, an altogether untrustworthy basis of calculation.

There is quite a number of other interesting historical trees dealt with in the article, for example, the Greendale Oak in Welbeck Park, which belongs to the Duke of Portland. Its height was recorded by John Evelyn in 1846 as 88 feet, while the altitude of the highest twig at the present day is only 54 feet. In 1724 a roadway was cut through the trunk, which girths 30 feet 1 inch at 4½ feet from the ground. The height of the archway was

Cowthorpe Oak, seen from North. The tree is supported by twenty-five props, disposed mostly on the South and East sides. There is a paling about 5 ft. high, which seems as if it had been put up from twenty to forty years ago.

then 10 feet 2 inches, but recent measurements show that the highest point is now only 9 feet 3 inches, and the lowest 8 feet 6 inches. This shows conclusively that a subsidence of the trunk must have taken place within the last 200 years, and, by assuming that a similar sinking into the ground has occurred in the case of the Cowthorpe Oak, Mr. Clayton explains the apparent discrepancies between the earliest and latest recorded girth dimensions of the veteran. The trunk being somewhat tapering, the diameter naturally lessens as the sinking in proceeds. Mr. Clayton adds a note on the testimony of a Cowthorpe man named Oates, who said, "The tree has shrunk very much in my time, and in shrinking the tree has twisted—the Eastern branches towards the South."

Another notable tree as regards size and age is the Crowhurst Yew, which girths 34 feet 4 inches on the ground. It stands in the churchyard of that place. The church must be very old, as it contains monuments of Saxon and Norman workmanship. The author points out that the oldest trees are usually in close proximity to a sacred edifice, such as this yew and the Cowthorpe Oak, and the association no doubt affords them protection.

Another notable veteran is the great chestnut of Tortworth, Gloucester, which girths 49 feet 2 inches at 4 feet from the ground. It also stands about 100 yards from a very old and beautiful church.

As regards the longevity of trees, the theory was promulgated at the beginning of the nineteenth century by De Candolle that the duration of life in trees was practically unlimited, neglecting accidents due to unfavourable external conditions, such as the ravages of parasites, injuries from storms, lightning, and other causes. Passing in review the vegetable kingdom, we find there are some lowly organised plants, such as certain algæ and fungi, the whole life cycle of which may be completed within the short space of a few days, or even hours. Among the higher plants we have annuals and biennials the existence of which terminates with the production of seed. Then we have the agave and certain palms, the aërial portions of which may live from ten to forty years until the production of flower and fruit terminates their span of life, their place being taken by new aërial portions developed from lateral buds at the base of the plant. In the case of trees and woody shrubs, on the other hand, new growing points are formed annually, but this vegetative process does not end in the production of flower and fruit, so that, excluding accidents, there is no reason why that vegetative process should not be continued for an unlimited time.

The giant Wellingtonias of California are well known examples of the age and dimensions which trees may attain. A stem in the British Museum shows 1330 year-rings with a diameter of about 15 feet. On the other hand, certain Japanese dwarf trees are known to be of very great antiquity, although lacking the size of the Wellingtonias. At the same time, one must not lose sight of the fact that the living cells are continually being renewed, and that in a tree like the Cowthorpe Oak the living parts are at most but a few years old.

## FISHERY INVESTIGATIONS IN THE NORWEGIAN FJORDS.[1]

DR. NORDGAARD has collected the results of investigations made in some of the fjords of northern Norway in the winters of 1899 and 1900, during the course of researches in the fishing waters of Lofoten, carried out at the expense of the Bergen Museum and the Norwegian Government. Two "expeditions" were made. The first, January to May, 1899, included the Vest Fjord and the sea beyond Lofoten, Vesteraalen, Sengen, and Finmarken, besides a large number of fjords, as the Kirk, the Øgs, the Kanstad, the Sag, and many others. The second, in the winter of 1900, was made so as to obtain material from the fishing banks which would compare with that of the previous year, and it included visits to the Morsdal, Salten, Skjerstad, and Folden fjords.

