THURSDAY, JANUARY 26, 1905.

A MONOGRAPH OF THE HELIOZOA.

Les Heliozoaires d'Eau Douce. By E. Penard. Pp. 341; illustrated. (Geneva: Henry Kundig, 1904.)

THE Heliozoa or "sun-animalcules" have always been favourite objects with microscopists on account of their abundance, especially in fresh water, their relatively large size, and their beauty as objects for the microscope. From the scientific aspect, however, they have not attracted so much attention as many other groups of Protozoa, on account, perhaps, of their somewhat isolated position from the systematic or phylogenetic point of view, no less than from their perfect innocuousness, so far as mankind is concerned. The work before us is a monograph of the fresh-water Heliozoa, based upon investigations upon those found in the environs of Geneva. It was the author's original intention, he tells us, to have confined himself to a description of the forms occurring in that territory, but since he obtained there nearly all the species hitherto known from fresh water, he has added to his catalogue descriptions of the species which appear not to occur in the sphere of his personal investigations in order to give his monograph a wider basis.

The monograph is divided into four chapters. The first contains general considerations on the structure, reproduction, and affinities of the group; the second gives a systematic account of those fresh-water forms, the position of which among the Heliozoa is above suspicion; the third deals with the "Pseudo-Heliozoa," that is to say, with organisms commonly referred to this group, but of which the affinities and systematic position are dubious; and the fourth discusses synonymic species, namely, those which are of doubtful nature, or which have not been described in a manner adequate for identification. The work further commences with a short introduction and ends with a full bibliography, and is illustrated by numerous text figures.

In his general chapter the author gives first an account of the methods employed by him for collecting these organisms, and then proceeds to consider their body-structure. Under the latter heading he distinguishes two principal types of Heliozoa. The first, or Actinophrys-type, has a large spherical nucleus occupying the centre of the body, and lying, surrounded by a clear zone of protoplasm, in the granular and vacuolated endoplasm, which in its turn is enveloped by the very vacuolated ectoplasm containing a large contractile vacuole. The pseudopodia, seldom longer than the diameter of the body, are supported by relatively strong axial filaments, centred round the nucleus and radiating thence to the periphery of the spherical body. To this first type, which might be called the text-book Heliozoön, may be referred, besides Actinophrys, the genera Clathrulina and Hedriocystis, while Actinosphærium is derived from it by multiplication of the originally single nucleus. The second or Acanthocystis-type is much commoner; here the centre of the spherical body is occupied, not by the nucleus, but by a central granule, apparently somewhat of the nature of a centrosome, from which radiate the delicate axial filaments, each passing to the surface of the body to be continued into one of the slender pseudopodia, which usually exceed the diameter of the body in length. The central granule and nucleus are both contained in the endoplasm ordinarily so called, which itself is eccentric in position, so that the surrounding zone of ectoplasm becomes thin on one side of the body and is thickest at the pole opposite to this. The large nucleus is placed eccentrically in the endoplasm, being always near the region where the ectoplasmic zone is at its thinnest, and is therefore still more markedly eccentric in relation to the body as a whole. The author inclines to the opinion that the ordinary use of the terms ectoplasm and endoplasm is incorrect in the case of the Acanthocystis-type of Heliozoön. He thinks that the true ectoplasm is here limited to a narrow peripheral zone of the body, and that the remainder of what is commonly called ectoplasm should really be considered as endoplasm, of which that part to which the term endoplasm is usually applied is only a special region, containing nucleus and central granule, and perhaps homologous with the clear zone round the nucleus in Actinophrys.

In the classification the author keeps to the division into the four well known orders founded by Bütschli, and since repeated in every text-book, although he is decidedly of opinion that this classification "is artificial and does not always correspond to the real affinities of the species." If this is the case, it is a matter for regret that the author did not attempt to embody his ideas of the natural relationships of the Heliozoa in a scheme of classification more suited to express them. He contents himself, however, by making only minor improvements, such as transferring the genus Heterophrys from the Chlamydophora to the Chalarothoraca. He also separates from Bütschli's list certain forms which are placed by him under the heading "Pseudo-Heliozoa." This category, he is at pains to explain, is not intended to have any systematic value, but merely to serve as a mode of uniting "certain organisms which exhibit points of resemblance to Heliozoa sufficiently striking to tempt one to unite them with the latter, and which nevertheless do not belong to the group." Under the Pseudo-Heliozoa are placed various aberrant types the descriptions of which constitute one of the most valuable portions of the book to the student of Protozoa.

For the many interesting details of structure or mode of life of these animalcules described by the author the reader must be referred to the book itself. The following sentences, however, from the section headed "Psychology" merit quotation:—

"If we wish to adopt the chemico-physical theory, so much in favour now-a-days, according to which everything in the lower beings is but mechanical reaction, it is necessary to apply the theory consistently, to examine the higher animals as well as the others, and we shall then be forced to recognise that between the top and the bottom of the psychical scale there is only a descending gradation. Hence, according to this theory, the savant solving a problem should only differ from the Protist in the greater complexity of the physico-chemical reactions. If on the contrary one is led to see something more than matter in the highest manifestations of human thought, this something must

likewise be admitted for the beings lowest in the scale. But then, we may add, on the supposition that the scale rests on pure matter, it is not on the lowest grade that we find the infinitely minute creatures, but already some way up, so much so that the gap separating them from the bottom is infinitely greater than that which they would have to traverse to arrive at the summit."

In conclusion, it may be said that everyone interested in the study of microscopic forms of life will welcome this work from the hand of an enthusiastic observer, who has a most intimate knowledge at first hand with the creatures about which he is writing, and who has achieved a wide reputation as an investigator of the fresh-water Protozoa. The work is weakest on the side which deals with the minuter phenomena of the cell and nucleus, especially in relation to reproduction, the study of which during the last decade has developed with such rapidity and has brought forth results of such fundamental importance in biology. The author is evidently more of a naturalist than of a cytologist, but it is perhaps too much to expect detailed cytological work in a systematic monograph even of a group of Protozoa. As a general survey of the peculiar forms dealt with it will be found most useful, not only as an exposition of the present state of knowledge, but even more as indicating how much still remains to be worked out with regard to the affinities of the Heliozoa and allied forms of life. By directing attention to the many interesting problems these lowly creatures present for solution, it may be hoped that this monograph will act as a guide and stimulus to investigators in all countries. E. A. M.

TREES.

Trees. By Prof. H. Marshall Ward. Vol. i. Buds and Twigs. Pp. xiv+271. Vol. ii. Leaves. Pp. x+348. (Cambridge: University Press, 1904.) Price 4*s.* 6*d.* net each.

AS one might naturally expect from the scant attention which has hitherto been given to the study of forestry in this country, our literature on the subject is by no means what it ought to be. True, we have several standard works, excellent of their kind, which, however, deal with trees more from a sylvicultural than from a botanical aspect. Students of forestry, and especially students of forest botany, and all those interested in the growth and cultivation of trees, have long felt the great want of a suitable text-book or guide to their studies, but happily now, with the appearance of the above handbook from the facile pen of Prof. Marshall Ward, this want has become a thing of the past.

The work will consist of several parts—each part forming a volume—the first of which is already to hand, and treats of buds and twigs. The mere mention of buds and twigs might suggest to some a dry, uninteresting study of minute details; but never was a greater mistake made than to imagine such is the case. The study of our trees and shrubs in their winter condition has a fascination all its own, and, in addition to this, the clear and simple way in which the author treats the subject is sure to inspire many with interest and enthusiasm for the study of forest botany.

The study of the minute structure of plants in the laboratory has in many cases received the lion's share of attention, with the result that students have been taught to know the internal structure of plants before they were able to recognise these plants in the field. The author clearly recognises this fact, and plainly states that his object is to bring the student more into touch with the plant in its natural surroundings, where he may form a personal acquaintance with it and learn to observe and note facts for himself, and thereby lay a solid foundation for the further study of the biology of the living plant of whatever kind or nature. The opening chapter gives a short but clear account of the general segmentation of the plant. The next eight chapters are devoted to a consideration of buds. The different kinds, structure, position, arrangement, and function are described in a most masterly and interesting fashion. The next seven chapters deal with the different kinds of shoots—their tegumentary systems, leaf-casting and the formation of leaf scars, lenticels, twigs and other accessory characters.

The second portion of the book contains a very comprehensive classification of trees and shrubs according to characters afforded by their buds and twigs. The classification is accompanied by a complete set of illustrations, showing very clearly in pictorial form all those features by which the species may be determined in their winter condition. Most of those drawings have been done by Miss Dawson, of the County School, Cambridge, to whose artistic skill they do great credit. The other illustrations with which the volume teems have been obtained from various sources, and are all duly acknowledged by the author.

The work will be found indispensable to those students who wish to make an expert study of forest botany. At the same time it is expressed in language so clear and devoid of technicalities that the amateur who wishes to know something about our trees and shrubs will find this one of the most useful guides to which he can turn.

Succeeding volumes will deal with leaves, inflorescences and flowers, fruits and seeds, seedlings, and the habit and conformation of the tree as a whole, and each of those volumes, like the present one, will contain diagnostic tables at the end, devised for use in the field.

From the foregoing it will be seen that the work is a many-sided one, acting not only as a guide to the naturalist in the field, but also as a laboratory handbook, where the use of the lens and microscope may be employed to amplify the study of objects already observed in their natural habitats.

Botanists generally, and especially forest botanists, will welcome the appearance of this book as supplying a decided want, and filling a distinct gap in our literature of forest botany.

Since the above was written the second volume has appeared. As already stated, it deals with leaves, and, like vol. i., consists of a general and a special part.

The general part contains an admirable and exhaustive treatment of the external features of leaves,

their form, composition and arrangement, together with the general characters of their venation, surface and texture; nor has the author omitted to go into the more detailed but equally important consideration of the anatomical structure and physiological functions of leaves. This part also contains many lists comprising those leaves which show the same common features as regards arrangement on the twig, form of venation, character of base, apex and margin of lamina, &c.

Part ii. of this volume, like that of vol. i., gives the classification of trees and shrubs, but, in this case, according to the character of their leaves. A useful glossary is given at the end of the volume, so that the beginner need have no difficulty in understanding the few but necessary technical terms which are used in the book.

ADVANCES IN PHYSICAL SCIENCE.

The Recent Development of Physical Science. By W. C. D. Whetham, F.R.S. Pp. xii+344. (London: John Murray, 1904.) Price 7*s.* 6*d.* net.

IT is now nearly thirty years since Prof. Tait published his lectures on "Recent Advances in Physical Science." The period that has since elapsed has been one of remarkable fruitfulness, and it is a suggestive fact that the fundamental problems of physical science which were dealt with by Prof. Tait have to so large an extent supplied the motive for the investigations now described by Mr. Whetham. Foremost amongst these perennial problems must be placed the structure of matter, the mutation of energy, and the nature of comets and nebulæ. Lord Kelvin's vortex-ring theory of the atom, so lucidly expounded by Prof. Tait, finds in the later volume its analogue in the electrical or corpuscular atom of Prof. J. J. Thomson, and the doctrine of the conservation of energy, which occupies the foremost position in the earlier volume, is again brought into prominence by the recent suggestions that the internal motion of the atom, be it that of a vortex ring or of a moving electron, may perhaps be drawn upon to supply the energy that is liberated from some hidden storehouse by the radio-active elements.

After an introductory chapter on the philosophical basis of the science, Mr. Whetham devotes two chapters to the liquefaction of gases and the phenomena of fusion and solidification. These two chapters afford striking examples of the way in which recent years have added to the equipment of the experimental sciences, not only by increasing the range of temperatures within which investigations may now be conducted, but also by providing the means of accurately measuring these temperatures. Under the heading of "Fusion and Solidification" Mr. Whetham has given a concise and readable account of the knowledge recently acquired with reference to the structure of metals and alloys. The examples, already classical, of the copper-tin alloys studied by Roberts-Austen and by Heycock and Neville, and the iron-carbon alloys studied by Osmond, le Chatelier, Roberts-Austen, and others are described. Photomicrographs of the former series of alloys are given. The most fascinating part of the chapter, however, is that which deals with Mr. Beilby's recent investigations of the surface structure of solids. These investigations have shown that even a brittle metal like antimony can be made at ordinary temperatures to flow like a liquid, so that when it is rubbed with fine emery paper the surface produced is not jagged or crystalline, but under the highest magnification appears rather like a freshly painted surface on which the rounded streaks left by the brush are still visible.

In the chapter on the problems of solution, the mechanism of electrolysis is discussed from the point of view of Arrhenius's theory of electrolytic dissociation, but the arguments in favour of this theory are stated with a moderation that is in marked contrast to the one-sided statements that have sometimes been put forward by ardent supporters of the theory. In considering the nature of colloidal solutions, a purely physical explanation is given of the coagulation of the proteids; the observation that "the direction of movement of certain proteids" under the influence of an electric current "could be changed by changing the solvent from a very dilute acid to a very dilute alkali" would be interpreted by the chemist as evidence of their power, as amino-acids, to function either as acid or as base, whilst the fact that "if the solvent was very carefully neutralised an isoelectric point was reached at which the solution became very unstable and coagulation seemed to occur spontaneously" would be ascribed to the tendency of the free amino-acid to condense and form a more complex molecule in the manner characteristic of this group of compounds.

The chapters on the conduction of electricity through gases and on radio-activity contain a concise account of the series of investigations that have been co-ordinated in the recently published works of Prof. J. J. Thomson and Prof. Rutherford. The chapter on atoms and æther derives its chief interest from the inclusion in it of the results of Prof. Thomson's recent investigations of the stability of a system of negatively charged corpuscles revolving in orbits within a positively charged sphere. The atomic model suggested by such a system gives, probably for the first time, a clear representation of the periodic properties of the elements, including the variation in valency, which is the most characteristic of these properties.

The final chapter, on astrophysics, contains an account of the more recent results of spectroscopic investigations of the sun and stars, and includes reproductions of three of the most striking of Prof. Hale's solar photographs. In the later part of the chapter the pressure due to radiation is considered and applied to the explanation of the curious phenomena of comets' tails, whilst the mutual repulsion of radiating particles is suggested as a possible explanation of the permanence of Saturn's rings.

The author has sought to express the results of recent physical investigations in a form which "might prove useful to students of science in general," and "also appeal to those who, with little definite scientific training, are interested in the more important conclusions of scientific thought." In the former part

of his task he has been eminently successful. In his appeal to a wider public, it is to be hoped that the difficulties of "treating the wider and deeper generalisations of natural science as fit subject-matter for current thought and literature" will not deprive him of a further measure of well merited success.

T. M. L.

THE CYANIDE PROCESS.

Cyaniding Gold and Silver Ores. A Practical Treatise on the Cyanide Process; embracing Technical and Commercial Investigations, the Chemistry in Theory and in Practice, Methods of Working and the Costs, Design and Construction of the Plant and the Costs. By H. Forbes Julian and Edgar Smart. Pp. xx+405; illustrated. (London: C. Griffin and Co., Ltd., 1904.) Price 21*s.* net.

THE cyanide process is still in its teens, but it is a lusty stripling. Much of the enormous increase in the production of gold during the last few years is due to it, either directly or indirectly. There are few gold mines of any importance in the world at which the process is not installed, and it has been stated on high authority that the majority of these mines could not earn profits and pay dividends without its aid. Owing to the shortness of the time since the industry of cyaniding gold and silver ores began to spring up, there is a lack of data on the subject readily available to men at work far from centres of civilisation. There are many books on the cyanide process, but new ones are still welcome, particularly a work like that of Messrs. Julian and Smart, in which some degree of completeness is attained.

The authors were well equipped for their task, both having been engaged in the industry for a number of years. They have not, however, merely written down the results of their own practical experience, a course which usually leads to dogmatic assertion on doubtful points, but, on the contrary, have studied the voluminous literature of the subject with evident care, and displayed some judgment in their extractions. If they had added a bibliography, one shudders to think of the portentous length it would have attained.

Not content with this, they have made a number of laboratory experiments on the dissolution and precipitation of gold, and advance views based on these which are in part novel and somewhat unsatisfactory. Exception may fairly be taken to this portion of the book, for whether these views are right or wrong, they are out of place in a text-book until they have been discussed adequately. To the practical worker, for whom this book is intended, theories are useful only if they explain and elucidate phenomena with which he is confronted in the mill, or enable him to decide on a course of action in unusual cases. Much of the authors' theorising does not appear to answer this test very well.

The book begins with an interesting, if not an impartial, chapter on the early history of the cyanide process. The authors next proceed to describe the laboratory experiments which are necessary to determine the method of applying the process to any particular ore. In the useful discussion on sampling, the omission of any reference to recent work is noticeable, and the account of automatic machines is hardly adequate.

The most serious omission in this section, however, is in regard to laboratory work in connection with a mill in operation. The examination of mill solutions for gold and other metals, for available cyanide, for oxygen, or for dissolving power is not touched on. The only reference to the matter is in the sentences:—

"It must however be understood that there is no relation between the (total cyanide) found present and the dissolving action of the solution on gold and silver. For this reason two different solutions containing by the test the same quantity of cyanide may have very different dissolving effects."

This would be cold comfort to anyone who wished to learn what he could of the methods adopted to determine the condition of a mill solution. The gap should be filled in a future edition.

