THURSDAY, JULY 23, 1913.

SOUTH AFRICAN DIAMONDS.

The Diamond Fields of Southern Africa. By Dr. P. A. Wagner. Pp. xxv+347+xxxvi plates. (Johannesburg: *The Transvaal Leader*; London: The Technical Book-Shop, 1914.) Price 27*s.* 6*d.* net.

THIS book is a greatly enlarged edition, in English, of Dr. Wagner's "Die Diamantführenden Gesteine Sudafrikas," which was published five years ago. The author states in his preface his aim to be that the book should "contain all that is worth knowing" concerning the subject of which it treats. If he has not altogether realised his ambition—and it is only necessary to glance at the list of 255 titles of works in his bibliography to realise the impossibility of doing so in a book of fewer than 350 pages—we may admit that he has certainly produced a work containing all that it is most important for prospectors, diggers, mining engineers, and investors, to whom the work is specially addressed, to know. Geologists also will find in it a good *résumé* of the work done in connection with the rocks containing the diamonds.

The first 250 pages of the book are devoted to an account of the primary occurrences of the diamonds in South Africa. The gems were first discovered at the Cape in 1868, and in 1874 the late Prof. Maskelyne showed that the rock in which they occur is a "peridotite" containing olivine, enstatite, and other minerals, for which the late Prof. H. Carvill Lewis, in 1887, proposed the name of "kimberlite." Much interest was aroused in 1899 by the fact established by Prof. Bonney, from the study of specimens obtained by Sir William Crookes, that the diamonds actually exist embedded in masses of "eclogite," a rock made up of garnet and augite, minerals which are found in the kimberlite. Since that date much discussion has taken place as to whether these masses of eclogite (which have received the local name of "griquaite") are nodules derived from a pre-existing rock or have been formed, like many other inclusions in the kimberlite, by a segregative action. Dr. Wagner suggests that a combination of the two hypotheses is possible and will best explain all the facts.

In the second division of the book, sixty pages are devoted to an account of the detrital deposits containing diamonds, including both those due to fluviatile and those due to marine action. The latter, occurring in German South-West Africa, are of especial interest to geologists. At points extending along the coast for 270 miles, but nowhere more than twelve miles from the sea, diamonds have been found. The district is nearly rainless and of most inhospitable character, but in certain valleys and depressions masses of sand and gravel occur yielding the diamonds—those obtained from these sources during the year 1913 being of the value of nearly 3,000,000*l.* Among the geologists who have studied the district, there appears to be much difference of opinion as to whether the rocks that have yielded the diamonds are in the "hinterland" or are now buried beneath the sea. It is interesting to note that certain guano islands off the coast have yielded diamonds, but, up to the present, not in sufficient numbers to pay the cost of prospecting.

The third portion of the book, which deals with "Diamond Mining Companies," does not call for remark from us, but the whole work may be recommended as a trustworthy and up-to-date treatise on the subjects with which it deals.

THE POPULARISATION OF EUGENICS.

The Progress of Eugenics. By Dr. C. W. Saleeby. Pp. x+259. (London: Cassell and Co., Ltd., 1914.) Price 5*s.* net.

DR. SALEEBY divides eugenics into natural or primary and nurtural or secondary. Natural eugenics is further sub-divided into positive, negative, and preventive. Few eugenists would support him in classing as eugenics much that he includes under the heading "nurtural," yet they would agree with him in general as to the desirability of making as favourable as possible the external conditions which influence nurture before and after birth, and of making education a real preparation for all that is important in life, including parenthood.

Positive eugenics means "the encouragement of worthy parenthood," negative eugenics "the discouragement of unworthy parenthood," and preventive eugenics the combating of "racial poisons," venereal diseases, alcohol, and lead. In treating these subjects Dr. Saleeby says, "We must be scientific or we are lost," and it is certainly true that he would have succeeded better if he had himself maintained a more scientific attitude. He falls short of it in particular in that he appears to judge of the validity of scientific work by the conclusions it arrives at. When the conclusions seem to him desirable, the work is accepted readily and uncritically, as, for example, that of the American Eugenics Record Office on the inheritance of epilepsy and feeblemindedness; when the conclusions seem undesirable, the work receives a very different treatment. Nevertheless, there is much contained in the book that is sensible

and is presented with considerable force and literary skill, and this circumstance makes its faults all the more regrettable. Besides that to which allusion has already been made there are two others, first the obtrusive egotism of the writer, and secondly his habit of misrepresenting people from whom he differs in opinion. To say that "for years the chief object of the biometrical laboratory at University College has seemed to be, and now clearly is, to prove the inheritance of this or that human character is 'not Mendelian'" is little short of libellous. Nor is it just to assert "Newton was a weakly baby, prematurely born, and would promptly have been condemned as not worth keeping had the statistical school been in power in his day."

Finally we should like to know what eugenists maintain that "a high birth-rate and a high infant mortality rate are to be commended because of their 'selection value,'" or that "slums are defensible on the ground that in the course of time there is bred in them a slum race which withstands and even thrives in such conditions."

A PRINCETON COLLOQUIUM ON MATHEMATICS.

The Princeton Colloquium: Lectures on Mathematics, delivered September 15 *to* 17, 1909, *before Members of the American Mathematical Society in connection with the Summer Meeting held at Princeton University, Princeton, N.J.* By G. A. Bliss and E. Kasner. Pp. iii+ii+107+ii+117. (New York: American Mathematical Society, 1913.)

THE first of the courses contained in this volume deals mainly with the theory of a set of implicit functions y_i, defined by a set of equations, $f_i = 0$ $(i = 1, 2, \ldots n)$, each involving the implicit functions and also the independent variables, x_1, x_2, $\ldots x_m$. In its general character the treatment is similar to that invented by Cauchy; but it is noticeable how the analysis has been simplified, and the results generalised, by improvements made quite recently. In particular, attention may be directed to the elementary character of the proof (by MacMillan) of what Prof. Bliss calls the preparation theorem of Weierstrass (p. 50): other illustrations might be given of a similar kind.

In carrying out the methods and ideas of Weierstrass, the principal result is that we obtain expansions for the y_i valid "in the neighbourhood of a point (a, b)." Prof. Bliss himself points out that one main object of his course is to deduce from the initial solution (a, b) something more than solutions of which we can merely say that they are valid very close to (a, b). By means of what he calls "a sheet of points" he is able to deduce from any initial solution (at an ordinary point) a sheet of solutions which only fail at "exceptional points," so we have something more or less analogous to Weierstrass's "analytical continuation" of a branch of a curve.

There are various interesting paragraphs on transformations from one plane region to another; a partial discussion of the singularities of the y_i, and a final lecture on existence-theorems connected with a set of differential equations.

Prof. Kasner's course on dynamics presents many features of novelty and interest. Broadly speaking, it is a quasi-geometrical study of trajectories with the aid of analytical (mainly contact) transformations. Many of the results obtained are of a remarkably elegant character: for instance, in the constrained motion of a particle on a surface under the action of positional forces, we have the theorem that the ∞^1 trajectories starting from a given lineal element have osculating spheres, at the common point, the centres of which lie on a conic in the plane normal to the element. A problem of more interest to physicists is this: given a system of curves in space, to find the condition that they may be trajectories, and to deduce the field of force from the set of curves when the proper condition is satisfied. This problem is fully discussed in chap. i., and the conditions for a conservative field are put into a remarkable geometric form.

We have also a section on least action, one on the space-time transformation used by Lorentz in the relativity theory, and various special illustrations of the general results.

Both these courses are so advanced that it is not easy to do them justice in a review: but from what has been said some idea may be gained of their general scope. Lectures of this kind are very valuable because they focus, so to speak, various lines of research upon a limited subject, and give an account of the really important results obtained. G. B. M.