The hydrographical observations, which are numerous, have been made according to recognised standard methods, and are therefore comparable with observations made further out at sea, in the regions in which the full explanation of many of the facts brought to light here is doubtless to be found. The chief hydrographical result arrived at by Dr. Nordgaard is that the northern fjords can be divided into two groups, those in which the bottom temperature is 6° C. to 7° C., and salinity about 35 *pro mille*, and those in which the bottom temperature is below 6° C., and salinity less than 35 *pro mille*. As examples of the former, the Salten, Folden, Tys, Ofot, and Vest fjords are given, and as examples of the latter the Malang, Lyngen, Kvaenang, Porsanger, Tana, Varaanger, Skjerstad, Skjomen, Kanstad, Øgs, and Kirk fjords. It is suggested that while in some cases, as the Skjerstad fjord, the inflow of ocean water is cut off by a submarine ridge, the occurrence of the two typical groups may be accounted for by the distribution of rainfall. The heavy winter rainfall in western Norway affords a large supply of fresh water to the surface layers of the fjords, which accordingly remain specifically light, notwithstanding the fall of temperature. In northern Norway the rainfall is much less, hence the surface waters retain a high salinity, and as their temperature falls they sink to considerable depths.

Dr. Nordgaard also discusses at some length the varying influence of different amounts of rainfall on the currents within the fjords. Heavy rainfalls, which raise the surface level of the water, are for the most part the result of winds from the ocean, which produce a similar effect; it is difficult to separate the effects of the two causes, but a rainfall above the average is taken as a fairly certain index of abnormal strength in the oceanic streams.

In the "biological notes" which accompany the tables a number of points are brought out showing and defining the connection between fauna and hydrography. It is shown that whereas in the first or warm-water group of fjords the deep-water fauna is chiefly boreal, in the second group, where cold water of lower salinity makes its way downwards, the predominant forms are Arctic. The effect of the increased precision of modern methods of investigation in greatly reducing the number of so-called cosmopolitan species is also emphasised.

The section of this memoir which deals with fisheries is specially important and suggestive. In discussing the Lofoten fisheries, Dr. Nordgaard adopts the view that the currents in the Norwegian Sea are controlled by the winds, and that, as already explained, abnormal movements of the currents off-shore or on-shore can be associated with rainfall above or below the average. Again, he says, "It is clear that during the movements to or from the coast of the surface water, a compensating current must be set in motion in the deep water; it has long been a recognised phenomenon in the fjords, that the surface and under currents go in contrary directions." From an examination of the observations, Dr. Nordgaard concludes that herrings move coastwards specially in the surface layers, while the cod travels along in the deeper layers. It must therefore, he continues, "be supposed that as cod and herrings, to a certain extent, depend upon contrary current phases, a particularly good spring herring fishery would prevent a correspondingly good cod fishery in the same district; for a strong tendency of the upper layers towards the coast certainly takes herrings along in the current, but this at the same time causes a compensation current in the deep water, and this current hinders the cod in its passage to the spawning places."

The statistics of the yield of the cod and herring fisheries for some years are discussed and compared with corresponding values of rainfall, with results which appear to support the hypothesis brought forward. It would of course be easy to suggest difficulties, such as the extension of the current *régime* observed in fjords to areas which can hardly be regarded as such, and may therefore have a different system of movements. But as the whole question is at present under investigation on the large scale by the International Council, we content ourselves with an attempt to summarise Dr. Nordgaard's results, deferring fuller discussion of them until the more abundant data are available.

[1] Bergens Museum. "Hydrographical and Biological Investigations in Norwegian Fjords." By O. Nordgaard. "The Protist Plankton and the Diatoms in Bottom Samples." By E. Jørgensen. Pp 254; with 21 plates and 10 figures in the text. (Bergen: John Grieg, 1905.)

