THURSDAY, MARCH 1, 1906.

MATHEMATICAL ASTRONOMY.

The Collected Mathematical Works of George William Hill. Vol. i. Pp. xviii+363. (Washington: The Carnegie Institution, 1905.)

IT is a rare mind that can handle the cumbrous developments of practical astronomy and leave uppermost with a reader the impression of variety, ease, and polish; and curiosity will be felt as to the circumstances which have developed Hill's remarkable powers. From an interesting introduction to the present volume by M. Poincaré we learn that he spent three years at Rutgers College, New Jersey, under a certain Dr. Strong. Dr. Strong "était un homme de tradition, un laudator temporis acti; pour lui Euler était le Dieu des Mathématiques, et après lui la décadence avait commencé; il est vrai que c'est là un dieu que l'on peut adorer avec profit," and if it led Hill to the study of originals, we may overlook the depreciation of the moderns. From New Jersey he went to Cambridge to continue his studies at Harvard; very soon here, by a paper contributed for a prize to a mathematical miscellany, he attracted the notice of Runkle, the editor, who was Newcomb's predecessor at the office of the *American Ephemeris*. Hill became attached to the *Ephemeris* as computer, and remained in discharge of these duties for thirty-two years. At first he worked at his own home, as was then the custom; but under Newcomb's management, and in order to complete his theory and tables of Jupiter and Saturn he lived for some years at Washington, incessantly absorbed in his task. "The only defect of his make-up of which I have reason to complain," Newcomb has written, "is the lack of the teaching faculty." In 1892 he withdrew to the little farm where his boyhood was passed, and where he still lives, asking nothing but the liberty to continue his labours.

The present volume carries us up to 1881, and includes most, but by no means all, of his best known papers. The essay which attracted Runkle's notice is No. 3, "On the Conformation of the Earth," and was written at the age of twenty-three. It is perhaps not of any permanent importance, yet it is marked by the clearness and the firm hand of his later writings and the same salutary determination that theory should give an account of itself arithmetically. It is natural to compare it with Stokes's memoir "On the Variation of Gravity," written some twelve years before, when he also was a young man, and the comparison shows strikingly how Stokes is the physicist and Hill the analyst.

The two great memoirs by which Hill is best known are No. 29, "On the Part of the Motion of the Lunar Perigee which is a Function of the Mean Motions of the Sun and Moon," and No. 32, "Researches in the Lunar Theory." These writings have been greatly praised, but it seems impossible to praise them too highly, whether for their difficulties or the way these are overcome, or the greatness of the advance which their solution implies. The latter paper was the first which threw any real light upon the general problem of three bodies, and it is well worth notice how large a part arithmetic plays in its success. The analysis is pregnant in the extreme, but it is the actual calculation of a whole sequence of periodic orbits which a moon might occupy that gives it shape and name.

If this memoir may be said to be the first significant word on the problem of three bodies, the former one, on the motion of the lunar perigee, seems to be almost the last word on a question that had outrun calculation from Newton's day to Delaunay's. It is doubtful whether the more determined effort to calculate this quantity was made by Newton or by Delaunay, but though naturally the degrees of approximation they attained were very different, they had this in common, that they proved the inadequacy of the methods employed. Hill first, with the smoothness of a conjurer, gives form to the intractable equations, and then shows how the solution is contained in a certain transcendental equation, an infinite determinant. It affords striking evidence of Hill's power to contrast his treatment of this determinant with that of Adams, who followed a similar route, *sed longo intervallo*, as he said himself. The complexity arising from an infinite sequence of equations might seem to preclude any general conclusions from being drawn, but Hill uses this very feature in the most beautiful manner to derive the eliminant in a transcendental form in the shape $\cos \pi c =$ a known quantity, and from this equation determines c, the required ratio. The secret of the success is now apparent. c is nearly equal to unity; hence it is very much easier to approximate to $\cos \pi c$, where we are in the neighbourhood of a stationary value, than to c directly; and though the difficulty recurs when we seek to find the arc πc from a cosine in the neighbourhood of its minimum, it is then an insignificant one, for we are past the true complexities of the problem.[1]

The remaining papers are naturally not of equal moment with these, but we may be grateful to the Carnegie Institution for making them accessible in the present collection. Several of them arose in connection with Hill's duties as computer to the *Ephemeris*, but even on such hackneyed subjects as eclipse computing and reduction of star places he has something good to say. He is a true artist; *nullum quod tetigit non ornavit*. Of considerable general interest are No. 18, "Remarks on the Stability of Planetary Systems," and No. 14, "A Method of Computing Absolute Perturbations," which contains a rescension of Hansen. Even the smaller papers, like No. 22, "On the Solution of the Cubic and Biquadratic Equations," are usually marked by some analytical felicity that makes one wish that Hill had been able to bring his great powers to bear upon a material not so invariably intractable and overloaded with tradition, and limited in its problems, as practical astronomy. But if we feel that his hand

[1] The point of this approximation is put somewhat incorrectly by M. Poincaré in his introduction.

is subdued to what it works in, we feel, too, that that is an essential ingredient of his success, and that with less complete absorption his work might have been less brilliant as well as less convincing.

R. A. S.

ULTRAMICROSCOPIC STUDIES OF THE COLLOIDS.

Zur Erkenntniss der Kolloide. Ueber irreversible Hydrosole und Ultramikroskopie. By Richard Zsigmondy. Pp. vi+185. (Jena: Gustav Fischer, 1905.) Price 4 marks.

THIS work forms a valuable addition to the literature of the colloids, giving as it does an authoritative account of the results obtained through the application of the method of ultramicroscopy to the study of solutions of colloids.

A brief account is first given of the nature and properties of colloid solutions or hydrosols. At the outset the author refers to the difficulty of giving a satisfactory definition of the term "solution." He adopts homogeneity as the most universal characteristic of solutions. The definition of homogeneity will naturally vary according to the delicacy of the methods employed to test it. By means of the method of ultramicroscopy devised by Zsigmondy and Siedentopf, the majority of colloid and even some crystalloid solutions can be shown to be optically heterogeneous. Every increase in the accuracy of the methods of examination would lead to a further limitation of the term "solution." In order to include the colloids Zsigmondy defines solutions as uniform distributions of solids in fluids, which are transparent to ordinary light, and not separable into their constituents by the action of gravity or by filtration.

In order to gain a clearer idea of the nature of colloid solutions, it is necessary to find criteria for distinguishing such solutions from those of crystalloids on the one hand and from suspensions on the other. Zsigmondy only refers very briefly to the distinguishing characteristics of the former, as this subject has been previously treated by Bredig in his monograph on "Inorganic Ferments." He deals more fully with the properties of colloid solutions which distinguish them from suspensions. In this connection he mentions the following as the chief features distinguishing colloid solutions from suspensions:—

(1) The particles in colloid solutions are much smaller than in suspensions. In colloid solutions the average diameter of the particles varies from 5 to 20 $\mu\mu$. This difference is, however, one only of degree.

(2) Many colloids are capable of undergoing irreversible changes. Separation of a metal from its colloid solution may be readily brought about by the withdrawal of water or the addition of electrolytes. In this process the metal has undergone an irreversible alteration or coagulation. For the reformation of the colloid solution, chemical or electrical means must be employed. In the case of suspensions, on the other hand, sedimentation rapidly takes place under the influence of gravity, and its rate is little influenced by the withdrawal of water or by the addition of electrolytes. The suspension may be reformed by purely mechanical means.

(3) Alterations in the total energy of the system are frequently associated with the process of coagulation. These have been measured in several cases by means of the calorimeter.

(4) Colloids in solutions are capable of undergoing reactions with one another, which closely simulate purely chemical reactions.

The next section of the book deals with the classification of colloid solutions or hydrosols. The classifications of the hydrosols have been based on two principles, namely, the size of the particles and the reversibility or irreversibility of the hydrosol (Hardy). On plate i. the author gives a graphic representation of a classification of colloids founded on these principles. The reversible colloids differ from the irreversible in not being readily coagulated by the addition of electrolytes. It is noteworthy that irreversible colloids may be partially protected from the coagulating action of electrolytes by the addition of a reversible colloid to their solutions. Great quantitative differences are found to exist in the extent of protection given by different reversible organic colloids to irreversible gold hydrosols.

A historical account of the preparation and properties of irreversible colloid solutions occupies the next section of the book.

The author next gives an interesting account of the development of the method of ultramicroscopy by Siedentopf and himself. A full description is also given of the necessary apparatus and of the method of using it.

The succeeding sections give details of the results of his own researches on gold hydrosols. By means of the ultramicroscope he was enabled to determine approximately the average size of the gold particles, their colour, and the rapidity of their movements both translatory and oscillatory. The limit of size determinable by the ultramicroscope appears to be about 6 $\mu\mu$ in the case of gold hydrosols. Still smaller particles (amicrones) are also present in gold hydrosols. Their presence may be proved by the coagulation of the hydrosols on the addition of electrolytes.

An excellent summary is also given of the results obtained by other observers through examination of various colloid solutions by means of the ultramicroscope.

Brief reference only is made to some points of great theoretical interest, namely, the causes of the stability of colloid solutions, and the mechanism of their formation.

The book concludes with a short summary of what is known with regard to the products of coagulation of colloid solutions.

The work as a whole is to be regarded as a valuable monograph indispensable for those interested in the ultramicroscope and its applications.

J. A. MILROY.

SCIENCE IN ARCHÆOLOGY.

Manuel de Recherches préhistoriques. Issued by the Société préhistorique de France. Pp. 332; with 205 figures and 4 plates. (Paris: Schleicher Frères, éditeurs, 1906.) Price 8 francs.

LAST year an eminent English Egyptologist published a handbook for excavators, with especial reference to Egypt, and remarked in his preface that "a complete archæological training would require a full knowledge of history and art, a fair use of languages, and a working familiarity with many sciences." The present work embraces a large number of subjects that should be familiar to the practical archæologist, especially if engaged in field-work on French soil.

The manual is issued by the Prehistoric Society of France, and has been written by several of its leading members. Taken in conjunction with the first congress of the society, held in the autumn at Périgueux, it indicates a widespread interest in the remote past as represented by flint implements, cave deposits, dolmens, and Gaulish burials. Of recent years, more and more emphasis has been laid on the need for systematic excavation as opposed to haphazard relic-hunting by amateurs; and this publication is intended, not only to assist the explorer in his search for records of the past, but also to render them accessible and self-explanatory when found. Private interest and personal feeling always stand in the way of corporate action in such investigations, but much would be gained if the advice contained in this manual were followed by the depredator, if only for his own ends. To put it on the lowest ground, relics accurately labelled and located gain enormously, not only in scientific, but also in market value; and if archæology is to justify its claim to be regarded as a science, scientific exploration must be the rule, and not the rare exception.

The chapters are all much compressed, and none can be singled out as more important than another. There are instructions for all the ordinary branches of exploration in a most compact form; but in spite of the French tradition, we venture to think that the volume would have been even more practical if published in a light but stout binding. A handbook in a paper wrapper is hardly fit for use in the field. Attention may be directed to the method of hardening and preserving skeletons and other bones by means of silicate of potash, and to the practical advantages of the process advocated for preserving iron. This metal is the scourge of museum curators, and neither the soda nor paraffin treatment has proved altogether successful. The simpler, and apparently the more satisfactory, method is to allow the metal to dry for several hours after brushing in water, and then to heat it to a dull red; if allowed to cool slowly, the object should then be rust-proof, and the surface clean and firm.

One of the most useful features of the manual is the table for computing the height of a subject from various bones of the skeleton; this method would no doubt greatly reduce the number of 7-feet skeletons found even in this country. Another point on which emphasis is laid is the desirability of photographing dolmens, menhirs, and other antiquities of the kind precisely from the four cardinal points; picturesque views are dear to the ordinary photographer, but are of little value for purposes of comparison. On this point a caution should have been given as to the difference between the true and magnetic north, as accurate compass bearings of megalithic monuments may often prove of considerable importance.

The student of prehistoric archæology in France and elsewhere will be glad to find the various classifications of the Stone age brought together, even if no attempt is made to coordinate them. The most important are those of Mortillet, Piette, Salmon, Boule, and Rutot, and in the last mentioned occurs (as occasionally elsewhere) the irritating term "Forest Cromer bed." Among the few cases where no scale is indicated for the illustrations is that of the Pressigny nucleus (Fig. 74); the extraordinary size of these flints ought surely to have been stated. Finally, it is somewhat of a shock to the orthodox to find the following item in the glossary at the end:—"*Bulbe de percussion.*—Mot impropre (voir *Conchoïde*)."

OUR BOOK SHELF.

Smoke Abatement: a Manual for the Use of Manufacturers, Inspectors, Medical Officers of Health, Engineers, and Others. By William Nicholson. Pp. xiii+256. (London: Charles Griffin and Co., Ltd.) Price 6*s.* net.

THE author of this handbook is chief inspector to the Sheffield Corporation, and seems to have an extensive acquaintance with the various enactments that have been passed in this and other countries with a view to ameliorate one of the greatest nuisances of modern times, and devotes more than a third of the 250 pages the book contains to their recital. This is undoubtedly useful to those desiring to make themselves acquainted with the legal aspects of the case, but scarcely justifies the subtitle of a "practical handbook," as the author's idea of the nature of smoke is of a most delightfully rudimentary character, and his power, therefore, of prescribing remedies necessarily limited. On searching the book for a clear definition of smoke and a description of the constituents that go to build it up, we find on p. 12 the following:—"Nature of the Nuisance—Smoke consists of minute particles of carbon together with a sticky tarry matter which settles and sticks to everything it comes in contact with. It is dirt. Lord Palmerston's definition of dirt from a health point of view is 'Matter in the wrong place,' and carbon or coal in the atmosphere is matter in the wrong place."

One of the chief remedies suggested by Mr. Nicholson is that the Sanitary Institute should now deal with the question, and arrange for courses of lectures on the subjects of "Smoke and the Injury therefrom," "The Causes of Smoke," and "The Practical Prevention of Smoke," after which examinations should be held, and "certificates of competency given to all who satisfy the examiners." The result of this is foreshadowed by the author as follows:—

"If such facilities were offered, hundreds of engineers and others would avail themselves of them, and would not rest satisfied until they had procured a smoke inspector's certificate, which would become as popular and as valuable as the sanitary inspector's

certificate. Having obtained the certificate and possessing the theoretical as well as the practical knowledge, they would quickly be on the look-out for official appointments, and if there was an unwillingness on the part of the Local Authorities to appoint them, the necessary pressure to compel them to do so would be forthcoming."

If Mr. Nicholson could induce the Sanitary Institute to add a lecture on "The Nature of Smoke" to the course he prescribes, and was to attend it, he would find the information of distinct advantage in dealing with "smoke abatement."

The Preservation of Antiquities, a Handbook for Curators. Translated from the German of Dr. Friedrich Rathgen by Dr. G. A. Auden and Dr. H. A. Auden. Pp. xiv+176; with 48 figures in the text. (Cambridge: University Press, 1905.) Price 4*s.* 6*d.* net.

DR. RATHGEN states in his preface to the German edition of this little book that it is intended to stimulate curators and others interested in the preservation of antiquities to make public their experiences in this branch of archæology.

The first part deals with the changes brought about by the long-continued action of soil, moisture, and air on metals, glass, organic substances, limestone and clay; the materials of which "antiquities" are most usually composed. This is a subject about which very little is known, one of the commonest cases, the "rusting of iron," being still a subject for argument and speculation among chemists. The author, therefore, is only able, as a rule, to state the effects produced by these natural agents, and in comparatively few cases can suggestions be made as to the modes by which these effects are brought about.

In the second part, methods of cleansing recently disinterred antiquities of various kinds and of preserving them are given, and here the author is able to quote largely and usefully from his own wide experience of this work.

The translators have added to the English edition some notes of recent work and additional illustrations which are useful in elucidating various points in the text. The book should be useful not only to curators for reference, but should prove suggestive to all interested in the preservation of natural or artificial structures exposed to the action of air, soil, or moisture.

Organography of Plants. By Dr. K. Goebel. Authorised English edition by Prof. I. Bayley Balfour. Part i., pp. xvi+270. 10*s.* net. Part ii., pp. xiv+708. 21*s.* net. (Oxford: The Clarendon Press.)

THE German edition of the "Organography" has already been reviewed in NATURE (vols. lviii., p. 74, lxiii., p. 149, lxvi., p. 51), and it is unnecessary, therefore, to insist again on the importance of Prof. Goebel's book, both to botanists and to others who are interested in the development of plant life.

The Clarendon Press is to be congratulated on having secured Prof. Bayley Balfour to undertake the responsibility of preparing the English edition, and his name on the title-page carries with it the assurance that the work has been well done. Moreover, his great knowledge of plants has enabled him to give that indefinable cast of originality and interest to the translation that one so often misses in presentations of this kind.

The text is well broken up, by means of headlines and by the use of different founts of type, thus rendering the book more easy to use. The printing, and also the figures, are excellent, and there is a good index, both of illustrations and of subject-matter.

Both the Clarendon Press and the editor have laid English-speaking botanists under obligation by the excellent production in our own language of this important work. J. B. F.

Catalogue of the Madreporarian Corals in the British Museum (Natural History). Vol. v., The Family Poritidæ, ii., The Genus Porites, Part i., Porites of the Indo-Pacific Region. By Henry M. Bernard. Pp. vi+303+xxxv plates. (London: The Trustees of the British Museum, 1905.)

IN the preparation of this important catalogue Mr. Bernard was confronted with the difficulty, experienced by nearly all naturalists who have attempted to arrange corals in specific groups, that the characters afforded by the skeletal structures only are so variable that there is no possibility of accurately defining the limits of "species." This is a difficulty which is wont to grow rather than dwindle as our knowledge of specimens of a genus increases, and Porites being a common and widely distributed coral, represented in the museum by very many specimens from numerous localities, the difficulty presented itself in a particularly exaggerated form.