The later chapters, dealing with the methods and machinery used in practice, form by far the most interesting and useful part of the book. The authors seem to be quite at home in describing the design and construction of leaching vats, precipitation boxes, pumps, launders, sizing plant, and all the accessories of a modern cyanide mill. The methods of treating different classes of material are also handled with skill and judgment, and are fairly up to date. It is not the fault of the authors that progress in the industry continues to be rapid, and that any description is behind the times almost as soon as it is printed. The book ends with a couple of excellent chapters on the cost of constructing plants and of treating ores, and the index has been carefully prepared.

The volume is handsomely got up, and enough has probably been said to show that the merits of the work so far outweigh its faults that those interested in the cyaniding industry cannot do without it.

T. K. R.

OUR BOOK SHELF.

Fireside Astronomy. By D. W. Horner. Pp. 105. (London: Witherby and Co., 1904.) Price 1*s.* 6*d.* net.

"THE articles which go to make up this little book originally appeared in the 'English Mechanic and World of Science,' and caused some discussion therein." This we read in the preface of the book before us, and we are further told there that this "simple worded treatise" is intended for the "man in the street."

A perusal of these pages will, however, tend to bewilder the mind of this very practical personage considerably, for the text is not a specimen of clearness, and the illustrations are very far from being self-explanatory; in fact, the latter are as bad as it seems possible for illustrations to be.

In justification of these statements it may be remarked that the zodiac is mentioned on p. 3 and *defined* on p. 14. On p. 4 we have a very ambiguous statement about the various altitudes of the sun at different *seasons* of the year, no reference being made

to the inclination of the earth's axis to the plane of the ecliptic, or to altitudes at *noon*. On p. 11 we read:—"By refraction we mean the property of the atmosphere to bend the rays of light from celestial bodies, and so make them appear at a point in the heavens some distance (greater according to the proximity to the horizon) from their true position." Such a statement, to the man in the street, could apply equally as well to a horizontal as a vertical change of position. On p. 19 is written:—". . . solid body of the Sun himself, which is probably a relatively dark body . . ."; for such readers as this book is intended a statement of this nature should have been carefully avoided.

On the same page we must conclude that for most days of the year, especially in years away from sun-spot minimum, the earth is subject to nearly a continuous series of magnetic storms, for "the appearance of spots on the sun is nearly always accompanied by a 'magnetic storm' . . . ." The use here of the term "magnetic storm" is quite unnecessary and misleading.

Enough, perhaps, has been said about the text of this "simple worded treatise," and we leave intending readers to criticise the drawings themselves, their attention being specially directed to those on pp. 6, 25, 36, and 89.

Observations océanographiques et météorologiques dans la Région du Courant de Guinée (1855–1900). (1) Texte et Tableaux. Pp. iv+116. (2) Planches, viii. The Netherlands Meteorological Institute. (Utrecht: Kemink & Zoon, 1904.) Price 5 francs.

THESE volumes contain the results of a discussion of observations recorded by Dutch shipmasters. The area extends from the equator to latitude 25° N., and from the meridian of Greenwich to 40° W. The work is a revised and more complete edition, brought up to date, of "De Guinea—en Equatoriaal Stroomen," published in 1895. Currents, winds, temperature and specific gravity of the sea water, temperature and pressure of the air, frequency of rain days, records of current ripples, flying fish, phosphorescence, and of green, brown, and blue water have been tabulated for each month in spaces of 1° squares, then grouped into 5° squares for each month and the year, also for each of twelve three-monthly periods—December to February, January to March, &c.—and finally, the current and wind results in 5° squares for each month and the year for each octant. So far as they go, the results for the various elements are interesting and valuable. Unfortunately, throughout this long period of thirty-six years Dutch ships kept so very closely within the narrow limits of the recognised outward and homeward routes that the information immediately beyond has been exceedingly sparse; indeed, over an area of about 400,000 square miles in the south-western quarter of the region under discussion not a single observation was available for the four consecutive months August to November, a period of the year when the east-going counter-current would be met with in this locality. We are presented, therefore, with very incomplete results as to the seasonal extension and contraction of this important current. It is admitted that, having failed to devise a wholly satisfactory system of weighting the frequency of winds, a method "subject to some objections" has been followed, so that whether the wind has been logged from the same point once or six times in the day it has been counted as one observation, whereas if logged from six different points in the same interval six observations have been tabulated. Except in table iv., and planches vi. and vii., the absence of current or wind has been ignored.

(1) *Opere matematiche di Francesco Brioschi.* Vol. iii. Pp. x+435. (Milan: U. Hoepli, 1904.) Price 25 lire.

(2) *Opere matematiche di Eugenio Beltrami.* Vol. ii. Pp. 468. (Milan: U. Hoepli, 1904.) Price 25 lire.

THESE are the continuations of series of collected papers of which the previous volumes have already been reviewed in NATURE.

The mathematical papers of Francesco Brioschi are published under the auspices of a committee consisting of Profs. G. Ascoli, V. Cerruti, G. Colombo, L. Cremona, G. Negri, and G. Schiaparelli. Of the papers in the third volume, Nos. 90 to 100 were published in the *Annali di matematica pura ed applicata* from 1887 to 1897, Nos. 101 to 125 in the Lombardy *Rendiconti* between 1867 and 1896, the next two in the *Memorie* of the Modena Society in 1855, and the remainder (Nos. 128 to 144) in the *Atti* of the Lincei Academy between 1870 and 1886. The papers have been revised by Profs. Bianchi, Capelli, Cerruti, Gerbaldi, Loria, Pascal, Pittarelli, and Tonelli; the volume has been edited by Profs. Gerbaldi and Pascal, and the former is mainly responsible for the revision of the proofs.

The second volume of Beltrami's works, like the first, is brought out under the auspices of the faculty of science of the University of Rome, and contains nineteen papers arranged in chronological order, numbered 27 to 45, and published between the years 1867 and 1873. The series is to be completed in five volumes.

The Science Year Book for 1905. Edited by Major B. F. S. Baden-Powell. Pp. iv+393. (London: King, Sell and Olding, 1905.)

A PLACE should be found for this Year-book on the writing table of every astronomer and meteorologist, and the volume should be available for ready reference in laboratories and schools where science is studied. The first section of the work contains an astronomical ephemeris throughout the year, short notes relating to the movements of the earth, particulars as to paths of the principal planets this year, details of eclipses, many useful tables, and maps of constellations. There are also meteorological tables and diagrams, physical and chemical constants, and tables of weights and measures of various kinds. Another section is devoted to particulars of scientific societies at home and in America, and notes on prizes and awards offered for scientific research. This list, which at present occupies only two pages, might be made a very valuable part of the book; for, so far as we are aware, the information does not exist in a convenient form anywhere. Particulars might be given, for instance, of the subjects and values of the prizes offered each year by the Paris Academy of Sciences and many similar bodies. Short articles are contributed on the progress of different branches of pure and applied science last year, and there is a biographical directory which includes the names of fellows of the Royal Society and a few other men of science, but is not complete enough to be of much use as a directory.

The remainder of the volume consists of a diary with pages for every day, for monthly notes, cash account, &c. For each day astronomical particulars are printed at the top of the page, and there are columns in which to enter results of meteorological observations. It is very convenient to have all these matters brought together so handily for reference and record; and we have no hesitation in saying that all who are interested in natural phenomena or concerned with scientific progress will find this Year-book of great service.

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.]*

The Origin of Radium.

EIGHT months have elapsed since I wrote in your columns (NATURE, May 12, 1904) giving an account of some experiments designed to test the view advanced by Prof. Rutherford and myself that radium is a product of the radio-active change of uranium. I then stated that in 1 kilogram of uranium nitrate that had been under observation over a period of one year since it was completely freed from radium, the quantity of radium reproduced in that time was less than one-ten-thousandth of the quantity theoretically to be expected. This result has been widely quoted, more widely, perhaps, than I intended, for the result was a preliminary conclusion only, and, as I pointed out, obtained under very unfavourable conditions owing to the very powerful preparations of radium that had been in use in the laboratory for other researches. The necessity for publishing it was to a certain extent forced upon me by the attention the problem was beginning to attract from other investigators, and by the prospect of several months' absence abroad. I relied on the fact that the result being negative, the presence of the radium in the laboratory could have had no effect, but in this I was mistaken.

Since my return I have resumed the research in the new chemical laboratories recently erected here, into which no radium has so far been brought, and have found that the earlier result was affected by an error which invalidates the conclusion drawn. It is therefore my duty to point this out at once without waiting for any further results. I am now fairly satisfied that there is a steady production of radium from uranium, and although the quantity formed, as measured by the amount of radium emanation evolved, is of a lower order of magnitude than is indicated by the disintegration theory, it is much greater than the ten-thousandth part.

At the present time, about eighteen months since the commencement of the experiment, the kilogram of uranium nitrate in solution contains, so far as the amount of emanation evolved is a measure, about $1{\cdot}5\times10^{-9}$ gram of radium, and if the whole series of measurements from the commencement are re-calculated, eliminating the error alluded to, they are fairly consistent with there having been a steady production of radium at this rate continuously from the commencement. This gives the value 2×10^{-12} for the fraction of the uranium changing per year, whereas the most probable theoretical estimate is 10^{-9}. The new result is thus still only one-five-hundredth of the theoretical.

The error in the result published last May was not in the determination of the amount of radium emanation evolved from the uranium, but in the determination of the amount of emanation given by a known weight of radium, against which the first mentioned determination was compared. The measurements on the uranium are in good agreement with those recently obtained, whereas the comparative experiments with radium gave results too high owing to extraneous radium in the laboratory. For the effect from the uranium is so minute that to obtain a comparable effect with the radium emanation, the quantity of the latter obtainable from the smallest weighable quantity of pure radium bromide must be diluted and subdivided until only a millionth part at most remains. Thus if any emanation were present in the air of the laboratory used for the dilution, or if by mischance any of the gas apparatus, rubber tubing, or mercury had been used previously in experiments with powerful radium preparations, the results obtained would be completely false. It is now known (*vide* Rutherford, *Phil. Mag.*, November, 1904, p. 637) that even metals, as copper and silver, absorb the radium emanation appreciably and slowly evolve it. The utmost precautions have to be observed in standardising the rate of leak of the electroscope by the emanation from a known weight of radium, so that each successive dilution of the emanation is performed in an entirely new apparatus with new mercury and rubber connections. Otherwise emanation is absorbed from the gas rich in it and given out to the diluted gas, and when the final dilution should contain only one-millionth of the original emanation, as in these experiments, it will be in reality far richer. This explains the apparently paradoxical result I obtained that the determinations of the amount of radium produced were far too *low*, owing to the extraneous radium of the laboratory.

The research is being continued with the view of eliminating what appears a probable explanation of the too low rate of production. It may be that under the conditions of the experiment the greater part of the emanation is retained by the uranium solution and not evolved as gas. New methods are being tried, and it is hoped that they will give a positive answer to this question.

FREDERICK SODDY.

The University, Glasgow, January 20.

A New Radio-active Product from Actinium.

AT the suggestion of Prof. Rutherford, I have made an examination to see if there is any product in actinium corresponding to the product UrX in uranium or ThX in thorium. The investigations were made with a preparation of the emanating substance of Giesel (of activity 300 times that of uranium), which has been shown to be identical in radio-active properties with the actinium of Debierne.

Taking into consideration the similarity of actinium and thorium, both as regards their chemical and radio-active properties, I resolved to try if the method used by Rutherford and Soddy for the separation of ThX would not serve also to separate an analogous product from actinium. The experiments were at once successful. If ammonia was added to a solution of actinium in hydrochloric acid, the actinium was precipitated, while a small amount of a very active substance was left behind in the filtrate. This substance, which is so similar in properties to ThX, will be called actinium X (AcX).

The product AcX, immediately after its separation, weight for weight, was more than a hundred times more active than the original actinium. The activity increased in the first day after removal to about 15 per cent. of its original value, and then decayed with the time according to an exponential law, falling to half value in about ten days. The actinium from which the AcX had been removed, almost inactive immediately after separation, gradually recovered its lost activity. As in the case of thorium, the curve of recovery of the activity was complementary to the curve of decay of AcX.

The behaviour of the product AcX is thus completely analogous in all respects to that of ThX, only the constant of change has a different value, which is characteristic for AcX.

Special experiments, made for the purpose, showed that the emanation was produced from AcX, and not directly from the actinium. The latter, immediately after separation of AcX, gave off very little emanation, while AcX produces the emanation in large amount. The amount of emanation from AcX diminished with the time at the same rate that AcX loses its activity. At the same time the actinium gradually increased in emanating power, due to the production of fresh AcX, and finally reached an equilibrium value.

The product AcX gives out both α and β and probably γ rays. It is, however, difficult to determine whether the β rays arise directly from AcX or from the excited activity to which the emanation gives rise.

There is an interesting point of distinction between the radio-activity of thorium and actinium. After the separation of AcX, the actinium is almost completely inactive, only 4 per cent. of the maximum activity being observed. It is probable that this amount could be still further reduced by successive precipitations. Thorium and radium, on the other hand, always show a non-separable activity of about 25 per cent. of the maximum. This points to the fact that the activity from ordinary actinium is due entirely to AcX and its successive products, and that little,

if any, is supplied directly by actinium itself. From the point of view of the theory of radio-active changes, this shows that the change of actinium into AcX is a "rayless" change.

A more complete account of these investigations will be published later. T. GODLEWSKI.

McGill University, Montreal, January 2.

A Simple Model for Illustrating Wave-motion.

MACH'S model for illustrating the transversal as well as the longitudinal wave is known to work in a beautiful manner. The arrangement for exciting the wave-motion is not, however, very simple. The fact that the period of a pendulum varies with the length of the string may conveniently be availed of for producing a wave-motion in a row of pendulum-bobs.

As shown in the annexed figure, a series of pendulums of equal length is suspended at equal intervals. Each ball hangs on two strings, each of which passes through the corresponding one in the row of holes in one of two parallel horizontal rods M and N; the strings pass through the holes from inside to outside, and are tied together to a horizontal rod L placed symmetrically above the two rods. One end of the upper rod is pivoted, while the

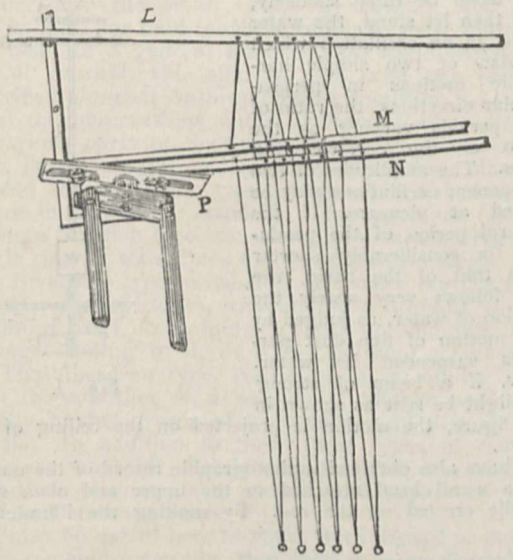


FIG. 1.

other can be raised to a suitable height. If this end be raised, the length of the pendulums increases from the end toward the other.

The two rods, M and N, can be separated or brought in contact by two links P and Q (not shown in the figure), attached to their ends. If the rods be in contact, the pendulums oscillate at right angles to the vertical plane containing the rod L; if they are separated, the pendulums oscillate in this plane. Hence, by the position of the links, the longitudinal as well as transversal oscillations of the pendulums can be excited at will.

To produce a wave-motion, the end of the upper rod L is raised, and then the two rods M and N are brought in contact. Then the pendulums are set in motion simultaneously by a long rod. After one or two minutes the phase-difference in each pendulum gradually increases, and a beautiful transversal wave-motion is produced. The wave-length becomes shorter and shorter; if a wave of a required wave-length is obtained, the rod L is lowered to its initial position. Each pendulum has then an equal length, so that wave-motion of a definite form incessantly proceeds from one end to another.

If the links be rotated, so as to separate the two bars M and N from each other, the plane of oscillation of each pendulum gradually changes, until the oscillation becomes at last longitudinal. Then a regular longitudinal wave is observed to proceed from one end to another.

On the other hand, a longitudinal wave can first be excited, and then be transformed into a transversal one. Raising the end of the upper rod, and separating the two horizontal rods M and N, each pendulum is simultaneously set in a longitudinal motion by a long rod with receiving holes for pendulum-bobs. A longitudinal wave is gradually formed; if a wave of a suitable length be obtained, the rod L is lowered to its initial position; then wave-motion of a definite form is established. By turning the links the longitudinal wave is transformed into a transversal one.

Tokyo, Japan. K. HONDA.

Recently Observed Satellites.

MAY I ask whether the small, distant, eccentric, and possibly retrograde satellites of Jupiter and Saturn, which have been discovered and seem likely to be discovered, ought not more properly to be regarded as cometary bodies, or a shoal of meteors not yet too much drawn out for visibility at a distance? Would it not be possible for the larger planets to be attended by such bodies, the orbits of which have been made moderately elliptical by an accidental perturbation? It is known that the larger planets are able to capture comets for the sun; is it possible that with the aid of their satellites and subsequent tidal action they may be able to catch a few for themselves?