## A NEW SLIDE RULE.

MESSRS. JOHN DAVIS AND SON, of Derby, the well known instrument makers, are bringing out a variation of the slide rule which is likely to increase its value for certain classes of calculation without interfering with the simplicity and convenience of the form with which we are all familiar. The lower groove on the outside of the rule, which ordinarily is only wide enough to hold the inturned edge of the cursor, is made wider, so as to take one of the tongues of a spare slide, and this slide is held in place when required by two light aluminium clips which grasp the ends of the rule and of the spare slide while leaving the usual slide free to move. An extra cursor is also provided which is long enough to grasp both the rule and the extra slide. By this means any rare or special scales upon the extra slide are for the time being equivalent to scales upon the rule, and these may be read against scales upon the other slide by means of the long cursor. If desired, the extra slide can take the place of the ordinary slide, or may be removed altogether when the rule, if provided with an ordinary cursor adapted to the altered lower groove, becomes an ordinary slide rule. In the example submitted, the extra slide carries what are called E and −E scales. The E scale is a log log scale, and is always being re-invented; it was called a P line or power line by Lieut. Thomson, who showed it at the Inventions Exhibition, and it was long before invented by Dr. Roget. This P or E line is very handy, for it at once enables the logarithm of any number on any scale, *i.e.* to any base, to be read according to its position against an ordinary A line, while fractional or high powers of numbers are read with equal facility. Compound interest, pressures and volumes of gases under isothermal or adiabatic conditions are readily evaluated with the aid of the E line read against an A line. If, however, a pair of E slides are used, one in the usual position and one attached below the rule by means of the clips, then against any value, say of $v$, on one, the cursor will show the value of $v^{\gamma}$ on the other, $\gamma$ having any desired value according to the relative position of the two slides.

The slide rules made by Messrs. Davis and Son are too well known for their accuracy and finish for it to be necessary to refer more to such points, but by some curious perversity or accident there is one little fault in the rule sent for examination which only needs to be pointed out to be put right. On the feather edge a scale of inches in 16ths is provided; on the lower face outside the rule there is no scale at all, while inside, to be used like a hat measure, there is a scale of millimetres beginning at 550. If, therefore, the rule is required for the prosaic but very useful purpose of measuring a length, this can only be measured in inches if it is 20 inches or less, or in millimetres if it lies between 550 and 1040 millimetres. If,

therefore, the bald outside edge were divided in millimetres, the whole range would be available for metric measurement, and if the lower half of the space at the back of the slide now empty were divided in inches, hat measurements from 20 to 41 inches would complete the range for the English scale. C. V. B.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. Frederick Wilkin, of Lower Consley Wood, Wadhurst, Sussex, proposes to found a studentship in memory of his son, Mr. Anthony Wilkin, late of King's College, and for this purpose he proposes to make over to the university the tithe rent charge on Wadhurst Parish. This benefaction is for the furtherance of ethnological and archæological research, and the holder is to be termed "The Anthony Wilkin Student." It is proposed that the student shall be selected by the board of anthropological studies; the income is estimated at about 40*l*. a year, and the board suggests that this should be accumulated for periods of five years in order that a substantial sum of about 200*l*. may be available for the selected candidate. The first studentship will be offered in 1910.

Mr. W. W. Watts, of Sidney Sussex College, Mr. H. Y. Oldham, of King's College, Mr. A. R. Hinks, of Trinity College, and Mr. G. G. Chisholm have been appointed examiners for part ii. of the examination for the diploma in geography.

A combined examination of non-resident candidates for open scholarships, exhibitions, &c., will be held at Trinity College, Clare College, Trinity Hall, Peterhouse, and Sidney Sussex College, Cambridge, beginning on Tuesday, December 5. Forms of application for admission to the examination may be obtained from any of the tutors of Trinity College, the senior tutor of Clare College, the tutor of Trinity Hall, the senior tutor of Peterhouse, or the master of Sidney Sussex College, to one of whom the form of application (when filled up), together with certificates of birth and of moral character, should be sent. Entries should be made not later than November 23.

A TEACHING observatory will, it is reported by *Science*, be established by the Ontario Government at the University of Toronto. Dr. C. A. Chant expects to visit the observatories of the United States to study their plans and methods.

A CONFERENCE of scientific students was held at Colorado College, Colorado Springs, on April 28 and 29, and representatives of leading universities and colleges were present. A number of papers upon subjects relating to the scientific problems of the Rocky Mountain country were read. A similar conference, held a year ago at the same institution, was of such importance that it led to this second series of meetings.