No one will deny that the binomial system when applied to such a genus is unsatisfactory, and it will probably remain so unless further investigation of the anatomy of the living polyps reveals some characters of better value for purposes of classification. But the system adopted by Mr. Bernard, of abandoning the old specific names and giving the specimens a geographical label and a number, does not appear to offer a more satisfactory solution of the problem, and will not, probably, be generally approved. Unsatisfactory as they may be, many of these specific names are of some value, and all of them of historical interest. To sweep them all away at a stroke is a drastic measure which cannot be recommended, either on the ground of science or expediency.

But even if Mr. Bernard's system is disapproved, naturalists will undoubtedly agree in their tribute of thanks for the skill and patience he has displayed in building up this monumental work on the Indo-Polynesian specimens of the genus. The detailed description of the specimens in the museum will be of value to those who may, in the future, be tempted to grapple with the species question in the genus; but a real and important contribution to knowledge is to be found in the concise statements concerning the morphology of the skeleton and the affinities of the genus. The catalogue is adequately illustrated.

Microscopes and Accessories: How to Make and Use Them. Edited by Paul N. Hasluck. Pp. 160. (London: Cassell and Co., Ltd., 1905.) Price 1*s.* net.

WE are very doubtful whether the first portion of this book, dealing with the practical construction of a microscope by the amateur, will serve any useful purpose. Such an instrument, however well constructed, must almost inevitably fall far short of the perfection attained by the instrument makers, even if the amateur be a first-class mechanic, and efficient instruments may nowadays be picked up second-hand at ridiculously low prices. In the description of the tube, all that is said with regard to the attachment of the objective is that at the bottom (of the tube) a disc of brass is sweated on, the hole in its centre being ⅞ in. diameter, and chased with a fine thread; not a word about the standard screw now adopted by all makers. The latter portion of the book, dealing with the preparation and mounting of objects, is concise and to the point, but presents nothing novel in its treatment of the subject. R. T. HEWLETT.

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.*]

Cooperation between Scientific Libraries.

THE note in NATURE (February 15, p. 372) on Dr. T. Muir's paper in the Proceedings of the Royal Society of Edinburgh directs attention to a difficulty which, as you rightly say, affects many others than the mathematicians of Scotland. You adduce, for example, Wales; but may I, without giving offence to the Principality, venture to suggest that the metropolis itself has still better claims to dishonourable mention?

In the two sciences which chiefly appeal to me, geology and zoology, the difficulty mentioned by Dr. Muir has long presented itself forcibly, and there is a lengthy list of books that I have been trying to see in vain, some of them for more than five years. They are, so far as I can ascertain, in none of the many libraries of this city. Naturally, the remedy suggested by Dr. Muir long ago presented itself to me, and I have lost no opportunity of urging it in conversation and in print. In view of your own recognition of the importance of the subject, I venture to ask you to reprint for a wider public the following paragraph from a paper contributed to the *Museums Journal* for April, 1902. After alluding to the cooperation between American libraries in the matter of cataloguing, and to the specialisation among the libraries of Chicago, I wrote :—

"The extraordinary difficulty that a student has, even in London, in seeing the literature of his subject—in fact, the impossibility, unless he is prepared to spend large sums of money on his private library—must have made many a one long for the day when the learned societies and other library authorities of London shall take this question of cooperation in hand. To what end is all this fuss about an international catalogue of scientific literature, with its elaborate mechanism and enormous expense, if, when the list of books is in his hands, it be still impossible for the student to refer to them? The amount of money annually spent by Government, through the libraries of the British Museum, the Education Department, the Patent Office, and the like, when joined with that spent by the great societies, such as the Royal, the Zoological, the Linnean, the Geographical, the Geological, with the College of Surgeons and other public bodies of like character, is surely enough, if properly administered, to buy the world's output of books each year; and far more than enough, if we remember that all publications of the United Kingdom go to the British Museum as a matter of course, and that the donation lists of many of these libraries are nearly as big as their purchase lists. If only the money could be pooled, and the purchases distributed according to some pre-arranged scheme among the various libraries; and if a joint catalogue were prepared, and kept up from month to month, showing not only the titles of books, periodicals, and papers, but the libraries in which they were to be found, then weary searching and fruitless wandering would no longer be the lot of the conscientious student. Even as things are, without so radical a reform as a redistribution of income, I feel sure that a conference of librarians, bent rather on furthering the interests of the reader than the pride of their own institutions, and armed with the necessary powers for cooperation, would soon lift London libraries out of the hopeless muddle that we now have to struggle with."

I hope that now this subject has been taken up in your influential pages it will not be allowed to drop until those concerned have at least attempted the remedy.

F. A. BATHER.

The Blondlot *n*-Rays.

IT would be interesting to know whether anyone has obtained success in repeating the latest experiment designed to show the objective reality of the *n*-rays, viz. that described by M. C. Gutton in *Comptes rendus* for January 15.

The writer has repeated M. Gutton's experiment with much care, but has met with no more success in obtaining any positive result than he has in repeating a large number of M. Blondlot's own experiments, most of which he has essayed, in all cases with absolutely negative results, provided proper precautions were taken to avoid effects due to temperature and other extraneous causes of disturbance.

According to M. Gutton's experiment, the effect of the *n*-rays that proceed from a Nernst electric lamp upon a spark in a primary circuit is to diminish the brilliancy of another spark electrically induced in a secondary circuit by the primary discharge. Here one would suppose that the degree of brilliancy of the secondary spark can only be a matter of the amount of the electrical energy in the secondary circuit, but the writer finds that a very sensitive Duddell thermo-galvanometer, which would indicate a very small percentage of variation in the amount of this energy, shows no variation whatever.

A. A. CAMPBELL SWINTON.

66 Victoria Street, London, S.W., February 20.

A 300-Year Climatic and Solar Cycle.

IN June, 1902, I made a few remarks on an apparent coincidence between sun-spot periods and longer periods of rainfall and famine in north China. Not being, in any sense, a meteorologist, I did not publish my conclusions except locally. In connection with a notice in the "Astronomical Column" of NATURE, November 9 last (vol. lxxiii. p. 38), they are of sufficient general importance to recall them. The notice in NATURE is headed "A 300-year Cycle in Solar Phenomena," and refers to a discussion in the *Astrophysical Journal* wherein Mr. H. W. Clough, of the Washington Weather Bureau, arrives at the conclusion that a 300-year cycle exists in solar and the allied terrestrial phenomena, and finds likewise an intermediate 36-year cycle, and supports both by a reference to various phenomena, such as auroræ, periods of grape harvest, &c.

In 1877 Mr. A. Hosie, H.M. Consul at Chengtu, published a paper in the Journal of the China Branch of the Royal Asiatic Society on droughts in China (new series, xii., 51), extracted from Chinese records. As the records included all China, south as well as north, the tables did not at first sight exhibit any apparent periodicity. Some years after, on making a careful division into north and south, I was struck with a remarkable period of about 300 years, which seemed to me marked clearly in north China as an especial era of drought and famine. As, however, there seemed no reason for founding a new period, for the intercalation of which there was as yet no accumulated evidence, I proceeded no further with the subject. Mr. Hosie's paper went from the year 620 to 1643, covering a period of 1023 years, and attached to it was another notice of sun-spots observed in China, also going back for some 1300 years. The latter table, on account of the want of any observation instruments, is, of course, very fragmentary, but at the time I deduced from it without reference to European observations, which I had not by me, a probable period of 99 maxima in the 1920 years covered, which seemingly gave a mean of 11·085 years, and which, produced to modern times, fell in sufficiently satisfactorily with the European records of the last century. Sir Norman Lockyer in 1901 had also published observations bearing on a climatic curve of about six sun-spot periods, and commenting on all these I made the following remarks, which are entirely confirmative of Mr. Clough's findings, although deduced from such entirely different authorities.

"I now come to the long period or era which Mr. Hosie's records seem to require. The first of these calling for notice seems to cover the three sun-spot periods 664–697, though this is not so well marked as the others. The second covers the similar period from the maximum in 963 to that in 996, when besides two years of drought in northern China, 961 and 962, we find no less than twenty-three years out of the thirty-three characterised by excessive droughts in one or more of the northern provinces. The third covers the periods 1262–1295, when, in addition to the antecedent year 1260, there are noted twenty-one years of drought in the same provinces. The fourth is included between the spot maxima of 1561 and 1594, and though not so marked as the second and third, yet ten years of

drought are recorded, besides the preliminary drought years of 1557–1558. The fifth will, then, cover the equally well marked cycle of drought, which, beginning in or about the year 1860, has continued with scarcely an exception up to the present."

This was written in 1902, and it is noticeable that, as required by the cycle, the intervening years have proved of normal rainfall in northern China. Proceeding, I stated :—

"We have thus four well marked eras of 299·25 years, the beginnings of which in each case were marked by perfectly similar climatal phenomena, each being characterised as a period of drought in some special locality. It has always seemed to me that meteorologists have been in the habit of excessive generalisation, and that the true way to arrive at the secular variations of climate is to compare all observations made within a limited locality, where the conditions are more or less specialised. The mean rainfall of China, as I remarked at the beginning, would not have afforded the necessary data for such a comparison as I have attempted, the reason being that droughts in north and south China are in effect complementary, and never occur contemporaneously : and herein lies the key to the phenomena.

"According to the accepted theory of the 'monsoon,' it is produced by the excessive heating of the continent of Asia between the degrees of 35 and 45 N.L. which causes the rarefied air to flow off and leaves a partial vacuum to be filled in by moist warm air rushing across the equator. If from any cause the heat radiated from the sun be greater one year than another, the regions where the monsoons are elaborated are raised to a higher temperature, and the force of the monsoon increased, and the warm air carrying an extra supply of moisture is carried further north and spread over a wider area; hence the north of China, the usual limit of the monsoon, is superabundantly watered.

"If, however, the heating of the surface be insufficient to set up the normal circulation, the moisture from the tropics is dumped down in or about the latitude of the Yangtse basin, and mid-China receives a superabundant supply of rain, while the entire north is parched, and famine in one or more province is the result. Hence a wet summer in Shanghai is rarely or never accompanied by a sufficient rainfall in the north."

Similar conditions to a large extent prevail in India, and hence it has happened that the latter third of the last century was a period of drought and famine, which severely taxed the resources of the country. I wound up the note with the following remarks :—"It is not for me to suggest an explanation. But the 299¼ year will probably be found to depend on some hitherto unsuspected cosmical cause."

I do not pretend in this to take any credit to myself for any discovery. My part was confined to drawing up a column of centuries divided into three lines; in one was marked the year, in the second the dates when sun-spots had been observed, and in the third the years when droughts had been recorded in the northern provinces; in each of the latter a dark line was drawn across the column. The result was remarkable at the first glance, the dark lines congregating themselves thickly at the ends of the seventh, tenth, thirteenth, and sixteenth centuries, the rest being almost a blank. Personal experience showed me how the nineteenth century had followed the same rule. Mr. Clough's observations may therefore be looked upon as fully borne out by Chinese records; and it only remains to ascertain the cause of the phenomenon, which has certainly had a very considerable effect on the history of Asia.

I may point out the curious coincidence that the climatic cycle of about thirty-four years seems to agree with three sun-spot cycles, while the greater period of 299¼ would seem to correspond with twenty-seven.

Shanghai, January 8. THOS. W. KINGSMILL.

The Origin of Bronze.

IN connection with Prof. W. Gowland's remarks on the origin of bronze in his presidential address to the Anthropological Institute, abstracted in your issue of February 15 (p. 381), it may be of interest to direct attention to the fact that Plutarch, in his "De defectu oraculorum," refers to worked-out copper deposits in the island of Eubœa, from which were formerly manufactured swords which were "cold-forged" (ψυχρήλατος), and in this connection he quotes Æschylus, who mentions a "self-sharpened (αὐτόθηκτος) Eubœan sword," self-sharpened meaning, I presume, sharpened without fire. I believe that bronze containing only a small proportion of tin is malleable in the cold, but do not know if this would be the case with that referred to by Prof. Gowland as containing antimony. It would be interesting to know if tin is associated with copper in Eubœa. Swords of pure copper would hardly be of much use.

JOHN W. EVANS.

Imperial Institute, February 23.

Result of War affected by Soldier's Stature.

MR. TWIGG at p. 340 of your issue of February 8 points out that the Japanese had an unquestionable advantage in the recent war, as being smaller than the Russians—they were smaller targets for fire-arms. This is quite correct, but the advantage is inversely as the cubes of their heights, and not as the squares only, which would only apply to plank dummies. Bullets come from all sides, and not from the front only, so that the thickness of the men's bodies must be taken into account as well as their height and breadth. The average targets offered by each to the enemy are (taking Mr. Twigg's figures) as the cubes of 1585 and 1642, or as 106 to 118, an advantage in favour of the Japanese of about 12 per cent., or nearly double that calculated by Mr. Twigg.

W. E. WARRAND.

Westhorpe Hall, Notts, February 24.

TWO BOOKS ON BIRDS.[1]

TO watch the ways and habits of birds is a taste which is growing rapidly. Some watchers of birds, indeed, are not content to stop at observing their habits; they want to know how the birds acquired those habits and of what use they are to them. They speculate upon what a certain habit, if persisted in, may ultimately lead to. They wish to know, among other things, how a bird came by its colours, and what purpose in the bird's economy is served by, for instance, the red inside to its mouth, seen only when it gapes. And when careful, minute, and scrupulously accurate observers write down on the spot what they see, or think they see, natural history will always be the richer for their labours; and the theories and speculations which these inquisitors weave from what they have seen and heard cannot fail to prove interesting and suggestive reading.

Mr. Selous, at once the pioneer and the great exponent of this "close observation," who in a former work on bird watching touched upon the birds of the Shetlands, returned to his loved islands two years later, and now gives us a whole volume devoted to their birds and seals. In some three dozen short chapters he discourses, with digressions, delightfully upon his experiences. With the exception of a few "peckings," and minor interpolations—mostly having to do with the working out of ideas jotted down in the rough—the chapters contain his journal, written from day to day amidst the birds with whom he lived without another companion on one or other of these remote islands, "hated by thousands" of birds, and feeling himself the most unpopular person on the island. Nothing more need be said to recommend the book to the notice of those who follow birds in the field. For his digressions, leading him sometimes wide of the subject of birds, the author does not apologise.

1 "The Bird Watcher in the Shetlands. With some Notes on Seals—and Digressions." By Edmund Selous. Pp. xii+338; with 10 illustrations by J. Smit. (London: I. M. Dent and Co., 1905.) Price 10s. 6d. net.

"Nature-Tones and Undertones." Being Sketches of Life in the Open. Illustrated by Photographs from Nature. By J. Maclair Boraston. Pp. 223. (London and Manchester: Sherratt and Hughes, 1905.) Price 6s. net.

He rather hopes that this batch of them will make it apparent that they are a part of his method, or, rather, a part of himself; and since they occupy so much space in the book it seems only right that they should appear on his title-page. Possibly the reader is not meant to take them all too seriously, for Mr. Selous warns us that he has not suppressed his errors even when he happened to know them, because, among other reasons, "if one has got in some idea or reflection that pleases one, or a piece of descriptive writing that does not seem amiss, how tiresome to have to scratch it out, merely because it is founded on a wrong apprehension!—the spire to come tumbling just for the want of a base!"

The author rather seems to deprecate being included in the ranks of the ornithologists, his ambition being to make a naturalist who shall use neither a gun nor a cabinet. That is all very well; but to decline to avail oneself of the work done by others is sometimes to miss the clue which would explain some puzzle. If he had handled cabinet specimens, or if he did not "hate the British bird book" so heartily, he might have known why the white lines on the diver's neck shone in such a peculiar way in the sunlight (p. 60), and perhaps would have experienced increased enjoyment in consequence. A theory anent the old puzzle of the puffin and the bunch of fish it brings home in its ornate beak, and some instructive observations on young fulmars, are only a crumb or two out of the good things which we mark in reading many charming pages. One of the illustrations shows birds following the ways of "Nature, red in tooth and claw"; and this (together with that of a herring-gull dealing with a downy puffin) we dedicate to the conversion of those who favour the protection of the larger gulls. We dare not begin to quote for fear of never ending, and must confine ourselves to this one sentence in explanation of the plate: "I saw another kittiwake being savagely murdered by another herring-gull." The chapters on seals are very interesting, for few people have the chance of watching these animals. A good index is a great advantage to the reader, not always found in books of this kind.