NATIONAL MUSEUMS AND SYSTEMATIC BIOLOGY.

(1) *Manual of the New Zealand Mollusca.* With an Atlas of Quarto Plates. By H. Suter. Pp. xxiii+1120. (Wellington, N.Z.; J. Mackay, 1913.)

(2) *Catalogue of the Ungulate Mammals in the British Museum (Natural History).* Vol. ii., Artiodactyla, Family Bovidæ, Subfamilies Bubalinæ to Reduncinæ (Hartebeests, Gnus, Duikers, Dik-Diks, Klipspringers, Reedbucks, Waterbucks, etc.). By R. Lydekker, assisted by G. Blaine. Pp. xvi+295. (London: British

Museum (Natural History); Longmans, Green and Co., 1914.) Price 7*s.* 6*d.*

(3) *A Revision of the Ichneumonidae based on the Collection in the British Museum (Natural History).* Part iii. Tribes Pimplides and Bassides. By C. Morley. Pp. xi + 148. (London: British Museum (Natural History); Longmans, Green and Co., 1914.) Price 5*s.* 6*d.*

(4) *British Museum (Natural History). A Monograph of the Genus Sabicea.* By H. F. Wernham. Pp. v + 82 + xii plates. (London: British Museum (Natural History); Longmans, Green and Co., 1914.) Price 6*s.*

(5) *Echinoderma of the Indian Museum.* Part viii., Echinoidea (1) "An Account of the Echinoidea." By Prof. R. Koehler. Pp. 258 + xx plates. (Calcutta: Indian Museum, 1914.) Price 20 rupees.

THE publication of these volumes justifies, we think, the view held by a large number of biologists, that one of the most important functions of a national museum is to act as a centre of research in systematic biology. These institutions alone possess collections sufficiently adequate in number of specimens and wide enough in scope for the successful accomplishment of such work, and besides collecting and storing such collections, it is clearly their duty to have them studied and classified.

Mr. Morley's work is a particularly forcible example of the importance of systematic biology, and of the responsibilities which rest on the nation of having such work done and published. At a time when the study of economic entomology is so much to the fore, and when it is more than ever established that the one successful method of controlling insect pests is by means of their natural parasites, a revision of the most important group of parasitic insects is doubly needed, for it is imperative that parasites should be correctly identified before remedial measures, based on their use as controlling agents, are introduced. We are glad to note that our National Museum is alive to its duties in this connection.

(1) We congratulate the New Zealand Government on its enterprise in publishing Mr. Suter's manual, and the author on the successful accomplishment of an enormous task. The extensive additions to our knowledge of the molluscan fauna of New Zealand during the last thirty years had rendered a re-issue of Hutton's manual of 1880 imperative. The latter work enumerated 447 valid species, whereas the present volume deals with 1079 species, besides 108 subspecies and varieties. Mr. Suter brings our knowledge of the mollusca of New Zealand right up to date, and by giving useful keys to the genera and species renders his work invaluable to students and specialists alike. His manual, moreover, possesses one advantage over Hutton's in that it is accompanied by a volume of plates. Mr. Suter does not, we think, correctly interpret the rules of priority in zoological nomenclature. The fact that a specific name is unaccompanied by a figure is not, in our opinion, sufficient excuse for the rejection of that name, provided the description is sufficiently clear for identification purposes. Otherwise Mr. Suter's work contains few serious errors or misprints, more especially as he had no opportunity of revising the later proof sheets. The name of the genus to which our common periwinkle belongs is, however, surely misspelt. The use of ten different qualities of paper in the production of this volume may have been unavoidable, but it does not enhance the appearance of the book.

(2) In this volume dealing with certain subfamilies of African antelopes, Mr. Lydekker continues his valuable catalogue of the Ungulata in the British Museum collections. The work is provided liberally with useful keys for the identification of families, genera, species and subspecies, and is accompanied by a number of useful photographs of heads and horns. We are very glad to notice that Mr. Lydekker has given special prominence to external characters, more particularly to the horns, for, besides rendering the work more readily acceptable to sportsmen, it is made of greater service to the museum curator who, more often than not, has only heads and horns at his disposal.

(3) We congratulate Mr. Morley on the rapid progress he is making with his important and much-needed revision of the Ichneumonidæ. This part follows the same general lines as the two preceding, and introduces nearly fifty species as new to science. Valuable as Mr. Morley's work is, it is as yet merely a collection of critical notes on species which the author has had the opportunity of examining. We think that such work would be more fittingly published in the Transactions of some learned society, or in some other serial publication, and this leads us to suggest that the British Museum authorities should consider the advisability of issuing a serial journal of their own for the publication of research such as Mr. Morley's, reserving their book publications for complete monographs, of the nature of those which are usually associated with their name. There is an abundance of work done under the auspices of the British Museum to justify such a periodical, and to keep it going. We hope that Mr. Morley's revision is but the necessary prelude to a fuller monograph.

(4) This monograph is based on a close examination of all the material of the genus contained in the principal European Herbaria, and the exhaustive nature of Mr. Wernham's work may be judged from the fact that he adds no fewer than sixty-two new species to the forty-four already known. All the species are briefly but concisely described, and there is an extremely useful key for their ready determination. The monograph, which is illustrated by twelve carefully lithographed plates, will be indispensable to all students of the Rubiaceæ and to curators of Herbaria who desire to have their material correctly labelled.

(5) In this memoir Prof. Koehler continues his valuable studies on the Echinodermata in the collections of the Indian Museum, and publishes the results of his examination of the Irregular Echinoids of the Spatangus group. Two genera and seventeen species are described as new to science. Several of the species had been given provisional new names by Anderson, and though they were unaccompanied by any kind of description, Prof. Koehler has, with characteristic courtesy, retained Anderson's names in all cases. The descriptions appear very clear and detailed, and are throughout accompanied by a wealth of illustrations. The work maintains the high standard set by Prof. Koehler in the six earlier memoirs in this series, of which he is the sole or part author. W. M. T.

OUR BOOKSHELF.

A Manual for Masons, Bricklayers, Concrete Workers and Plasterers. By Prof. J. A. van der Kloes. Revised and adapted to the requirements of British and American readers by Alfred B. Searle. Pp. xii+235. (London: J. and A. Churchill, 1914.) Price 8*s.* 6*d.* net.

In this book will be found much useful information regarding the composition of various kinds of mortar, together with the effects of mortar of unsuitable composition. These subjects occupy practically the whole volume. The book opens with some physical and chemical principles, among which we note that the scaling of stone, brick and concrete structures is ascribed to osmotic pressure caused by the expansion of material in the pores. A valuable feature of the book is the number of photographs included showing defects in existing continental structures—similar defects may be found in many British buildings.

In the section dealing with dams it is pointed out that engineers generally have confined themselves to the results of tensile and crushing tests of the mortar employed, notwithstanding the fact that a mortar strong under test may become the cause of disintegration of the structure in consequence of its bad composition. Many of the dams built in the last half-century will be found to be leaking if they are examined carefully. The author gives photographs showing the defects in the Gileppe dam, near Verviers, in Belgium, and quotes it as the worst example known to him. This dam was built in 1870–75 and has a height of 157 ft.; the thickness at the base is about 220 ft. and the breadth at the top is 50 ft. Sandstone and limestone from neighbouring quarries were used and the mortar was composed of five measures of hydraulic lime from Tournai, one measure of trass and four measures of sand, so that four to five times too much lime was used. The leakage at first amounted to 5570 gallons a day, and after four years the outside of the dam remained permanently wet. In May, 1911, the upper part of the dam showed dry incrustations, lower down the masonry was wet under the incrustations, and at the lowest part of the steps the dripping water was like a small waterfall.