WITH the view of making the municipal museum a centre of education in the broad principles of natural science, the Hull authorities have arranged with the curator, Mr. T. Sheppard, for the delivery by him of simple lectures to school children on geology, zoology, and anthropology. The lectures are given in the mornings by arrangement. Permission for pupils to visit the museum must be obtained from the clerk of the education committee. Each lecture lasts about half an hour, and is illustrated by objects from the cases. The remainder of the morning is occupied in examining the specimens, taking notes, and making sketches.

MR. A. C. BENSON contributes to the *National Review* an important article on an Eton education. Mr. Benson, though a classicist, is by no means satisfied with the existing state of educational matters at Eton. Describing the average boy who leaves Eton, Mr. Benson says:—"The basis of his education has been, as a rule, the classical basis; that is to say, the greater part of his working hours have been devoted to Latin and Greek. A small percentage of fair classical scholars and a still smaller sprinkling of distinguished classicists is the result. But the average boy leaves Eton with no mastery of either of these languages. He cannot, as a rule, construe at sight an easy passage in either, or turn a piece of English into either language without a large crop of mistakes." In another place Mr. Benson states that the boy "never reaches the stage at which classics become literature." He urges that for the large class of boys who are not intended for the university, the strictly classical programme might be with advantage modified. Mr. Benson believes that a boy who left school with a thorough knowledge of French, "who knew the elements of science, so as to be able to understand something of what was going on in the world around him, in heaven and earth and sea, in field and wood," who knew arithmetic and had a reasonable knowledge of geography and history, would leave school a fairly educated man. Mr. Benson would have a very simple core of education on the lines just indicated, and then any evidence of special capacity, linguistic, mathematical, scientific, or historical, should be carefully observed, and at a certain age a boy's studies should converge more closely upon a special subject, care being taken at the same time that the general education should not be neglected.

A VALUABLE address was delivered by Prof. A. Pedler, F.R.S., Vice-chancellor of the University of Calcutta, and Director of Public Instruction with the Government of Bengal, at the recent convocation of the Senate of the university for conferring degrees. During the course of his remarks, Prof. Pedler said that fifty years ago university education in Bengal had no existence, the doors of western learning had not been opened, and the knowledge of western science was absolutely beyond the reach of anyone in the country. During the last half-century the possibilities of obtaining western knowledge and western culture, and the facilities for higher education, have been rapidly developed, until a whole network of educational institutions has been spread over Bengal. Inquiring as to whether the form of education being given to the people is affecting them in the most satisfactory way, Prof. Pedler came to the conclusion that it is not. The arrangements, he said, are wanting in concentration of effort, in thoroughness of method, and in the intelligent appreciation of means to ends. After instituting a comparison between what has been accomplished in Japan and in Bengal, he came to the conclusion that the secret of the brilliant success of university education in Japan is to be found in the observance of certain cardinal principles, viz. patience in obtaining results; thoroughness in work; concentration of university work in a few really well equipped and strongly staffed colleges, each institution being devoted to one special section of learning, which is taught thoroughly; adaptation of the courses to the practical wants of life and of modern civilisation, as exemplified by the large proportion of graduates who elect the practical rather than literary courses of study; originality as shown by the large number of young men who undertake research work, and also shown by the large number of original contributions in science. In the future, Prof. Pedler remarked, it will be necessary in Bengal to adopt all these principles and to adhere to them with uncompromising tenacity, if university work is to be placed on a really satisfactory footing. The principles could also be applied with profit to a large part of the work of our own educational institutions.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Geological Society**, April 19.—Mr. H. B. Woodward, F.R.S., vice-president, in the chair.—The Blea Wyke beds and the Dogger in north-east Yorkshire: R. H. **Rastall.** The author describes the type-section at Blea Wyke in detail, dividing the rocks into the following divisions, enumerated in descending order:—(5) Dogger; (4) yellow beds; (3) Serpula beds; (2) Lingula beds; (1) Striatulus shales. Descriptions and fossil lists from these divisions are given, and the succession is compared with others.—Notes on the geological aspect of some of the north-eastern territories of the Congo Free State: G. F. J. **Preumont,** with petrological notes by J. A. **Howe.** This paper is a brief sketch of the geological structure of the northern part of the Congo State, from Buta on the River Rubi and Bima