A considerable part of Mr. Boraston's new work is occupied by an account of a remote and little known corner of Anglesey, and it is saying a good deal to say that this is perhaps the pleasantest and most interesting part of the book. How he journeyed there—and back—and what birds and other things he saw is told in the attractive and distinctly original style so much commended in the notices of his former work. Of more highly scientific interest, perhaps, is the series of careful notes which the author made upon a young cuckoo. These include several important observations which must not be detailed here; but we cannot refrain from quoting the author's concluding reflections on the strangely ferocious fledgling he watched so patiently. "And knowing it for a solitary and a wanderer beyond any of its kind, smuggled into life in an alien nest, tended in blind devotion by creatures it requites as blindly by destroying their own offspring; fashioned like a hawk to be hunted by every chit that flies; never to mate, never to nest, never to rear or lead its young; remembering this, I could have wished that this Unnatural Selection had not been, or that this strange mockery of life might be undone." In this chapter, too, we have an interesting inquiry into the theory of the assimilation of the cuckoo's eggs to those of the foster-species, with an analysis of collections of more than seventy nests of various birds containing cuckoos' eggs and the eggs of the foster-parents. The author writes, "The variation exhibited in the collections I have seen was considerable, but I could in most cases have improved the assimilation by transferring the eggs from one nest to another. Unless more convincing evidence were brought forward than such as was furnished by the seventy-six nests mentioned above, I should con-

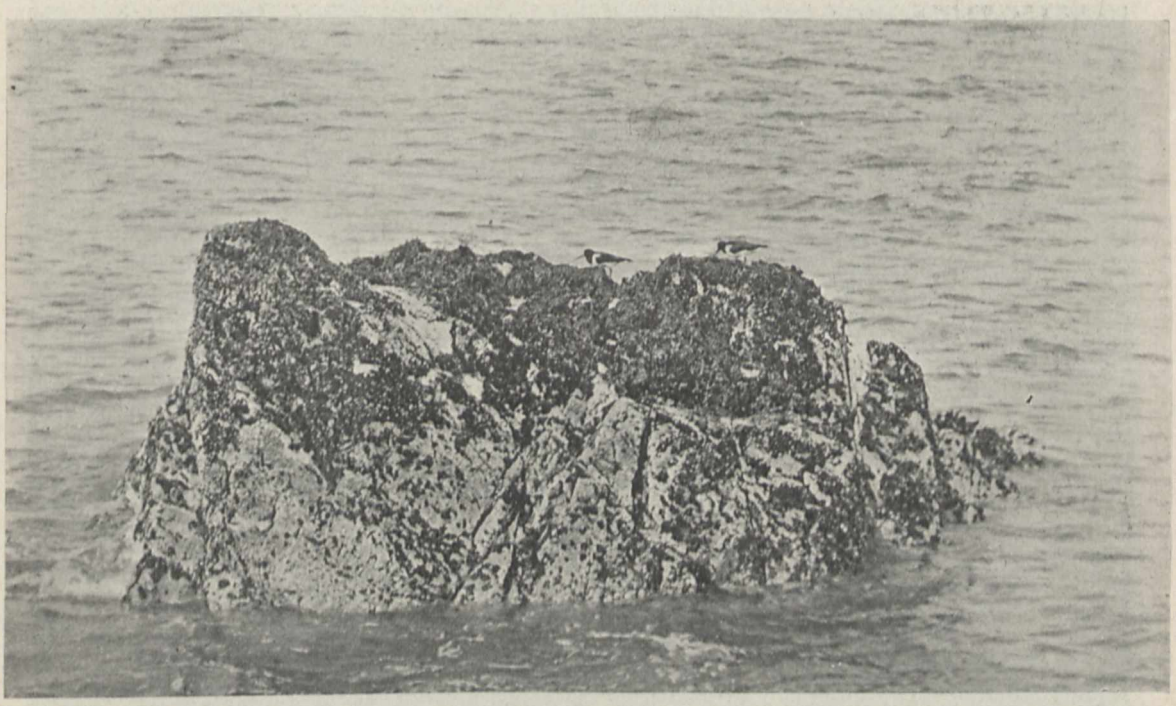


FIG. 1.—Oyster-Catchers. From "Nature-Tones and Undertones."

clude that cases of resemblance between cuckoos' eggs and those of the species in whose nests they are deposited, are due to coincidence rendered possible by a large degree of variation in the former." Although digressions are not announced on the title, the latter is wide enough to cover many things, and many odd bits of out-of-the-way knowledge are woven into this book, which is mainly concerned with birds. A rather bitter attack on game preservers and sportsmen (with a slap at the army dropped in) is sandwiched between some most charming studies of wild life and natural scenery, written in clear and powerful and often quaint and humorous style. When has the barn owl been more aptly described than in this passage? "Never a sound from wing or throat as it flaps or skims in the half-light, watching the ground with its cat's eyes as it goes, until suddenly the silence is startled by a single, rasping yell such as might make the hair stand on the back of every mouse for a quarter of a mile around. The Arch-mouser is on the trail, and such a master of his craft that he appears at times to toot his horn in contempt of his quarry. Or, is this sudden shriek used to start any mouse that may be lurking below, so that when moving it may be more readily discerned?" Mr. Boraston, too, sometimes wants to know why. The eighteen photographs which illustrate this nicely got up volume are almost beyond praise. We have selected this one for reproduction, not because it is by any means the most beautiful, but because of the cleverness with which the whole of this rock, with its seaweed and its oyster-catchers, has been focused; it will appeal strongly to those who love our west coast and its birds. The whole book will be welcomed and treasured up by the great fraternity of British birdmen.

O. V. APLIN.

STUDIES OF CLOUDS.[1]

MR. CLAYDEN'S work will be a standard one for all students of clouds. When the now international classification was first proposed by the late Ralph Abercromby and the present writer, our purpose was to devise a classification for common use at all meteorological stations and in all the navies of the world. It is evident that such a classification must be simple and practicable. A great number of forms must lead to constant errors when used by ordinary observers. Therefore we only proposed the ten types given now in the international cloud atlas.

We were well aware, however, and expressed the view in plain words, that these ten forms are not sufficient for special studies of the transformation of clouds or of the relations between cloud form and weather. For these cases each of the ten great types must be divided into several subspecies, to which proper names must be given.

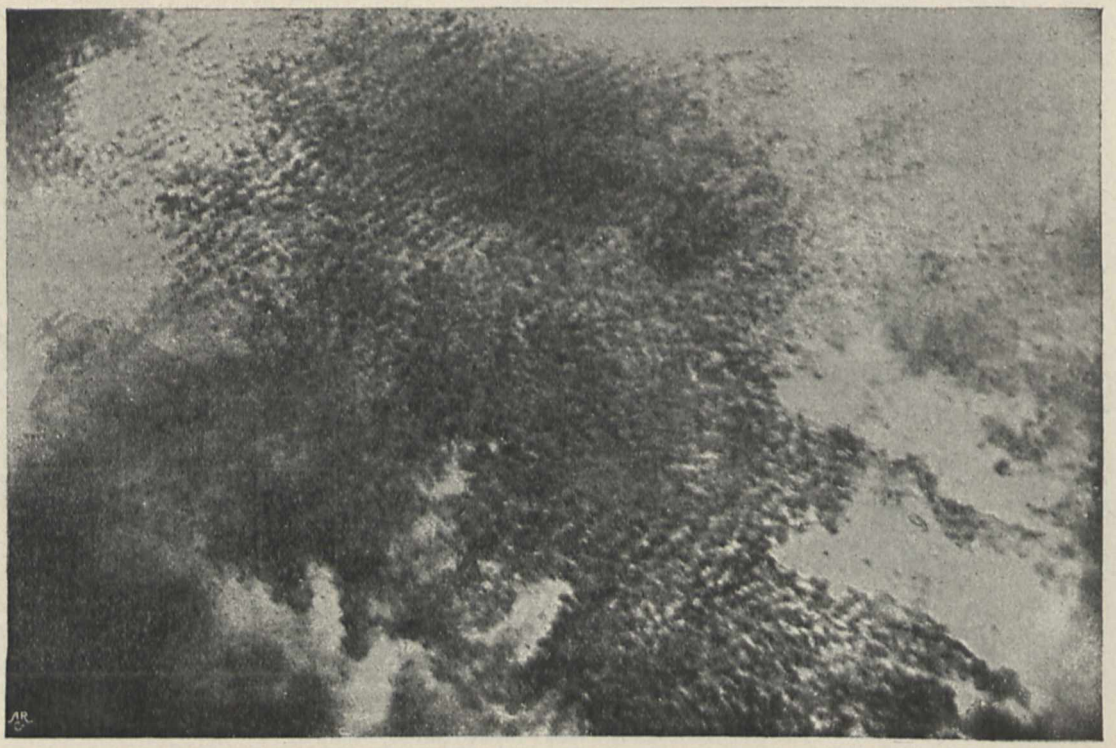


FIG. 1.—Cirro-nebula changing to cirro-cumulus. From "Cloud Studies."

Various attempts have been made to extend the scheme in this way. Abbé Maze in France, Prof. Köppen in Germany, the Rev. F. L. Odenbach in America, and, above all, the Rev. Clement Ley in England, have proposed and defined more detailed classifications; and Mr. Clayden has now in his cloud studies taken a great step forward in this direction.

The descriptions and the illustrations reproduced from photographs are excellent, and everyone who is accustomed to observe the ever-changing panorama of skies will admire the large amount of exact observations given in this book. The book contains reproductions of many typical cloud-forms and certain intermediate forms showing the transformation of one cloud-form into another.

1 "Cloud Studies." By Arthur W. Clayden, M.A. Pp. xiii+184; 61 plates. (London: John Murray, 1905.) Price 12s. net.

It is important to notice that the author accepts the types of the international cloud atlas and arranges his various forms as subforms of these types. There is, however, one exception. Mr. Clayden does not admit the nimbus cloud as a special type, but puts it under the type stratus. He employs nimbus as an adjective indicating that rain is falling from a cloud. We cannot agree with this plan. Every form of cloud can be transformed into another. It is, indeed, well known that the true typical forms are rare, the majority of clouds being intermediate forms. Of course, it often happens that stratus cloud is transformed to nimbus. The farmer in Sweden says, "if the fog is falling the weather will be fine, if the fog is lifting it comes back as rain." It is really the case that in certain weather conditions the fog follows the upward motion of the air; in the rising air the temperature falls, condensation goes on, and the light fog is transformed to a dense nimbus with rain.

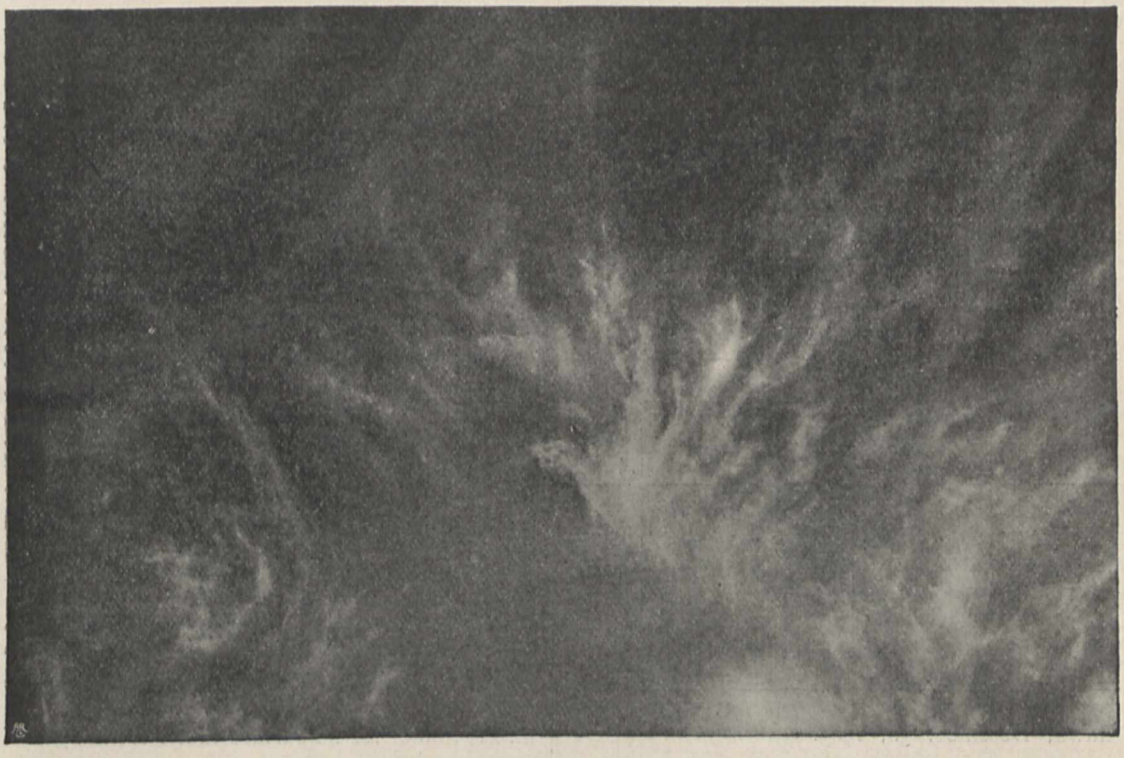


FIG. 2.—High Cirrus (*Cirrus Excelsus.*) From "Cloud Studies."

Nevertheless, there is a vast difference between the fog formed on or near the ground and the true canopy of nimbus cloud rushing forward beneath a layer of alto-stratus in the front of a storm. But here, as always, one form does sometimes pass into another. The alto-stratus does also sometimes sink down and become transformed into nimbus. We know that during summer all low clouds, as a rule, assume more or less the cumulus form. Thus we cannot say that a stratus or an alto-stratus is a nimbus more than that a stratus or a nimbus is a cumulus.

It is not possible to give in this short notice a description of the different forms presented in this book. We must also abstain from an exposition of the author's views regarding the causes which produce the different cloud forms. These views are in most cases highly probable, and in all cases useful hints are given for further investigations. Our purpose now is only to direct the attention of our fellow-students of clouds to a work of the greatest value, which should be studied with the greatest care. No one who desires to study the transformations of clouds or the relation of cloud forms to weather can neglect to consider the valuable results and ideas put forward by Mr. Clayden.

Of course, it is not possible for an international committee or conference to establish a very detailed classification of clouds, but we think it would be very useful if the author would provide the plates and short descriptions as a small atlas for use in observatories and for specialists.

H. HILDEBRAND HILDEBRANDSSON.

TRANSPACIFIC LONGITUDES.

DURING the year 1903 Canada extended the longitude work, carried from Greenwich to Vancouver, across the Pacific to Australia and New Zealand. This was made possible by the completion of the British Pacific Cable—the All Red Line—in the autumn of 1902. The sections of the cable are :—

	Nautical miles
Vancouver to Fanning Island...	3654
Fanning to Suva, Fiji	2181
Suva to Norfolk Island...	1019
Norfolk to Southport, Queensland	906
Southport to Doubtless Bay, New Zealand...	513

The observers (Dr. Otto Klotz and F. W. O. Werry) were provided with practically identical instruments, the principal ones being the two Cooke transits, of 3 inches clear aperture, and of about 36 inches focal length. Cement or brick piers were built at every station. The observers occupied alternate stations across the Pacific, and as the number of stations is odd, Southport and Doubtless Bay are free from the personal equation, without a direct determination of the latter, although the personal equation was determined. Mr. Werry occupied Fanning and Norfolk,

the writer the other stations, including Sydney, Brisbane, and Wellington for personal equation. At Southport connection was made with the observatories at Sydney and Brisbane, and from Doubtless Bay with Wellington.

It was on September 29, 1903, that the first mutual observations and clock exchange were had with Sydney, and so this night may be considered as the one when for the first time longitude from the west clasped hands with longitude from the east, and the first astronomical girdle of the world was completed.

In making the comparison at Sydney between the longitude brought from the east with that from the west, I have used the value of Prof. Albrecht for the arc Greenwich-Potsdam oh. 52m. 16·051s., and for the arcs from Potsdam to Madras, *viâ* Teherân, Bushire, Karachi, Bombay, and Bolaram, those of Major Burrard, giving for the longitude of Madras 5h. 20m. 59·235s.

As there has been no re-determination of the various arcs from Madras to Australia, I have adopted the values given in the Australian report of Ellery, Todd and Russell.

Applying these latter to the longitude of Madras, we get for the longitude of Sydney

	h.	m.	s.		s
	10	04	49	...	0·355±0·088
The Canadian value is	10	04	49	...	0·287±0·058
Difference					0·068

equivalent for the latitude of Sydney to 84 feet. The 1886 value for Sydney is 10h. 04m. 49·54s.

The final values of the Canadian determinations are :—

Final Longitude Values.

Station	Longitude			
	Time	Prob. error	Arc	Prob. error
	h. m. s.	s.	° ′ ″	″
Vancouver . .	8 12 28·368 W.	±0·050	123 07 05·520	±0·75
Fanning . . .	10 37 33·774 W.	±0·054	159 23 26·610	±0·81
Suva	11 53 42·389 E.	±0·055	178 25 35·835	±0·82
Norfolk . . .	11 11 41·146 E.	±0·056	167 55 17·190	±0·84
Southport . . .	10 13 39·782 E.	±0·056	153 24 56·730	±0·84
Sydney	10 04 49·287 E.	±0·058	151 12 19·305	±0·87
Brisbane . . .	10 12 06·044 E.	±0·073	153 01 30·660	±1·09
Doubtless Bay .	11 33 56·146 E.	±0·060	173 29 02·190	±0·90
Wellington . .	11 39 05·087 E.	±0·075	174 46 16·305	±1·12

OTTO KLOTZ.

Ottawa, December 30, 1905.

THE KANGRA EARTHQUAKE OF APRIL 4, 1905.

AFTER a lapse of only eight years since the great earthquake of 1897, India suffered another calamity of the same nature on April 4, 1905, less in violence and extent, but more calamitous in its results, for it claimed a death-roll of 20,000 souls. An interesting preliminary account of this earthquake, by Mr. C. S. Middlemiss, appears in the concluding part of vol. xxxii. of the *Records of the Geological Survey of India*, where the total area over which the shock was felt is estimated at about 1,625,000 square miles, as against 1,750,000 in 1897. The area over which the shock was destructive is smaller in proportion than these figures would suggest, for the isoseist corresponding to 10 degrees of the Rossi-Forel scale includes only 200 square miles, and that corresponding to 8 degrees of the same scale 2150 square miles, as against 300 and 145,000 in 1897. In comparing these figures an allowance must be made for the personal equation, and it seems that, if Mr. Middlemiss's standard had been adopted in 1897, the former of these figures would have been considerably increased and the latter somewhat reduced.

There were two centres of great violence, one near Kangra and Dharmsala, where the tenth degree of the Rossi-Forel scale was surpassed, the other in the Dehra Dun, where the ninth degree was not reached. Between these two the violence was much less, and Mr. Middlemiss points out that the two districts of greatest destruction lie, each, in an embayment of the course of the great boundary fault of the Himalayas; they are the only two irregularities in the generally even sweep of the boundary of the Tertiaries of the sub-Himalayan tract, and as the general effect of the Tertiary, and post-Tertiary, folding and fold-faulting has been to obliterate irregularities in the outline of the mountain-foot, it is natural to suppose that any marked irregularities still left may be in a peculiar state of strain, especially liable to give rise to geotectonic movements. Those which took place on April 4 last seem to have exhausted themselves

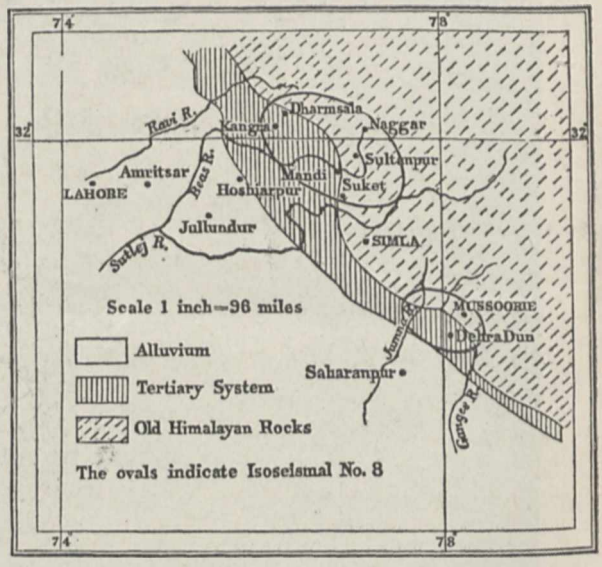


FIG. 1.—Origin of the Kangra earthquake of April 4, 1905.

underground, for no surface faults or changes of level were detected.