We have probably quoted enough from the book to indicate the value of its contents to the engineer, architect, builder, and student; it is, however, a matter of regret from the student's point of view that the price of this useful volume has been fixed rather high.

The History and Economics of Indian Famines. By A. Loveday. Pp. x+163. (London: G. Bell and Sons, Ltd, 1914.) Price 2*s.* 6*d.* net.

The literature of Indian famines is so extensive that Mr. Loveday has had no light task in compiling the main historical facts and formulating the conclusions contained in this enlarged prize essay. Famines are rightly regarded as natural calamities, caused by failures or irregularities of the monsoons. Indian historians record their occurrence under native rule. The policy of the native rulers was rather prevention (by wrong methods) than cure: the mortality was fearful. Under the East India Company the famine policy was uncertain and unsuccessful, the systems of famine-relief were inadequate, the economic conditions different from the present. After 1858 the Government adopted, in the great famine of 1860 in Upper India, a famine relief organisation which has been greatly developed but never abandoned. The Orissa failure, 1866–7; the excessive expenditure accompanying the success in Bengal, 1874; the great mortality in Madras, 1877, led to the Famine Commission of 1878–80. Since then Famine Codes have been framed for famine-relief administration. With subsequent experience, mistakes have been corrected and the Codes perfected, so that now famines—of work rather than of food—are managed effectively. Mr. Loveday describes briefly the various stages of policy, *e.g.* importation, emigration, poor houses, etc., etc.; the later tendency has been to greater generosity and decentralisation. Irrigation works (when possible) to grow food are being extended; and railways to transport it to distressed tracts. Meanwhile the economic condition of India is varying, changes must be recognised, protective measures and the wider economic problems—indebtedness, agriculture, cooperative societies, etc., etc.—must be considered together. B.

The Statesman's Year-Book: Statistical and Historical Annual of the States of the World for the Year 1914. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Fifty-first annual publication. Revised after Official Returns. Pp. lxxix + 1500. (London: Macmillan and Co., 1914.) Price 10*s.* 6*d.* net.

As the years go by, the growth in size and usefulness of this welcome summary of the world are signs not only of the value of the contents, but of the carefulness which marks its compilation. Much wants more, and many readers would, no doubt, appreciate the extension of the introductory tables to include world surveys of other commodities than coal, gold, etc. The maps this year deal with new political boundaries in Balkania and Mongolia, the extension of railway communications in America, and the position and number of the wireless stations of the world. Many portions of the main text have been subjected to a thorough revision by competent authorities, and no effort seems to have been spared to bring the fifty-first issue thoroughly up-to-date. The complete bibliographies add specially to the usefulness of this indispensable year-book.

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.*]

Man's Chin: a Dynamical Basis for Physical and Psycho-physiological Utilities.

To account for the presence of man's chin at least three different explanations have been brought forward and discussed:—(1) That the chin has been evolved by sex selection for its æsthetic value; (2) that it was needful for the development of the genio-glossal muscle and speech; (3) that with man's erect posture the chin has been chiefly useful in affording room for important structures in the throat, and in protecting them during combat, etc. These explanations have so far met with very little acceptance.

A conception of the chin as a *dynamical* factor in both mastication and speech does not appear to have received attention. An engineer examining the dental mechanism as a type of machine new to him would, on finding there was a considerable bulk of constructional material projecting from the chief moving member, be nearly certain to ask—What does this do? The chin mass is situated at the outer end of the jaw lever, where its momentum is greatest. It is built up in the heavier material used in the general construction. There is another point, too, that one should not too readily dismiss as a mere coincidence. Every rotation movement of the mandible during its elevation or shutting has combined with it a movement—obliquely upward and backward—of translation. The combined movements are so directed that at some parts of the jaw the resultant velocity is less than would exist if either component were to act alone; and at about a point situated between the jaw angle and the condyle, the resultant velocity is so small that some observers mistakenly believed it to be nil. At the chin, on the other hand, the directions of the component movements are such that the resultant velocity reaches nearly its maximum acceleration.

My suggestion is not quite that the chin is simply man's masticating hammer; something rather less crude than a purely percussive function is conditioned by the momentum of the chin. No doubt the momentum of the chin may appear to be a very small contribution to the considerable muscular force often used in chewing. Yet on the teeth themselves many morphological details that have been preserved as distinct specific features are so small that we do not yet know what the particular utilities are that determined their shape and survival. Further, there is another peculiarity in the mandible movement that may have some significance in this connection. During a (supposable) uniform movement of rotation about the condyle as horizontal axis, the accompanying translation movement is not uniform, but relatively varied—slow or small in the beginning, quicker in the middle, and slower again towards the end of the condyle path. This is favourable to the normal *rhythmical* movement of the jaw by giving in some degree a pendulum-like character to its swing. And it so happens that the position of maximum velocity (and momentum) coincides with the position of greatest resistance and food-strain in chewing—that is, when the cutting-edges of the external blades of the lower cheek teeth are just about to pass their upper opponents in the inward-and-upward shearing thrust. The chin momentum operates most strongly just about the point where it is most useful in preserving the rhythmical movement of mastication, so as to render less necessary any *consciously*-directed variation in the muscular effort put forth in any single chewing stroke.

Then, in the numerous smaller chewing movements for the finer reduction of food morsels, the chin mass (by both inertia and momentum) has at least some value as a "balance," controlling and guiding the niceties of direction in the thrust. The utility of balance influences the construction of many man-made implements (pen- or brush-holder, razor handle, spear, etc.) in the use of which some precision is required; this feature in construction has usually been adapted and has survived quite independently of any conscious or theoretical estimation of its special function. The obvious objection that animals manage the "niceties" of mastication without a chin could be met only by going more fully into the dynamics of the subject. This much at least can be stated here as being susceptible of proof—that as compared with the prognathous savage or the ape, the dental apparatus of modern civilised man is the "finer" machine, in so far as it is the better adapted for those shearing stresses by which tough foodstuffs are comminuted with economy of effort.

The above suggestion of "balancing" and "steadying" utilities can also be applied to the rapid and yet delicately controlled movements of the mandible in speech. The man who wrote a book on "The Speech of Monkeys" might possibly have had hope of more success in interpretating the "language" of these animals if only he could have subdued and steadied their jibberings and chatterings by providing them with good weighty chins.

D. M. SHAW.

Eltham, S.E.

Meteoric Streaks and Trains.

PROF. C. C. TROWBRIDGE, of New York, has been conducting an interesting investigation, during recent years, into the heights and velocities of the streaks and trains of meteors. He has been collecting old records of these phenomena, and will be glad to receive any new materials which may be gathered during this year's Perseid shower. Every year brings us some brilliant Perseids leaving durable streaks, and it is important that when these appear the drift

amongst the stars should be noted at short intervals. In the case of a streak enduring ten minutes, a series of diagrams showing the positions of the streak and neighbouring stars every two minutes would be valuable.

There is a large amount of data available from past observations, but it is for the most part of very rough imperfect character, and we require more exact and complete records before we can determine the exact heights of the streaks and the motions of the outer atmosphere. However, the discussion so far as it has gone proves that the streaks are usually from fifty to sixty miles high, and that their motion is often more than one hundred miles an hour. A very destructive hurricane on the earth's surface would about equal this, so that it is certain that the upper tenuous air is influenced by currents of far swifter character than the atmosphere immediately overlying the earth.

If observers of meteors will only carefully record meteoric streaks and trains whenever they are seen we shall soon be in a position to ascertain more trustworthily and definitely the behaviour of these curious afterglows. From balloon ascents it has been concluded that the general drift of the air in the region of ten or fifteen miles altitude is to E. and S.E., and this precisely accords with the direction of the majority of meteoric trains between about fifty and sixty miles high.