OLIVER LODGE.

The University, Birmingham, January 20.

Compulsory Greek at Cambridge.

MY experience of Greek at Cambridge is very similar to that of Mr. Willis, but the slight differences are, I think, instructive.

When I decided to go up to Cambridge to study mathematics and philosophy I was living abroad, and I crammed Greek just as Mr. Willis describes, except that I worked entirely alone. But on going in for the "Little Go," though I passed easily in translation, I failed by a few marks in Greek grammar. It was so near a thing that I thought I might pull through in December with a few hours more grind; but unfortunately I ran it too fine, and again failed by a few marks. This meant that I had to get up a complete new set of translation books for the following June, and to prevent further mistakes I went to a coach for the grammar part. I then passed, getting a second class. Like Mr. Willis, I can only say my present knowledge of the language is *nil*, although I had a double dose of it. It cannot for a moment be pretended that I got any insight into "Greek thought" which I could not have got equally well by reading a good translation. But I confess my opinion of the value of Greek thought was not raised by what I read—at best it only seemed to me creditable, considering how long ago it was written. But this may have been due to my resentment at being forced to waste time in an uncongenial study, when I was keen to get on to something else.

EDWARD T. DIXON.

Racketts, Hythe, Hants, January 20.

Super-cooled Rain Drops.

WALKING home from the university last night at about 8.45 p.m. an interesting phenomenon occurred.

Something was falling which at first appealed to one as hail, but I soon found that it was large rain drops evidently cooled below the freezing point; at the moment they struck objects such as one's hat, coat, or walking stick, &c., they instantly solidified in small hemispherical lumps; falling on the ground they gave it the appearance of a sheet of ice, but the roads were not slippery, as the solidified rain gave the road just a nice amount of roughness. The noise of the falling rain was very curious—a crackling noise, not unlike that of small electric sparks.

EDWARD E. ROBINSON.

The University, Birmingham, January 17.

Polar Plotting Paper.

MAY I be allowed to direct the attention of all interested in mathematical teaching in our schools and colleges to the polar plotting paper recently prepared by Mr. Ellice Horsburgh, lecturer on technical mathematics in Edinburgh University?

The special feature of this paper is that it is ruled radially with lines which subdivide the region about a point into aliquot parts of a radian. There are two forms of sheets now in the market. In one the origin is at the centre, and the radial subdivision is carried right round through four right angles. In the other, a reduced copy of which is here reproduced, the origin is taken near one corner, and the graduation is carried through a little more than a quadrant. Dotted radial lines show the backward continuation of the axis from which the radians are measured, and also the axis perpendicular to it. These dotted lines do not, of course, belong to the system of lines dividing the region into aliquot parts of a radian.

The radius of the fiftieth orthogonal circle is taken as the unit, and on the margins just outside the proper radian subdivisions small radial lines are drawn giving the usual division into degrees. The two circles drawn, the one on the axis as diameter and the other on the dotted perpendicular of unit length, serve to give by inspection the sines and cosines of the angles given in radians.

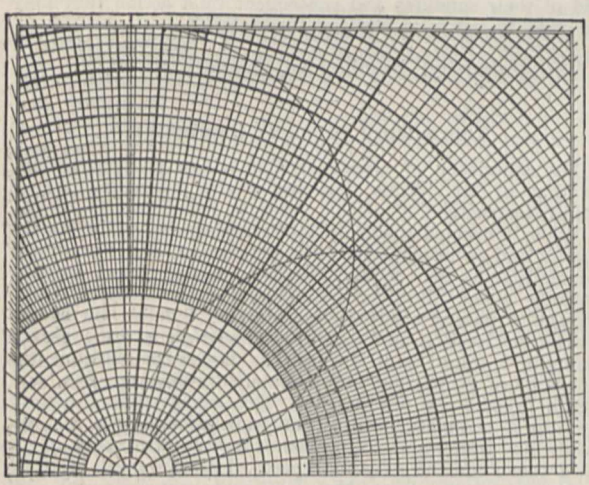


FIG. 1.

Thus the paper contains on its own surface the means of plotting with great ease the polar equations of curves involving radians, sines and cosines, and a little calculation will enable the student to take account of other functions.

The first important use in the hands of the student is obviously to get a clear idea of the radian as the true scientific measure of angle; but a great many other important uses will at once occur to the teacher of practical mathematics, such, for example, as finding reciprocals, geometric means, mean proportionals, fourth proportionals, squares, square-roots, &c.

Another use is the evaluation of the integrals $\int r^2 d\theta$ and $\int r d\theta$. The former is got by simply counting the elements included in the area, and the latter by multiplying the total angle between the initial and final radius by the mean radius, the value of which may be obtained by a method similar to Simpson's rule.

From these few statements and indications the purpose of Mr. Horsburgh's patent will be readily appreciated. It is doubtful if the average student, taught along the usual lines, ever gets an accurate working knowledge of the radian or circular measure of an angle, indispensable though that is for all higher trigonometrical and analytical work. A few hours' systematised exercise with the polar paper will do more than days of arithmetical transformations in the usual academic style. C. G. KNOTT.

Lissajous's Figures by Tank Oscillation.

THE oscillation of a rectangular water basin may be utilised for the illustration of the composition of two simple harmonic motions in two directions, perpendicular to each other.

A light pendulum was constructed of a thin aluminium rod, R (Fig. 1), 10 cm. long. The bob B was made of a disc of wood. On the upper end of the rod a light mirror M was attached. The rod could be supported at any desired point by a small gimbal G, so that the rod could oscillate as a spherical pendulum. A small brass weight W was attached to adjust the period of oscillation by raising or lowering it to a proper position.

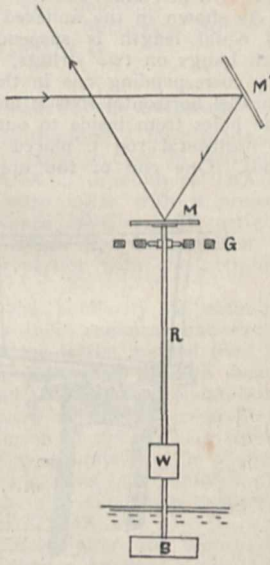
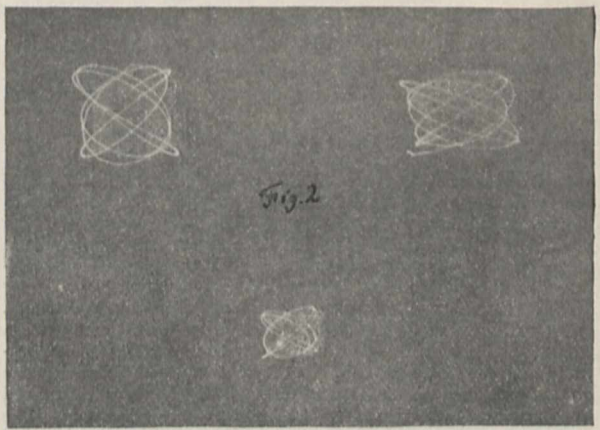


Fig. 1

The bob is sunk into the middle part of a suitable rectangular basin, filled with water to a proper depth. If the basin be tilted suddenly, and then let stand, the water is set in an oscillation which consists of two simple harmonic motions in perpendicular directions, the ratio of the periods varying as the ratio of the corresponding sides. The amplitudes of two component oscillations may be varied at pleasure. If the natural period of the pendulum is considerably shorter than that of the basin, the bob follows very nearly the motion of water, as judged by the motion of fine dust particles suspended in water. Now, if a beam of strong sun-light be sent as shown in the figure, the motion is projected on the ceiling of the room.

I have also obtained a photographic record of the motion of a small bead attached to the upper end of a small needle erected on the rod. By making the illumination intermittent by means of a perforated rotating disc, the difference of velocities at different phases may be shown.



The motion of a kaleidophone may be projected in a similar manner. T. TERADA.

Physical Laboratory, Tokyo, December 19, 1904.

NOTES ON STONEHENGE.

I.—CONDITIONS AND TRADITIONS.

AFTER Mr. Penrose, by his admirable observations in Greece, had shown that the orientation theory accounted as satisfactorily for the directions in which the chief temples in Greece had been built as I had shown it did for those in Egypt, it seemed important to apply the same methods of inquiry with all available accuracy to some example, at all events, of the various stone circles in Britain which have so far escaped destruction. Many attempts had been previously made to secure data, but the instruments and methods employed did not seem to be sufficient.

Much time has, indeed, been lost in the investigation of a great many of these circles, for the reason that in many cases the relations of the monuments to the chief points of the horizon 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 astronomical conditions of the problem.

So far as I know, there has never been a complete inquiry into the stone circles in Britain, but Mr. Lewis, who has paid much attention to these matters, has dealt in a general manner with them (*Archaeological Journal*, vol. xlix. p. 136), and has further described (*Journal* Anthropological Institute, n.s., iii., 1900) the observations made by him of stone circles in various parts of Scotland. From an examination of a large number he concludes that they may be divided into different types, each of which has its centre in a different locality. The types are (1) the Western Scottish type, consisting of a rather irregular single ring or sometimes of two concentric rings. (2) The Inverness type, consisting of a more regular ring of better-shaped stones, surrounding a tumulus with a retaining wall, containing a built-up chamber and passage leading to it, or a kist without a passage. (3) The Aberdeen type, consisting of a similar ring with the addition of a so-called "altar-stone" and usually having traces of a tumulus and kist in the middle. In addition to these three types of circles, there are what Mr. Lewis calls sun and star circles, with their alignments of stones, and apparently proportioned measurements.

It may be useful here to state, with regard to megalithic remains generally, that they may be divided as follows:—

(*a*) Circles. These may be single or double, and either concentric or not.

(*b*) Menhirs, or single stones, in some cases still upright, but in many overthrown.

(*c*) Alignments, *i.e.* lines of stones in single, double, or in many parallel lines. If these alignments are short they are termed avenues.

(*d*) Cromlechs; this term generally means a collection of stones; the term is applied to irregular circles in Brittany. It also applies to a single stone raised on the summits of two or more pillar stones forming the end and sides of an irregular vault generally open at one end ("Dolmens of Ireland," Borlase, p. 429).

(*e*) Coves. A term applied by Dr. Stukeley and others to what they considered shrines formed by three upright stones, thus leaving one side open. I take them to be partially protected observing places. There are well-marked examples at Avebury, Stanton Drew, and Kit's Coity House.

(*f*) Dolmens, from Dol Men, a table stone. These consist of a flat stone resting on two or more upright stones forming a more or less complete chamber, which may or may not have been sepulchral. I note the following subdivisions, "Dolmen a galérie" having an entrance way of sufficient height, and "Galgal," similar but smaller. In the "Dolmen à l'allée couverte" there is a covered passage way to the centre. It is a more elaborate cove. For the relation between cromlechs and dolmens, see Borlase (*loc. cit.* and p. 424 *et seq.*).

With regard to dolmens, I give the following quotation from Mr. Penrose (NATURE, vol. lxiv., September 12, 1901):—

"Near Locmariaquer in the estuary named Rivière d'Auray, there is an island named Gavr' Inis, or Goat Island, which contains a good specimen of the kind of dolmen which has been named 'Galgal.'

"At the entrance our attention is at once arrested by the profusion of tracery which covers the walls. From the entrance to the wall facing us the distance is between 50 and 60 feet. The square chamber to which the gallery leads is composed of two huge slabs, the sides of the room and gallery being composed of upright stones, about a dozen on each side. The mystic lines and hieroglyphics similar to those above mentioned appear to have a decorative character.

"An interesting feature of Gavr' Inis is its remarkable resemblance to the New Grange tumulus at Meath. In construction there is again a strong resemblance to Mæs-Howe, in the island of Orkney. There is also some resemblance in smaller details."

While we generally have circles in Britain without, or with small, alignments, in Brittany we have alignments without circles, some of them being on an enormous scale[1]; thus at Menec (the place of stones) we have eleven lines of menhirs, terminating towards the west in a cromlech, and notwithstanding that great numbers have been converted to other uses, 1169 menhirs still remain, some reaching as much as 18 feet in height.

The alignments of Kermario (the place of the dead) contain 989 menhirs in ten lines. That of Kerlescant (the place of burning), which beginning with eleven rows is afterwards increased to thirteen, contains altogether 579 stones and thirty-nine in its cromlech, with some additional stones.

Both circles and alignments are associated with holidays and the lighting of fires on certain days of the year. This custom has remained more general in Brittany than in Britain.

At Mount St. Michael, near Carnac, the custom still prevails of lighting a large bonfire on its summit at the time of the summer solstice; others kindled on prominent eminences for a distance of twenty or thirty miles round reply to it. These fires are locally called "Tan Heol," and also by a later use, Tan St. Jean.

In Scotland there was a similar custom in the first week in May under the name of Bel Tan, or Baal's Fire; the synonym for summer used by Sir Walter Scott in the "Lady of the Lake":—

> Ours is no sapling chance-sown by the fountain
> Blooming at Beltane in winter to fade.

At Kerlescant the winter solstice is celebrated by a holiday, whilst Menec greets the summer solstice, and Kermario the equinoxes, with festivals. The adoration paid these stones yielded very slowly to Christianity. In the church history of Brittany the *Cultus Lapidum* was denounced in 658 A.D.

Many of the fallen menhirs in these alignments have been restored to their upright position by the French Government. Some of them may have been overturned in compliance with the decree of 658 A.D. above referred to. Several of the loftier menhirs are surmounted by crosses of stone or iron.

[1] "The French Stonehenge: an Account of the Principal Megalithic Remains in the Morbihan Archipelago." By T. Cato Worsfold, F.R.Hist.S. F.R.S.L. (London: Bemrose and Sons, Ltd.)

Regarding both circles and alignments in the light of the orientation theory, we may consider simple circles with a central stone as a collection of sight-lines from the central stone to one or more of the outer ones, or the interval between them, indicating the place of the rise or setting of either the sun or a star on some particular day of the year, which day will be a new year's day.

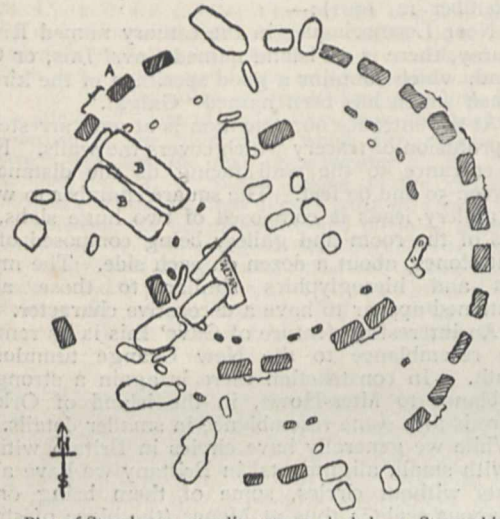


FIG. 1.—Plan of Stonehenge, standing stones shaded. A, Stone which fell in 1900; BB, Stones which fell in 1797. (*Reproduced from "Man."*)

Alignments, on the other hand, will play the same part as the sight-lines in the circles.

Sometimes the sight-line may be indicated by a menhir outside, and even at a considerable distance from, the circle.

The dolmens have, I am convinced, been in many cases not graves originally, but darkened observing places whence to observe along a sight-line; this would be best done by means of an allée couverte, the predecessor of the darkened naos at Stonehenge, shielded by its covered trilithons.

In order to bring some measurements to test the orientation theory in Britain, I found that Stonehenge is the ancient monument in this country which lends itself to accurate theodolite work better than any other. Avebury and Stanton Drew are known to a great many archæologists; there are also other very wonderful stone circles near Keswick and in other parts of England; but unfortunately it is very much more difficult to get astronomical data from these ancient monuments than it is in the case of Stonehenge, one reason being that Stonehenge itself lies high, and the horizon round it in all directions is pretty nearly the same height, so that the important question of the heights of the hills along the sight-line—a matter which is very important from an astronomical point of view, although it has been neglected, so far as I can make out, by many who have made observations on these ancient monuments—is quite a simple one at Stonehenge. Hence it was much easier to determine a date there than by working at any of the other ancient remains to which I have referred.

In orientation generally, such orientation as has been dealt with by Mr. Penrose and myself in Egypt and in Greece, the question frequently was a change in direction in the axis of a temple, or the laying down of the axis of a temple, by means of observations of stars. Unfortunately for us as archæologists, not as astronomers, the changes of position of these stars, owing to certain causes, chiefly the precessional movement, are very considerable; so that if a temple pointed to a star in one year, in two or three hundred years it would no longer point to the same star, but to another one.

Acting on a very old tradition, the people from Salisbury and other surrounding places go to observe the sunrise on the longest day of the year at Stonehenge. We therefore are perfectly justified in assuming that it was a solar temple used for observation in the height of midsummer. But at dawn in mid-summer in these latitudes the sky is so bright that it is not easy to see stars even if we get up in the morning to look for them; stars, therefore, were not in question, so that some other principle had to be adopted, and that was to point the temple directly to

FIG. 2.—View of Stonehenge from the west. A, Stone which fell in 1900; BB, Stones which fell in 1797. (*Reproduced from an account of the fallen stones by Mr. Lewis in "Man."*)

the position on the horizon at which the sun rose on that particular day of the year, and no other.