The nature of the shock seems to have differed from that of 1897, when all accounts agreed in describing it as simple, with only one marked maximum of violence. In 1904 there were, both in the Kangra and Dehra Dun districts, two or three distinct shocks, and we may mention that this is reflected in the long-distance records of the shocks, which indicate at least two distinct impulses, following each other at an interval of a couple of minutes, whereas in 1897 there was no indication of more than a single impulse. The violence of the shock at its greatest seems to have been a little less than in 1897; at Kangra Mr. Middlemiss's observations give the acceleration of wave particle as about 13 feet per second per second, the amplitude as 9·75 inches, and the period as 1·57 seconds. The time of origin, as deduced from local observations, is said to have been 6h. 9m. 0s. Madras time, within a second or two of error; the rate of propagation was 1·95 to 1·98 miles per second as between the origin and the seismograph stations at Bombay, Calcutta, and Kodaikanal, but it must be

remarked that this rate refers to the large motion on the Milne seismographs, not to the felt shock, the discussion of which is deferred to the larger memoir promised.

Among miscellaneous effects of the earthquake it is mentioned that in some cases the flow of springs was more or less completely checked, while others increased or broke out in new places. In Sind and Burma the shock was not felt, but affected the bubbles of level tubes during survey operations, the movement in the former district indicating a surface tilt of about 30 seconds of arc above and below the horizontal, in a north-east–south-west direction.

HENRY JAMES CHANEY.

ON February 13 Henry James Chaney, who for more than forty years was an authority on our standards of weight and measure, ended his lengthy official career at Hampstead after a painful illness of some months' duration.

He was born at Windsor in March, 1842, was educated privately, and entered the Civil Service at an early age. In 1860 he was appointed to the Exchequer, the department in which at that time the statutory powers with respect to weights and measures were vested. Here he had the good fortune to come into contact with Airy and Miller, who had just completed their researches, undertaken at the instance of the Government, in connection with the restoration of the Imperial standards. Profiting by their advice and encouragement, he devoted himself with much zeal to the technical duties which were imposed upon his department by the Sale of Gas Act, 1859. Under the direction of H. W. Chisholm, the Warden of the Standards, he took an important part in perfecting the official apparatus for verifying gas-measuring instruments. He acted as secretary to the Standards Commission, 1867–71, and had much to do with the preparation of the voluminous appendices to its reports.

On the abolition of the separate office of Warden of the Standards in 1878, Mr. Chaney was placed in charge of the Standards Department of the Board of Trade. As superintendent of weights and measures he was responsible for the model regulations with respect to weights and measures on which the local regulations throughout the country have been based. He was for many years the representative of the United Kingdom on the Comité International des Poids et Mesures, and took an active share in its proceedings. When the metric system of weights and measures was made permissive in this country in 1897, Mr. Chaney compiled the new tables of metric equivalents which were legalised the following year by Order in Council.

Mr. Chaney's scientific writings are for the most part to be found in the periodical publications of the Standards Department, and include, *inter alia*, "Report on the Standards of Measurement for Gas," "Verification of Standards for the Governments of India and Russia" (1877), "Screw Gauges" (1881–3), "Densities and Expansions" (1883), "Expansion of Palladium," "Re-comparison of the Imperial and Metric Units" (1883), "Verification of the New Parliamentary Standards of Length and Weight" (1881–3). His "Re-determination of the Mass of a Cubic Inch of Distilled Water" (Phil. Trans., 1892), which was intended to serve as a basis for calculating the relation between measures of capacity and volume, gave for the cubic contents of the gallon the value 277·463 cubic inches, a much better approximation than the value 277·274 cubic inches, due to Kater, which was accepted up to that date. The researches which have since been undertaken at the Bureau International des Poids et Mesures, and are still in progress, have yielded a provisional result for the mass of a cubic decimetre of distilled water at its maximum density which leads to the value 277·420 cubic inches for the cubic contents of the gallon. This does not differ much from Chaney's result, and is to be considered as the best determination up to date.

His well known work "Our Weights and Measures," which appeared in 1897, contains a mass of metrological information not readily accessible elsewhere. One of his latest contributions to science was the article "Weights and Measures" in the supplement to the ninth edition of the "Encyclopædia Britannica." His last official publication was a report on the "Construction and Verification of a New Copy of the Imperial Standard Yard" (1905).

His great experience in precise measurement caused him to be regarded as a valuable cooperator, and his advice was frequently sought by official committees. The Imperial Service Order was conferred upon him in 1902, and the services rendered by him in connection with the restoration of the Russian standards of weight and measure were recognised by the present Tsar as well as by his grandfather, Alexander II.

Mr. Chaney's name has long been familiar in metrological circles, and his death has removed another link with the past. The memory of his kindly disposition and ready assistance will be treasured by all those who were in any way associated with him.

NOTES.

WE are informed that the council of the Royal Society has selected the following candidates for election as fellows of the society:—Dr. C. W. Andrews, Mr. G. T. Beilby, Mr. F. F. Blackman, Prof. T. J. I'Anson Bromwich, Mr. P. H. Cowell, Mr. W. Heape, Mr. J. H. Jeans, Dr. C. H. Lees, Captain H. G. Lyons, R.E., Prof A. B. Macallum, Mr. J. E. Marsh, Dr. P. Chalmers Mitchell, Mr. J. Swinburne, Prof. H. A. Wilson, Prof. A. E. Wright.

A MEETING was held at the Mansion House on Monday, the Lord Mayor presiding, to consider what steps should be taken to commemorate the discovery by Dr. W. H. Perkin fifty years ago of the first artificial colouring matter obtained from a coal-tar product, and to celebrate the great development of the coal-tar colour industry thus started. A note describing the origin and nature of the movement appeared in these columns on February 15 (p. 370). The proceedings at Monday's meeting were opened by Lord Halsbury, who moved:—"That, in view of this being the fiftieth year of the foundation of the coal-tar colour industry, it is desirable that steps should be taken to memorialise the event and to do honour to Dr. W. H. Perkin, the founder." Sir William Bousfield seconded the motion, which was supported by the Master of the Leathersellers' Company and Prof. H. E. Armstrong, and unanimously carried. Lord Rayleigh moved:—"That an appeal be made in this country and abroad for subscriptions for the purpose of carrying out the following objects:—(1) The presentation to Dr. Perkin for his lifetime of an oil portrait of himself, executed by an eminent artist, the portrait to become the property of the nation at his death. (2) The execution of a marble bust of Dr. Perkin to be placed in the rooms of the Chemical

Society. (3) The establishment of a 'Perkin Research Fund' for the promotion of chemical research to be administered through the Chemical Society." This resolution, which was also adopted, was seconded by Sir William Ramsay, and supported by Sir Henry Roscoe and Mr. David Howard. It is unnecessary here to detail the steps in the growth of the German coal-tar colour industry which is the commercial outcome of Dr. Perkin's discovery—an industrial development by which this country might have been expected to benefit. But, as a correspondent writes in the *Times* of February 24:—"Although in this country there have never been wanting capable chemists able to carry on and extend the manufacture of colouring matters, there has been complete lack of understanding on the commercial side of the complex requirements of the industry and complete lack of sympathy between the capitalist and the scientific worker. The failure must be credited to our universities and to our faulty system of higher education—to our inbred Philistinism. Little, if anything, has been done either in school or university to evoke in the community even an elementary understanding of the principles of science and of their application to commerce and industry. We are now paying the penalty of our neglect." To secure that the nation shall derive full industrial value from scientific discoveries will be possible only when we have developed a system of secondary and higher education in which modern needs and modern methods are recognised; for not until then will there be among us a generation of employers and capitalists able to understand expert opinions and with scientific imagination enough to read the signs of the times.

THE encroachments of the sea on parts of our coasts, and the question of national responsibility for the protection of the seaboard against such erosion, was raised in the House of Commons on Monday in an amendment to the Address. Several members urged that the Government should give financial assistance for the construction of works for coast protection and afford facilities to local authorities for obtaining loans on easy terms for the defence of the sea coast. The President of the Board of Trade stated that the Government has decided to have an inquiry in the form of a Royal Commission, which will extend not merely to coast defence, but to two or three other kindred subjects, such as waste lands and probably afforestation. A Commission will be appointed at an early date to inquire into the matter. Some objections to the expenditure of Imperial funds upon the protection of private property at sea-side resorts and other localities were stated in an article in NATURE of February 15 (p. 309).

SEVERAL years ago a commission was appointed by the Imperial Academy of Sciences of Vienna to collect phonographic records to be preserved for scientific study. Some of the results obtained by expeditions to Kroatia, Slavonia, and Lesbos were described in NATURE of January 29, 1903 (vol. lxvii., p. 301). The Vienna correspondent of the *Pall Mall Gazette* now states that from North Tyrol and Vorarlberg fifty-seven specimens of German dialects have been obtained for the archives, and another forty-seven from Carinthia. From New Guinea have been sent thirty-two phonographs recording the language and music of the natives, with especially interesting war songs and the accompanying drum music. From India have been received valuable records of old Sanskrit songs. An expedition which was sent out to Australia is now on its way back, and another party is about to start for Greenland.

IT is stated that the new director of the Vatican Observatory will be Father J. G. Hagan, S.J., professor of astronomy in Georgetown University, U.S.A., and director of the observatory there.

IN connection with the indication by the London County Council of houses in London which have been the residences of distinguished individuals, a memorial tablet was erected on Monday on No. 110 Gower Street, where Charles Darwin resided from 1839 to 1842.

MR. E. T. WHITTAKER, F.R.S., has been appointed Andrews professor of astronomy in the University of Dublin, in succession to the late Prof. C. J. Joly, F.R.S. The appointment carries with it the office of Royal Astronomer of Ireland.

A REUTER message from Paris states that the committee of the Alliance Française-Britannique received at the Sorbonne on Monday the delegates of the London branch of the Alliance, headed by Sir Archibald Geikie, F.R.S., the chairman. M. Liard, Vice-Rector of Paris University, and M. Levasseur, director of the Collège de France, and honorary president of the Alliance Française, welcomed the British delegates. After Sir Archibald Geikie had delivered an address on geology, the British guests visited the laboratory and the large amphitheatre of the Sorbonne. In the evening they were present at a banquet given in their honour, the Minister of Public Instruction being in the chair.

WE learn from the *British Medical Journal* that the next meeting of the Congress of Experimental Psychology will be held at Würzburg, April 18–21. Among the communications promised are the following:—Dr. F. Krüger, on the relations between experimental phonetics and psychology; Prof. O. Külpe, on the present position of experimental æsthetics; Dr. F. Schumann, on the psychology of reading; Prof. R. Sommer, on psychiatry and the psychology of the individual; Dr. W. Weygandt, on the psychological investigation of congenital feeble-mindedness. Communications relative to the congress should be addressed to Prof. O. Külpe, Würzburg.

ABOUT two years ago steps were taken to erect a fitting memorial to James Watt at his birthplace. This is to take the form of a commemorative public building and statue at Greenock. In the *Engineer* of February 23 disappointment is expressed that an object so obviously worthy, and an appeal so influentially prosecuted, should not have had greater success. Only 700*l.* has been subscribed in Great Britain and 190*l.* in America. Influential canvass, nevertheless, was made by Mr. Carnegie in the United States, while in Great Britain Dr. Robert Caird sent out 10,000 circulars inviting subscriptions. The balance required, 930*l.*, has been contributed by Mr. Carnegie.

ORNITHOLOGY has lost its oldest votary by the death, on February 20, of Prof. Jean Louis Cabanis, for many years in charge of the collection of birds in the Museum of Berlin. Born in 1816, his earliest work of importance seems to have been the ornithology of Tschudi's "Fauna Peruana" in 1845 and 1846. He afterwards did the same service for Sir Richard Schomburgk's "Reisen im Britisch-Guiana"; but the "Ornithologische Notizen" in the *Archiv für Naturgeschichte* for 1847 almost marked a new epoch in the progress of the science, for they were written in conjunction, it may be said, with Johannes Müller, and practically applied the principles of taxonomy laid down by that great anatomist, in his contributions to the Academy of Sciences in Berlin in 1845 and 1846, On certain variations in the vocal organs of the Passeres—

a line of investigation so well worked out subsequently in this country by Garrod and Forbes. In 1853 Cabanis established the *Journal für Ornithologie*, of which he remained editor until succeeded in 1893 by his son-in-law, Prof. Reichenow, and with that journal—the prototype of the *Ibis*, and hence of several others—his name will be ever associated. The "Museum Heineanum" is another work by which he will be remembered; but the above-mentioned "Ornithologische Notizen" must be regarded as by far his greatest performance, and, of course, they excited no attention in this country for many years.

MR. MORTEN P. PORSILD informs us that during the summer of the present year a permanent station for the study of Arctic science will be established on the south coast of Disco Island, in Danish West Greenland. The cost of the foundation is to be defrayed by a gift from Mr. A. Holck, of Copenhagen, and the Danish Government has promised an annual grant of 600*l*. towards its maintenance. A laboratory, equipped with appliances and instruments, especially for biological researches, will be attached to the station, and work-places will be furnished for visiting naturalists, foreign as well as Danish. The establishment of two such places is contemplated at present. The visitors will be allowed free use of instruments, travelling outfit, and library of the station; lodging will be free, and a small fee only will be charged for board. The first visitors will be received in 1907, and notices, inviting application, will be issued in due course. A library of Arctic literature is to be founded at the station, and is to be made as complete as possible. Mr. Porsild, the leader of the station, whose address until May 1 next is Copenhagen, S., Denmark, will be glad to receive presentation copies of works on Arctic and Antarctic subjects, especially on Arctic biology, for addition to the library.

MR. BALFOUR proposed the toast "The School and Union" at the annual dinner of the Students' Union of the London School of Economics and Political Science held on February 24. Answering the question, What is it we mean by economics in its wider sense? Mr. Balfour spoke of the scientific character of the study of economics, and went on to say:—"Science, if it means anything, means a progressive knowledge, and I confess I detest the habit of the unreasoning appeal to authority, especially when, as is often the case, the authority is somewhat antiquated. In science there is, or ought to be, no such thing as authority whatever. A man of science builds, and gratefully builds, on the foundations left by his predecessors; but they are but foundations. It is his business to raise tier after tier the fabric of ever-progressive knowledge." Later Mr. Balfour said he desired to see the school "inspired with that detached and disinterested scientific spirit which is, after all, the true origin of all progress in this world." We note with pleasure this frank recognition of the value of the scientific spirit in all branches of learning and in every department of enterprise by a great politician, and we look forward to the time when every human activity in this country will be governed by the methods of science and imbued with its spirit.

DURING the past few days the following reports of seismic disturbances have appeared in the daily papers:—*February* 21.—Shemakha (Government of Baku), Earthquake was felt at 12.10 a.m. Fort de France, Earthquake shock was felt at 12.13 p.m. St. Lucia, Severe earthquake occurred at 8.30 p.m. Other shocks were afterwards felt at frequent intervals. Mont Pelée, Martinique, is active. At Fort de France many houses have been demolished by earthquakes. La Soufrière, the St. Vincent volcano, is more active than it has been since 1902. Buenaventura, Colombia, Earthquake lasting seven minutes occurred at 10.35 a.m., the movement being from north to south. After the earthquake there was a huge wave, which was of no consequence at Buenaventura; but according to reports from the coast so far as 50 leagues to the south, 2000 persons were killed by falling houses or drowned by the wave, whole families being lost.

ACCORDING to the *Chemiker Zeitung*, the General Electrical Company, of Berlin, in conjunction, it is said, with the firm of W. C. Heraeus, of Hanau, intends to start a company for the production of mercury lamps made out of quartz glass.

ON February 10 Prof. van 't Hoff gave a lecture on thermochemistry before a large gathering of members and guests of the Austrian Engineers' and Architects' Society in Vienna. After a few preliminary remarks on the heat of reaction and combination of chemical substances and their calorimetric measurements, Prof. van 't Hoff dwelt upon the heat of alcoholic fermentations, of thermite decomposition and of various illuminants, pointing out the great amount of heat developed in the decomposition of acetylene and the pressure developed in explosions, and finally discussed the relations between heat development and chemical affinity, referring at length to Berthelot's principle, which would find a measure of chemical affinity in the heat developed, but which Prof. van 't Hoff declared untenable. The lecturer concluded with the remark that this subject of thermochemistry was one in which a more general application of modern chemistry was most desirable; he was, however, of the opinion that it was the duty of the man of science to seek out new ways and to find out new laws, but that here his duties ceased, whilst the practical technical man must himself sort out that which was necessary and usable. After the lecture the leading chemists and physicists of Vienna entertained Prof. van 't Hoff to a dinner given in his honour.