W. F. DENNING.

Bristol, July 13.

Climatic Change.

I HAVE just seen the translation of Prof. Albrecht Penck's lecture on "The Shifting of the Climatic Belts," printed in the *Scottish Geographical Magazine* for June, 1914. The main line of the author's argument is that certain lakes—*e.g.* Lake Chad in the Sahara, the lakes of Mexico City, and of the Titicaca basin, being very slightly salt, indicate an *increasing* precipitation, and during the so-called "pluvial period" were drier than at present, owing to a shifting of the arid belt equatorwards.

Surely it is more reasonable to attribute the comparatively slight salt content to the fact that the basins have only recently ceased to have an outlet, owing to a *decrease* in the precipitation. A slow fluctuating decrease in the rainfall of Mexico has been practically proved by Prof. Ellsworth Huntington (*e.g.* "The shifting of climatic zones as illustrated in Mexico," Bull. Amer. Geogr. Soc., vol. xlv., 1913, Jan.–Feb., and also his recent memoir on the "Climatic Factor"). In the case of Lake Chad, K. v. Zittel, an accomplished observer, describes evidence of a former greater extent (*Palaeontographica*, vol. xxx., 1883, p. 39). Information as to whether the lake has an old outflow channel would be valuable.

So long ago as 1876 A. Agassiz, in his "Hydrographic Sketch of Lake Titicaca" (Proc. Am. Acad., vol. xi., 1876, p. 268), wrote: "The whole of this district is receiving a much smaller waterfall than in former times."

Prof. Penck is unfortunate in his examples; the weight of evidence against him, pointing to a former moister period on the equator side of the arid belts, is too great to be ignored. And as he admits desiccation on the poleward sides of these belts, the facts suggest that the dry area may vary in breadth as well as in position, and that the "pluvial period" had a real existence—*outside the glaciated regions*.

CHAS. E. P. BROOKS.

"Homeleigh," 3 Roseleigh Avenue, Highbury, N.
July 17.

THE PLUMAGE PROHIBITION BILL.

BEFORE these lines are published the fate of the Plumage Prohibition Bill may have been decided. It seems little to our credit that London should be the chief market for the nefarious traffic which this Bill was framed to abolish; and this view was surely endorsed by the House when, on the second reading, the Bill was passed by a majority of nearly three hundred. Nevertheless, during the committee stage the Bill was virulently opposed by a small, well-organised minority, including some actually engaged in the sale of plumage for millinery purposes.

Unfortunately, the hands of the opposition have been strengthened by the action of "The Committee for the Economic Preservation of Birds"—a committee which, strangely enough, does not contain the name of a single ornithologist of repute. So completely have these opposing forces contrived to play into one another's hands that it is probable that, to save the Bill, it will have to be modified. For total prohibition a schedule will have to be substituted, which must be so framed as to secure the safety of such species as are at present in actual danger of extermination.

It would be useless to urge the need of preserving these threatened species because of their immense value as living witnesses of the evolution theory; for science, and scientific problems, have little weight in this country. But, if for no other reason than that of its inhumanity, this ghastly traffic should be ended.

The contention that if this Bill passes a large number of workpeople will be thrown out of employment has been shown, on figures furnished by the trade itself, to be without justification. Equally groundless is the assertion that the placing of the Bill on the Statute Book will simply divert the trade to Paris without saving the life of a single bird. If there were any sort of foundation for this, the French Chamber of Commerce would not have implored the British Government to throw out this Bill. Furthermore, we are assured that if this Bill passes, Germany will follow our lead. This done, the plume-trade in Europe is dead.

If only an emasculated Bill succeeds in running the gauntlet of trade interests a step in the right direction will have been achieved. If, on the other hand, the present Bill is defeated, then it is fervently to be hoped that a new Bill will be introduced at the earliest possible moment; and having regard to the voting on the second reading of the present Bill, there is every reason to regard its success as assured.

SPACE AND TIME.[1]

"FROM this time forth space and time apart from each other are become mere shadows, and only a kind of compound of the two can have any reality." So spoke Herrmann Minkowski in 1908. But his statement has not yet been realised.

[1] H. A. Lorentz, A. Einstein, H. Minkowski: Das Relativitätsprinzip. A Collection of the Classical Papers in the Development of the Theory of Relativity, from 1895 to 1910. Pp. 89, with portrait of Minkowski. (Leipzig: B. G. Teubner, 1913.) Price 3 marks.

It is still the elect to whom it is given to escape from the bondage of their own consciousness so completely that they can think of time as nothing more than the most convenient means of ordering events. Sir Oliver Lodge was voicing the feeling of the man in the street when, at Birmingham, he said: "Surely, we must admit that space and time are unchangeable: they are not at the disposal even of mathematicians."

It is not so long since a similar divergence of view existed in respect of the other fundamental dynamical magnitude *mass*. But here the controversy has subsided; the mass of a body is still something more than a shadow, though no teacher of dynamics would to-day think of defining it as "the quantity of matter" in it. Rather the conception has gained in concreteness through its separation from the crude intuitive notion of heaviness, through the realisation that no precise definition is possible apart from the uniformity which is expressed in the laws of motion.

A reader of "The Grammar of Science" might well have exclaimed: "From this day forth mass is a mere shadow." But no one now would assert that mass as a measurable quantity is an *a priori* and obvious concept, independent of the phenomena of motion.

Now, apart altogether from the particular assumption of the principle of relativity that electrical phenomena cannot reveal an absolute motion, it was implied by its founder that as measurable quantities space and time are on exactly the same footing as mass, in that they are inseparable from the uniformities which they are used to describe. They are no more at the disposal of the metaphysician than of the mathematician. The psychologist is within his province in endeavouring to elucidate the nature of the consciousness of duration, but in the region of exact physical measurement this aspect of time is eliminated, so that only experiment can say whether there is, for instance, a unique sense in which two events at different places are simultaneous. It is exactly this which experiment has failed to do. Whether it will ever do so cannot be foreseen; the principle of relativity seeks to examine some of the consequences of assuming that it will not. But it is for the present generation to decide whether it is a sound scientific principle that time, like other physical concepts, is dependent for its significance on the observation of uniformity in physical processes, and that the reality of it to our minds is only due to the unbroken regularity of these processes. In this sense we may surely say with Sir Oliver Lodge that space and time are unchangeable, but at the same time we must leave it to nature to tell us what they are, and not foist upon the measures of them a metaphysical significance borrowed from a conceptual scheme which has been outgrown by experiment as the dynamical universe conceived by Laplace has been. The small volume before us embodies the classical papers, in which the gradual transition from the Newtonian thought about space and time to this point of view is developed.

THE HAVRE MEETING OF THE FRENCH ASSOCIATION.

THE arrangements are now complete for the visit of members of the British Association who have been unable to take part in the meeting in Australia, to the congress of L'Association Française pour l'Avancement des Sciences at Havre, beginning on Monday, July 27, and ending Sunday, August 2. Nearly one hundred members have intimated their intention of availing themselves of the courteous and kindly invitation with which they have been honoured by the French society. Among them are about fifty delegates of the associated and affiliated societies which are in correspondence with the British Association. The council of that association has approved of the holding of a meeting of the conference of delegates at Havre during the present year, to be followed later on, if necessary, by a meeting in London for any formal business that may still require to be done.

The session of the conference of delegates will be held at Havre on Tuesday, July 28, at 2.45 p.m., and as it forms part of the accepted programme of the French Association, it is hoped that it may be attended by many members of that association. It will be presided over by Sir George Fordham, who will deliver an address, in which he will direct attention to the work of the conference, since its establishment in 1885, and that will be followed by a discussion, in which the functions of local societies will, it is hoped, be considered from an eminently practical point of view. There is, it is understood, a strong feeling among scientific men in France in favour of the organisation of local societies in that country upon similar principles, and it would be very satisfactory if one result of this joint meeting should be to facilitate the movement in that direction.