Now, if there were no change in the position of the sun, that, of course, would go on for ever and ever; but, fortunately for archæologists, there is a slight change in the position of the sun, as there is in the case of a star, but for a different reason; the planes of the ecliptic and of the equator undergo a slight change in the angle included between them. So far as we know, that angle has been gradually getting less for many thousands of years, so that, in the case of Stonehenge, if we wish to determine the date, having no stars to help us, the only thing that we can hope to get any information from is the very slow change of this angle; that, therefore, was the special point which Mr. Penrose and I were anxious to study at Stonehenge, for the reason that we seemed in a position to do it there more conveniently than anywhere else in Britain.

But while the astronomical conditions are better at Stonehenge than elsewhere, the ruined state of the monument makes accurate measures very difficult.

Great age and the action of weather are responsible for much havoc, so that very many of the stones are now recumbent, as will be gathered from the accompanying plan, for which I am indebted to Mr. Lewis, who described the condition of the monument in 1901 in *Man*.

But the real destructive agent has been man himself; savages could not have played more havoc with the monument than the English who have visited it at different times for different purposes. It is said the fall of one great stone in 1620 was caused by some excavations of the then Duke of Buckingham; the fall of another in 1797 was caused by gipsies digging a hole in which to shelter, and boil their kettle; many of the stones have been used for building walls and bridges; masses weighing from 56 lb. downwards have been broken off by hammers or cracked off as a result of fires lighted by excursionists.

It appears that the temenos wall or vallum, which is shown complete in Hoare's plan of 1810, is now broken down in many places by vehicles indiscriminately driven over it. Indeed, its original importance has now become so obliterated that many do not notice it as part of the structure—that, in fact, it bears the same relation to the interior stone circle as the nave of St. Paul's does to the Lady Chapel.

It is within the knowledge of all interested in archæology that not long ago Sir Edmund Antrobus, the owner of Stonehenge, advised by the famous Wiltshire local society, the Society for the Protection of Ancient Buildings and the Society of Antiquaries, enclosed the monument in order to preserve it from further wanton destruction, and—a first step in the way of restoration—with the skilled assistance of Prof. Gowland and Messrs. Carruthers, Detmar Blow, and Stallybrass, set upright the most important menhir, which threatened to fall or else break off at one of the cracks. This menhir, the so-called "leaning stone," once formed one of the uprights of the trilithon the fall of the other member of which was said to have been caused by the digging and researches of the Duke of Buckingham in 1620. The latter, broken in two pieces, and the supported lintel, now lie prostrate across the altar stone.

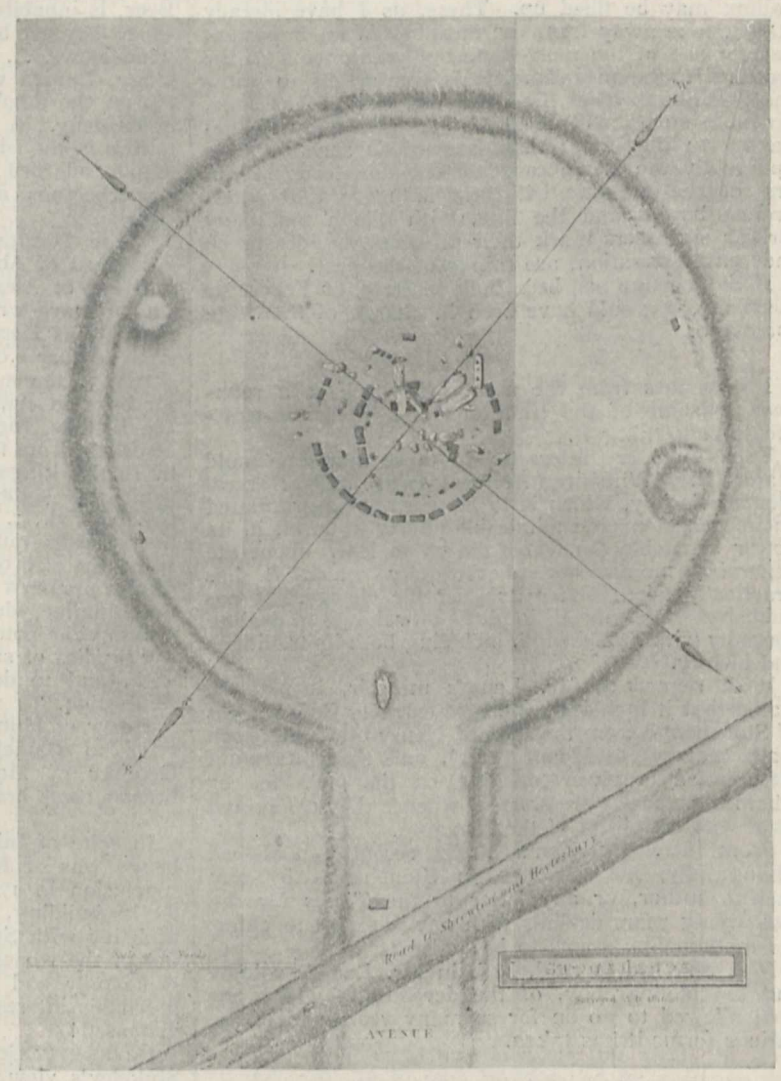


FIG. 3.—Co Hoare's plan of 1810, showing unbroken Vallum and its relation with the Avenue.

This piece of work was carried out with consummate skill and care, and most important conclusions, as we shall see in a subsequent "Note," were derived from the minute inquiry into the conditions revealed in the excavations which were necessary for the proper conduct of the work.

Let us hope that we have heard the last of the work of devastators, and even that, before long, some of the other larger stones, now inclined or prostrate, may be set upright.

Since Sir Edmund Antrobus, the present owner, has acted on the advice of the societies I have named to enclose the monument, with a view to guard it from destruction and desecration, he has been assailed on all sides. It is not a little surprising that the "unclimbable wire fence" recommended by the societies in question, the Bishop of Bristol being the president of the Wiltshire Society at the time, is by some regarded as a suggestion that the property is not national, the fact being that the nation has not bought the property, and that it has been private property for centuries, and treated in the way we have seen.

Let us hope also that before long the gaps in the vallum may be filled up. These, as I have already stated, take away from the meaning of an important part of one of the most imposing monuments of the world. In the meantime, it is comforting to know that, thanks to what Sir Edmund Antrobus has done, no more stones will be stolen, or broken by sledge-hammers; that fires; that excavations such as were apparently the prime cause of the disastrous fall of one of the majestic trilithons in 1797; that litter, broken bottles and the like, with which too many British sightseers mark their progress, besides much indecent desecration, are things of the past.

If Stonehenge had been built in Italy, or France or Germany, it would have been in charge of the State long ago.

I now pass from the monument itself to a reference to some of the traditions and historical statements concerning it.

Those who are interested in these matters should thank the Wiltshire Archæological and Natural History Society, which is to be warmly congratulated on its persistent and admirable efforts to do all in its power to enable the whole nation to learn about the venerable monuments of antiquity which it has practically taken under its scientific charge. It has published two most important volumes[1] dealing specially with Stonehenge, including both its traditions and history.

With regard to Mr. Long's memoir, it may be stated that it includes important extracts from notices of Stonehenge from the time of Henry of Huntingdon (12th century) to Hoare (1812), and that all extant information is given touching on the questions by whom the stones were erected, whence they came, and what was the object of the structure.

From Mr. Harrison's more recently published bibliography, no reference to Stonehenge by any ancient author, or any letter to the *Times* for the last twenty years dealing with any question touching the monuments, seems to be omitted.

It is very sad to read, both in Mr. Long's volume and the bibliography, of the devastation which has been allowed to go on for so many years and of the various forms it has taken.

As almost the whole of the notes which follow deal with the assumption of Stonehenge having been a solar temple, a short reference to the earliest statements concerning this view is desirable; and, again, as the approximate date arrived at by Mr. Penrose and myself in 1901 is an early one, a few words may be added indicating the presence in Britain at that time of a race of men capable of designing and executing such work. I quote from the paper communicated by Dr. Penrose and myself to the Royal Society:—

"As to the first point, Diodorus Siculus (ii., 47) has preserved a statement of Hecatæus in which Stonehenge alone can by any probability be referred to.

"We think that no one will consider it foreign to our subject to say a word respecting the Hyperboreans.

"Amongst the writers who have occupied themselves with the mythology of the ancients, Hecatæus and some others tell us that opposite the land of the Celts [ἐν τοῖς ἀντιπέραν τῆς Κελτικῆς τόποις] there exists in the Ocean an island not smaller than Sicily, and which, situated under the constellation of The Bear, is inhabited by the Hyperboreans; so called because they live beyond the point from which the North wind blows. . . . If one may believe the same mythology, Latona was born in this island, and for that reason the inhabitants honour Apollo more than any other deity. A sacred enclosure [νῆσον] is dedicated to him in the island, as well as a magnificent circular temple adorned with many rich offerings. . . . The Hyperboreans are in general very friendly to the Greeks.

"The Hecatæus above referred to was probably Hecatæus of Abdera, in Thrace, fourth century B.C.; a friend of Alexander the Great. This Hecatæus is said to have written a history of the Hyperboreans: that it was Hecatæus of Miletus, an historian of the sixth century B.C., is less likely.

"As to the second point, although we cannot go so far back in evidence of the power and civilisation of the Britons, there is an argument of some value to be drawn from the fine character of the coinage issued by British kings early in the second century B.C., and from the statement of Julius Cæsar ('De Bello Gallico,' vi., c. 13) that in the schools of the Druids the subjects taught included the movements of the stars, the size of the earth and the nature of things (Multa præterea de sideribus et eorum motu, de mundi magnitudine, de rerum natura, de deorum immortalium vi ac potestate disputant et juventuti tradunt).

"Studies of such a character seem quite consistent with, and to demand, a long antecedent period of civilisation."

Henry of Huntingdon is the first English writer to refer to Stonehenge, which he calls Stanenges. Geoffrey of Monmouth (1138) and Giraldus Cambrensis come next.

In spite of Inigo Jones's (1600) dictum that Stonehenge was of Roman origin, Stukeley came to the conclusion in 1723 that the Druids were responsible for its building, and Halley, who visited it in 1720—probably with Stukeley—concluded from the weathering of the stones that it was at least 3000 years old; if he only had taken his theodolite with him, how much his interest in the monument would have been increased!

Davies ("Celtic Researches," 1804) endorses Stukeley's view:—

"Amongst the pure descendants of the Celtae, the Druidism of Britain was in its highest repute. The principal seat of the order was found in Mona, an interior recess of that ancient race, which was born in the island. Into that sequestered scene, the Druids, who detested warfare, had gradually retired, after the irruption of the Belgae, and the further encroachment of the Romans. They had retired from their ancient magnificent seat at Abury, and from their *circular uncovered temple* on Salisbury Plain, in which the Hyperborean sages had once chaunted their hymns to Apollo and Plenyz."

NORMAN LOCKYER.

[1] "The Wiltshire Archæological and Natural History Magazine. Stonehenge and its Barrows." By William Long, M.A., F.S.A. (1876.)
"The Wiltshire Archæological and Natural History Magazine. Stonehenge Bibliography Number." By W. Jerome Harrison. (1902.)

PROF. ERNST ABBE.

FORTY YEARS' PROGRESS, 1866–1905.

ERNST ABBE, born January 23, 1840, was the son of a foreman in a spinning mill at Eisenach. He was a student at Jena and Göttingen, graduating at the latter university with a thesis on the mechanical equivalent of heat. After teaching for some time at Frankfort-on-Main, he established himself at Jena in 1863 as a privat docent in mathematics, physics, and astronomy, taking for a special subject of instruction the theory of errors. In 1870 he was appointed an extraordinary professor. In 1874 there was a proposal to establish a physical laboratory at Jena, and Abbe was offered the professorship of physics, but his connection with Carl Zeiss had then begun, and he was compelled to decline the offer. He had married in 1871 the daughter of Prof. Snell, and has left two daughters.

Carl Zeiss had established himself at Jena in 1846 as a manufacturer of optical instruments; for some years the business prospered, his microscopes were as good as those of other makers, probably neither better nor worse; but Zeiss was not satisfied; he felt that the microscope ought to be improved, and in endeavouring to effect improvement he realised the deficiency of his own equipment; after one other unsuccessful attempt he enlisted Abbe's help in his work.

The partnership which has had so remarkable an effect on the manufacture of optical instruments began in 1866. Abbe's task was a hard one; the theory of the microscope was at that date only partially understood; the corrections to the lenses were made by a rough trial and error method, and the results were doubtful; the first step was to solve a mathematical problem of no small difficulty, and trace the path of the light through the complex lenses of a microscope objective.

Abbe soon found out the defects of the ordinary theory, and was led in 1870 to what is now known as the Abbe theory of microscopic vision; unfortunately, no complete account of that theory from his own pen has yet been printed, though the "Collected Papers of Ernst Abbe," of which the first volume was published last year under the skilful editorship of Dr. Czapski, and noticed in these pages recently (NATURE, vol. lxix. p. 497), go far to fill the gap, and it is to be hoped that Dr. Czapski himself or some other member of the Jena staff will now be in a position to give the complete theory to the world. It is not necessary here to discuss the controversy which has arisen over the matter, due in great measure to an incomplete representation of the problem and to a misconception of the theory.

It is clear that if we can treat the object as self-luminous, or if we know the distribution of light with respect to both intensity and phase over the object plane, then we may start from the object as our source, and the principles of the wave-theory, as Lord Rayleigh has shown, will allow us to determine the distribution in the view plane. If, however, the distribution in the object plane is unknown, we must go back to the source, consider how the light from the source is modified both by the object and the lenses, and from this infer what the resulting image will be like.

Diffraction patterns will be formed practically in the second focal plane of the object glass, and the distribution of the light in the image can, theoretically at any rate, be deduced from a knowledge of the intensity and phase of the disturbance in these patterns.

This theory, at any rate, led Abbe to most valuable results, and was one source of the success of the Zeiss microscope. From it, among other consequences, he deduced the importance of what is now known as the numerical aperture, the quantity $\mu \sin \alpha$, where μ is the refractive index of the first lens of the object glass, and 2α is the angle which that lens subtends at the point where the axis of the system cuts the object plane.

But the assistance given by the new theory was not alone sufficient to solve the problem. It had long been known that when the best glasses then obtainable were combined to form an achromatic system, a secondary spectrum remained, and until this could be removed it was hopeless to look for perfection in the image.

The experiments of Stokes and Harcourt had been directed to the discovery of glasses free from this defect, and Abbe and Zeiss in their early days made many attempts in the same direction, using in some cases liquid lenses to secure the desired end.

In 1876 the South Kensington Loan Exhibition of Scientific Apparatus took place, and Abbe came over to inspect it. In his report, published in 1878, he writes:—"The future of the microscope as regards further improvement in its dioptric qualities seems to lie chiefly in the hands of the glass maker," and then he explains in what direction changes are required and how difficult it is to introduce them.

This report of Abbe's fell into the hands of Dr. Otto Schott, a glass maker of Witten, in Westphalia. Schott communicated with Abbe in 1881, and commenced his investigations into the subject. Next year he removed to Jena, and, aided by a large grant from the Prussian Minister of Education, the experiments were satisfactorily concluded, and the firm of Schott and Co. was established; in 1884 he was in a position to commence the wholesale production of optical glass. The combination was now complete. "To-day it is difficult," as Prof. Auerbach writes in his recent work on the Carl Zeiss Stiftung in Jena, "to think of the Optical Works without the Glass Works, or *vice versâ*."

From this time onwards Abbe's time was fully occupied in developing the new undertaking; the history of his life would be the history of the works, and in the Zeiss instruments, known throughout the world, his monument is to be found.

But in many ways the latter years of his life are not the least interesting. Carl Zeiss died in 1888; next year his son Roderick retired from business, and Abbe was left sole proprietor of the optical works. In 1891 he created a kind of trust known as the Carl Zeiss Stiftung, to which he ceded all his proprietary rights, both in the optical and also in the glass works.

The story of the Carl Zeiss Stiftung as told by Prof. Auerbach is a very striking one. The statutes, due to Abbe himself, which were confirmed by the Grand Duke of Saxony in 1896, and have the force of law, can up to 1906 be modified by a simple procedure; afterwards legal action is practically required to render a change valid.

The works are a great cooperative concern. "To provide a large number of people with the most favourable opportunities for labour is both the means and the end of the Stiftung. The individuals who benefit by it are at the same time those who maintain and increase it. The officials and workmen employed at the optical works, the community and the university contribute their share towards the increase of the value of the property, and these, therefore, are entitled to participate in the benefits." The university alone will shortly have received 100,000*l.* from the scheme.

The Stiftung is managed by the Stiftung Adminis-

tration; on this the Saxon Government appoints a representative or trustee whose duty it is to see that the statutes are obeyed; the works are supervised by boards of management appointed by the administration.