AS was mentioned in NATURE of February 1 (p. 322), the sixth International Congress of Applied Chemistry will be held this year in Rome from April 25 to May 3. It may be remembered that the first congress was held in Brussels in 1894, the second in Paris in 1896, the third in Vienna in 1898, the fourth in Paris in 1900, and the fifth in Berlin in 1903; a desire has been expressed that the seventh meeting should be held in England. All communications and applications for membership of the sixth congress should be addressed to the Ufficio del Congresso, Via Panisperna, 89, Rome. The subscription fee of 20 lire is to be forwarded by P.O.O., made payable to Prof. Giovanni Giorgis, the treasurer of the congress. Upon application a pamphlet will be forwarded containing all information requisite for applicants, together with the regulations of the congress, a list of Italian and foreign committees, a list of the sections, and the titles of papers and communications that have been announced up to the present. The English committee contains some thirty-three names of representatives of fifteen leading scientific societies connected with chemistry, including the Royal Society, the Chemical Society, Society of Chemical Industry, Society of Public Analysts, the Iron and Steel Institute, the Faraday Society, the Institute of Chemistry, &c. In addition to the sectional meetings, which are to take place on April 27, 28, and 29, and on May 1 and 2, lectures of a general nature will be arranged (such lectures by Profs. H. Moissan, Sir W. Ramsay, and O. N. Witt

are announced), a social gathering of the members will take place on the evening of April 25, an excursion in the neighbourhood of Rome will be made on Sunday, April 29, and two alternative excursions, the one to Sicily and the other to the Island of Elba, to places of chemical interest on May 3; as the number of participators in the latter is limited, preference will be granted to those who are first to send in their names, and more especially to foreign members. Members may further obtain a reduction of 40 per cent. to 60 per cent. on the Italian State Railways, and 60 per cent. on tickets issued by the navigation companies Navigazione Generale Italiana and La Veloce. The papers to be contributed will be grouped in eleven sections, and may be in one of the four official languages of the congress, namely, Italian, French, German, and English. The discussions after the reading of the papers may also be carried on in one of these languages.

Museum News for February records the addition to the Brooklyn Museum, New York, of a skeleton of the sperm-whale, measuring 47 feet in length, which has been suspended to the roof of the building.

In the *American Journal of Science* (February) Mr. C. C. Trowbridge re-opens the disputed question of the interlocking of the emarginate primary flight-feathers in raptorial birls, adducing apparently conclusive evidence that this takes place in certain American hawks, with a resulting increase of wing-power.

The contents of vol. lxxx., part iv., of the *Zeitschrift für wissenschaftliche Zoologie*, comprise a paper by Dr. E. Strand, of Christiania, on the structure and development of spiders; a second, by Mr. J. Wilhelmi, on the excretory organs of the fresh-water turbellarian flatworms of the section Tricladida; and a third, by Dr. C. Hennings, of Rostock, on the "tömövarysche" organ in myriapods. The latter is the continuation of a paper the first part of which appeared in the same journal in 1904. A systematic classification of the myriopods is given.

In the report of the Maidstone Museum, Library, and Art-Gallery for 1905 is published a photographic reproduction of an original drawing by the late Mr. W. H. Bensted of the well known slab (now in the Natural History Museum) containing a large portion of the skeleton of a young iguanodon, obtained by him from the ragstone quarry in Queen's road, Maidstone, in 1834. The drawing is, of course, mainly of historical interest. An offer of the loan, for an indefinite period, of an exceedingly valuable, and in this country almost unique, collection of Japanese pottery, made by the Hon. H. Marsham, has been accepted by the museum authorities.

The January issue of the *Emu* contains an excellent portrait of the late Captain F. W. Hutton. From the report of the proceedings of the fifth session of the Australasian Ornithologists' Union, held at Adelaide, which appears in this number, we learn that the acting president devoted his address to the subject of European and other birds introduced into Victoria. The two species that have thoroughly established themselves are the starling and the sparrow. No one appears to have a good word for the latter, but as regards the former it is stated that the residents in Riverina are longing for its arrival in numbers to help them to cope effectually against the armies of locusts and caterpillars that frequently infest those districts. Thrushes, blackbirds, and greenfinches have established themselves to a small extent in and around the districts where they were first liberated, but chaffinches, yellow-hammers, and siskins have practically failed to accommodate themselves to their new surroundings.

In discussing the early stages of the Palæozoic rugose corals, as a clue to the origin and relationships of the group, Mr. C. E. Gordon, in the February number of the *American Journal of Science*, finds himself unable to accept Mr. Duerden's views as to the close connection between the ancient tetrameral and the modern hexameral types of corals. On the contrary, he is of opinion that we are not yet in a position to define their relationships or to state which is the earlier of the two. In a second paper in the same journal Mr. C. R. Eastman discusses the affinities to the lung-fishes presented by the group of armoured Palæozoic fishes typified by Coccosteus, and commonly known as the Arthrodira. From the study of the North American genera Dinichthys, Dinomylostoma, &c., the author comes to the conclusion that the alleged relationship is well founded, thus confirming the views of Dr. A. Smith Woodward. The author goes, however, somewhat further, and urges that while the living Australian *Ceratodus* (*Neoceratodus*) *fosteri* bears an intimate relation to Arthrodira on the one hand, and to the Palæozoic Dipterus and its allies on the other, yet that it is a more primitive type than any of these. It represents, in fact, the direct line of descent from primitive Palæozoic Ceratodonts, from which Dipterus and its allies diverged in one direction and the Arthrodira in the other. Hence the Dipnoi cannot be descended from the crossopterygian ganoids, but are more probably derived from Pleuracanthus-like sharks. Further, the association of the Arthrodira with the Ostracophora (Pterichthys) in one group, Placodermata, becomes obviously impossible. Mr. R. S. Lull points out that the name Ceratops proposed by Marsh for the Laramie horned dinosaur is preoccupied, and he accordingly suggests the new name Proceratops, with Agathaumidæ as the family title.

The *Pioneer Mail* remarks that the immunity of Europeans continues to be one of the most noticeable features of the plague epidemic. Last year, in the Bombay Presidency, where the disease carried off more than a quarter of a million people, only nineteen Europeans in all were attacked, of whom ten died. In the previous year, in the same region, where 316,000 deaths took place, only eight were amongst Europeans.

Mr. A. Elenkin, writing in the *Bulletin du Jardin impérial botanique*, St. Petersburg (vol. v., part v.), on the marine algæ found near the biological station at Mourmane, discusses the different forms of Lithothamnin, and describes a new species characterised by the development of bicellular spores.

In recording his impressions of the botanical congress at Vienna in the *Bulletin de l'Académie de Géographie botanique*, Mr. L. Navas, who represented the Société Aragonaise des Sciences naturelles, presents his arguments in favour of giving the authority for the genus and not the authority for the binomial name of a plant.

A periodical bulletin—*Le Bambou*—devoted to the study of the bamboo, its cultivation and uses, has been started by Mr. J. H. de Lehaie, Mons, Belgium. The first number, published January 15, contains an article on the flowering and seeding of bamboos in Europe. From a study of the collated data, the writer concludes that in the section Arundinaria the majority of species flower gregariously, produce seed and die, but in the case of Phyllostachys the production of seed does not appear to be the harbinger of death.

IN addition to the descriptions of a number of Indian forest fungi that Dr. E. J. Butler has been contributing to the *Indian Forester* (October to December, 1905), some of his remarks possess a more general interest. In connection with the genus Chrysomyxa, a heteroecious species in Europe produces teleutospores on rhododendrons and æcidia on the spruce. In India, both æcidial and teleuto stages of a Chrysomyxa have been found on *Rhododendron campanulatum*, thus giving grounds for an assumption that Chrysomyxa was originally confined to a single host. Dr. Leather also makes some definite statements on the subject of wheat rust, *Puccinia graminis*, and the æcidial stage that occurs on the barberry. In India, the stages on the wheat do not seem to depend upon the presence of barberry bushes, as the most destructive areas of rust were hundreds of miles distant, and, further, at the only part of the Himalayan range where *Aecidium berberidis* is known to occur black rust is extremely rare on cereals.

IT has always been recognised that there is an uncertainty as to the plant that yields the Manila Elemi of commerce. Trimen and Bently, in "Medicinal Plants," referred it to a species of Canarium allied to *Canarium commune*, and later writers have generally referred it to that species. Mr. E. D. Merrill, the botanist in the Philippine Islands, with specimens before him of fruit, flowers, and the pitch locally known as "brea," assigns it to *Canarium luzonicum* in Publication No. 29 of the Bureau of Government Laboratories. Other species of Canarium yield brea, but, according to the writer, do not furnish the article of commerce. The same publication contains the third list of new or noteworthy plants that Mr. Merrill has identified. It includes a number of new species of Medinilla and Rhododendron; of the fourteen species of Rhododendron, thirteen are believed to be endemic.

IN a note contributed to the *Atti dei Lincei*, xiv. (2), 12, Dr. G. Noè discusses the functions of the remarkable organs of sense first discovered by Hicks in 1857 on the wings of many species of Diptera.

IN the *Memorie* of the Italian Spectroscopists' Society, xxxiv., 6, Messrs. A. Mascari and A. Cavasino discuss the effect of atmospheric disturbances on the outline of the sun's disc, with special reference to the direction of the wind and other meteorological conditions.

MEMBERS of the recent British Association party will remember enjoying English salmon for dinner one day on the voyage home from Beira. This reminiscence is suggested by a note in the *Revue générale des Sciences* from which we learn that an undertaking has successfully been carried out for obtaining in Paris fish from the French fisheries on the west coast of Africa, transported under cold storage.

IN connection with Prof. Sydney Hickson's article on "Miners' Worm" (February 8, p. 344), attention may be directed to a paper by Gino Peri in the *Atti dei Lincei*, xiv. (2), 12, dealing mainly with the question as to how far *Ankylostoma duodenale* is parasitic on animals other than man. The author has succeeded in infecting dogs through the mouth and by penetration of the skin, and there are good reasons for believing that horses are also liable to infection.

M. GEORGES CLAUDE describes in the *Journal de Physique* a series of apparatus for the separation of oxygen and nitrogen by the liquefaction of air. In these the necessary degree of cold is obtained by expansion accompanied by performance of external work, and the process of separation depends on the small difference between the boiling points of oxygen and nitrogen. The whole apparatus is of a compact form, and of two examples in actual working at Boulogne-sur-Seine, one is capable of generating 700 and the other 1000 cubic metres of 96 to 98 per cent. oxygen per diem.

THE *U.S. Monthly Weather Review* for September last contains a graphic account of a tornado of marked severity which visited Carbondale, Pennsylvania, on August 30, 1905. Mr. W. M. Dudley, meteorologist in charge at Scranton, about sixteen miles distant, issued a circular of inquiry, and obtained special reports from neighbouring districts. From these it appears that a funnel-shaped cloud, from which vivid lightning played, moved across the northern portion of Carbondale in a south-west to north-east direction, covering a track two miles in length and from 25 to 200 yards in width. About thirty houses and other buildings were blown down, and some of the roofs were carried to a distance of 600 feet. The trees which were blown down fell to the eastward. The area affected was, as usual, very small, the storm being chiefly confined to the Carbondale district. At Scranton there was

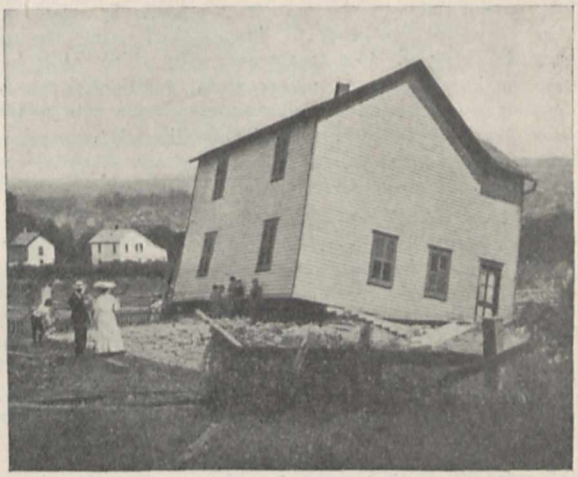


FIG. 1.—A building which was moved in line with the direction of motion of a tornado on August 30, 1905.

vivid lightning, but no other special characteristics were observed; the barometer was low, reading 29·64 inches, but remained steady; there was no noticeable increase in the wind velocity, and very little rain fell. The passage of the cloud, which appeared to revolve in a backward direction, was accompanied by a heavy rumbling noise. The illustration, from one of the photographs taken, shows the effect of the storm on the buildings; the tornado occurred about 8h. 30m. p.m., but its duration is not stated.

M. CH. ED. GUILLAUME contributes to the *Revue générale des Sciences* for January 15 an interesting account of the career of Colonel Charles Renard, whose death took place in April of last year. From a popular point of view, Colonel Renard sprang into fame in 1884–5 in connection with the successful trips made by the navigable balloon *La France*; but his scientific work covers a wider range than this series of experiments, his inventions dating from 1875, when he devised a new air-valve for balloons, up to within a short time of his death. Among other innovations we notice the introduction of the coefficient of

"laminage" in connection with problems of thermal conductivity between gases and solids; also improvements in the construction of boilers and surface condensers based on the same study, having for their object the construction of light motors for aërial navigation. Then, again, we find Renard turning his attention to portable hydrogen generators for military ballooning and pneumatic elevators for grain and other materials. Last, but not least, we have the motor train, exhibited in December, 1903, all the carriages of which were self-propelled by power transmitted from the motor through a series of jointed shafts. This train was successfully conducted round sharp corners through the streets of Paris.

THE February number of *Symons's Meteorological Magazine* commences the forty-first volume of this useful periodical. It began as a two-page "Rain-circular," intended to keep rainfall observers in touch with each other's work; in 1866 it became an eight-page magazine, and has now gradually increased to twenty pages, and has attained, under the editorship of Dr. H. R. Mill, to the position of one of the most important monthly meteorological reviews published. Dr. Mill points out that the readers of the magazine frequently tender advice; although this cannot always be adopted individually, he has endeavoured to give effect to the principal desiderata put forward during the last few years. The chief result has been the introduction of a very useful additional table of fifty-four rainfall stations, giving the position and height above sea, and the statistics of rainfall and temperature for each month; it shows the value and date of the maximum and minimum temperature, and the number of nights at or below 32°, both in the shade and on the grass; the thirty years' average and the actual rainfall for the month, the greatest fall in twenty-four hours, and the number of rainy days, together with the mean annual fall. Following numbers will show, somewhat like the Weekly Weather Report of the Meteorological Office, the total rainfall from January 1 to the end of the month dealt with. This new table involves a considerable amount of additional labour, but greatly enhances the value of the publication.

A VERY interesting article on the uranium deposits of St. Joachimsthal is contributed by Dr. Paul Gaubert to No. 1 of vol. iii. of *Le Radium*. The article is illustrated by geological maps of the district and of the mines, and by two photographs of the town. The same number of *Le Radium* contains also a *résumé*, by Prof. G. Sagnac, of the experimental methods used in the study of the transformation of Röntgen rays.

THE report of the International Committee on Atomic Weights for 1905 is published in the Proceedings of the Chemical Society (vol. xxii., No. 303). During the past year there was unusual activity in the determination of atomic weights, and some of the work done relates to the most fundamental values. The entire system of atomic weights is thus affected more or less profoundly, and a general revision would seem to be needed in the near future. In particular, the recent re-determinations of the atomic weights of chlorine, sodium, and nitrogen appear to show that the values obtained by Stas for these elements are now no longer tenable. Guye's work in connection with nitrogen has already been noticed in NATURE (vol. lxxiii., p. 37). The other elements of which the atomic weights have been re-determined are cadmium, carbon, gadolinium, iodine, potassium, silicon, strontium, tellurium, and thorium.

SOME interesting results have been obtained by Mr. Percival Lewis in studying the degree of ionisation in the gases resulting from coloured flames (*Physical Review*, vol. xxi., No. 6). The specific ionic velocity was measured in the case of a Bunsen flame into which solutions of known concentrations of various salts of the alkalis and alkaline earths were sprayed. The ionic velocity apparently varies in the case of each salt inversely as the square root of its concentration in the flame; the specific ionic velocity has, moreover, the same magnitude for ions of the same sign from equimolecular solutions of all the salts of all the alkali metals. The velocity of the negative ions is always somewhat greater than that of the positive ions. The measurements given show also that the rate of re-combination of the ions from the colourless Bunsen flame is much greater than that observed in the case of the coloured flames.

PROF. HENRI MOISSAN in a recent paper gave an account of his experiments on the fusion and distillation of metals of the platinum group. In the current number of the *Comptes rendus* (February 19) he describes similar experiments on the metals of the iron group, the metals examined including nickel, iron, manganese, chromium, molybdenum, tungsten, and uranium. All these were distilled in the electric furnace, but the boiling points varied considerably. The most volatile proved to be manganese, which distils readily before the line of the furnace is volatilised. Nickel is fairly easy to distil, then chromium, which distils with regularity under the action of a current of 500 amperes at 110 volts. Iron offers difficulties, on account of the dissolved gas causing foaming at the commencement of distillation, but with a current of 1000 amperes at 110 volts 400 grams of iron distilled in twenty minutes. The boiling point of uranium is higher than that of iron. The greatest difficulty was experienced with molybdenum and tungsten; the latter metal, with a current of 500 amperes at 110 volts, showed no signs of fusion in five minutes; even when the current was raised to 800 amperes only 25 grams could be distilled in twenty minutes.

DR. G. H. FOWLER desires it to be known that the Marseilles Exhibition of Oceanography and Sea Fisheries has not been "postponed," as stated in a circular issued by the British Commission of the Milan Exhibition. No postponement of the Marseilles Exhibition has been contemplated, though H.M. Treasury has refused financial support.

MESSRS. SAMPSON LOW, LTD., have just published the eighth edition of Mr. W. T. Lynn's "Remarkable Eclipses" and the thirteenth edition of his "Remarkable Comets." Each book, though it contains only about fifty pages, gives an interesting and accurate statement of the main facts of the subject with which it deals.

THE Country Press, Ball Street, Kensington, W., has issued a series of seven pictorial post-cards on which are shown in an effective manner forty-two species of British ferns. The idea is a good one, and should serve to direct the attention of young people to the beauties of this branch of plant life. Other natural objects are to be dealt with in a similar manner in future series of post-cards.

WE have received a copy of the thirty-seventh annual report of the Wellington College Natural Science Society, that, namely, for 1905. It is quite clear that the society's activity has in no way diminished. The open Saturday meetings provide the boys of the school with excellent fortnightly lectures, the subjects of which are by no means

exclusively scientific. The meteorological record is as exhaustive as ever, and some reproduced photographs included in the report show that the photographic section is doing good work.