At the opening meeting of the congress, to be held in the Grand Theatre, Place Gambetta, on Monday, July 27, at 2.30, Sir William Ramsay will speak as the principal representative of the British Association. In the sectional meetings on the four following days, several papers will be contributed by the English visitors. On Friday, July 31, at 2.30, a general Anglo-French meeting will be held, at which it is proposed that the subject of the Channel Tunnel should be discussed, and on the evening of the same day a discourse will be delivered by a member of the British Association in the Grand Theatre. Thursday, July 30, will be devoted to an excursion to Rouen, and the congress will conclude with a cruise and visit to Cherbourg on the Transatlantic steamer *La Touraine*.

The committee to which the council of the British Association has entrusted the making of these arrangements owes much gratitude to Dr. A. Loir, who two years ago conveyed the invitation of the French Association to the meeting at Dundee, and has been most assiduous in his care for the comfort of the English visitors. The invitation is felt to be a very graceful act on the part of the French Association.

OSCILLATIONS OF FRENCH GLACIERS.[1]

THIS part of the valuable publication issued by the French Government, is chiefly devoted to the glaciers of Savoy, because, though those of the Pyrenees have been studied with the same thoroughness, they have not attracted so much notice in the past, and thus less information was obtainable. In Savoy also the history of the glaciers of the Mont Blanc range is far more complete than in the Maurienne, because, fewer than seventy years ago, these districts were but rarely visited by travellers. Careful search in the archives and libraries of Annecy, Geneva, and Chamonix has discovered more than could have been anticipated about the history of the Mont Blanc glaciers, and that of the Glacier du Bois has been traced back with fair completeness for more than three centuries.

The earliest maps, restricted to northern Savoy, are dated 1555 and 1562, but these are practically worthless, and the first on which the glaciers are indicated is as late as 1742. They are, however, mentioned in some detail in documents written in 1580 and 1605, during which time a notable advance of the ice evidently did serious damage to property in the valley of Chamonix. After this the information is for a time less complete, but it rapidly improves with the coming of travellers, and from about 1780 illustrations provide another source. Several of them are reproduced in this publication, and though often rude, they form valuable records of the extent of the ice at particular dates. The glaciers of which information has been obtained—not in all cases equally complete—are six in number, and their oscillations show a general, though not an exact correspondence. Including the glaciers of the Maurienne, their advances and retreats indicate a certain periodicity. From 1605 to 1894 (inclusive) there have been seven of the former, the longest interval being forty-four years and the shortest thirty-one years, giving an average of forty years in 284 years; of these, the advances about 1610, 1716, and 1822 were exceptionally great, and these maxima are 106 years apart. Numerical correspondences are also noted between two other groups of oscillations, with the result that the figures suggest general periodicities of about thirty-six years, and special of three times that amount.

The mean temperature and rainfall, of which records are given, must produce effects on these movements, and it is remarkable that the former, between 1773 and 1860, rose steadily by 0·871° C. and has since then declined by 0·698° C. The remainder of the volume is devoted to glaciers in the Pyrenees, but we must be content to mention these, as the information is more imperfect, and only to direct attention to another part (Annexe du Tome v.) of the same publication, which contains a valuable series of maps of the hydrography of the river-basins of the Bréda, the Arc, and the Durance. T. G. B.

[1] Ministère de l'Agriculture: Direction Générale des Eaux et Forêts. 2e Partie, Eaux et Améliorations Agricoles. Service des Grandes Forces Hydrauliques (Régions des Alpes et du Sud-ouest). Études Glaciologiques Savoie-Pyrénées. Tome iii., 1912.

A NATURE-RESERVE IN SPITSBERGEN.

THE question of the government of the Arctic isles of Spitsbergen is occupying an international commission, and meanwhile Prof. H. Conwentz opportunely directs attention to the need for the demarcation of a Polar natural history reserve. In the second part of vol. iv. of his *Beiträge zur Naturdenkmalpflege*, he brings together the views of a number of scientific men who have visited Spitsbergen, and points out the wanton destruction of reindeer, polar bears, and other animals, that is encouraged by many of the pleasure-expeditions to the north. The establishment of a recognised government would enable such "sport" to be rigorously held in check. As Prof. Penck reminds us in his contribution, a traveller may land in summer on Spitsbergen, may see the antlers of reindeer and their tracks in the soil, and yet may never come across a single individual. The accessibility of Spitsbergen makes it especially attractive to the geologist and the naturalist, and the scale of its scenery provides an admirable illustration of our own islands during the waning of the Quaternary ice-age.

A complete nature-reserve is now proposed for the region north-west of the Ice-fjord, leaving the coal-mining area of Advent Bay and the whale-fisheries of Green Harbour in a larger area over which partial control may be effected. Anyone who has seen the fog roll like a curtain from the ice-flecked water, and the great panorama of peaks and glaciers appear as a first vision of the Arctic world, will assuredly give sincere support to those who would limit the private exploitation of Spitsbergen. Prof. Sapper has the foresight to propose the prohibition of hotels in proximity to glaciers of special beauty. He directs attention to such geographical features as the polygonal soils and the hillsides grooved by arid erosion, and to the marring effect that factories might have upon landscapes of such exceptional interest. We may add that the driving of a road across the boulder-clay of the von Post Glacier would deprive geologists of one of the most valuable "modern instances." The conditions along the vales from which the ice has shrunk away are those amid which our palæolithic ancestors founded man's dominion in European lands. If scientific workers seek to preserve Spitsbergen from the fate that has overtaken Switzerland, it is in no selfish spirit but in the desire to retain for all an intellectual heritage. GRENVILLE A. J. COLE.

DR. ADOLF LIEBEN.

DR. LIEBEN, whose death occurred on June 6 at the age of seventy-eight, was born on December 3, 1836, at Vienna, and was the son of a merchant in that city. Until the age of twelve his education was entrusted to the care of Moritz Hartmann, who was later to make a name as a poet. Later young Lieben began to interest himself in chemistry, and attended lectures at the university under Redtenbacher and Schrötter. In 1855 he entered the University of Heidelberg, and worked in Bunsen's laboratory, where he met

many students—Beilstein, Baeyer, Landolt, L. Meyer, and Roscoe—who were destined later to become distinguished in the science of chemistry.

After taking his doctorate in 1856, he left Heidelberg, and studied for a time in Paris. On the recommendation of Dumas he entered the alkali works of Kuhlmann in Lille; but industrial chemistry had no attractions for him, and in 1859 he was back again in Vienna in Schrötter's laboratory, where he remained until 1861. In 1862 he made a second visit to Paris, where he met Cannizzaro, who offered him a post in the laboratory at Palermo, where he ultimately became professor. In 1867 he was elected to the chair of chemistry at Turin, and remained there until 1871, when he was appointed to a professorship at Prague. In 1875, on the death of Rochleder, he was called to fill one of the two recently created chairs at the new University Institute at Vienna, where he remained for thirty years, actively engaged in teaching and research, until his failing health obliged him to retire. He is described as a lucid lecturer and brilliant experimenter, and his lectures were largely attended by students, many of whom later became secondary-school teachers or obtained important positions in various chemical industries.

The esteem in which Lieben was held by them and by his colleagues is shown by the celebrations which attended his fiftieth jubilee and seventieth anniversary in 1906, and by the numerous honours and distinctions which were conferred upon him in his later years. His researches cover a wide field, and include important investigations in inorganic and physical chemistry; but his principal contributions lie in the domain of organic chemistry. He was among the earliest investigators to adopt Kekulé's new structural formulæ.