on the Uelle in the west, to Lado and Dufile on the Nile. In the whole of this region, the only post-Primary rocks met with, other than those of comparatively modern alluvial origin, were chocolate-coloured shales (Buta Shales) and sandstone, and an Oolitic limestone, on the extreme west. From the Lipodongu Falls on the Rubi, and thence through Poko to Rungu, on the Bomokandi River, none but granitic rocks (gneisses) were observed. Along the Uelle, from Bima to Bomokandi, the same rocks were seen. In the centre of the region mica-schists, quartzites, and similar metamorphic rocks replace the granite wholly or in part. A noticeable feature here is the presence of a range of isolated hills, composed almost completely of great beds of magnetite and hæmatite occurring in the schistose series. In the south-eastern portion of the region visited, between the Uelle-Kimbali and Bomokandi rivers, a great plutonic massif is laid bare in the mountainous district of Arebi. The plutonic massif itself contains microclinic gneiss, and abundant diabasic rocks, and the same rocks in all stages of dynamo-metamorphism. On the boundary between the Congo State and the Bahr-el-Ghazal, several hills made up of rocks of coarse gneissose and schistose character are described; some of these rocks are rich in tourmaline, kyanite, and garnet in large crystals. From the region of the Enclave de Lado and the western side of the Nile between Lado and Dufile, mica-schists, quartzites, and microcline-gneisses are described. The alluvium of a large part of the Uelle is covered, on the higher ground, by a deposit of limonitic conglomerate; in places this may be due to the decomposition *in situ* of the alluvium, but in the neighbourhood of the iron-mountains a sort of passage may be seen between a conglomerate of fresh iron-ores and the more general type of limonitic conglomerate (laterite?).