The employés possess the right of combination; they can be represented by their own committees, which may address the administration direct on any subject relating to the affairs of the concern. They are paid by piece-work, with a minimum time wage, and there is in the scheme a proviso by which no one, even though a member of the board of management, can receive a salary greater than ten times the average yearly earnings of workers of twenty-four years and over who have been at least three years with the firm. Moreover, when an employé has once received a certain wage and drawn it for one year his wage cannot be reduced because of slackness of trade. In addition to the wages calculated on the work done, every worker receives a share of the profits depending in any year on the net sum realised. There is also a liberal pension scheme, under which every employé who enters the works before his fortieth year is entitled, after five years' service, to a pension calculated at a rate which reaches 75 per cent. of his salary at the end of forty years' service, while the widows and orphans of employés have also pension rights. Finally, the working day is eight hours, and Abbe has put it on record in an address, delivered in 1901 to the Social Science Association, that in the case of 233 piece-workers about whom accurate statistics could be taken the total output was increased by 4 per cent. in the first year that followed the change from nine to eight hours.

Such has been Ernst Abbe's work; until 1903 he remained an active member of the board of management of the optical works; then he retired, partly on account of the state of his health, partly, if his health improved, to devote himself to his scientific work. The improvement hoped for never came, and he died last week, leaving it to the trained band of workers he had gathered round him to continue his task, and to show still further what can be done by the organised application of science to industry and manufactures. R. T. G.

M. PAUL HENRI.

ABOUT the year 1864, two brothers entered the meteorological department of the Paris Observatory, and for nearly forty years laboured with zeal and success to promote the best interests of that institution and of astronomical science generally. In the autumn of 1903, one brother, M. Prosper Henri, died suddenly on a holiday tour, and we now have the melancholy duty of chronicling the death of the second brother, M. Paul Henri. It is necessary to recall the close and intimate relations that existed between these two, because the scientific life of one was that of the other. No one has ever thought of them separately, no one has ever attempted to discriminate between their successes and their triumphs. The same day (November 8, 1889) they were both elected associates of the Royal Astronomical Society, and other instances of similar recognition of their united work might be quoted. We may quote the words of the late M. Callandreau of these two:—"si unis que nous ne voyons souvent en eux qu' une seule personne pour ainsi dire, si oublieux de faire ressortir leur mérites respectifs qu' il est difficile de distinguer ce qui peut appartenir à chacun dans l'œuvre commune."

It is an oft-told tale to recall how these brothers, with whom mechanical art was a conspicuous gift, constructed their own instruments, and laboured to complete the ecliptic charts on which Chacornac had worked, how their systematic work and diligence added to the number of small planets, and how, finally, the necessity was forced upon them of adopting improved methods in registering the places of stars in the crowded regions of the heavens. The history of the "International Chart of the Heavens," which has taxed the resources of so many observatories, was the outcome of their skill and resource. Not only did they provide the optical parts of the instruments that were employed in many observatories, but they laboured zealously on the zone allotted to the Paris Observatory, and it is believed brought their share to a successful issue. They led the way in the photographic examination of clusters like the Pleiades, and showed to others how unsuspected nebulæ might be detected.

A new era of activity opened for astronomy in the general application of photography, and few have contributed more to the harvest of results that has followed that activity than have the brothers Henri. They not only supplied the instruments with which the negatives were taken, but they suggested devices for the construction of measuring machines by which these negatives could be discussed. The reputation of one and both rests on their photographic work. Smaller work, such as the careful and accurate delineation of planetary markings, the observation of minute satellites, and the more ordinary routine of observatory work, are all forgotten in the large share taken in the application of photography to celestial measurement. His colleagues in the observatory spoke of the many excellent qualities that distinguished M. Prosper Henri as a colleague and friend, and one is sure that no less kindly expressions will be used towards M. Paul Henri, who has enjoyed the confidence and respect of all the directors of the Paris Observatory who have followed M. Le Verrier.

W. E. P.

NOTES.

THE cross of officer of the Legion of Honour has been conferred, *La Nature* states, upon Dr. Otto Nordenskjöld for his South Polar explorations. Mrs. Bullock Workman has been appointed Officier de l'Instruction publique for her travels in the Himalayas.

THE autumn meeting of the Iron and Steel Institute is to be held this year in Sheffield for the first time. Mr. R. A. Hadfield has been elected to succeed Mr. Andrew Carnegie as president of the institute. The visit will take place during the week beginning September 25. The most influential members of the Sheffield steel industry have associated themselves with the invitation to the institute, and a committee has been formed, of which the Lord Mayor of Sheffield and the Master Cutler are chairman and vice-chairman respectively. Colonel H. Hughes, C.M.G., has been appointed chairman of the reception committee, with Mr. J. Rossiter Hoyle as honorary secretary. Mr. Frank Huntsman—who is, we learn from the *Times*, a descendant of the Huntsman who founded the Sheffield industry of melting steel in pots about 170 years ago—will act as honorary treasurer, and Mr. John Wortley as honorary assistant secretary.

ON Thursday next, February 2, Prof. W. Schlich will deliver the first of a course of two lectures at the Royal Institution on "Forestry in the British Empire." The discourse on Friday, February 3, will be delivered by Prof. T. Clifford Allbutt on "Blood Pressure in Man."

THE International Congress of Psychology will meet this year at Rome on April 26–30. We learn from the *British Medical Journal* that there will be four sections. The section of experimental psychology, the president of which is Prof. G. Fano, of Florence, will deal with psychology in its relations to anatomy and physiology, psycho-physics, and comparative psychology. That of introspective psychology will, under the presidency of Prof. R. Ardigo, of Padua, devote itself to psychology in its relations to philosophical sciences. The section of pathological psychology, the president of which is Prof. E. Morselli, of Genoa, will discuss hypnotism, suggestion, and analogous phenomena, and psycho-therapeutics. The programme of the section of criminal, pædagogic, and social psychology, which is under the presidency of Prof. Lombroso, of Turin, has not yet been published. The president of the congress is Prof. Giuseppe Sergi, of Rome; the general secretary, Dr. Sante de Sanctis, to whom all communications relative to the meeting should be addressed at the Istituto Fisiologico, 92 Via Depretis, Rome.

WE are informed that Dr. Carl Otto Weber, the well known chemical authority on india-rubber, died suddenly on January 14 at his residence in Massachusetts, U.S.A.

ON November 16 last the University of Lehigh was bereaved of its president, Dr. Thomas Messinger Drown, and a brief obituary notice is contained in the *Popular Science Monthly* for January. Dr. Drown was born on March 19, 1842, at Philadelphia, and he graduated in medicine at Pennsylvania, subsequently studying chemistry in Germany and America. He held the chair of chemistry at Lafayette College for seven years, and at the Massachusetts Institute of Technology for seven years. He was secretary and editor of the American Institution of Mining Engineers for ten years from its foundation, and was elected president in 1897. His researches in quantitative analysis were devoted in the first place to devising standard methods in the analyses of iron and steel, and in the second place to water analysis, especially in connection with the natural waters of the State of Massachusetts, and the distribution of normal chlorine. He was elected president of Lehigh University in 1895, at a time when that institution's influence was at a low ebb, and since his appointment the efficiency of the college has developed in many important directions.

REUTER'S Agency has been informed by the Pacific Cable Board that by an arrangement between the Washington and Sydney Observatories, with the cooperation of the telegraph administrations concerned, time signals were sent on New Year's Eve from the Washington Observatory to the Sydney Observatory at 3h., 4h., 5h., and 6h. The mean interval between the times when these signals were sent and when they were received was 2·90s. The distance separating Sydney and Washington is more than 12,000 miles. The signals through the Vancouver-Fanning cable, the longest cable span in the world (3457·76 nautical miles), were sent by automatic apparatus, and were recorded, as they passed, at the Vancouver station on an instrument placed in the artificial line which balances the cable for the purpose of duplex working. The signals consisted of second contacts, omitting the thirtieth and last five of each minute, except the last minute of the hour, when the thirtieth and all after the fiftieth second were omitted, the circuit closing with a long dash on the even hour. The signals were sent for five minutes before the hour from 3 p.m. to 6 p.m., Sydney time; equivalent to midnight to 3 a.m. Washington time.

WRITING from Amsterdam, Dr. C. M. van Deventer desires to direct attention to an interesting fact observed by a schoolboy. Two years ago, during a lesson in physics given at the high school at Batavia, one of the boys, called Van Erpecum, told Dr. Deventer, as an observation of his own, that the water in a glass, filled to the brim with water and floating ice, does not flow over when the ice melts. The observation was communicated to Profs. Van der Waals and Zeeman, who judged it worthy of being the subject of a note presented by them to the Royal Academy of Amsterdam. Dr. Deventer says that the observation of his pupil tells only the half of the phenomenon—the truth being that the water neither rises nor sinks. He therefore states the proposition that "In a vessel containing water and floating ice, the level stays at the same height when the ice melts." Or, speaking more generally, "When a vessel contains a solid floating in its own liquid, the level of the latter does not change by the melting of the solid." This proposition Dr. Deventer proposes to call the "law of the permanent level." The law can be deduced from Archimedes's principle; but it is only rigorously exact when the weight of the air is neglected.

AT the meeting of the Society of Antiquaries on January 19 Mr. A. J. Evans communicated an account of the tombs of Minoan Knossos. Mr. Evans's last season's work at Knossos was devoted largely to the search for the tombs in relation with the Minoan palace and city. On a hill about a mile north of the palace a cemetery was discovered. One hundred tombs were opened, and the contents showed that the bulk of them belonged to the period immediately succeeding the fall of the palace. The character of the art displayed by the relics found showed the unbroken tradition of the later palace style. The jewelry and gems discovered were of the typical "mature Mycenæan" class, and a scarab found in one of the graves is of a late eighteenth dynasty type. The tombs were of three main classes:—(*a*) Chamber tombs cut in the soft rock and approached in each case by a *dromos*; in many cases these contained clay coffins, in which the dead had been deposited in cists, their knees drawn towards the chin. (*b*) Shaft graves, each with a lesser cavity below, containing the extended skeleton, and with a roofing of stone slabs. (*c*) Pits giving access to a walled cavity in the side below; these also contained extended skeletons. A number of skulls have been secured, and are to be sent to England. On a high level called Sopata, about two miles north again of this cemetery, an important sepulchral monument was discovered. This consisted of a square chamber, about eight by six metres, constructed of limestone blocks, and with the side walls arching in "Cyclopean" fashion towards a high gable. The back wall was provided with a central cell opposite the blocked entrance. This entrance, arched on the same horizontal principle, communicated with a lofty entrance hall of similar construction, in the side walls of which, facing each other, were two cells that had been used for sepulchral purposes. A second blocked archway led from this hall to the imposing rock-cut *dromos*. A number of relics were found scattered about, including repeated clay impressions of what may have been a royal seal. Specially remarkable among the stone vessels is a porphyry bowl of Minoan workmanship, but recalling in material and execution that of the early Egyptian dynasties. Many imported Egyptian alabastra were also found, showing the survival of middle empire forms besides others of early eighteenth dynasty type. Beads of lapis lazuli were also found, and

pendants of the same material, showing a close imitation of Egyptian models. The form of this mausoleum, with its square chamber, is unique, and contrasts with that of the tholos tombs of mainland Greece. The position in which it lies commands the whole south Ægean to Melos and Santorin, and Central Crete from Dicta to Ida.

WE have to welcome an addition to the already lengthy list of American biological serials in the form of a *Bulletin* issued by the Springfield (Mass.) Museum of Natural History, of which the first number is in our hands. This is devoted to the description of the early stages in the development of the ground-beetles of the family Carabidæ, as exemplified by a member of the genus Dicælus, in which the larva is of the ordinary predaceous type, and one of Brachinus, in which the larva is parasitic and degenerate. Of the adult beetles, the more specialised seems to be Brachinus. The authors of the paper are Messrs. Dimmock and Knab.

THE Albany Museum, according to the report for the first half of 1904, continues to make steady progress, and it is satisfactory to learn that arrangements are under consideration both for augmenting the staff and for increasing the size of the building. An important part of the museum's work is the investigation of the life-history of insects injurious to agriculture and horticulture, and the discovery of the best means of checking their ravages. For this purpose a piece of ground adjoining the museum has been enclosed, and it is hoped that funds will shortly be forthcoming for erecting in this enclosure an insect-house, without the aid of which the work can be carried on only with difficulty.

THE *Field Naturalists' Quarterly* for December, 1904, strikes us as being an unusually excellent number. It includes, in the first place, the second of the series of plates illustrating the development of the frog. Later on we have the first instalment of a set of articles by the editor (Dr. G. Leighton) explaining modern investigations on heredity in a manner calculated to bring home the fundamental truths of this complex subject to every intelligent reader, the development of the germ-plasm being the text of this contribution. In a preliminary note the editor expresses the hope that his articles will induce many persons who reside in the country to take up the practical investigation of some form of heredity for themselves. A third article to which we may direct attention is one by Mr. H. E. Forrest in which simple methods of distinguishing the various species of British bats are formulated. We notice that the author adheres to the old-fashioned nomenclature for the members of this group.

WE have received the January number of *Climate*, which contains an illustrated description of the Japanese soldier's outfit, and articles on blackwater fever, water and its connection with disease, the drinking habits of native races, climate and health in hot countries, &c. The medical articles are semi-popular in character, and should be useful to missionaries and others stationed in districts remote from medical aid.

THE *Journal* of the Royal Sanitary Institute (vol. xxv., part iii.) forms a bulky volume of some 600 pages. It contains a number of interesting and important papers and discussions thereon contributed to the congress of the institute at Glasgow last year. They are on such varied subjects as disinfection in phthisis (Prof. Kenwood and Dr. Allan), prevention of diphtheria (Dr. Cobbett), sewage disposal, school hygiene and ventilation, conditions of housing, &c.

THE December (1904) number of the Johns Hopkins Hospital *Bulletin* (vol. xv., No. 165) contains an account of the opening of the new surgical building and clinical amphitheatre of the Johns Hopkins Hospital, a description of a new chromogenic bacillus, *B. cyaneum*, and various papers of medical interest. In the new buildings a tablet has been erected to the memory of Dr. Jesse Lazear, who died from an attack of yellow fever while investigating that disease in Cuba.

IT is proposed to add to Reichenbach's "Icones Floræ Germanicæ et Helveticæ" a number of extra volumes containing monographs of critical genera. The publishers, Messrs. von Zezschwitz, of Gera, announce the immediate issue of the first of these, in which the genus Hieracium is treated by Dr. J. Murr and Mr. H. Zahn.

THE cultivation of mushrooms is not such an important business in the United States of America as in Great Britain and France. With the view of extending and improving the trade, Prof. B. M. Duggar has written a pamphlet on the subject, which has been issued by the U.S. Department of Agriculture as a *Farmers' Bulletin*. The preparation of English brick spawn and French flake spawn is dependent upon the haphazard collection of what is known as "virgin spawn" in the open. Prof. Duggar has for some time attempted to discover the conditions which are necessary for the germination of mushroom spores. He has already succeeded in germinating spores in pure cultures by means of chemical stimulation, and hopes shortly to make the process more practical. This will enable the grower to produce a definite strain, and if necessary to obtain improved varieties by selection.

THE *Ani-i-Akbari*, or annals of the Emperor Akbar, written in the Persian language, contain descriptions of various customs which prevailed during the Moghul period. Amongst these was the use of perfumes in religious observances, and the emperor took a personal interest in the preparation of the ingredients. A short summary of the principal substances and their sources is contributed by Mr. D. Hooper to the October (1904) number of the *Calcutta Review*. Among vegetable products, *Aquilaria agallocha*, aloe-wood, was then as now valued for the oleo-resin agar, and an oil known as chuwah; sandal-wood was used as a powder, and perfumes were distilled from the rose, orange, jasmine, and broad-leaved willow, *Salix caprea*. Ambergris obtained from the sperm whale, the moist secretion of the civet cat, and the opercula of certain molluscs, known as "fingernails," were important animal products.

PAMPHLET series No. 32, issued by the Imperial Department of Agriculture for the West Indies, gives a summary of the results on the cultivation of seedling and other canes at the Barbados experiment stations in 1904. As in previous years the investigation has been conducted by Prof. d'Albuquerque and Mr. Bovell. Sixteen sugar estates in typical localities were selected, thirteen on black soils and three on red soils. The seedlings were treated in precisely the same manner as the ordinary canes. The season was favourable, there was very little root disease, and the crop consequently was above the average. Cane B 208 again gave uniformly good results, both as plant canes and ratoons, and it is recommended for a general trial on a field scale in all red soil districts. A newer cane, B 1529, however, takes the first place in the black soil list, coming out second to B 208 in the red soil list. Its cultivation will consequently be extended to as many experimental plots as possible. Cane B 147, at one time

considered the most promising of the seedling varieties, did not give such good results as in previous years, but it appears to be cultivated with some success in the rather light soils in the parish of St. Philip.