One of his first researches was carried out in Wurtz's laboratory in Paris (1856–1859) on the action of chlorine on acetaldehyde, alcohol, and ether, which led to the discovery of the chloroacetals and dichloro-ethers; but his most productive period was during the time he held the chairs at Turin and Vienna, where he became associated with Rossi and later with Zeisel and with Haitinger. In Turin he began his investigations on the synthesis of the alcohols by the method of Piria and Limpricht by heating the calcium salts of the fatty acids with calcium formate, and thus obtaining aldehydes which on reduction yielded the alcohols. In this way he prepared a series of alcohols from methyl alcohol to hexyl alcohol. This was followed by a study of the aldol and crotonic aldehyde condensation, which he applied to a variety of aldehydes, and obtained by reduction new glycols and alcohols. It was at this time that he discovered the iodoform reaction for ethyl alcohol which goes by his name. But one of his most interesting contributions which he carried out with Haitinger during 1883–85 is on the structure of chelidonic acid (a constituent of the yellow juice of the greater celandine), which was recognised as a pyrone derivative, and was converted into a hydroxypyridine carboxylic acid by the action of ammonia.

Lieben also interested himself in what is now termed biochemistry. By the aid of the iodoform reaction he was able to detect small quantities of alcohol in urine, and also gave some attention to the reduction products of carbon dioxide under the influence of light in an attempt to elucidate the process of plant assimilation. J. B. C.

THE REV. OSMOND FISHER.

FULL of years, but with interests unabated and working until within a few days of the end, the veteran geologist, Osmond Fisher, passed away on July 12, at the age of ninety-six.

He was born on November 17, 1817, at Osmington, in Dorset, of which place his father, the Rev. (afterwards the Ven.) John Fisher, was vicar. Educated at Eton under Dr. Keate and at King's College, London, he proceeded in 1836 to Jesus College, Cambridge, from which he graduated as eighteenth wrangler in 1841, the year in which Stokes was senior. He was ordained deacon in 1844, and priest the following year. After a short period of clerical work at Writhlington, near Radstock, and Dorchester, he returned to Cambridge in 1853 as tutor of Jesus College, but left after four years' work on his presentation to the college living of Elmstead, near Colchester. In this year, also, he married Maria Louisa, daughter of Mr. Hastings N. Middleton, of Ilsington House, near Dorchester. In 1867 he was presented to another college living, that of Harlton, near Cambridge, and here he resided until his retirement in 1906. The last eight years of his life were spent in the home of his eldest son, the rector of Graveley, near Huntingdon. He lies buried in the quiet Harlton churchyard, within sight of his forty years' home.

From his childhood, Mr. Fisher was a geologist. Fossils collected from the Coral Rag before he was fifteen are now in the Sedgwick Museum. His contributions to pure geology relate to beds of Cretaceous or more recent date. Among them may be mentioned his papers on the Bracklesham beds, the phosphatic deposits of the Cambridge Greensand, and the mammaliferous deposits of Barrington, as well as those on the "trail" and the denudations of Norfolk.

It is, however, as a physical geologist that Mr. Fisher is most widely known. His originality in this branch of geology is shown by the facts that in 1841 the contraction theory of mountain-formation occurred to him, and that in 1855 he attributed the Visp earthquake of that year to the growth of a fault. That he was by no means a slave to his own theories is equally manifest, for by 1873 he had abandoned the contraction theory, believing the cause invoked to be incapable of producing the known inequalities of the earth's surface. With the contraction theory went also his belief in the practical solidity of the earth's interior, and from this time dates his championship of the hypothesis of a liquid substratum between the solid crust and core of the earth, and of the well-known theory of mountain-building with which his name will always be connected. It

is not too much to say that the leisure of his last forty years was spent in developing this theory, and in meeting, with unfailing courtesy, the objections which from time to time were urged against it. On the whole, his work failed to attract the attention and criticism of mathematicians in this country, but by geologists, both here and abroad, it has always been highly valued. The Geological Society, ever ready to welcome the aid of mathematicians, awarded him a grant from the Lyell fund in 1887, the Murchison medal in 1893, and the Wollaston medal in 1913.

CHARLES DAVISON.

NOTES.

AT the thirty-third annual meeting of the Society of Chemical Industry held in Nottingham last week it was announced that the society's medal had been awarded to Sir Henry Roscoe, the first president, for his services to science, education, and the society. In his presidential address, which was read in his absence, Sir William Crookes said that the world is still greatly in need of able researchers, perhaps more so now than at any previous time in its history. Discoveries of vast importance are waiting their Newtons. But is not the attitude of the public towards investigators lacking in understanding and imagination, and do not the authorities treat scientific exploration in a niggardly spirit? Scientific research is being starved. The allotment of public moneys to the furtherance of scientific work, the tangible recognition of the services of scientific men, the provision of opportunities for all kinds of investigations of scientific problems without reference to their immediate commercial value—these are the benefits which should be looked for at the hands of the Government and of the nation. On the same day that Sir William Crookes's address was read, Mr. Cowan asked the Prime Minister in the House of Commons whether any existing fund is available out of which men of science may be compensated for losses incurred by them in doing unremunerative scientific work when such work has proved to be of advantage to his Majesty's Government and subjects; and whether, if no such fund is available, he would consider the advisability of providing funds for meeting such cases? In his reply, Mr. Asquith mentioned that nine civil list pensions were awarded for scientific services last year, and he said: "I am not satisfied that further provision is necessary." A list of these pensions was given in our issue of July 9 (p. 485), but we suggest that such grants, made partly on account of inadequate means of support, do not give a satisfactory answer to Mr. Cowan's question or provide the encouragement of research to which Sir William Crookes referred.

THE death is announced, in his sixty-sixth year, of Sir Christopher Nixon, ex-president of the Royal College of Physicians of Ireland, and Vice-Chancellor of the National University of Ireland. He was the author of a number of books on medical subjects and also the first president of the Royal Veterinary College of Ireland.

THE Royal Agricultural Society of England is offering a medal, together with life membership of the society, for a monograph or essay, which has not been previously published, giving evidence of original research in any agricultural subject or any of the cognate agricultural sciences applicable to British farming. Intending candidates should forward their essays to the secretary of the society at 16 Bedford Square, W.C., not later than July 25.

THE American Museum of Natural History has received 1,000,000*l.* under the will of the late Mrs. Morris K. Jesup, who died on June 17. According to *Science*, Mrs. Jesup made other bequests to public institutions amounting to 690,000*l.*, including 60,000*l.* to Yale University. Mrs. Jesup's husband, who died in 1908, became president of the Museum of Natural History in 1882, and devoted a large part of his time and energy to its interests. In his lifetime Mr. Jesup gave more than 200,000*l.* to the museum, and under his will it inherited an additional 200,000*l.*

WE understand that a National Council is about to be formed for the purpose of combating venereal disease. The preliminary arrangements are being made by Sir Thomas Barlow, president of the Royal College of Physicians, Sir Rickman Godlee, until recently president of the Royal College of Surgeons, Sir Francis Champneys, president of the Royal Society of Medicine, the Bishop of Southwark, and Major Leonard Darwin, president of the Eugenics Education Society. A meeting has been held at which, besides those mentioned above, those present included Sir Clifford Allbutt, Sir W. Osler, Sir A. Pearce Gould, Sir Henry Morris, Sir Wilmot Herringham, and Mr. Charters Symonds.