## PARIS.

**Academy of Sciences**, May 1.—M. Troost in the chair.—New researches on chemical combination: M. **Berthelot.** Various substances were sealed up in fused quartz tubes, heated for one hour at 1300° C. in an electric furnace, and suddenly cooled by dropping into water. Nitrogen and hydrogen gave no trace of ammonia; ammonia was completely split up into its constituents, and the stability was not increased by the presence of hydrochloric acid. The latter gas, heated alone, was not decomposed, and hydrogen sulphide behaved similarly if the cooling was slow, but showed evidence of dissociation into hydrogen and sulphur with instantaneous cooling.—On the permeability of tubes of fused silica: M. **Berthelot.** At the ordinary temperature, no hydrogen will pass through the walls of a fused quartz tube, even into a barometric vacuum, and even at 600° to 800° no appreciable amount passes through. At 1300° C., on the other hand, the amount transpired is considerable. Neither hydrochloric acid nor carbon dioxide get through at 1300° C.; the transpiration of nitrogen is not sensible at 600° C., very slight at 1000° C., becoming marked at 1300° C. to 1400° C. Some preliminary experiments with glass at lower temperatures appear to show similar effects, and these observations are being continued.—The action of mercuric iodide on sulphuric acid and on the sulphates of mercury: Alfred **Ditte.**—On the earthquake of April 29: M. **Mascart.** The seismograph at Bagnères-de-Bigorre showed horizontal vibrations at 2h. 1m. 20s., whilst the same oscillation was indicated at Grenoble at 1h. 59m. 15s., a difference of time corresponding to the rate of transmission through the ground.—On the triboluminescence of arsenious acid: M. **Guinchant.** The light given off by arsenious acid is due to the breaking and transformation of the crystals after their formation. The radiations are actinic, and are without any effect on the electroscope. Similar phenomena taking place during the reduction of hypochlorites and hypobromites are described, the effects in this case being attributed to the production and decomposition of haloid compounds of nitrogen.—On the physical impossibility of putting in evidence the motion of translation of the earth: P. **Langevin.** In a discussion of an experiment by Trouton and Noble it is proved that it ought to give a negative result for all orders of approximation and whatever system of suspension be employed for the condenser.—On the heat of vaporisation of liquefied gases: E. **Mathias.**—Heat in the displacement of a capillary system: M. **Ponsot.**—On the difference in temperature of bodies in contact: E. **Rogovski.** Fine wires of different diameters were heated by an electric current, and cooled by water flowing at known rates. The temperature of the wire was measured by means of its electrical resistance, and the difference of temperature between the wire and the cooling water determined as a function of the rate of flow of the water and of the diameter of the wire.—The preparation of anhydrous chlorides of the metals of the rare earths: Camille **Matignon.** The solid material obtained by the evaporation of the solution of the oxide in hydrochloric acid is heated in a current of chlorine and hydrochloric acid gas charged with the vapours of chloride of sulphur. It is possible to obtain in this way very rapidly either large or small quantities of anhydrous chlorides. Particulars are given with analyses showing the purity of the products, of the chlorides of lanthanum, neodidymium, praseodidymium, samarium, and yttrium.—On cæsium amide: E. **Rengade.** The amide is prepared by the action of dry ammonia upon the fused metal at 120° C., the purity of the product being fixed by the determination of the amount of hydrogen evolved. The amide dissolves readily in liquid ammonia, and the solution absorbs oxygen at −60° C. giving a precipitate, the hydroxide and nitrite of cæsium being formed, together with ammonia.—On a new reagent for potassium: Eugenio Pinerua **Alvarez.** The reagent proposed is a 5 per cent. solution of sodium amido-naphthol sulphonate.—On the conditions of development of the mycelium of Morchella: G. **Fron.** The mycelium of this edible mushroom requires for its strong growth plenty of hydrocarbon food, inulin and starch being especially favourable; the mineral food is of less importance.—Calcium nitrate in agriculture: E. S. **Bellenoux.** The author proposes to replace nitrate of soda by the nitrate of calcium, and gives results of comparative trials of the two showing the superiority of the latter as a manure.—The variation of the osmotic pressure in muscle caused by contraction: Stéphane **Leduc.** It is shown experimentally that an elevation of the osmotic pressure in a muscle is a consequence of contraction, the rise of the pressure being more marked as the stimulations are more prolonged.—The variations undergone by glucose, glycogen, fat, and soluble albumens in the course of the metamorphoses in the silkworm: C. **Vaney** and F. **Maignon.**—On a combination of methæmoglobin containing fluorine: H. **Ville** and E. **Derrien.** In a previous paper the authors have shown that the addition of fluorine compounds to a solution of methæmoglobin causes a marked change in the absorption spectrum, and they were thus led to the conclusion that a definite compound might possibly be produced. This compound has been isolated in the crystalline form, details of its preparation and properties being given in the present note.—Philocatalase and anticatalase in animal tissues: F. **Battelli** and Mlle. L. **Stern.**—On the action of formic acid in nervous diseases accompanied with trembling: E. **Clément.** The use of formic acid has been attended with great success in certain cases.—The volcanic regions traversed by the Sahara expedition: F. **Foureau** and Louis **Gentil.**

## NEW SOUTH WALES.

**Linnean Society**, March 29.—Mr. T. Steel, president, in the chair.—The botany of north-western New South Wales: F. **Turner.** The characteristics of the indigenous vegetation and the exotic weeds of the country lying between the New South Wales-Queensland border and 33° S. lat., and 147° and 151° 20′ E. long., are discussed. The census of the phanerogams and vascular cryptogams given comprises a total of 452 genera and 1137 species.—Contribution to our knowledge of the physiology of the pancreas: H. G. **Chapman.** The conclusions arrived at in this paper, which is a preliminary communication, may be summarised as follows:—(1) secretins from the echidna, wallaby, Australian water-tortoise, and ibis are active upon the dog in causing a flow of pancreatic juice; (2) secretin does not appear to cause pancreatic secretion in the echidna; (3) the flow of pancreatic juice produced by pilocarpine is inhibited by atropine, while the flow produced by secretin is not so

inhibited; (4) stimulation of the vagus nerve does not inhibit the secretion due to secretin; (5) the pressure under which the fluid is secreted in the pancreatic duct is equivalent to 9 inches of the juice; (6) pancreatic juice may be activated by leucocytes so that it acts upon proteids.

## DIARY OF SOCIETIES.

*THURSDAY*, MAY 11.