THE Barbados *Official Gazette* of December 19, 1904, contains some correspondence relating to Cassava poisoning. Mr. Briggs, one of the district coroners, noted to the Colonial Secretary that witnesses in inquest cases frequently assert that if roasting and poison cassava grow closely side by side, the roasting cassava takes up some of the poison from the poison cassava; also that the roasting cassava gets a "spring in it," and that makes it poisonous. The Colonial Secretary submitted the note to Sir Daniel Morris, who replied that (1) "there can be no direct connection between the two plants, and it is impossible that the poison can pass through the soil from the poisonous cassava to the sweet," and (2) "if by the 'spring in it' is meant that the plant starts into second growth after heavy rain, it is probable that certain changes may take place inducing an increase of the poisonous quality." What probably happens when persons die from eating sweet or roasting cassava is that it is either too old or it has not been sufficiently cooked to drive out all the acid. It is only really wholesome when the roots are not too old, and when they have been cooked until they are quite soft. If the centre is hard it is probably more or less poisonous, and should not be eaten. Even properly cooked cassava which has been allowed to become cold is not fit to eat unless it is cooked a second time.

BECKELITE, a new mineral species named in honour of Prof. F. Becke, of Vienna, is described by Prof. J. Morozewicz in the December (1904) *Bulletin* of the Cracow Academy of Sciences. It occurs as an accessory constituent of a dyke-rock composed of albite, nephelite, ægirite, and magnetite in the elæolite-syenite complex near Mariupol, on the Sea of Azov. The wax-yellow octahedral or rhombic-dodecahedral crystals resemble pyrochlore in general appearance and physical characters, though the somewhat indistinct cleavage is cubic instead of octahedral. Chemically, however, the new mineral is quite distinct from pyrochlore, containing 17·13 per cent. of silica and 65·31 per cent. of rare earths, with no niobium or tantalum. The formula is $Ca_3(Ce,La,Di)_4Si_3O_{15}$, which presents a certain resemblance to the garnet formula with rare earths in place of alumina. From analogy to calcium "alumo-silicate," the new mineral is described as a calcium cero-lanthano-didymo-silicate.

FOR the twenty-second time, the climatological records of the British Empire are summarised in the current number of *Symons's Meteorological Magazine*, viz. for the year 1903. The stations number twenty-five, but, as the editor points out, it is impossible to represent the average conditions of the climate of the Empire by so small a number of stations, however well distributed. Adelaide, which has almost constantly held the first place in the summary for extreme maximum temperature, now, as in 1902, gives way to Coolgardie, in Western Australia, where the shade temperature reached 113°·4 on January 27; the lowest shade temperature was −60°·8 at Dawson on January 26. Dawson had also the greatest yearly range (150°·3). The greatest mean daily range was 23°·5 at Winnipeg, and the least 8°·5 at Hong Kong. London had the highest relative humidity (82 per cent.) and Adelaide the lowest (62 per cent.). The greatest rainfall, 93·67 inches, was recorded at Hong Kong, and the least, 10·74 inches, at Dawson. We may mention, incidentally, that the present number of the magazine is the largest since its foundation in 1866; we hope to refer shortly to another of the interesting articles that it contains.

WE have received the *Journals* of the Meteorological Society of Japan for October and November last. They contain (as we see from the English titles) several interesting articles in Japanese. There is also one in English, on the duration of rainfall, by T. Okada. The object of the author is to show that Dr. Köppen's formula for the calculation of the probable duration of rainfall in a month, or any interval of time, from three or six observations daily, holds good for all climates. The calculation is very simple, and the formula in question, $(r/n)N$, is contained in an article by Dr. Köppen in the Austrian *Meteorologische Zeitschrift* for 1880; n is the total number of observations, r that of observations with rainfall, and N the total number of hours in a month (or other period). The author shows that the duration of rainfall, computed from tri-daily observations, does not differ materially from that computed from hourly observations—in the annual mean at most 4 per cent., and in the monthly mean 18 per cent. In the majority of cases the differences are much less; the method gives more approximate results than an ordinary self-recording rain-gauge, owing to the usual want of sensibility of such instruments.

IN the *Zeitschrift für physikalischen und chemischen Unterricht*, xvii., 5, Mr. Walter Stahlberg, of Steglitz, gives an account of the Zeiss "Verant" by which photographs are made to stand out in natural relief with monocular vision. The apparatus can hardly be correctly described as a stereoscope, since one of the most important features of the stereoscope depending on binocular vision is absent. The Verant is a single lens, the focal length of which should be equal to that of the camera used in taking the photographs, and this lens is convexo-concave, so that the axes of the pencils from different parts of the picture meet in the eye. From Mr. Stahlberg's account, we think the principle of the Verant may be roughly explained by the following illustration:—When a photograph of cloisters is taken from one corner in the interior the photograph gives the impression that the two colonnades meet at a very acute angle instead of at right angles. If the picture were seen through the Verant the angles would appear correct as they would to a person standing in the cloisters themselves. The now old-fashioned graphoscope appears to have had a somewhat similar purpose.

TWO papers which are of importance in the study of superfusion phenomena are published by Drs. Tullio Gnesotto and Gino Zanetti in the *Atti* of the Royal Venetian Institute (1903, vol. lxii., p. 1377). By means of a modified ice calorimeter, the variation of the specific heat of superfused liquid sodium thiosulphate at temperatures between 0° C. and the melting point of the salt, 48°·8 C., was determined, the observations being also extended above this temperature up to 100° C. On calculating the specific heat at all temperatures within this range, it is seen that in the neighbourhood of the melting point a sudden diminution in its value occurs, but that slightly above this temperature the specific heat again increases, so that the curve resumes the same direction that it had below the melting point. The latent heat of fusion of the salt at 0° C. was also determined.

A VALUABLE paper on the properties of chrome-vanadium steels was read before the Institution of Mechanical Engineers on December 16, 1904, by Captain Riall Sankey

and Mr. J. Kent Smith. These steels appear to be most valuable from their power of resisting rapid alternations of stress and sudden shock, especially after they have been subjected to special thermal treatment. The temperature of their recalescence is at about 715° C., and the effect of quenching in oil from 900° C. and subsequently reheating at 600° C. is to increase enormously the resistance of the alloy to shock, as measured by an impact test, and to alternations of stress, without affecting the tensile strength. A spring of chrome-vanadium steel which was prepared was found to have double the strength of an ordinary steel spring of the same dimensions, the extension being directly proportional to the load throughout a very much wider range. Like the nickel steels, those which contain vanadium and chromium are very efficient in withstanding bending tests.

MESSRS. DAWBARN AND WARD, LTD., have added a booklet, "How to Read a Workshop Drawing," by Mr. W. Longland, to their "Home-Worker's" series of practical handbooks.

A THIRD edition of Mr. M. M. Pattison Muir's translation of Prof. Lassar-Cohn's "Chemistry in Daily Life" has been published by Messrs. H. Grevel and Co. The book has been revised and enlarged.

A TEACHERS' edition of part ii. of "Elementary Algebra," by Messrs. W. M. Baker and A. A. Bourne, has been published by Messrs. George Bell and Sons. Teachers are likely to find the plan of printing the answers on the page opposite to the examples a convenience in class work.

THE Engineering Standards Committee has just issued the "British Standard Specification for Portland Cement." The specification deals with the quality and preparation of the cement, gives particulars as to sampling and preparation for testing and analysis, and goes on to enumerate what should be its fineness, specific gravity, chemical composition, &c. The specification also considers at length the various tests which a satisfactory cement should pass. Copies of the publication may be obtained from Messrs. Crosby Lockwood and Son, price 2*s*. 6*d*. net.

THE 1905 issue of "Hazell's Annual" has now been published. Twelve pages are devoted to scientific progress during 1904, and about five to scientific societies and institutions. Education in the United Kingdom in all its branches is given some fourteen pages.

OUR ASTRONOMICAL COLUMN.

THE REPORTED SIXTH SATELLITE OF JUPITER.—A telegram from the Kiel Centralstelle gives the position of a minor planet, P.V., photographed by Prof. Wolf on January 23·135 at the Konigstuhl Observatory, at 7h. 8·8m. (Konigstuhl M.T.), as

R.A. = 1h. 31m. 59s., dec. = +8° 36′ 13″.

The daily movement of this object is +23′ in R.A. and −9′ in declination, and it is suggested that the body may possibly be identical with the object announced by Prof. Perrine as a sixth satellite to Jupiter.

PERIODICAL COMETS DUE TO RETURN IN 1905.—In the January *Observatory* Mr. W. T. Lynn directs attention to the periodical comets which are due to return to perihelion this year. There are only two, of which the first, Encke's, has already been seen, and passed through perihelion on January 4. The second is that discovered by Prof. Max Wolf on September 17, 1884 (comet iii., 1884), which has a period, variously estimated, of about 6·76 years. This object returned as comet ii., 1891, and comet iv., 1898, its perihelion being passed during the latter return on July 4, although its nearest approach to the earth did not take place until the end of November. Accordingly it should again pass through perihelion early in April next.

CHANGES ON THE SURFACE OF JUPITER.—An interesting popular exposition of the knowledge acquired during the past twenty-five years concerning the conditions of, and the changes on, the visible surface of Jupiter is given by Prof. G. W. Hough in No. 1, vol. xiii., of *Popular Astronomy*.

Prof. Hough's own observations of Jupiter have extended over twenty-five years, and the present article summarises them and the conclusions to which they have led him. He particularly refers to the determined values for the rotation periods at different latitudes, and sees no evidence for the existence of any law connecting the two, giving diagrams which illustrate the point. Two other diagrams show the variations in the latitude and the rotation period of the great red spot from 1879 to 1903, whilst yet another illustrates the changes in the position and width of the equatorial belt during the period 1895–1904. From the latter diagram it is seen, very clearly, that the changes in the northern part of the belt are much more sudden and of a greater magnitude than those which take place in the southern portion.

STARS HAVING PECULIAR SPECTRA.—During the examination of the Henry Draper memorial plates, Mrs. Fleming has discovered some additional stars which are either variable or have peculiar spectra. Thirty-one of these are announced and briefly described in No. 92 of the Harvard College Observatory *Circulars*. Of those having peculiar spectra a few are worthy of special notice. For instance, λ Cephei (mag. 5·6) was found to have a spectrum identical with that of ζ Puppis, which hitherto has been regarded as unique. The stars D.M. −11° 1460 (Monoceros) and +64° 1527 (Cepheus), amongst others, show a bright Hβ line. In the former the other hydrogen and the helium lines are double, whilst in the latter they are single but broad. The spectrum of D.M. +39° 4368 (R.A. = 20h. 51·6m., dec. = +39° 55′, mag. = 7·2), as photographed on September 15, 1904, was continuous, showing no trace of lines, although the lines in the spectra of neighbouring stars were sharply defined; on other plates the hydrogen lines show faintly, although the spectrum was not so well defined.

REAL PATHS, HEIGHTS, AND VELOCITIES OF LEONIDS.—From the observational data submitted to him by various observers, Mr. Denning has computed the real paths, heights above the earth's surface, and velocities of several Leonids seen during the last shower. From three observations of the brightest meteor seen at Greenwich, at 16h. 24m. 42s., November 16, 1904, he finds that the height of this object was from 88 to 44 miles along a path extending not more than 60 miles from near Petersfield to Hungerford. The velocity was about 46 miles per second, and the radiant point was 151° + 22°.

A second meteor recorded by two observers was seen at Greenwich, at November 14d. 10h. 26m., and at Enniscorthy (Ireland), 280 miles away. This had a long horizontal flight from over the neighbourhood of Sheffield to near Carmarthen, and was 83 to 78 miles high, the velocity being about 40 miles per second. Another meteor travelled at a height of 79 to 58 miles from over Faringdon to Stroud, its visible path being 35 miles long and its velocity 39 miles per second (*Observatory*, January).

NEW METHOD FOR MEASURING RADIAL-VELOCITY SPECTROGRAMS.—At a meeting of the International Congress of Arts and Sciences held at St. Louis in September, 1904, Prof. J. Hartmann, of Potsdam, gave a brief outline of a new method whereby he proposes to reduce considerably the labour involved in measuring the displacements of lines in stellar spectra for the purpose of determining the radial velocities of the stars. Hitherto it has been customary to measure the displacement of each line separately, and subsequently to reduce the individual measures; but in Prof. Hartmann's new method the dis-

placement of the whole of the lines in the star spectrum would be measured simultaneously. He proposes to photograph the spectrum of the star, with the terrestrial comparison spectrum alongside it, as usual, and then to photograph the solar spectrum and the same comparison with the same instrument. The two negatives are then placed in a specially devised measuring machine, and the solar plate moved by the micrometer screw until the similar lines in both the solar and the stellar spectra coincide. Then the solar plate is again moved by the screw until the lines in the comparison spectrum on it coincide with the analogous lines in the comparison spectrum on the stellar spectrogram. The difference between the two settings gives the displacement of the stellar lines, from which the radial velocity is computed. In the reduction, which is simple, the only assumption made is that the lines have the same wave-lengths in the solar and the stellar spectra, and this is permissible, at least with second-type stars for which the method was primarily devised (*Astrophysical Journal*, vol. xx., No. 5).

MEDICAL RESEARCH IN EGYPT.[1]

AN interval of three years has elapsed since the first volume of these "Records" was published. The present series of papers would alone afford abundant evidence of the activity of the members of the staff in the intervening period. But it is still more satisfactory to recollect that this does not represent the total output of research, for many other memoirs from the same source have already appeared elsewhere. There are evidently many problems of both local and general importance which require investigation, and the standard of excellence reached in the "Records" already published arouses a desire that succeeding volumes should appear more frequently.

The papers are naturally chiefly concerned with problems of special local importance. The three scourges of Egypt are said to be the malarial parasite, Ankylostoma and Bilharzia. The last seems to bring an extraordinary number of cases under the care of the surgical staff, some 16 per cent. of all surgical in-patients suffering directly from lesions produced by this parasite. From the pathological report by Dr. Symmers, it would appear that about 7 per cent. of the deaths are directly due to Bilharzia. In 100 consecutive admissions to the medical wards, 35 were found to have the eggs in their urine, though only two of these were suffering in any way from the infection. The surgical aspects of the disease are discussed in two interesting papers by Mr. Madden and Mr. Milton; they find that many pathological conditions turn out most unexpectedly to be due to the worm. At one period of life or another practically the whole of the native population is said to be infected. Unfortunately, no material progress has been made in elucidating the extra-corporeal history of the parasite; it is therefore impossible to take any direct preventive measures.

Dr. Phillips contributes an article on the relation of ascites to malaria. In at least one-third of the cases of ascites in Kasr-el-Ainy no cause could be found other than malaria, but the ætiological connection is not very clearly established. A definite malarial cirrhosis occurs in a certain number of the cases, but it is not always present, and the conditions found appear to be very variable.

Of ankylostomiasis there is nothing in this volume beyond incidental mention. But, as is well known, the most important recent contributions to our knowledge of this destructive world-disease have come from the Cairo Medical School. Dr. Looss, in a long series of papers, has most ably carried on the investigations begun by Griesinger in the same school fifty years ago, and we are disappointed to find here no sequel to his account of the Sclerostomidæ of horses and asses which appeared in the first volume of the "Records."

Dr. Wilson follows up his observations on the poisons of spiders by a very interesting study of the venom of Egyptian scorpions. An aqueous extract of the poison gland is treated with excess of alcohol, and from the precipitate thus obtained a substance may be extracted with normal saline which possesses toxic properties of a very high order. The toxic value is about ten million, that is, 1 milligram will kill 10 kilograms of guinea-pig—a figure of the same order as that obtained for similar preparations from the venoms of the more poisonous serpents. A full-grown specimen of the common Egyptian species (*Buthus quinque-striatus*) contains about 3½ milligrams of this (impure) "toxin." If the susceptibility of man is the same as that of the laboratory animals, it follows that a single sting can kill at the utmost 35 kilograms. These calculations correspond very well with the fact that fatal cases of scorpion sting in adults are extremely rare, though the mortality in young children reaches 60 per cent. Scorpions are in this way on a different level from many of the poisonous snakes; as Captain Lamb has shown, the amount of toxin normally injected by a vigorous cobra is many times the minimum lethal dose for an adult man. Dr. Wilson finds that certain animals living in the desert (including the hedgehog) are naturally immune (at any rate relatively) to the venom; and Dr. Tallart has immunised goats and obtained an anti-toxic serum with curative properties.

An article by Dr. Tribe shows that phthisis in Egypt does not differ very much in frequency, incidence on rural and urban populations, and type from the same disease in western Europe; and Dr. Sobhy gives a curious account of the obstetric customs of the natives, which seem to have undergone no material change since very remote times. The volume concludes with the first instalment of what promises to be a monumental contribution to the morphology of the human brain, by Dr. Elliot Smith. The present section, which is fully illustrated, deals with the occipital region, and contains a great deal of original matter on the vexed questions of the significance and homologies of the convolutions.

The general printing of the volume is excellent, though the inevitable misprint has crept in here and there. The illustrations are good and useful, but we are sorry to see that the coloured plate illustrating Dr. Symmers's case of secondary sarcoma of brain could not be printed in Egypt.

A. E. B.

[1] "Records of the Egyptian Government School of Medicine." Vol. ii., 1904. Edited by H. B. Keatinge, M.B., Director. Pp. 169+plates. (Cairo: National Printing Department, 1904.)

WIRELESS TELEGRAPHY IN WAR.