AT the recent July meeting of the executive committee of the British Science Guild, Sir Norman Lockyer, K.C.B., F.R.S., in the chair, a special committee was appointed to inquire into and report upon the question of the provision, in this country, for veterinary research. A special committee, consisting of the president, the Right Hon. Sir William Mather, Sir Norman Lockyer (chairman), Lieut.-Colonel Sir Chas. Bedford, Hon. Sir John Cockburn, Prof. Meldola, Major O'Meara, Sir Boverton Redwood, Sir Ronald Ross, and Prof. Silvanus P. Thompson, was appointed to consider and report upon various matters arising in connection with science and the State and the encouragement of discovery referred to in the address delivered by Sir Ronald Ross at the annual meeting of the guild, at the Mansion House, on May 22. A report was received from the technical optics committee dealing with the inadequate provision for, and the unsatisfactory state of, technical training in optics in this country, and proposals for the establishment of a British Institute of Technical Optics were considered.

THE following list of members of the Imperial Transantarctic Expedition has been officially announced:—*Weddell Sea Party*: Sir Ernest H. Shackleton, leader of the expedition; Mr. Frank Wild, second in command; Mr. G. Marston, Mr. T. Crean, Captain Orde Lees, Lieut. F. Dobbs, Lieut. Courtney Brockle-

hurst, Mr. J. Wordie, geologist; Mr. R. W. James, physicist and magnetician; Mr. L. H. Hussey, assistant magnetician and meteorologist; Mr. F. Hurley, photographer and kinematographer; Mr. V. Studd, geologist; Lieut. F. A. Worsley, in navigating command of the *Endurance* on the voyage from London to Buenos Aires and the Weddell Sea, and afterwards to take part in the surveying and exploring of the coast; Mr. Jeffreys, Mr. Hudson, and Mr. A. Cheetham. *Ross Sea Party*: Lieut. Aeneas Mackintosh, leader and meteorologist; Mr. E. Joyce, zoologist; Mr. H. Ninnis; Mr. H. Wild; and Dr. Macklin, surgeon. There only remain two vacancies, and these are to be filled by another doctor and a biologist. The arrangements for the Ross Sea ship *Aurora* are not yet quite complete, but the *Endurance*, with the Weddell Sea party, will sail in a few days.

ONE half of the present summer has gone, and the weather so far has been generally fine. The weekly weather reports issued by the Meteorological Office for the first six weeks of summer, ending July 11, show that the mean temperature for the period is in excess of the average over the whole of the United Kingdom, except in the north of Ireland, where it is normal. The greatest excess is 2° in the east and north-east of England. The rainfall differs very materially in the various districts. In the north-east of England the aggregate rainfall is 166 per cent. of the average, in the midland counties 144 per cent., in the south-west of England 138 per cent., in the Channel Islands 110 per cent., and in the north-west of England 103 per cent. of the average; in all other districts of the United Kingdom there is a deficiency. The least rainfall for the six weeks in any district is 2 in. in the west of Scotland, which is 49 per cent. of the average. In the north of Ireland the rainfall is 60 per cent. of the average, in the north of Scotland 62 per cent., in the south of Ireland 67 per cent., in the east of Scotland 82 per cent., in the south-east of England 84 per cent., and in the east of England 96 per cent. of the average. The duration of bright sunshine is in excess of the average over the eastern section of the kingdom, but it varies somewhat in the western section. At Greenwich there have already been twelve days since the commencement of June with a shade temperature of 80° or above, whilst the average for the three summer months in the last seventy years is only thirteen. The rainfall is decidedly deficient of the average, whilst the sunshine is largely in excess of the average.

THE University of Pennsylvania Anthropological Publications (vol. iii., No. 3) is devoted to an account of excavations at Urokastro, in eastern Crete, by Miss E H. Hall. The importance of this investigation lies in the fact that while the work of Sir A. Evans and others has hitherto been mainly devoted to the culture of the Bronze age, little has been systematically done to work out the Iron-age culture. This raises important ethnological problems; and the writer ventures the theory that in the remains discovered it is possible to recognise, in order, three great invasions of Crete from the north: those of the Mycenæans, Achæans, and the Dorians.

IN the Perthshire Society of Natural Science Transactions, vol. v., the Rev. G. A. Frank Knight directs attention to a little-known series of ancient fortifications on the western side of Ben Scallaidh at a height of about 2000 ft. above the sea, and fully two-thirds of the way up the Kirkton Glen. He counted in all eight lines of fortifications which reveal enormous labour and no small skill in construction. In some respects they present features resembling the well-known prehistoric forts of Peeblesshire which have been described by Dr. D. Christison (Proc. Soc. Antiq. Scot., xxi., 1886–7, p. 13f.). The writer justly remarks that this remarkable series of ancient fortifications should be investigated by a skilled archæologist, who, preferably, is also a trained military strategist.

DR. J. E. POGUE, mineralogist in the U.S. National Museum of Washington, has been engaged in collecting material for a monograph on the turquoise, from the mineralogical, historical, and ethnological points of view. Mr. B. Lanfer, associate curator of Asiatic ethnology, was invited to cooperate in the work. As the publication of Dr. Pogue's monograph has been delayed, Mr. Lanfer has now published "Notes on Turquoise in the East," as Publication No. 169 of the Field Museum of Natural History. He discusses in detail all available information regarding the stone in India, Tibet, and China. He has collected much interesting information which he publishes, with full references, in this well-illustrated and scholarly monograph. The turquoise, from its power of repelling evil spirits, has always been valued in the East, and we have here a full account of the stone from the economical as well as the religious point of view.

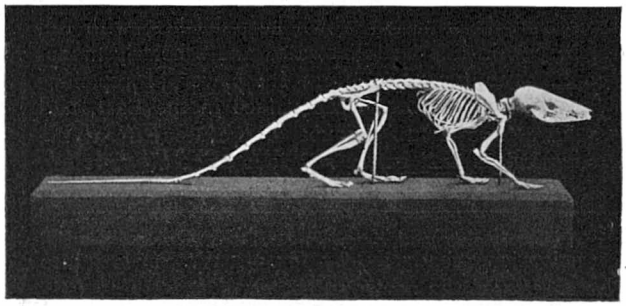
BY the liberality of Mr. P. G. Gates the United States Museum was enabled in 1905 to resume the investigations conducted by Dr. J. W. Fewkes into the culture of the ancient Pueblos of the Upper Gila river region in New Mexico. Immense numbers of specimens, particularly of perishable objects found in caves, render it possible to throw much light on an archæological area hitherto not scientifically explored. A remarkable series of specimens illustrates the cult of fire, fire-sticks, invested with a sacred character, being apparently offered, when worn out, in shrines. Numerous ceremonial cigarettes, consisting of sections of arrow-reed, tightly filled with artemisia and other aromatic herbs, were found in the ceremonial caves, and in the inhabited houses a number of "cloud-blowers," stone tubes of various sizes, used for blowing clouds of incense smoke during the tribal rites. These people were ignorant of metal-working, in one case only a lump of raw copper, rubbed and smoothed like a stone, having been found. The results of his expedition are well described by Mr. Walter Hough, ethnological curator of the museum, in Bulletin 87 of the Smithsonian Institution.

"MAN and the Microbe" is the title of an article by Prof. Winslow in the *Popular Science Monthly* for July, in which he describes the various ways by which infective diseases are spread, and discusses some of the means of prevention. To show how much has been done in the last-named direction, he points out

that in every twenty-four hours there are 200 death-beds in New York; had the death-rate of twenty years ago persisted there would be 130 more!

ACCORDING to the report for 1913, the Rhodesia Museum, Bulawayo, is arranging an economic section for the display of the natural products of the country, which it is hoped will aid in the development of the latter. Thanks to an annual grant voted by the British South Africa Company, the staff has commenced to collect specimens for exhibition which will represent the raw products of the country and the preparation they have to undergo before being converted into finished commercial products. Despite an insufficiency of funds, of floor-space, and of exhibition-cases, certain departments of the museum—notably the herbarium—continue to make satisfactory progress.