ROYAL SOCIETY, at 4, Election of Fellows.—At 4.30, On the Resemblances existing between the "Plimmer's Bodies" of Malignant Growths and certain Normal Constituents of Reproductive Cells of Animals: Prof. J. B. Farmer, F.R.S., J. E. S. Moore, and C. E. Walker.—The Effect of Plant Growth and of Manures upon the Soil: the retention of Bases by the Soil: A. D. Hall and Dr. N. H. J. Miller.—A Study of the Process of Nitrification with Reference to the Purification of Sewage: Miss H. Chick.—Pathological Report on the Histology of Sleeping Sickness and Trypanosomiasis; with a Comparison of the Changes found in Animals infected with *T. gambiense* and other Trypanosomata: Dr. A. Breinl.—(1) The Experimental Treatment of Trypanosomiasis in Animals; (2) Remarks on Mr. Plimmer's Note on the Effects produced in Rats by the Trypanosomata of Gambian Fever and Sleeping Sickness: Dr. H. Wolferstan Thomas.

ROYAL INSTITUTION, at 5.—Flame: Sir James Dewar, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Manufactures of Greater Britain. III. India: H. J. Tozer.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Telephone Traffic: H. L. Webb.

SOCIOLOGICAL SOCIETY, at 8.15.—Some Guiding Principles in the Philosophy of History: Dr. J. H. Bridges.

MATHEMATICAL SOCIETY, at 5.30.—On the Intersections of two Conic Sections: J. A. H. Johnston.—On a System of Conics yielding Operators which Annihilate a Cubic and its Bearing on the Reduction of the Cubic to the Sum of four Cubes: H. G. Dawson.—High Pellian Factorisations: Lt.-Col. A. Cunningham.

*FRIDAY*, MAY 12.

ROYAL INSTITUTION, at 9.—The Pressure due to Radiation: Prof. E. F. Nichols.

PHYSICAL SOCIETY, at 8.—A Simple Method of Determining the Radiation Constant; suitable for a Laboratory Experiment: Dr. A. D. Denning.—A Bolometer for the Absolute Measurement of Radiation: Prof. H. L. Callendar, F.R.S.—The Resistance of a Conductor the Measure of the Current flowing through it: W. A. Price.

MALACOLOGICAL SOCIETY, at 8.—Note on *Helix pellita*, Fér., and other Shells from the Pleistocene Cave-deposits of East Crete: Rev. R. Ashington Bullen.—Notes on Recent Spanish Shells from Granada and Carmona: Rev. R. Ashington Bullen.—Description of a new Species of Vitrea from Greece: E. A. Smith.—Descriptions of new Forms of Marginellidæ and Pleurotomidæ: E. R. Sykes.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Discussion of the Observations of the Satellite of Neptune made at the Royal Observatory, Greenwich, in the years 1902-3-4: F. W. Dyson and D. J. R. Edney.—Further Note on the Density and Prolateness of Close Binary Stars: A. W. Roberts.—On Hansen's Coefficients for the Inequalities in the Moon's Longitude: E. Nevill.—A Supposed Instance of Sudden Change on Jupiter: Major P. B. Molesworth.—Optical Distortion of the Object Glass of the Astrographic Telescope, deduced from Measures of the Eros Photographs, Communicated by the Astronomer Royal: Royal Observatory, Greenwich.—*Promised Papers*: On the Formula for Connecting Photographic Diameters with Stellar Magnitudes: H. H. Turner.—The Determination of Stellar Proper Motions without Reference to Meridian Observations: A. R. Hinks.—Notes on the Use of Thorp Gratings for Eclipse Work: Dr. W. J. S. Lockyer.

*SATURDAY*, MAY 13.

ROYAL INSTITUTION, at 3.—Moulds and Mouldiness: Prof. Marshall Ward, F.R.S.

*MONDAY*, MAY 15.

SOCIETY OF ARTS, at 8.—The Uses of Electricity in Mines: H. W. Ravenshaw.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Exploration and Survey in Central Tibet and to the Sources of the Brahmaputra: Captain C. H. D. Ryder.

VICTORIA INSTITUTE, at 4.30.—The Messiah of Quadian: The Rev. Dr. Griswold.

*TUESDAY*, MAY 16.

ROYAL INSTITUTION, at 5.—The Study of Extinct Animals: Prof. L. C. Miall, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.