A VERY interesting account of the working of the wireless telegraphic war correspondence of the *Times* during the early part of the Russo-Japanese war was given by Captain James at a meeting of the Society of Arts last week. This is the second occasion on which the *Times* has played a prominent and important part in the practical development of wireless telegraphy. The first was when, shortly after Mr. Marconi had established communication between America and England, a regular correspondence was started between the two countries by means of wireless telegraphy—a correspondence which was not, however, destined to last for very many days. Very soon after its inception something went wrong, and though since that time the Marconi Company has greatly developed its Transatlantic signalling and has effectively demonstrated its utility and convenience for communicating with liners, the shore to shore correspondence has not been renewed.

The second case in which the *Times* intervened was also only of short duration; but here the cessation was due to its having met with too great success, the results achieved having demonstrated not that wireless telegraphy is useful for war correspondence, but that it is too effective to be permissible.

The system selected for the equipment of the *Haimun* was that of Dr. de Forest, a system which had already shown its efficiency during the yacht races of 1903; the reasons that led to the choice of this system were its freedom from interference and the speed at which it could be worked, it being possible to transmit thirty to thirty-five words a minute, as against ten to twelve words by any other system. The experiences of Captain James seem certainly to bear out the claim of freedom from interference. In spite of the fact that four other systems were at work in close proximity to the *Haimun*—the

Russian, Japanese, British, and Italian—Captain James never found his messages interfered with in any way. This notwithstanding that many of the messages sent were of considerable length, running from 1500 to 2000 words. To transmit these long messages under all the attendant difficulties was no mean achievement for wireless telegraphy and journalism alike.

Some of the incidents narrated by Captain James are both interesting and amusing. On one occasion, when the Japanese steamed in to attack Port Arthur, the *Haimun* telegraphed the news of the firing of the first shot to Wei-hai-wei, whence the message was forwarded express to London, with the result that two hours later the *Times* received the news, so that, on account of the difference in time, the journal knew that an engagement was taking place six hours before it started. On the occasion of the transmission of their first long message—one of 1500 words—which was sent from a distance of 130 miles from Wei-hai-wei, the operator listened anxiously at his telephone receiver, after the first section of 350 words had been transmitted, to know whether it had been satisfactorily received. For five minutes he waited; then his face lighted up, and he remarked, "Captain, we will deliver the goods, Wei-hai-wei says that it is coming in like a drum." It is a remarkable achievement, which journalists and men of science highly appreciate, that wireless telegraphy is capable even in adverse circumstances of transmitting messages that will "come in like a drum." Wireless telegraphy may still be in its infancy, but the results attained by its use have shown that it is no longer in an experimental stage. M. S.

FLOODS IN THE UNITED STATES.

IN our number for July 28 we gave particulars of the great flood that occurred in the Mississippi valley in 1903, and of the damage done in Kansas and other places, and also of floods in the Passaic River, the information being obtained from the reports issued by the Geological Department of the United States. We have recently received a further report on floods in other parts of the States.[1]

This report states that the year 1903 will be long remembered for its extreme local variations from normal climatic conditions. Besides the floods in the Mississippi valley already referred to, due to heavy and continuous rainfall, a cloud-burst at Heppner, in Oregon, caused the loss

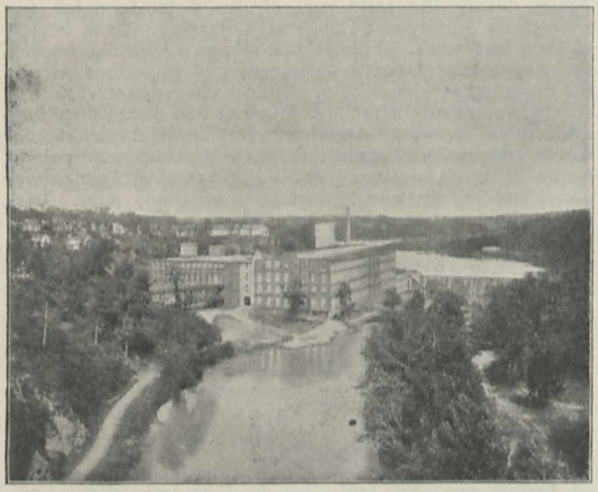


FIG. 1.—Clifton before the Flood of 1903.

of 100 lives and of property valued at half a million dollars, one-third of the town being entirely destroyed. This flood was due to a very heavy storm of short duration covering a very small area, such storms being peculiar to this arid region, and locally called a "cloud burst." Such a storm is almost like a tornado in its suddenness, destructibility, and limited extent. The duration of this storm was only half an hour, and the resulting flood lasted less than an hour. It was estimated that the storm area was from two to four miles in width and eight to ten miles in length, and affected an area of twenty square miles.

This storm was accompanied by a very heavy fall of hail; some of the hailstones measured 1¼ inches in diameter.

FIG. 2.—Clifton after the flood of 1903.

Five days after the storm some that measured five-eighths by seven-sixteenths inch were removed from a house buried under silt and mud, and bodies were found in drifts of hail in nearly a perfect state of preservation.

Another destructive flood due to heavy rain occurred in South Carolina in the district situated on the southern slope of the Saluda Mountains, which includes the foothills and rolling country. About half of it is covered with timber, the remainder being cultivated and pasture land. The surface slopes are such that the water runs off rapidly, and there is very little storage.

Rain had occurred daily for some time previously, saturating the ground, and culminating in a fall of from 3½ to 5 inches in twenty-four hours.

The greatest destruction caused by the flood due to this rainfall was the wrecking of three large cotton mills situated at Clifton (Figs. 1 and 2), on the river Pacolet. At one mill a chimney stack 137 feet high was washed down, and the mill, with shops, engine and boiler houses, and sixteen cottages, entirely destroyed. At another mill 110 feet of the main building and the wheelhouse were totally wrecked, and the machinery of the lower floors severely damaged by water, mud, and drift, and several cottages were destroyed. In another mill fifty-two women and children were drowned. Railway traffic was stopped for a week. The damage to the mills and other property was estimated at 3½ millions of dollars.

SEISMOLOGICAL NOTES.

THE third number of vol. x. of the *Bolletino* of the Italian Seismological Society contains the first instalment of the earthquake record for 1903. This is now in charge of Dr. G. Agamennone, and follows the same lines as in previous volumes, except that it has been found impossible to continue the attempt to reproduce all the records of earthquakes registered in Italy. This change is a consequence of the great increase in the number of stations where instruments devoted to the new seismology have been set up, and the consequent impracticability of collecting in one periodical all the records of even the limited number of great world-shaking earthquakes. Italy will, therefore, be content with publishing its own records, and at most a few lines will indicate those earthquakes which have also been recorded out of Italy.

[1] "Destructive Floods in the United States in 1903." By E. C. Murphy. Water Supply and Irrigation Papers, No. 96. (Washington.)

Improvements are continually being made in the instruments used in every branch of science, and seismology is no exception. Prof. Omori publishes (*Publications* of the Earthquake Investigation Committee, No. 18) an account of a combination of light, inverted, vertical, with a heavy horizontal pendulum, with which it is claimed that a period of sixty seconds can easily be got from an instrument which does not exceed 1 metre in height and length of boom. Prof. Alippi, in the *Boll. Soc. Sismol. Ital.*, vol. x., No. 3, describes a simple device for overcoming the tendency to adherence in the electric contacts of delicate seismoscopes; it consists in placing an ordinary electric bell, without the gong, in the circuit, and fixing it so that the clapper beats against the stone slab on which the seismoscope rests. He finds that the vibration set up by this is sufficient to cause the two parts of the contact to separate, without in any way affecting the instrument, and suggests that it would be better to incorporate a small electric vibrator in the base of the seismoscope to act like the decoherer in wireless telegraphy.

The mysterious sounds known locally as mist-poeffers, barisal guns, &c., and now generally looked upon as seismic, are the subject of a short note by Prof. Alippi, who records two new localities and names. In the neighbourhood of Arezzo they are known as "baturlio della marina," and in the country between Bologna and Modena as "romba di Sassuolo." The multiplication of localities where these sounds are familiar, and of local names for them, is thought by Prof. Alippi to render a generic name desirable, and he suggests *brontid*, which has certainly the advantages of being descriptive and of implying no theory of origin (*Bol. Soc. Sismol. Ital.*, x., part iii.).

The relation between the variations in latitude at Tokio and the occurrence of earthquakes in Japan is the subject of a paper by Prof. Omori in No. 18 of the *Publications* of the Earthquake Investigation Committee; he finds that the destructive earthquakes of the last eight years all occurred during periods of high or low value of the latitude, and none at times when this was changing from one to the other. This result is said to be in harmony with the results obtained by Prof. Milne, but we may point out that this is not so; what Prof. Milne found was that the greatest frequency of world-shaking earthquakes coincided with the most rapid variation in the position of the pole, while Prof. Omori finds that the destructive earthquakes of Japan occurred at times when the latitude was stationary or only changing very slowly. What his investigation seems to show is that any connection which there may be between the occurrence of really great earthquakes and changes in the position of the axis of revolution, does not extend to local earthquakes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IN accordance with the will of the late Mr. George Smith, of St. Louis, the treasurer of Harvard University has received, it is stated by *Science*, a payment of 51,500*l.* When this fund reaches 90,000*l.* by accumulation, three new dormitories are to be erected.

AT the institute of archæology of the University of Liverpool, a course of lectures dealing with recent researches on the ancient sites of Greece and with the historical geography of western Asia, particularly Palestine, has been arranged, and will be delivered on successive Wednesdays of this spring term. The lecturers are Dr. Caton and the Rev. M. Linton Smith.

THE President of the Board of Education has appointed Mr. T. S. Dymond, of the Essex County Technical Laboratories, Chelmsford, to an inspectorship under the Board, and to act as special adviser in matters of rural education, of nature-study in public elementary schools, of agricultural instruction in evening (including afternoon and Saturday) schools, and of the advancement of various forms of technical education in rural districts.

THE Bucks Education Committee, under the presidency of the chairman, Lord Buckinghamshire, has decided that a communication should be issued to all school correspondents in the county requesting the managers to consider the desirability of introducing the teaching of the subjects of hygiene and temperance into the schools under their charge, and referring to the support given to the movement by 15,000 members of the medical profession.

ABOUT twenty scholarships ranging in value from 20*l.* to 50*l.* a year, and exhibitions for men and women tenable at University College, King's College, and the East London Technical College, in the faculties of arts, science, and engineering, will be offered for competition on June 27 and following days. Full particulars and forms of application may be obtained on application to the secretary of the Inter-Collegiate Scholarships' Board, King's College, Strand, W.C.

THE conference on school hygiene, which will be held at the University of London on February 7–10, will be opened with an address by Sir Arthur W. Rucker, F.R.S., on "The Coordination of the Teaching of Hygiene." The subjects of papers for discussion include the following:—"Physical and Mental Development during School Life," Miss A. J. Cooper; "Physical Inspection," Dr. A. K. Chalmers; "Building and Equipment," Sir Aston Webb, R.A.; "Sanitary Inspection," Dr. J. F. J. Sykes; "Training of Teachers," Prof. C. S. Sherrington, F.R.S.; and "Training of Scholars," Prof. Findlay.

THE *British Medical Journal* announces that the French Congress of School Hygiene will hold its second meeting in Paris this year at Whitsuntide. The following is the programme of discussions:—(1) the medical inspection of primary schools; (2) the education of families in school hygiene; (3) vacations and holidays; (4) tuberculosis and teachers; (5) the overloading of school courses and competitions for admission to large schools. Profs. Debove, Grancher, Landouzy, and Pinard are honorary presidents of the congress. All communications should be addressed to Dr. I. Ch. Roux, 46 rue de Grenelle, Paris.

THE annual general meeting of the Association of Technical Institutions is to be held at the Manchester School of Technology on January 27. The business will include the address of the president, Sir Philip Magnus, consideration of the council's report, the election of officers, and the reading of papers. The subjects to be dealt with are:—"The Coordination of the Work of Evening Continuation Schools and Municipal Technical Institutions," "The Cooperation of Employers in the Technical Training of their Apprentices," and "The Registration of Teachers in Technical Institutions."

THE annual general meeting of the members of the Association of Directors and Secretaries for Education was held in London on January 19 and 20. Mr. F. Wilkinson, the chairman for the year, presided, and in the course of his remarks dealt with the new regulations for secondary schools of the Board of Education. The following resolution was adopted by the association:—"That the policy at present pursued at South Kensington with reference to the erection, financing, and control of secondary day schools is calculated to cast a heavy burden upon the ratepayers, while at the same time depriving them of adequate control."

MR. A. J. GIMSON described before the Institution of Mechanical Engineers on January 20 his impressions of sixteen engineering workshops visited by him in America. In the course of his remarks, he said that a feature of the engineering industry that impressed him was "the close intercommunication of technical institutes and manufacturing workshops, of professors and manufacturers, and the presence, in minor positions of authority, of young men who had passed through a complete course of technical instruction." In this country, manufacturers as a rule have yet to learn the value of scientific investigation and scientific education as factors of industrial progress.

SIR WILLIAM WHITE delivered an address at the Battersea Polytechnic on January 21 on the systematic study of

engineering. He expressed the opinion that in the teaching of those who have to work during the day and have only the evening in which to study, Great Britain is making progress. In many departments of technical education there is still much to learn, but in classes such as those in polytechnics England has led the way. The full value of such studies is often not attained, said Sir William White, because of the absence of a scientific method of teaching. Some teachers are uninformed themselves, and the consequences are serious to their students. The want of a good English elementary education has been recognised, but in secondary education there is much which still remains undone. He advised every student of engineering to apply himself to the study of mathematics and applied mechanics, without which an engineer must be at a disadvantage and have to work in the dark.

REFERENCE was made last week (p. 286) to the grant of 400*l.* a year, for the next five years, voted by the Drapers' Company for work in the department of applied mathematics at University College, London. The company has long taken an active part in the development of higher education, and the enlightened policy which has prompted it to make grants in aid of university work and scientific research in London will, we trust, be adopted by other city companies. No better testimony to the value of such grants could be obtained than is afforded by the memoirs which have been published containing the results of work carried on in Prof. Karl Pearson's laboratory (see, for instance, a note in NATURE of November 3, 1904, p. 15). In acknowledgment of the assistance given by the Drapers' Company to work of this kind, the council of University College passed the following resolution at its last meeting:—"That the council desire to convey to the Court of the Worshipful Company of Drapers their best thanks for the vote of 2000*l.* towards further assisting the statistical work and higher teaching of the department of applied mathematics at University College. By their original grant of 1000*l.* for this purpose the court has enabled the council to appoint an adequate staff and to purchase valuable apparatus for the work of the department. By generously continuing their aid the court will enable the work thus begun to be placed upon a more permanent footing, and will prepare the way for the establishment of a permanent statistical institute."

A RETURN showing the amount spent on technical education by local authorities in England and Wales—with the exception of four which have made no return—during the year 1902–3, has been prepared by the Board of Education and issued as a Blue-book. The return shows that the total amount of the residue received under the Local Taxation (Customs and Excise) Act, by the councils of counties and county boroughs in England (excepting the county of Monmouth), in 1902–3 was 879,405*l.*, of which 840,253*l.* was appropriated to educational purposes, and 39,152*l.* to relief of rates, the latter sum including 22,366*l.* devoted by the London County Council to relief of rates. Of the 49 county councils, 45 were applying the whole of the residue to technical education, and 3 a part of it to the same purpose. Of the councils of the 64 county boroughs, 61 were devoting the whole, and 3 a part of the residue to technical education. Further, 4 county councils and the councils of 31 county boroughs, 101 boroughs, and 211 urban districts, in England, were making grants out of the rates under the Technical Instruction Acts; and 31 local authorities were devoting funds to technical education out of the rate levied under the Public Libraries and Museums Acts. Thirty-three local authorities raised sums by loan on the security of the local rate under the Technical Instruction Acts. The total amount expended on technical education during the year was 1,149,216*l.* The total amount of the residue paid to the 13 county councils and the councils of the 3 county boroughs in Wales and Monmouth was 42,201*l.* These local authorities devoted the whole of it to intermediate and technical education, chiefly under the Welsh Intermediate Education Act, 1889. The total amount expended on technical education in Wales and Monmouth under the Technical Instruction Acts during the year was 42,781*l.*

SOCIETIES AND ACADEMIES.

LONDON.