THE Cambridge University Press has published a third edition of "Hydrodynamics," by Prof. Horace Lamb, F.R.S. The second edition of this standard work was reviewed at length in NATURE of November 21, 1895 (vol. liii., p. 49). In the present issue no further change has been made in the general plan and arrangement of the first edition, but the work has been carefully revised, occasional passages have been re-written, and many interpolations and additions have been made, amounting in all to about one-fifth of the whole.

MR. S. HIRZEL, Leipzig, has commenced the publication of a new and elaborate work entitled "Handbuch der anorganischen Chemie," edited by Dr. R. Abegg, assisted by many leading workers in chemistry—particularly physical chemistry—in Germany and elsewhere. The second part of vol. ii. has recently been issued, the title being "Die Elemente der zweiten Gruppe des periodischen Systems." The first part of this volume has not yet appeared, but the first part of the third volume will be published in the spring of this year. We propose to notice the work when the volumes have been completed.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MARCH :—

March 1. 6h. 14m. to 7h. 9m. Moon occults ζ Tauri (mag. 4·3).
,, 2. 6h. 41m. to 7h. 45m. Moon occults γ Tauri (mag. 3·9).
,, ,, 8h. 5m. Minimum of Algol (β Persei).
,, ,, 11h. 51m. to 12h. 40m. Moon occults θ^1 Tauri (mag. 3·9).
,, ,, 12h. 3m. to 12h. 31m. Moon occults θ^2 Tauri mag. 3·6).
,, 11. 16h. 11m. to 16h. 59m. Moon occults γ Virginis (mag. 3·0).
,, 12. 6h. 21m. to 8h. 31m. Transit of Jupiter's Satellite III. (Ganymede).
,, 14. 17h. 22m. to 18h. 23m. Moon occults γ Libræ (mag. 4·1).
,, 15. Venus. Illuminated portion of disc = 0·993; of Mars = 0·962.
,, 18. 5h. Mercury at greatest elongation (18° 31′ E.).
,, ,, 10h. 34m. Transit (ingress) of Jupiter's Satellite III. (Ganymede).
,, 19. 12h. 58m. Minimum of Algol (β Persei).
,, 21. 1h. Sun enters Aries. Spring commences.
,, 22. 9h. 47m. Minimum of Algol (β Persei).
,, 29. 10h. Jupiter in conjunction with Moon (Jupiter 4° 32′ N.).
,, ,, 20h. 56m. to 21h. 35m. Moon occults α Tauri (Aldebaran, mag. 1·1).

COMET 1906*a* (BROOKS).—A further extract from Herr M. Ebell's ephemeris for comet 1906*a*, as published in No. 4075 of the *Astronomische Nachrichten*, is given below :—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) ° ′	log *r*	log Δ	Brightness
Mar. 6 ...	5 46 7 ...	+60 47 ...	0·2329 ...	0·0909 ...	0·48
8 ...	5 44 18 ...	+58 26 ...	0·2376 ...	0·1072 ...	0·43
10 ...	5 43 6 ...	+56 15 ...	0·2423 ...	0·1236 ...	0·39
12 ...	5 42 22 ...	+54 13 ...	0·2470 ...	0·1398 ...	0·36
14 ...	5 42 2 ...	+52 20 ...	0·2517 ...	0·1559 ...	0·33
16 ...	5 41 58 ...	+50 35 ...	0·2564 ...	0·1718 ...	0·30

This comet is now travelling nearly due south towards the constellation Auriga, and will apparently pass between Capella and β Aurigæ, nearer to the latter, on about March 21.

COMET 1905*c* (GIACOBINI).—Comet 1905*c* has now become so faint as to be beyond the reach of the naked-eye observer. On March 3 it will be only a little brighter than at the time of discovery, and will set just before 9 p.m., or about three hours after sunset, slightly to the south of west.

An extract from Herr A. Wedemeyer's daily ephemeris, as published in No. 4074 of the *Astronomische Nachrichten*, is given below :—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) ° ′	log *r*	log Δ	Brightness
Mar. 2 ...	1 53 41 ...	−5 10 ...	0·0384 ...	0·1855 ...	1·20
4 ...	2 2 13 ...	−4 0 ...	0·0546 ...	0·1983 ...	1·05
6 ...	2 10 16 ...	−2 54 ...	0·0700 ...	0·2109 ...	0·92
8 ...	2 17 55 ...	−1 51 ...	0·0846 ...	0·2234 ...	0·81
10 ...	2 25 11 ...	−0 52 ...	0·0986 ...	0·2358 ...	0·72
12 ...	2 32 6 ...	+0 4 ...	0·1120 ...	0·2480 ...	0·64
14 ...	2 38 42 ...	+0 58 ...	0·1248 ...	0·2600 ...	0·57

From this it will be seen that the comet is now apparently traversing the constellation Cetus, and will be about 1° due north of the wonderful variable Mira on the evening of March 7.

A number of full notes of the observation of this comet at the Arcetri Observatory, between December 11 and 31, 1905, are given by Signor A. Abetti in No. 4073 of the *Astronomische Nachrichten*.

LIFE OF PIETRO TACCHINI.—We have received an interesting short biography of Prof. Tacchini, written in Italian by Signor L. Palazzo, who evidently knew the great Italian astronomer intimately, and appreciated his works. The brochure contains nine pages of text and a fine reproduction of Tacchini's portrait; it is published by the Typographical Society of Modena.

SUN-SPOT SPECTRA.—A valuable paper on the spectra of sun-spots is published in No. 1, vol. xxiii., of the *Astrophysical Journal* by Profs. Hale and Adams. The "widened lines" given in the table accompanying the paper number 345, and were measured on ten photographs —including three separate spots—taken with a grating spectrograph in connection with the Snow telescope of the Mount Wilson Solar Observatory.

The region measured was from λ 5000 to λ 5853, and, in a second table, the wave-lengths of a number of "bands" shown in the spot spectrum are also given.

The discussion of the results is extremely interesting, but is too lengthy to be even summarised here. It may be remarked, however, that the lines of titanium showed the greatest mean change of intensity, and that all the silicon lines in the region considered were much weakened.

Reproductions of some of the photographs obtained accompany the paper, and show the widened lines very clearly.

"THE HEAVENS AT A GLANCE."—This well known card calendar reaches its tenth year of issue with the present (1906) copy, which contains the usual data and notes. As in former years, we can only remark that it will be found to be a very handy and useful source of reference to everyone engaged in observational astronomy.

The calendar may be obtained from its author, Mr. A. Mee, Tremynfa, Llanishen (near Cardiff), for sevenpence, post free.

THE LANDSLIDE IN THE RHYMNEY VALLEY.

THE principal source of the Rhymney River is a copious spring in which the rain-water that has disappeared into numerous swallow-holes, and flowed for some distance underground in the Mountain Limestone, again rises to the surface near the edge of the Millstone Grit. From this point the incipient river flows in the direct line of dip of the strata, that is, in a south-south-easterly direction, across the outcrops of the Millstone Grit, the Lower Shale series, and the Pennant Sandstone series of the South Wales Coalfield. The length of its course on the Millstone Grit is nearly two miles, and on the Lower Shale series five miles.

The Brithidir—in some parts called the Tillery—seam of coal constitutes the dividing plane between the Pennant Sandstone and the Lower Shale series.

In a section taken at right angles across the valley at the point where the landslide—the subject of the present notes—is taking place, that is, about one and a half miles higher up the stream than the point at which the Brithidir seam dips under it, the bottom of the valley is 750 feet wide and 700 feet above sea-level; the outcrops of the Brithidir seam are 3000 feet apart and 1000 feet above sea-level, and the summits of the Pennant Sandstone are about one and a half miles apart and 1300 feet above sea-level. The average inclination from the outcrop of the seam to the bottom of the valley on each side is thus approximately 1 in 4.

Above the outcrops of the seam the ragged edges of the sandstone escarpments are seen projecting above the accumulations of débris which hide their bases; below the outcrops a superficial, grass-grown deposit, partly perhaps of Glacial origin, consisting of earth, clay, sand, and stones, probably not more than from 10 feet to 20 feet thick at any point, and possibly thinner in many places, lies upon and entirely conceals the shales. Part of this deposit, having a width of between 2000 feet and 3000 feet measured along the line of the valley, is known to have been slowly moving down the western slope ever since the Rhymney Railway was constructed across it, near the bottom of the valley, some fifty years ago. The excessive slowness of its general motion is shown by the following facts:—first, the railway, together with a stone bridge over it, has only been carried to a distance of from 6 feet to 10 feet eastwards from its original position during the whole of that long period of time; secondly, the arch of the bridge, which, although damaged and partially distorted, was prevented from being entirely broken up by placing heavy balks of timber between its side-walls under the level of the rails, was only removed, and replaced by a girder bridge, three years ago; lastly, the river, which flows at the foot of a steep bank, not far from the railway bridge, has retained its old channel, and has been able to carry away the débris from the foot of the moving bank sufficiently fast to prevent the latter from invading its bed.

Although the general movement of the ground is so slow and uniform that the roads and fences, and the vegetation which grows upon the surface, give no clue as to what is taking place over the greater part of the affected area, there are local indications here and there which show that a number of smaller and comparatively rapidly moving landslides have occurred within the larger area from time to time. One of these smaller landslides recently damaged the village of Troedyrhiwfuwch, situate near the upper end of the moving slope. This village consists of a public house, a school-room, and two rows of twenty or thirty houses, built upon the opposite sides of a road which runs parallel to the valley at a height of about 200 feet above the river. The pine-ends of many of the houses, in the row nearest the centre of the valley, appear to have lately undergone substantial repairs, and the public house has been entirely re-built, with its foundations, it is said, now resting on the solid rock. The gardens of the houses nearest the northern end of the row now under consideration, together with the division walls between them and the outhouses contained in them, have been ruined beyond repair, and part of the ground on which the gardens were formed has been broken and piled up behind the houses like the front of a wave advancing down the slope, and appears to be still moving.

In this part of the coalfield, as well as over practically the whole of Monmouthshire and part of East Glamorganshire, the strata immediately underlying the Pennant Sandstones consist of a succession of red and blue shales and marls of greater or less thickness. In the New Tredegar pits, which are not far from this locality, the red and blue ground has a thickness of more than 300 feet. This is, therefore, the kind of ground upon which the landslide is taking place. But as most strata of this kind disintegrate and soften when exposed to air and moisture, it is not improbable that this property of theirs accounts, to some extent at least, for the gradual movement of the deposits lying upon them on the west side of the valley, and that it may be likewise responsible for the more sudden landslide that took place a year or two ago on the opposite side of the valley, which seriously damaged both the Brecon and Merthyr Railway and one of the Powell Duffryn collieries which lay in its path.

My thanks for information concerning the Rhymney Railway and the bridge over it are due to Mr. Cornelius Lundie, formerly general manager, and now consulting director, to the railway company, who has known, and has had occasion to observe, the movements taking place in this locality for the last forty-five years, and is therefore thoroughly conversant with the subject.

W. GALLOWAY.

THE LAW RELATING TO UNDERGROUND WATERS.

IN one of the State papers recently issued by the department of the United States Geological Survey there is a report by Mr. D. W. Johnson dealing with the rights of landowners and others to underground waters, for the purpose of giving the owners of such waters some idea of their rights and obligations.[1]

The report is not intended to be a legal treatise, but as a practical guide for the officers of the hydrological department, showing the relation of the law to problems which are of a more or less hydro-geological character.

The law relating to underground waters in the United States is practically the same as in this country, and the decisions given in the courts there are founded on British precedents modified in some cases by the different circumstances of the two countries.

Underground water is held to comprise all water which for the time being is below the surface of the ground, whether by penetration of the rainfall or soakage from rivers and lakes, and which is dissipated throughout the mass of porous soil or rock, except in cases where the underground water can be traced as moving in a well ascertained and definite course that can be located.

The fundamental principle upon which the laws regulating the use of underground water is formed is this:—That such percolating subterranean waters are a part of the land itself. The land belongs to the owner, whether it be rock, porous ground, earthy matter, or part soil and part water, the water being as much his property as rock, ores, or minerals. Consequently, he may take and use such waters as he pleases, even though such use may damage his neighbour by removing or diminishing water from adjacent wells or springs, by causing subsidence to land or buildings by abstraction of the water, or by rendering the water useless by pollution from sewage or refuse from factories or mines, &c.

This principle has been admitted in the decisions given by the courts owing to the difficulty of proving how much of such water was within the limits of any given area, how much comes from adjacent land, or how much passes from one man's land to that of his neighbour, and the impossibility of predicting what result may ensue from interference with what has been regarded as an unknown quantity. There are, of course, local circumstances or conditions which modify this general statement, but, broadly, this is how the law stands at present.

In the United States, however, conditions have for some time past been undergoing an alteration, and the investigations and observations undertaken by the hydrological department of the Government have been throwing considerable light on the action of underground waters. In many cases the original lack of knowledge which was the reason for the ruling of the law as it now stands has already disappeared.

We recently gave a short illustrated description of the methods adopted by surveyors of the department for measuring and defining the rate and direction of the flow, and more particularly for showing the effect of percolation of deleterious matter from factories, oil wells, &c., on the underground supply of drinking water (NATURE, December 21, 1905).

1 "Relation of the Law to Underground Waters." By D. W. Johnson. Water Supply and Irrigation Papers, No. 122. (Washington: Government Publishing Office, 1905.)

The state of knowledge regarding the properties of underground water may be said now to have become in advance of the ruling of the courts on some of the questions involved. The earlier legal decisions were made when little or nothing was known regarding the action of the water beneath the surface. Since then the progress of hydro-geological science has established as facts many things regarding underground waters previously unknown or only speculative, and the knowledge of the working of underground waters remains much less in the realms of the "secret, occult, and concealed." It has now become possible to define certain rights in these waters and to protect these rights equally as well as those in surface waters.

A case recently dealt with in one of the American State courts directs attention to the importance of emphasising the influence that the ever-increasing knowledge concerning underground waters may have in governing legal decisions. In an action brought in the State of Pennsylvania regarding the pollution of underground water, the judge remarked:—Geology has become a progressive and in many respects a practical science. More deep wells have been sunk in one State of America than had previously been dug in the entire earth in all time; and that which was formerly held to be unknown and merely speculative regarding the properties of underground water has been by experience reduced almost to a certainty. If it can be shown that the work done by the owner of the land would cause the inflow of salt water or oil to mingle with fresh water, and the means of preventing the mixing are available at a reasonable expense, then clearly it is a violation of the spirit of the law not to recognise the change, and to apply the settled principles of right to the altered conditions of fact.

In another case tried in California it was held that the usual rule of common law on the subject of percolation was not to be held as applying to an arid district that depended entirely for its cultivation on water derived from underground sources, and where the conditions were totally different from those existing in the locality where the rule in question was first established, and therefore an owner has no right to injure his neighbour's land by any unreasonable diversion of underground water by transferring the same for gain to another district.

PHYSICAL RESEARCH IN AMERICA.

TWO volumes, representing the first instalments of what is promised to be an annual publication, have been received from the physical laboratories of Harvard University.[1] Each contains fourteen papers contributed by the professors, staff, and students. In the preface the director, Prof. Trowbridge, acknowledges the great stimulus received by the establishment of the Thomas Jefferson Coolidge research fund, which has provided the laboratory with what the volumes show to be a very fine equipment, and has greatly increased the enthusiasm for physical research.

Most of the papers included are reprints from the *Proceedings of the American Academy* and the *Astrophysical Journal*. It is hardly possible to speak too highly of the handsome treatment they have received at the hands of the printer and binder, and especially of the manner in which the numerous plates have been reproduced. The range of subjects treated is a very wide one, and in a review of this kind it is not possible to deal with each paper individually.

In the first volume Prof. Trowbridge contributes an interesting paper on the spectra of gases and metals at high temperatures. He attempts to apply electrical stimulus of known amount to the gas in a vacuum tube by discharging through it a condenser of known capacity charged to a high potential by his powerful accumulator battery, by which he can obtain pressures up to 40,000 volts. He contrasts the relative intensities of the lines in the spectra thus obtained with the results got by other methods. When theorising on the relative volatility of metals it is desirable, however, to adopt more accurate data than some of those used in this paper, where "soft-iron" is said to melt "not far from 1100°," and aluminium "between 700° and 800°," instead of 657°.

Spectroscopy is evidently a favourite study in the laboratory, since five papers in each of the two volumes are devoted to it. Mr. Lyman gives an explanation of the "ghosts" and "false spectra" sometimes met with when using gratings, particularly in the extreme ultra-violet, and shows in a number of cases the relation between the wave-lengths of the various false lines and those of the parent lines to which they are due.

In another paper he discusses the various kinds of pro longations of spectral lines met with when using gratings, and shows them to be due to a cause quite different from Sir Norman Lockyer's "long and short lines."

Another interesting paper is by Mr. Morse on the spectra from the break in the Wehnelt interrupter, which appears to give spectra of a special character not classifiable under the division of "flame," "arc," "spark," or "enhanced spark."

Mr. B. O. Pierce contributes, in continuation of an earlier research, papers on thermal conductivity of rocks, one of which must have involved a long period of painstaking work. The apparatus employed was on a scale only possible where very considerable funds were available.

Prof. Hall has a paper on a theory of thermoelectric action, and, along with three other workers, one on thermal and electrical effects in "soft iron."

In several instances, work commenced in the laboratory appears to have been dropped on the publication of some paper slightly overlapping the research contemplated. It is a pity, for example, that the fine resistance bridge for platinum thermometry, described by Mr. Edwards, should not be used to solve some of the problems for which it is suited, and that the construction of a gas thermometer should not be proceeded with because of the publication during the past few years of several researches on gas thermometry.

Though none of the papers appear to be of epoch-making importance, the volumes show how a well equipped laboratory may contribute substantially to the advancement of knowledge. It would be interesting to see what effect the endowment of a representative physical laboratory in this country, with funds for research purposes, would have on the character of the work done, especially if at the same time it were possible to arrange that members of the teaching staff should have a more reasonable proportion of their time to devote to research work.