ZOOLOGICAL SOCIETY, at 8.30.—A Contribution to the Knowledge of the Encephalic Arterial System in Sauropsida: F. E. Beddard.—On Stridulating Halyinæ with Descriptions of New Genera and Species: Dr. E. Bergroth.—On the Classification of the Anthropoid Apes as Proposed by the Hon. Walter Rothschild: Sir Harry Johnston.

SOCIETY OF ARTS, at 8.—Excavation of the Oldest Temple at Thebes: H. R. Hall.

*WEDNESDAY*, MAY 17.

SOCIETY OF ARTS, at 8.—The Use of Wood Pulp for Paper Making: S. Charles Phillips.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Movements of Diatoms and other Microscopic Plants: D. D. Jackson.—Exhibition of Slides of the Oribatidæ.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—Measurement of Evaporation; R. Strachan.—Logarithmic Slide-Rule for reducing Readings of the Barometer to Sea-level: Dr. J. Ball

CHEMICAL SOCIETY, at 5.30.—The Chlorination of Methyl Derivatives of Pyridine. Part I. 2-Methyl Pyridine: W. J. Sell.—The Absorption Spectra of Uric Acid, Murexide and the Ureides in Relation to Colour and to their Chemical Structure: W. N. Hartley.—Further Studies on Dihydroxymaleic Acid: H. J. H. Fenton.—The Thermal Decomposition of Formaldehyde and Acetaldehyde: W. A. Bone and H. L. Smith.—The Synthesis of Formaldehyde: D. L. Chapman and A. Holt, Jun.—The Influence of Light on Diazo-reactions. Preliminary Notice: K. J. P. Orton, J. E. Coates, and (in part) F. Burdett.

*THURSDAY*, MAY 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On Lesage's Theory of Gravitation and the Repulsion of Light: Prof. G. H. Darwin, F.R.S.—The Atomic Weight of Chlorine; an Attempt to Determine the Equivalent of Chlorine by burning with Hydrogen: Prof. H. B. Dixon, F.R.S., and E. C. Edgar.—The Flow of the River Thames in Relation to British Pressure and Rainfall: Sir Norman Lockyer, K.C.B., F.R.S., and Dr. W. J. S Lockyer.—Thorianite, a New Mineral, from Ceylon: Prof W. R. Dunstan, F.R.S., and G. S. Blake.—The Elastic Properties of Steel at High Temperatures: Prof. B. Hopkinson and F. Rogers.—Modified Apparatus for the Measurement of Colour, and its Application to the Determination of the Colour Sensations: Sir William de W. Abney, K.C.B., F.R.S.—Further Observations on the Germination of the Seed of the Castor Oil Plant (*Ricinus communis*): Prof. J. Reynolds Green, F.R.S., and H. Jackson.—On the Efferent Relationship of the Optic Thalamus and Deiter's Nucleus to the Spinal Cord, with Special Reference to the Cerebellar Influx Theory (Hughlings Jackson) and the Genesis of Decerebrate Rigidity (Sherrington): Dr. F. H. Thiele.—On Reciprocal Innervation of Antagonistic Muscles. Eighth Note: Prof. C. S. Sherrington, F.R.S.—The Structure and Function of Nerve Fibres: Prof. J. S. Macdonald.—On the Occurrence of Anopheles (Myzomyia) Listoni in Calcutta: Major A. Alcock, C.I.E., F.R.S., and Major J. R. Adie.

ROYAL INSTITUTION, at 5.—Flame: Sir James Dewar, F.R.S.

SOCIETY OF ARTS, at 4.30.—Plague in India: Dr. C. Creighton.

FARADAY SOCIETY, at 8.—An Application to Electrolytes of the Hydrate Theory of Solutions: T. M. Lowry.

*FRIDAY*, MAY 19.

ROYAL INSTITUTION, at 9.—The Native Races of the British East Africa Protectorate: Sir Charles Eliot, K.C.M.G.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

*SATURDAY*, MAY 20.

ROYAL INSTITUTION, at 3.—The Evolution of the Kingship in Early Society: Dr. J. G. Frazer.

## CONTENTS.