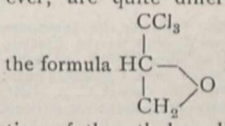
Geological Society, January 4.—Dr. J. E. Marr, F.R.S., president, in the chair.—The marine beds in the Coal-measures of North Staffordshire: J. T. **Stobbs**, with notes on their palæontology by Dr. Wheelton **Hind**. The stratigraphical position of the marine beds can be located with exactness *in situ*. The horizons can be utilised for the subdivision of the Coal-measures. The known horizons at which marine fossils have been obtained were enumerated, and a map of the distribution of these beds was given. The Speedwell and Nettlebank bed appears to be the most important marine bed in the coal-field. A detailed table of the beds in North Staffordshire was given to show the exact position of the marine beds. Dr. Hind, in his notes on the palæontology, remarked that from the base of the Pendleside series to the top of the Coal-measures there is an unbroken succession of beds—at one time marine, at another estuarine, without unconformity.—The geology of Cyprus: C. V. **Bellamy**, with contributions by A. J. **Jukes-Browne**. The Kyrenia Mountains rise to heights of more than 3000 feet. They are composed of rocks tilted into a vertical position, altered by compression and intrusion, and are devoid of fossils. They are referred by Prof. Gaudry to the Cretaceous period, and are compared by him with the hippurite-limestones of Attica. The Kythræan rocks (Upper Eocene) are based on breccias and conglomerates made up of fragments of the Trypanian limestones. No fossils, except a few small tests of Globigerina, have been found in this series, which consists entirely of volcanic débris. The Idalian (Oligocene) series appears to rest conformably on the last. The gypsum-beds are largely developed in the south; the white chalky marls and limestones extend over nearly one-half of the island, and are always conspicuous from their intense whiteness. Foraminifera are abundant, and other fossils have been found which indicate that the beds are mainly of Oligocene age. Igneous rocks are most conspicuous in the centre of the island. They are intrusive into the formations already mentioned. The rocks include augite-syenite, rhyolite, liparite, olivine-dolerite, basalt, augite, and several varieties of serpentine. Miocene rocks have only been recognised in the south-east of the island. The Pliocene strata lie in horizontal or slightly inclined beds, resting unconformably upon all older rocks. The Pleistocene rocks sometimes attain a thickness of 50 feet. The cave-earths have yielded *Hippopotamus minutus* and *Elephas Cypriotes* to Miss D. M. Bate. An account of the chief economic mineral products of the island is given. Descriptions of some of the rocks, a note on the Miocene rocks, and a sketch of the physical history of the island are contributed by Mr. Jukes-Browne.

Mathematical Society, January 12.—Prof. A. R. Forsyth, president, in the chair.—Basic generalisations of well known analytic functions: Rev. F. H. **Jackson**. Recent investigations have led to generalised forms of the serial expressions of certain functions. The functional characters of the new series, the domains of convergence, and the possibility of finding linear differential equations satisfied by the generalised functions are the matters that next claim attention. The author explained the degree of success which he had attained in these lines of investigation.—Current flow in rectangular conductors: H. Fletcher **Moulton**. The paper deals with the resistance of a rectangular lamina between electrodes which occupy portions of opposite sides, and the distribution of currents which flow in a conducting lamina bounded internally and externally by squares.—On the kinematics and dynamics of a granular medium in normal piling: J. H. **Jeans**. The paper is occupied with problems suggested by Prof. O. Reynolds's "Sub-mechanics of the Universe." An attempt is made to examine the question of the permanence or non-permanence of peculiarities of piling such as Prof. Reynolds interpreted as matter, electricity, magnetism, &c. The results go to show that such peculiarities would be transient, and that a universe constructed as imagined by Prof. Reynolds would suffer instant dissolution, after which particles of matter, charges of electricity, &c., would

appear fortuitously at rare intervals, and have no continuous existence either in time or space. If the æther were a granular medium in normal piling, it would be æolotropic with eighteen elastic constants, and the velocity of propagation of waves of high frequency would be much greater than that of waves of low frequency. Light transmitted from distant stars would consist largely of mirages and coloured spectra.—On a class of expansions in oscillating functions: Prof. A. C. **Dixon.** The paper deals with expansions of the kind discussed by Liouville and Sturm in which arbitrary functions are expanded in series of special functions which satisfy differential equations of a certain type. These expansions are used frequently in applications of mathematics to physics. The object of the paper is to give a rigorous proof of the possibility of such expansions in the case of functions which are analytic throughout the proposed range of validity of the expansions.—Generational relations for the abstract group simply isomorphic with the group $LF[2,p^n]$: Dr. W. H. **Bussey.**—On alternants and continuous groups: Dr. H. F. **Baker.** The paper is occupied with the proof of that fundamental theorem of non-commutative algebra which is usually written in the form $e^A e^B = e^C$, where A and B are non-commutative quantities, and C is a series of alternants of A and B. The proof is derived from a property of a matrix called the E-matrix, which involves the structure constants, and one set of the canonical variables, of the parameter group. This property is established independently of the theory of continuous groups. It is proved, further, that every alternant of E-matrices is an E-matrix, and thence is obtained a general expression for the equations of the first parameter group.—A generalisation of the Legendre polynomial: H. **Bateman.**—Isogonal transformation and the diameter transformation: H. L. **Trachtenberg.**

Royal Astronomical Society, January 13.—Prof. H. H. Turner, president, in the chair.—The eclipse of Agathocles in the year −309: Prof. **Newcomb.** The author considered that this eclipse had been identified by Celoria with an eclipse said by Cleomedes to have been total in the Hellespont. Assuming this to be the case, it would be necessary to make a diminution of 1″·5 in the secular acceleration.—The longitude of the moon's perigee: Mr. **Cowell.**—Magnetic storms and associated sun-spots: Rev. A. L. **Cortie.** Discussing Mr. Maunder's paper (read at the November, 1904, meeting), Father Cortie considered it was still possible to consider sun-spot phenomena and magnetic storms as produced by some common cause, and brought forward evidence from the Stonyhurst observations which he thought conflicted with some of Mr. Maunder's conclusions.—A paper on the same subject: Prof. **Schuster.** From Mr. Maunder's statistics, which Prof. Schuster discussed, it appeared that in some form or other magnetic storms recur at intervals apparently identical with that of the revolution of sun-spot zones. The author was unable, however, to accept Mr. Maunder's explanation of the cause of the storms, which he considered as of terrestrial origin, the earth's diurnal rotation being the real source of the energy. The energy thus drawn away from the earth would tend to diminish its velocity of rotation, but in a million years this diminution would not amount to more than a second a year. Without forming a definite theory on the subject, Prof. Schuster suggested that there is some solar effect, propagated in straight lines, which may increase the electric conductivity of the earth's atmosphere, and thus set a magnetic storm going without supplying its energy. The author concluded that Mr. Maunder had shown the urgent importance of further investigation, but that the facts have become more difficult to understand and explain. After a discussion, followed by a reply from Mr. Maunder, the meeting adjourned, many other papers being taken as read.

PARIS.

Academy of Sciences, January 16.—M. Troost in the chair.—On the generalisation of an elementary theorem of geometry: H. **Poincaré.** The theorem that the sum of the angles of a plane triangle is equal to two right angles is extended to the case of the tetrahedron.—On some theorems relating to algebraic surfaces of linear connection greater than unity: Émile **Picard.**—On some physical constants of calcium and on calcium amalgam: H. **Moissan** and M. **Chavanne.**—On the β-methyl-ε-alkylcyclohexanones and the corresponding alcohols, homologues of menthone and menthol: A. **Haller.** β-Methylcyclohexanone, which can be prepared either by the decomposition of pulegone or from metacresol by Sabatier and Senderens's method, is treated with sodium amide and the alkyl iodide. A mixture of various alkyl derivatives is obtained which up to the present has not been completely separated into its constituents.—On a synthesis of menthone and menthol: A. **Haller** and C. **Martine.** Methylcyclohexanone is treated successively with sodium amide and isopropyl iodide, the mass treated with water, extracted with ether, and the latter solution fractionated in a vacuum. The physical properties of the menthone obtained, as well as those of its oxime, semicarbazone, and other derivatives show that the synthetical is identical with the natural product.—Observations of the Borrelly comet (1904 *e*) made at the Observatory of Paris with the 30·5 cm. equatorial: G. **Bigourdan.**—On irregular algebraic surfaces: Federigo **Enriques.**—On some points in the theory of numbers: Georges **Rémoundos.**—On equations of the parabolic type: S. **Bernstein.**—On fluorescence: C. **Camichel.** The author has repeated some experiments of J. Burke on fluorescence with some additional precautions. His conclusion, which is opposed to that of Burke, is that the coefficient of absorption of uranium glass for the radiations which it emits during fluorescence is the same whether the fluorescence be excited or not.—Some combinations of samarium chloride with ammonia: C. **Matignon** and R. **Trannoy.** Samarium chloride forms eight different compounds with gaseous ammonia. The range of temperatures between which each of these compounds can exist, together with the heats of dissociation, were determined.—On a colloidal hydrate of iron obtained by electrodialysis and on some of its properties: J. **Tribot** and H. **Chrétien.** A solution of ferric hydrate in ferric chloride was placed in an ordinary Graham dialyser, and the amount of chlorine remaining in the solution determined at different intervals of time, in the first place on simple dialysis, and afterwards when a current of 1 ampere was passed through the solution. In the latter case the chlorine was more quickly and more completely removed; the theory of the two cases is given in detail, and the theoretical and actual results compared.—On an isomeride of trichloracetone: G. **Perrier** and E. **Prost.** Aluminium chloride is allowed to act upon alcohol in carbon bisulphide solution, and chloral is added. A liquid product possessing the composition and molecular weight of trichloracetone is obtained. The reactions, however, are quite different from this latter substance, and the formula  is provisionally proposed.—The migration of the ethylene linkage in unsaturated acyclic acids: E. E. **Blaise** and A. **Luttringer.** The migration of the ethylene linkage has been studied in the case of six alkylacrylic acids and normal αβ-hexenic acid. It appears to move into the longest chain, giving either an isomeric acid or a γ-lactone.—On the combination of natural leucine with carbamic acid: M. **Hugounenq** and Albert **Morel.**—On a new method of synthesising saturated ketones by the method of catalytic reduction: M. **Darzens.** It is shown that in applying the reaction of Sabatier and Senderens the temperature at which the reduced nickel is reduced is of equal importance with the temperature at which the reduction is carried out. If the nickel is prepared at 245° C. to 250° C., and the reduction is carried out at 180° C. to 190° C., unsaturated ketones can be readily reduced to the corresponding saturated compounds without the formation of considerable amounts of secondary alcohols as by-products. The reaction has been applied to mesityl oxide, methylhexanone, and methylheptenone.—Observations on the Borrelly comet (1904 *e*) made at the Observatory of Besançon: P. **Chofardet.**—Observations of the Borrelly comet (*e* 1904) made at the Observatory of Algiers with the 31·8 cm. equatorial:

MM. **Rambaud** and **Sy.**—Orogenic sketch of the chains of the Atlas mountains to the north-west of Chott el Hodna: M. **Savornin.**—On the existence and the abnormal tectonic situation of the Eocene deposits in New Caledonia: J. **Deprat** and M. **Piroutet.**—Geological observations collected by the Chari—Lake Chad expedition: H. **Courtet.**—Contribution to the chemical study of the soil, water, and mineral products of the region of Chari and of Lake Chad: Alex. **Hébert.**—On the spring at Hammam Moussa, near Tor, Sinai: R. **Fourtau** and N. **Georgiadès.** The water from this spring approximates to the water at Wiesbaden, containing sodium chloride and the sulphates of lime and magnesia. It has a slightly acid reaction.—Man and the mammoth at the Quaternary period in the soil of the Rue de Rennes, south of Saint-Germain-des-Prés: M. **Capitan.** Excavations in this district have led to the discovery in the Quaternary strata of several roughly executed flint heads and a well preserved tooth of the mammoth. It follows from this and previous discoveries that man, the elephant and the rhinoceros lived in the Seine valley, on the actual spot where Paris now stands.—Chlorophyll assimilation in the absence of oxygen: Jean **Friedel.** It is shown that the presence of oxygen in the atmosphere surrounding the leaf is not indispensable for the process of assimilation.—A gum bearing Stereospermum in Madagascar: Henri **Jumelle.**—The physiological effects of ovariotomy in the goat: P. **Oceanu** and A. **Babes.** Amongst the advantages of this operation in the goat are the disappearance of the characteristic smell of the milk, an increased secretion of the milk, and prolongation of the lacteal period.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 26.

ROYAL SOCIETY, at 4.30.—On the Boring of the Simplon Tunnel, and the Distribution of Temperature that was Encountered: F. Fox.—On the Comparison of the Platinum Scale of Temperature with the Normal Scale at Temperatures between 444° and −190° C., with Notes on Constant Temperatures below the Melting Point of Ice: Prof. M. W. Travers, F.R.S., and A. S. C. Gwyer.—On the Modulus of Torsional Rigidity of Quartz Fibres, and its Temperature Coefficient: Dr. F. Horton.—On a Method of Finding the Conductivity for Heat: Prof. C. Niven, F.R.S.—On the Drift produced in Ions by Electromagnetic Disturbances, and a Theory of Radio-activity: G. W. Walker.—Exterior Ballistics. "Error of the Day" and other Corrections to Naval Range Tables: Prof. G. Forbes, F.R.S.—The Theory of Symmetrical Optical Objectives. Part ii.: S. D. Chalmers.—Coloration of Glass by Natural Solar and other Radiations: Sir William Crookes, F.R.S.—Note on the Cause of the Period of Chemical Induction in the Union of Hydrogen and Chlorine: C. H. Burgess and D. L. Chapman.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Fuel Economy in Steam Power Plants: W. H. Booth and J. B. C. Kershaw. (Conclusion of discussion.)

FRIDAY, JANUARY 27.

ROYAL INSTITUTION, at 9.—The Life-History of the Emperor Penguin: Dr. Edward A. Wilson.

PHYSICAL SOCIETY, at 5.—Action of a Magnetic Field on the Discharge through a Gas: Dr. R. S. Willows.—Action of Radium on the Electric Spark: Dr. R. S. Willows and J. Peck.—The Slow Stretch in India-rubber, Glass, and Metal Wires when subjected to a Constant Pull: P. Phillips.—Determination of Young's Modulus for Glass: C. A. Bell.—Some Methods for Studying the Viscosity of Solids: Dr. Boris Weinberg.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Concrete-Making on the Admiralty Harbour Works, Dover: T. L. Matthews.

SATURDAY, JANUARY 28.

MATHEMATICAL ASSOCIATION, at 3.—Models and their Use: E. M. Langley.—The New Geometry: W. H. Wagstaff.—Should Greek be Compulsory for Mathematicians at Cambridge? A. W. Siddons.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—On the Occurrence of Gypsum in Essex Soils: T. S. Dymond.—The Bog-Mosses (Sphagnaceæ) of Essex, a Contribution to the Flora of the County: F. J. Chittenden.

MONDAY, JANUARY 30.

SOCIETY OF ARTS, at 8.—Reservoir, Stylographic and Fountain Pens: J. P. Maginnis.

INSTITUTE OF ACTUARIES, at 5.—On Staff Pension Funds: G. King.

FARADAY SOCIETY, at 8.—Mass Analyses of Muntz's Metal by Electrolysis, and some Notes on the Electrolytic Properties of this Alloy: J. G. A. Rhodin.—On the Equilibrium between Sodium and Magnesium Sulphates: Dr. R. Beckett Denison.—"Refractory Materials": E. K. Scott.

TUESDAY, JANUARY 31.

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

INSTITUTION OF CIVIL ENGINEERS, at 8.—Floating Docks: L. E. Clark.

MINERALOGICAL SOCIETY, at 8.—(1) On Danalite from Cornwall: (2) Crystallographic Characters of Barium-radium Bromide: Prof. H. A. Miers, F.R.S.—On the Regular Growth of Crystals of one Substance upon Those of Another: T. V. Barker.—Apparatus for Determining the Density of Small Grains: K. A. K. Hallowes.

WEDNESDAY, FEBRUARY 1.

GEOLOGICAL SOCIETY, at 8.—On the Sporangia-like Organs of *Glossopteris Browniana*, Brongn.: E. A. Newell Arber.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Volumetric Estimation of Reducing Sugars: A. R. Ling and T. Rendle.—The Inversion of Cane Sugar in the presence of Milk Constituents: Hon. Francis Watts.—The Colorimetric Estimation of Salicylic Acid in Food Stuffs: F. T. Harry and W. R. Mummery.

SOCIETY OF ARTS, at 8.—The Navigation of the Nile: Sir William H. Preece, K.C.B.

THURSDAY, FEBRUARY 2.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Compressibility of Gases between One Atmosphere and Half an Atmosphere of Pressure: Lord Rayleigh, O.M., F.R.S.—On the "Blaze Currents" of the Gall Bladder of the Frog: Mrs. A. M. Waller:—The Theory of Photographic Processes; on the Chemical Dynamics of Development: S. E. Sheppard and C. E. K. Mees.—On the Relation between Variation of Atmospheric Pressure in North-East Africa, and the Nile Flood: Capt. H. G. Lyons.—Note on the Determination of the Volume Elasticity of Elastic Solids: Dr. C. Chree, F.R.S.—Theory of the Reflection of Light near the Polarising Angle: R. C. Maclaurin.

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

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—The Mechanics of Flour Milling: A. R. Tattersall.

LINNEAN SOCIETY, at 8.—New Chinese Plants from the Neighbourhood of Hong Kong: W. J. Tutcher.—European Marine Species of Isopoda: Dr. H. J. Hansen.

RÖNTGEN SOCIETY, at 8 15.—Some Points in the Construction of a High Frequency Machine: Dr. Clarence A. Wright.

CHEMICAL SOCIETY, at 8.—Studies in the Camphane Series. Part xvi. Camphorylcarbimide and Isomeric Camphorylcarbamides: M. O. Forster and H. E. Fierz.

FRIDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 9.—Blood Pressure in Man: Prof. T. Clifford Allbutt, F.R.S.

GEOLOGISTS' ASSOCIATION, at 7.30.—Address on Modern Methods in the Study of Fossils: the President, Dr. A. Smith Woodward, F.R.S.

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