J. A. H.

[1] "Contributions from the Jefferson Physical Laboratory of Harvard University." (Cambridge, Mass., vol. i., 1903; vol. ii., 1904.)

FIREBALL OF JANUARY 27, 1906.

A MAGNIFICENT fireball was seen by many persons in the north of England on the evening of January 27 at 8h. 33m. Descriptions of its appearance have been received from Hull, Bramley, Bradford, Patrington, and other places in Yorkshire, from Sleaford and Billingborough in Lincolnshire, from Cheadle, Staffordshire, &c.

Mr. H. Beckwith, at Hull, observed the meteor travelling horizontally between the "square" of Ursa Major and the Belt of Orion, while at Cheadle, Miss Blagg noted the path as just above ζ Leonis. Mr. R. Felton, at Patrington, estimated the brightness of the object as quite equal to that of the full moon. It left a trail visible for some time afterwards; one observer says it remained for five minutes, two others estimate the duration as eight minutes, while at Billingborough a spectator watched it for more than ten minutes.

The meteor gave a very brilliant flash near its end point, and the suddenness of its apparition startled many people. Several of the observers were enabled to give the position of its flight with fair accuracy from the luminous trail it left behind.

The radiant point appears to have been near θ Boötis, or in 214°+53°, and the height of the meteor was from about 59 to 45 miles over the North Sea immediately east of the Lincolnshire coast. The disappearance occurred at a point over "the Wash," about 6 miles S.S.E. from Wainfleet. The length of observed path was approximately

42 miles, and probable velocity of the object 24 miles per second.

The radiant point in the right hand of Boötes is very little known as a centre of meteoric divergence in the month of January. The only shower conformable with it was observed at Bristol in 1887–9 January 25–29, 213°+52°.

In recent years fireballs have been very numerous in this month, and especially at the epochs about January 9 to 13 and 24 to 29. They appear, however, to have belonged to a great many different systems, and have not supplied evidence of any rich individual display of bright meteors at this time of the year.

W. F. DENNING.

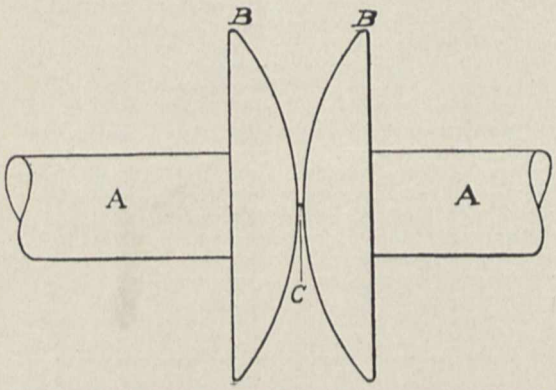
METHOD OF PRODUCING WAVES OF FREQUENCY INTERMEDIATE BETWEEN HEAT WAVES AND HERTZIAN WAVES.

THERE is at present a considerable gap of unexplored wave-lengths intermediate between those of Hertzian waves and what is commonly known as heat. The shortest Hertzian waves which have heretofore been produced are of the order of one millimetre length.

Some years ago the writer discovered a method of producing the heretofore unknown waves above referred to.

It is based on the phenomenon discovered by the writer and published by him in a paper on insulation and conduction read before the American Institute of Electrical Engineers in 1894.

In the accompanying figure, AA are copper rods, BB are plano-convex lenses. The distance between the surfaces of



the lenses depends upon the wave-length which it is desired to produce.

If BB were metallic terminals, the discharge passing at C would have a long wave-length on account of the capacity of BB. It is impossible to make metallic terminals small enough to get very short wave-lengths. But, in the apparatus shown in the sketch, if AA are connected to the terminals of a high-voltage machine sparks will be found to pass at C, and the oscillating conductor is merely the small column of incandescent gas, C.

If the distance between BB is very short, the wave-length will also be very short.

Waves may be produced in this method having a wave-length certainly not longer than a few ten-thousandths of an inch, and there would appear to be no necessary limit to the frequency. It sometimes happens that the discharge tends to pass at a point outside the axis, and hence to give a longer wave-length than desired, but this can be avoided by properly proportioning the curvature of the lenses and the diameter of the rods AA.

Inert gases of the helium type seem to give the best results, but very good results are obtained by using quartz lenses in air, the use of quartz having been suggested to me by Prof. Elihu Thomson. Quartz does not seem to become conducting on being heated by the passage of the discharge to anything like the same extent as glass, and hence the wave-length remains more constant.

Owing to pressure of other work, the writer has been unable to continue these experiments, but the apparatus would seem to be of interest as offering a means of obtaining waves of any desired high frequency.

REGINALD A. FESSENDEN.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The statement of the income and expenditure of the Common University Fund for 1905, published in last week's *Gazette*, shows that the income was 6806*l.* 9*s.* 8*d.*, to which the colleges contributed 6197*l.* 19*s.* 4*d.* under the statute concerning college contributions for university purposes, and the Royal Geographical Society 400*l.* towards the support of the department of geography. The total expenditure was 6260*l.* 14*s.* 11*d.*, of which sum 3662*l.* 19*s.* 5*d.* was devoted to scientific purposes, partly in the payment of the salaries of university readers and professors, and partly in assisting various laboratories and providing demonstrators and assistants.

At a meeting of the Junior Scientific Club, held at the Museum on February 23, Mr. M. H. Godby (Christ Church) read a paper on "The Place of Natural Science in Education."

CAMBRIDGE.—The Vice-Chancellor has been authorised to convey to Lord Rayleigh the grateful thanks of the University for his magnificent gift of 7733*l.* 12*s.* 8*d.*, being the amount of the Nobel prize awarded to him in 1904. Lord Rayleigh desires that 5000*l.* of this should be employed in erecting a new building in connection with the Cavendish Laboratory, and that the remainder should be devoted to the purchase of scientific books and periodicals for the University Library.

Sir George Darwin, K.C.B., Plumian professor of astronomy, will represent the University at the celebration of the 200th anniversary of the birth of Benjamin Franklin at Philadelphia in April.

The Special Board of Biology and Geology recommended that the agreement between the University and Dr. Dohrn, director of the Zoological Station at Naples, be renewed for a further period of five years by the payment to him of 100*l.* per annum out of the Worts travelling bachelors fund.

The General Board of Studies has nominated the following gentlemen as members of the Board of Electors to the professorships named below:—Dr. B. C. A. Windle, to the professorship of human anatomy; Prof. F. W. Oliver, to the professorship of botany; Lord Walsingham, to the professorship of zoology and comparative anatomy; Mr. J. Hutchinson, to the professorship of surgery; the Earl of Carrington, G.C.M.G., to the professorship of agriculture.

The following have been nominated examiners by the General Board of Studies for the special examination in agricultural science and for the diploma in agriculture:—Mr. J. B. Peace, Mr. H. Woods, Mr. T. B. Wood, Mr. R. H. Biffen, Prof. Middleton, Dr. Shore, Mr. T. A. Dickson, and Mr. A. E. Shipley.

At Gonville and Caius College the triennial Thruston prize of 54*l.*, open to a member of the college of not more than fifteen years' standing who has published in the course of the preceding three years the best original investigation in physiology, pathology, or practical medicine, has been awarded to Mr. W. S. Perrin, research student of the college. Mr. Perrin is an expert on protozoology, and has published papers on a so-called trypanosome in the oyster and on *Pleistophora periplanetae*.

LORD RAYLEIGH has promised to lay the foundation-stone of a new science school at Dulwich College on Saturday, March 3.

To the new buildings of the Sorbonne it has been decided to add a new university chemical laboratory, the Institut de Chimie, on a site between la rue Saint-Jacques and la rue d'Ulm, that is, in the neighbourhood of the Sorbonne.

PROF. R. J. HARVEY GIBSON writes from the Hartley Botanical Laboratories, University of Liverpool, to point

out that the proposed grant referred to in a note last week (p. 406) is to be made to the botanical laboratories to meet the expenses of investigations in applied botany which the agricultural committee of the County Council desires the botanical department of the University to carry out. He adds:—"There is no department of economic botany in the University, nor has any fund been collected for the establishment of such a department, so that the cost of such a school is not in any sense 'guaranteed.'"

THE Treasury has appointed a permanent committee to advise the department as to the distribution of the grant-in-aid of colleges furnishing education of a university standard. The constitution of the committee is as follows:—The Rev. H. G. Woods, chairman, Sir Francis Mowatt, G.C.B., Sir William J. Collins, M.P., Prof. Henry Jackson, and Prof. W. S. McCormick. Mr. R. G. Hawtrey, of the Treasury, will act as secretary. Dr. H. G. Woods, the chairman of the committee, was in 1901 a Treasury Commissioner for the inspection of university colleges. It will be noticed that the interests of science are not represented upon the committee.

THE academic congress, which recently met in St. Petersburg to consider a number of questions relating to Russian higher education, arrived at the following conclusions:—The Imperial Russian universities ought to be State institutions, the duty of which should be to foster the natural sciences; they should be autonomous institutions, responsible only to the Minister of Education; they should, further, be open to persons of both sexes alike, irrespective of nationality and religious creeds; the university diplomas should give no privileges in the entrance to the professions, &c.; the State examinations should be maintained, and those persons desirous of exercising the right of putting their knowledge to professional uses should be required to submit themselves to the corresponding State examinations; the degree of "Master" should be abolished, and those now holding it should receive the "Doctor's" degree.

THE Charity Commission has forwarded to the Education Committee of the London County Council a draft scheme which provides that the City Polytechnic, which hitherto has comprised the Birkbeck College, City of London College, and Northampton Institute, shall cease to exist. It is proposed that the Birkbeck College and the City of London College shall constitute separate foundations, while the Northampton Institute shall constitute a separate charity. The whole of the endowments of the Birkbeck College and the City of London College are determined as educational endowments, and will therefore henceforth be under the control of the Board of Education and not of the Charity Commissioners, but the Northampton Institute, as a charity, will presumably continue to be supervised by the Charity Commission, and power is reserved for the establishment of further schemes in respect of the two colleges by the Board of Education and in respect of the Northampton Institute by the Charity Commission. Subject to these provisions, the several institutions are to be managed in accordance with their existing schemes and by their present governing bodies.

IN the House of Commons on Monday Mr. Austen Chamberlain asked the Chancellor of the Exchequer whether he had undertaken to include in the Estimates for 1906–7 a sum of 20,000*l.* for the building fund of the University College of North Wales, to which fund 61,000*l.* had been subscribed locally; if so, whether any conditions had been attached to the proposed grant; and whether he would make provision in the Estimates for similar grants to the universities and university colleges of England in the same proportion to the local subscriptions. In reply, the Chancellor of the Exchequer said:—"I have undertaken to ask Parliament to make a grant of 20,000*l.* to the building fund of the college when the money is actually required for the scheme, and subject to the condition that a similar sum has first been spent upon it from other sources. No part of this grant will have to be provided in the Estimates for 1906–7. Similar grants have already been made to the two other Welsh colleges of like character. No such grants have in the past been made to university colleges in England, and, as the annual grants to these institutions were largely increased—as I think most properly increased—by the right hon. gentleman when he was Chancellor of the Exchequer, I am not, as at present advised, prepared to recommend a change of policy."

THE annual meeting of University College was held on February 21. Lord Reay, who presided, referred to the incorporation of the college in the University of London, and said its object is to secure the good of university education in London as a whole. Speaking of the proposed college of technology, Lord Reay said he is convinced that increased facilities for higher technological work are required in London, but unless all such higher technological work is in the hands of the same authority there will be the same risk of overlapping, duplication, possibly of triplication, that there has been in the past. Now is the great opportunity for giving to the University its due responsibility, and from what the University has done in the last five years, said Lord Reay, it will not fail to bear that responsibility. If brought within the University the new college of technology would be managed by a college committee much as University College will be managed. Such college committee would be subject to the general direction on matters of university policy of the Senate, but in all other matters it would be practically self-governing. It would be possible to start the new college at once within the University, and while starting it with a committee under the Senate there would be time to consider what modifications in the general constitution of the University would be made necessary.

IN the absence of Mr. Chamberlain, the Chancellor, Alderman C. G. Beale, the Vice-Chancellor, presided at the sixth annual meeting of the Birmingham University Court of Governors on February 21. From the financial statement it was seen that the income for the year had been nearly 43,000*l.*; two new chairs had been inaugurated during the last twelve months, one for electrical engineering and the other for civil engineering. The engineering department as a whole had moved into its new quarters at Bournbrook; although they were expecting the early completion of this section, they were also looking forward to the beginning of another by reason of the generous donation of 50,000*l.* in November of last year; the exact form of the extension was not yet fully decided, but plans for the erection of new chemical and physical departments were being prepared. Remarking upon the difficulty of determining how far a certain sum of money would go in providing such accommodation, Alderman Beale observed that whatever was done should be done on a sufficiently large scale to be permanent; they had sufficient experience to show that the large scale would be the best in the long run. The erection of the Harding Memorial Library, the outcome of the generous gift of 10,000*l.* from the family of the late Mr. Charles Harding, was contemplated. The University had broken new ground, as stated in the principal's report, by the appointment of Mr. W. E. Collinge as special lecturer in economic biology.

LORD HALSBURY delivered an address at the annual prize distribution of the City and Guilds of London Institute on February 16. He said that the old apprenticeship system was a good rough-and-ready way of teaching young people what they wished to practise later in life. What has been attempted more recently, however, is to teach, not only how to do things, but the principles underlying their action. As the result of the developments of modern life, the whole world has become the market for competition. In Germany, France, Switzerland, and other Continental nations it has long been recognised that the old ways in trade and commerce will not do, and the people there have been preparing themselves by technical education, and in other respects, not only to hold their own, but to forge ahead in the industrial race. It is all very well for us to assume an indifferent air, and say that we have been getting on very well. Unfortunately, the facts seem to tell a different story. For the maintenance of our commerce we must use the means that other countries have used with such successful results. As a judge, Lord Halsbury was often struck with the large number of patent cases that

came before him in which the patents had been taken out in Germany and brought over here to be developed and worked at a profit. Why was this? While Germany has founded numerous places for chemical experiment and research, nothing of the kind is provided here, except at such colleges and schools as those belonging to the City and Guilds of London Institute. It is a matter of national concern that whatever is possible should be done to give a stimulus to the scientific and industrial activity of the country.

SOCIETIES AND ACADEMIES.

LONDON.

Society of Chemical Industry (London Section), February 5.—Mr. R. J. Friswell in the chair.—Carburetted water gas in the Bunsen burner: M. **Chikashigé.** Carburetted water gas is now prepared in the Kyoto University by injecting heavy petroleum oil with steam into a water-gas generator filled with ignited coke. The gas produced is passed through a superheater loosely packed with fire-bricks, and then through a scrubber, after which treatment it enters the gas holders. The mean composition of the gas differs little from that of coal gas, and the products of combustion closely resemble those of coal gas. The carburetted gas has no effect on the ordinary laboratory vessels, and the products of combustion, unlike those of plain water gas, are not more injurious in insufficiently ventilated laboratories than those of coal gas.—The loss of nitre in the chamber process, part ii.: J. K. H. **Inglis.** The loss of nitre, which usually amounts to about 3 per cent. of the sulphur burnt, can best be traced by complete analyses of the flue gases. The analysis cannot be carried out by means of aqueous absorbents owing to the formation of complicated bodies by the interaction of nitrous acid and sulphur dioxide. But the analysis may be conveniently made by the fractional distillation of the gases, first at the temperature of liquid air and subsequently at higher temperatures. The results showed that only about 4 per cent. of the lost nitre was lost as nitrous oxide and 43 per cent. as nitrogen peroxide. In the first experiments the temperature of liquid air was insufficient to effect the separation of nitric oxide from the flue gases owing to the vapour pressure of nitric oxide. Some further experiments were therefore made at a lower temperature obtained by making liquid air boil under diminished pressure. The amount of nitrogen oxides found was no greater than in the earlier experiments, and this might therefore mean that nitric oxide is not present in the flue gases.—The removal of nitrous acid from concentrated nitric and sulphuric acid: O. **Silberrad** and B. J. **Smart.** The experiments were made to determine to what extent the reaction between nitrous acid and amines or amides occurs in concentrated acids. Nitric acid containing a small percentage of nitrous acid was taken either alone or in admixture with sulphuric acid. The addition of hydrazine occasions an explosion, and with this exception substances such as urea, lead peroxide, oxamide, methylamine nitrate, and amido guanidine are very inert towards nitrous acid in presence of concentrated nitric acid, although they react readily in dilute solution. The observation of Franchimont that urea nitrate decomposes with evolution of carbon dioxide and nitrous oxide was confirmed.

Zoological Society, February 6.—Mr. G A. Boulenger, F.R.S., vice-president, in the chair.—Mounted cubs of the timber-wolf (*Canis occidentalis*), obtained in the province of Keewatin, Canada: F. **Gillett.**—Restored models of the skulls and mandibles of Mœritherium and Palæomastodon: Dr. C. W. **Andrews.** The models were prepared by Mr. F. O. Barlow from the original specimens collected from the Upper and Middle Eocene beds of the Fayûm, Egypt, and now preserved in the British Museum and the Geological Museum, Cairo.—Lantern-slides of sections of skin from the palmar and plantar surfaces of twenty-four species of mammals, and the plantar surfaces of seven species of birds: Dr. W. **Kidd.** The functions of the papillary ridges and the papillary layer of the corium in connection with the sense of touch were alluded to.—Histology and physiology of the placenta in the Ungulata: Dr. J. W. **Jenkinson.** A recent examination of the histological structure of the placenta in the sheep and cow has shown (1) that in the formation of the accessory cotyledons of the cow the epithelium lining the cotyledonary crypts arises by simple modification of the uterine epithelium; (2) that in the fully formed principal cotyledons of both cow and sheep there is complete continuity of the intra- with the extra-cotyledonary uterine epithelium; (3) that the greenish-brown pigment so abundantly present in the trophoblast-cells is a derivative of the hæmoglobin of the maternal corpuscles which those cells have ingested. The pigment—which contains no iron—is of two kinds, one of which has a definite absorption spectrum resembling closely that of oxyhæmoglobin. In acid solution the spectrum approaches that of acid hæmatoporphyrin.—A living specimen of a dwarf species of cavy, probably the salt-marsh cavy (*Dolichotis salinicola*): Sir Edmund **Loder,** Bart. Owing to Burmeister (the original describer of the animal) being under the erroneous impression that he had founded the species on young specimens and the fact that two distinct species occurred in the same district, some considerable confusion had been caused as to the status of the different forms of Dolichotis. The author pointed out that the common Patagonian cavy (*D. patagonicus*) differed from the dwarf *D. salinicola* and the larger *D. magellanicus centricola* (the two species found together) in having a broad dark band above the white rump-patch.—A description of Trichorhiza, a new hydroid genus: E. S. **Russell.**—Description of the new genus Melissomorpha, formed for the reception of a horse-fly of the Pangoninæ division of the family Tabanidæ, discovered by Colonel C. T. Bingham in Sikkim: Gertrude **Ricardo.** The insect closely mimicked the Indian bee *Apis dorsata*, L., having the flattened wide tibiæ characteristic of the hive-bee, the general resemblance between the bee and the fly being very striking.—Mammals collected at Kuruman and Molopo in Bechuanaland by Messrs. R. B. Woosnam and R. E. Dent: H. **Schwann.** The specimens, numbering about 120, and belonging to 26 species, were of great interest as being topotypes of several species described by Sir Andrew Smith in his expedition to Kuruman and the interior of South Africa.—Description of a new species of ratel (Mellivora) from Central Africa, also notice of the occurrence of a new subspecies of chevrotain (Dorcatherium) in that district: R. **Lydekker.** The author proposed to divide the genus into three geographical races, viz. the typical form from the Gambia, Bates's chevrotain from the Cameroons, and the present—Cotton's chevrotain—from the Ituri Forest.—The articulation of the vertebrate jaw: H. G. F. **Spurrell.** The object of this paper is to direct attention to the existence of two types of mouth in vertebrates. In one type the articulation is in the plane in which the teeth meet; in the other type it is not in the plane in which the teeth meet, but in mammals above, in reptiles below that level. This alteration in level is attained in mammals by an ascending ramus of the jaw, in reptiles by a long quadrate bone.

Entomological Society, February 7.—Mr. F. Merrifield, president, in the chair.—*Exhibitions.*—Specimen of *Lathrobium laevipenne*, Heer, a beetle new to the British list, taken in a sandpit near Oxted, Surrey, in August, 1905: W. E. **Sharp.**—Specimens of South African butterflies belonging to the Nymphalinæ, Acræinæ, Danainæ, and Papilioninæ: Dr. F. A. **Dixey.** Attention was directed to the significance of the fact that scents of an agreeable nature (as in Pierinæ generally, *Mycalesis safitza*, &c.) were as a rule confined to the male sex, while those of a disagreeable or disgusting character (as in Acræinæ and many Papilios) were often common to both sexes.—Four species of Acræa taken in South Africa during the visit of the British Association: Dr. G. B. **Longstaff.** The species were (1) *A. anemosa*, Hew., from the Victoria Falls, and Mochudi, in Bechuanaland; (2) *A. alboradiata*, Auriv., previously known to Mr. Roland Trimen by two females only, and considered by him as a variety of *anemosa*; (3) *A. atolmis*, Westw., to which Westwood gave the names of *atolmis* and *acontias*, although there seems no doubt they are one species; (4) *A. atergatis*, Westw., the two types of which are in the Hope collection at Oxford.—Two Diptera, which had been observed follow-

ing the bee, *Andrena labialis*, Kirb., by Mr. A. H. Hamm, identified by Mr. G. H. Verrall as a species of Chortophila: Prof. E. B. **Poulton.** Prof. Poulton stated that new and interesting light had been thrown on the observation by Colonel Yerbury, who pointed out that both flies were males. At first sight it seemed astonishing that the bees should be pursued by the males of inguiline flies, but he suggested that the males in this way find their way to the burrows, where they meet the females, which have also reached them in the same manner, or where, more probably, they lie in wait for the freshly emerging females.—Collection of Rhopalocera made in Spain during July and August, 1905: W. G. **Sheldon.** There were also shown for comparison typical European specimens; an aberration of *A. aglaia*, with the black blotches on the superiors enlarged and banded, and with dark suffused ground colour on all wings; and an interesting series of *L. corydon* and var. *hispana*, with forms approaching var. *polonus*, from Aragon, and intermediates between all these forms, and also British, French, and Swiss typical specimens for comparison.—*Papers.*—(1) Some rest attitudes of butterflies; (2) some bionomic points in certain South African Lamellicorns: Dr. G. B. **Longstaff.**—Some new or hitherto unfigured species of South African butterflies: Roland **Trimen.**—Some observations on the reproduction of Hemiptera-Cryptocera by Claydon Hewett: Commander J. J. **Walker.**

Chemical Society, February 15.—Prof. R. Meldola, F.R.S., president, in the chair.—Cuprous formate: A. **Angel.** This salt was prepared by dissolving cuprous oxide in an aqueous ammoniacal solution of ammonium formate under petroleum, diluting with alcohol, acidifying with formic acid, and washing the deposited crystals with ethyl formate. Water immediately hydrolyses it to cuprous oxide and formic acid, and dilute sulphuric acid at once produces a precipitate of metallic copper.—The solubility of triphenylmethane in organic liquids, with which it forms crystalline compounds: H. **Hartley** and N. G. **Thomas.** The results of these experiments confirm the existence of a metastable region in which supersaturated solutions cannot crystallise spontaneously.—The spontaneous crystallisation of supersaturated solutions: H. **Hartley.** It was shown how the difference between metastable and labile solutions might be explained from the kinetic standpoint as a result of the increased solubility of the small crystals which must be first formed in a spontaneous crystallisation.—Preparation and properties of some new tropeines: H. A. D. **Jowett** and A. C. O. **Hann.** The tropeines of methylparaconic, terebic, glycollic, protocatechuic, and phthalidecarboxylic acids were prepared. The results of physiological experiments with these confirm Ladenburg's view that for mydriatic action to exist in a tropeine the acyl group should contain a benzene nucleus and an aliphatic hydroxyl in the side-chain containing the carboxyl group.—Studies in asymmetric synthesis, iv., the application of Grignard's reaction for asymmetric syntheses: A. **McKenzie.** The author has studied the action of magnesium propyl iodide, magnesium *iso*butyl iodide, and magnesium α-naphthyl bromide respectively on *l*-menthyl benzoylformate, and effected in each case an asymmetric synthesis of a substituted *l*-glycollic acid.—*o*-Cyanobenzenesulphonic acid and its derivatives: A. J. **Walker** and E. **Smith.** The authors described a modification of Jesurun's method for the preparation of *o*-cyanobenzenesulphonic chloride, and referred to various substances obtained from this by reduction and hydrolysis.—The condensation of dimethyldihydroresorcinol and of chloroketodimethyltetrahydrobenzene with primary amines, part ii., diamines, *m*- and *p*-phenylenediamines: P. **Haas.**—A modification of the volumetric estimation of free acid in the presence of iron salts: C. Chester **Ahlum.** The iron is precipitated by means of sodium dihydrogen phosphate, and the filtrate titrated with standard sodium hydroxide. In the reaction of the ferric salt with the phosphate, a definite quantity of acid, directly proportional to the amount of "ferric" iron present, is liberated, and is corrected for by estimating the "ferric" iron present before titrating. The method is applicable to natural waters containing iron salts and free acid.—The theory of alkaline development, with notes on the affinities of certain reducing agents: S. E. **Sheppard.**—Resolution of 2:3-dihydro-3-methylindene-2-carboxylic acid into its optically active isomerides: A. **Neville.** The acid forms with *l*-menthylamine a well defined crystalline salt, which on crystallisation from ethyl acetate gives, after a few crystallisations, the pure salts of the *d*-acid and *l*-base.

PARIS.

Academy of Sciences, February 19.—M. H. Poincaré in the chair.—The simultaneous determination of two points by means of graphical construction on the large scale: M. **Hatt.**—The boiling and distillation of nickel, iron, manganese, molybdenum, tungsten, and uranium: Henri **Moissan** (see p. 424).—The function of organic matter in nitrification: A. **Müntz** and E. **Laine.** The experiments of Winogradsky and Omeliansky have given rise to the idea that the presence of humic material is not only unnecessary, but even harmful to the process of nitrification. The present researches deal specially with the *rôle* of humus in the nitrifying process, and it was found that organic material in this form does not hinder the process, and may be favourable. Abundance of humus is not an indispensable condition for nitrification, but its presence is favourable to the multiplication of the organisms, and the nitrification ultimately becomes more rapid.—The reproduction of architectural monuments from their photographs, practised especially in Germany: M. **Laussedat.**—Synthesis of tertiary alcohols derived from paramethylcyclohexane: Paul **Sabatier** and A. **Mailhe.** Methylcyclohexanone (1:4) is readily obtained from paracresol by reduction in presence of reduced nickel. It reacts energetically with organomagnesium halogen compounds, and the product of the reaction treated with water gives tertiary alcohol. The alcohols arising from the action of the methyl, ethyl, propyl, isopropyl, isobutyl, isoamyl, and octyl magnesium iodides (or bromides) are described in detail, and also the substituted ethylenes arising from their dehydration. The reaction with phenyl-magnesium bromide and benzyl-magnesium chloride is also given. The optical constants were determined, and found to correspond very closely with the molecular refractive powers calculated from the coefficients of Conrady and Brühl, thus furnishing a further proof that the hexamethylene ring introduces no abnormality into the refractive constant.—The dangers of the ingestion of dead tubercle bacilli into tuberculous and healthy animals: A. **Calmette** and M. **Breton.** In the experiments described the tuberculous bacilli were sterilised by heating to 100° C. Tuberculous guinea-pigs had their death hastened by the repeated injection or ingestion of sterilised tubercle bacilli, the general effect being similar to that produced by repeated injection of tuberculin. In healthy animals the results are injurious, sometimes producing disorders resembling those produced by tuberculin. One practical conclusion to be drawn from this work is that milk from tuberculous cows, even after sterilisation by heat, is not a safe food, especially if the person taking such milk is already tuberculous.—The photographic study of the duration of discharge in a Crookes' tube: André **Broca** and M. **Turchini.** The photographs of the spark were taken from a rotating mirror, the velocity being adjusted so that a time of 0·001 second corresponded to 63 mm. on the plate. The photographs showed a sudden commencement of the discharge lasting 0·00025 second, followed by a weakening terminating asymptotically at the end of about 0·0008 second. With a soft tube the same form of discharge was observed, but the time throughout was greater. The authors regard this method as giving an upper limit for the time of discharge.—A method for measuring the total quantity of X-rays emitted in a given time: M. **Gaiffe.**—The radio-activity of springs of potable water: F. **Diénert** and E. **Bouquet.** Measurements are given of the radio-activity of the water from the Group de Nouvet, Erigny, Rivière, and Breuil springs.—The condensation of the acetylenic nitriles with phenols. A general method of synthesis of β-substituted acrylic β-oxyphenol nitriles: Ch. **Moureu** and I. **Lazennec.** It has been found that the condensation between alcohols and nitriles of the type R—C≡C—CN also takes place when phenols are substituted for the alcohols. Details are given of seven compounds formed in this way.—Researches in the pyrane series: E. E. **Blaise** and H. **Gault.**—The presence of

formaldehyde in caramelised substances: A. **Trillat.** Quantities of formaldehyde varying from traces up to 0·27 per cent. have been found in caramel; the higher the temperature at which the caramel is formed, the higher the percentage of formaldehyde. This fact may account for the observed variation in fermentation of slightly burnt sugar.—The bryological vegetation of the Antarctic regions: Jules **Cardot.** An account of forty-six mosses collected in various Antarctic expeditions.—The sporulated yeasts of Glœosporium: P. **Viala** and P. **Pacottet.**—The influence of grafting on the quality of the grape and wine, and its use in the systematic improvement of sexual hybrids: M. **Curtel** and A. **Jurie.**—The evolution of colonies of *Diplosoma spongiforme* and the "displanchtomy" of the ascidiozoids: Antoine **Pizon.**—The male and the sucker of *Nicothoa Astaci*: A. **Quidor.**—The peat deposits of the sea shores of Brittany, to the north of Morlaix, Finistère: L. **Cayeux.**—A whirlwind of very small dimensions: M. **Luizet.**

CALCUTTA.

Asiatic Society of Bengal, January 10.—Types of fever in Calcutta: Major L. **Rogers.**—Description of two new species of cyprinoid fishes from the Helmand basin: C. Tate **Regan.** Five species of fish were taken in the stream of the Helmand basin by the members of the recent Seistan Arbitration Commission. Of these, two, *Scaphiodon macmahoni* and *Nemachibus rhadinaeus*, are described as new.—The origin of mankind (according to the Lamaic mythology): Rai Sarat Chandra Das Bahadur. In the beginning of the *Kalpa*, when living beings had sprung up in the regions of the Rirab (*Sumeru*) mountain, situated above the residence of the four *Dika Pala* (guardians of the world called *Maharaja Kayiko*), two Devaputra (angels) came down to this earth from Heaven, being miraculously transformed into human shape. One of them was *Nima* Rabnang, and the other was *Dawa* Dimeh. These were followed by other angels, whose term of residence in Heaven had expired at the exhaustion of the merit they had acquired before. Thus humanity evolving from heavenly origin in course of time multiplied on earth.—Persian folk songs: Major D. C. **Phillott.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 1.

ROYAL SOCIETY, at 4.30.—An Experimental Inquiry into the Factors which determine the Growth and Activity of the Mammary Glands: Miss J. E. Lane-Claypon and Prof. E. H. Starling, F.R.S.—The Specificity of the Opsonic Substances in the Blood Serum: Dr. W. Bulloch and G. T. Western.—The Internal Anatomy of Stomoxys: Lieut. F. Tulloch, R.A.M.C.

CHEMICAL SOCIETY, at 8.30.—Studies of Dynamic Isomerism. Part IV. Stereoisomeric Halogen Derivatives of Camphor: T. M. Lowry.

ROYAL INSTITUTION, at 5.—The Physiology of Plants: F. Darwin, F.R.S.

LINNEAN SOCIETY, at 8.—On a New Type of Stem from the Coal-measures: Dr. D. H. Scott, F.R.S.—Notes on Some Species of Nereis in the District of the Thames Estuary: Dr. H. C. Sorby, F.R.S.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Coast Lines Protected by Chain Cable Groynes: R. G. Allanson-Winn.

GEOLOGISTS' ASSOCIATION, at 8.—Note on an Ostracodal Limestone from Durlston Bay, Dorset: F. Chapman.—(1) Remarks on the Upper Chalk of Surrey: (2) The Devonian Limestones of Lummaton Hill, near Torquay: A. J. Jukes-Browne.

FRIDAY, MARCH 2.

ROYAL INSTITUTION, at 9.—Hippocrates and the Newly Discovered Health Temple at Cos: Dr. R. Caton.

SATURDAY, MARCH 3.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

MONDAY, MARCH 5.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Ignition of Nitro-compound Explosives in Small Arm Cartridges: W. D. Borland.

VICTORIA INSTITUTE, at 4.30.—On the Bearing of Recent Oriental Discovery on Old Testament History: Rev. A. C. Robinson.

TUESDAY, MARCH 6.

ROYAL INSTITUTION, at 5.—Food and Nutrition: Prof. W. Stirling.

SOCIETY OF ARTS, at 8.—Imperial Questions in the West Indies: Sir Nevile Lubbock, K.C.M.G.

ZOOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Continued Discussion*: A Plea for Better Country Roads: G. R. Jebb.—Country Roads for Modern Traffic: J. E. Blackwall.—*Probable Paper*: The Widnes and Runcorn Transporter-Bridge: J. J. Webster.

WEDNESDAY, MARCH 7.

SOCIETY OF ARTS, at 8.—Art in Painting and Photography: J. C. Dollman.

ENTOMOLOGICAL SOCIETY, at 8.—The late Prof. Packard's Paper on the Origin of Markings of Organisms: H. Eltringham.

GEOLOGICAL SOCIETY, at 8.—On the Occurrence of Limestone of the Lower Carboniferous Series in the Cannock Chase Portion of the South Staffordshire Coalfield: G. M. Cockin.—Liassic Dentaliidæ: L. Richardson.

SOCIETY OF PUBLIC ANALYSTS, at 8.

THURSDAY, MARCH 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Microscopic Changes in the Nervous System in a Case of Chronic Dourine or "Mal de Coit," and Comparison of the Same with Those found in Sleeping Sickness: Dr. F. W. Mott, F.R.S.—On the Relationship between Hæmolysis and Phagocytosis of Red Blood Cells: Dr. R. D. Keith.

ROYAL INSTITUTION, at 5.—The Physiology of Plants: F. Darwin For. Sec. R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—A New Single-Phase Commutator Motor: V. A. Fynn.

MATHEMATICAL SOCIETY, at 5.30.—On Function Sum Theorems connected with the Series $\sum_{1}^{\infty} x^n/n^2$: Prof. L. J. Rogers.—On Sommerfeld's Diffraction Problem and on Reflection by a Parabolic Mirror: Prof. H. Lamb.

FRIDAY, MARCH 9.

ROYAL INSTITUTION, at 9.—Some Dietetic Problems: Dr. R. Hutchison.

PHYSICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.—Descriptions of twenty-seven Marine Gastropoda, and one Scaphopod, from the Persian Gulf and Gulf of Oman: J. C. Melvill.—Note on *Capulus lissus*, Smith: J. C. Melvill.—Mollusca from a Rainwash, 150 ft. O.D. at Harlton: Rev. R. Ashington Bullen.—Report on a Small Collection of Land and Freshwater Shells from Uganda, with Descriptions of two New Species of Limicolaria and one of Martensia: H. B. Preston.—On New Species of Polyplacophora from South Australia: W. T. Bednall and E. H. V. Matthews.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design of a Two-hinged Spandrel-Braced Steel Arch: R. Freeman.

SATURDAY, MARCH 10.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

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