IN the annual report of the Field Museum of Natural History, Chicago, for the past year it is stated that the energies of the staff have been largely occupied in preparing exhibition material for the new building. The result of this has been a crowding of cases in some of the exhibition galleries "to a degree that must be confusing to visitors, as it certainly is most unsatisfactory to the management." So great, indeed, is the pressure, that it is suggested it will be necessary



Skeleton of the South American Marsupial Cænolestes, believed to be the only one on exhibition. About one-third natural size. From the Report of the Field Museum

to close some of the public galleries and use them as storage rooms. An important item in the museum's progress was the return of an expedition, under Dr. Lewis, which for three years has been collecting ethnological subjects in the islands of the South Pacific, and has brought back a vast series of specimens. An interesting feature of the report is a figure (herewith reproduced) of the skeleton of the South American marsupial, Cænolestes, the sole survivor of the Tertiary family Epanorthidæ. This skeleton is claimed to be at present unique, no other museum, it is believed, having a specimen.

IN the report of the U.S. National Museum, Washington, for 1913, after reference to the great labour involved in the installation of the cases and specimens in the new buildings, and a notice of the work that has been accomplished in the anthropological section, attention is directed to the exhibits illustrative of the geographical distribution of animals—a subject to which special attention is being devoted in the public galleries. The chief faunas illustrated are those of North America and the Palæarctic, Oriental, and Ethiopean regions, a smaller amount of space being assigned to those of South America and Australasia. Most striking of all appears to be the exhibit of groups of African big game, these including a family of lions, another of Cooke's hartebeest, and a third of the Lado white rhinoceros, as well as of the African buffalo (incorrectly termed the "water-buffalo") and Grévy's zebra.

IN No. 11 of the *Bull. Ac. Sci., St. Petersburg*, for 1914, Dr. N. Nasonov proposes the name *Ovis severtzovi* for the wild sheep inhabiting the low range on the Turkestan frontier of Bokhara, variously known as the Karatau, Nuratyntau, Nuratanyntu, Nurata, Nuratau, or Nuratadagh. In the *Field* for 1909 this sheep was identified by Mr. Douglas Carruthers with Severtzow's *O. nigrimontana*, typically from the other Karatau, in the province of Syr Daria, on the right bank of the river of that name, eastward of the city of Turkestan; but Dr. Nasonov, from the evidence of specimens in the St. Petersburg Museum, is enabled to show that the two are distinct. *O. severtzovi*, which is the smaller, approximates, as pointed out by Mr. Carruthers, to the *O. vignei* (*arkar*) group, especially in the presence of a distinct, although narrow, throat-ruff, while *O. nigrimontana* comes nearer to the *poli* type. In referring to it as *O. poloi nigrimontana*, Dr. Nasonov alters Blyth's name *poli*, which is the genitive of polus, the Latinised form of polos. It may be added that, owing to a confusion between the two "Karataus," Mr. Lydekker has given Bokhara as the typical locality of *O. nigrimontana*.

FROM the Maine Agricultural Experiment Station two important studies on reproduction in domestic fowls have lately been issued. Maynie R. Curtis writes on double and triple-yolked eggs (*Biol. Bulletin*, vol. xxvi., No. 2, 1914). Some young pullets are found to produce double-yolked eggs when they first begin to lay, about 20 per cent. of those which lay before the age of seven months producing among their first eggs one or more with two yolks. Mature birds rarely produce these abnormal eggs, and no single bird under observation ever produced more than a few of them. Of triple-yolked eggs only three were laid in six years among more than three thousand birds; in each case the abnormality was one of a young pullet's first progeny. Various disturbances of the normal processes of egg production may bring two yolks together in the oviduct, and double-yolked eggs do not always represent simultaneous ovulations. The other paper is by Alice M. Boring and Raymond Pearl (*Journ. Exp. Zool.*, vol. xvi., No. 1, 1914), and deals with the nature of the "odd chromosome," described by M. F. Guyer in 1909 in the spermatogenesis of the chick. The existence of such a chromosome would suggest that the male is heterozygous for sex, whereas crossing experiments with breeds of domestic poultry and other birds that show sex-limited characters seem to indicate clearly that the female and not the male is heterozygous. Guyer worked with "Langshan" birds, Boring and Pearl have used "Barred Plymouth Rocks." They find in about 12 per cent. of the first spermatocytes, and 3 per cent. of the second spermatocytes, a

piece of chromatin like that described as an "odd chromosome" by Guyer. As the structure is present in spermatocytes of both orders, and varies in shape, size, and number, the authors conclude that it cannot be an "odd chromosome" at all.

IN the *Izvestiya* of the Eastern Siberia branch of the Russian Geographical Society, Mr. M. Nikitin gives some results of the levelling operations carried out by Captain Kremlyakof in connection with the Siberian railway. The mean height of Lake Baikal is calculated to be 1485 ft. Other figures are Irkutsk (railway station), 1410 ft.; Mysovaya, 1514 ft.; Verkhneudinsk, 1763 ft.; Petrovski Zavot, 2627 ft.; Chita, 2150 ft.

THE geology of the islands in the Arctic Ocean, discovered by Captain Vilkitski (vol. xcii., p. 456), is described by Messrs. Baklund and Tolmachef in the Bulletin of the Imperial Academy of Sciences of St. Petersburg (No. 10, 1914). The island General Vilkitski is connected as regards its geological structure with the adjacent New Siberia islands, while those lying off the Taimyr peninsula are similar to the latter. Thus the specimens collected on Emperor Nikolas II. Land are of rocks found on Cape Cheliuskin, and also found by the expedition on the eastern coast of the Taimyr peninsula. Emperor Nikolas Land is therefore a northern continuation of the peninsula, now separated from it by a strait some tens of miles in breadth, in which lies the island Tsesarevich Alexis, built up of detritus from the Taimyr peninsula, especially from the western coast. The Emperor Nikolas Land is, however, known at present only at two points, and future investigations may materially modify present conclusions.

AN interesting article by Dr. A. E. Douglass, on a method of estimating rainfall by the growth of trees, was published in the May number of the Bulletin of the American Geographical Society. The author reasons that the rings of a tree measure its food supply, and that the latter, especially in the dry climate of the plateau of Arizona, which is dealt with, depends largely upon moisture. With the cooperation of other men of science curves of tree growth were prepared, and the connection with rainfall and possibly with astronomical phenomena was investigated. Dr. Douglass states that the method of measurement consisted of determining the thickness of each annual ring in millimetres along some typical radial line. The average age of the trees (yellow pine) was 348 years, with two extending to 520 years. The total number of individual measurements exceeded ten thousand. For any detailed description of the laborious investigation we must refer to the original article; the conclusion states that the purpose of the work has been accomplished, a connection has been found between tree growth and rainfall, as well as indications of association between meteorological and astronomical phenomena. With regard to the latter point due reference is made to investigations at Eberswalde (Germany) and elsewhere in connection with tree growth.

A COPY has reached us of the report for 1912–13 of the chief of the Weather Bureau of the U.S. Department of Agriculture. Referring to the aerial investigations in charge of Prof. W. R. Blair, the report states that the temperature distribution up to about the 1·5 km. level shows the same type of diurnal variation as is observed at the earth's surface. In the region near the 1·5 km. level a second maximum of temperature appears after midnight, while the 3 p.m. to 4 p.m. maximum practically disappears. Above this region the 2 a.m. to 4 a.m. maximum is the principal, the minimum for the day being found at 2 p.m. to 3 p.m. or earlier. There is some variation with the season in the times given for these maxima and minima. As regards the solar radiation investigations of which Prof. H. H. Kimball has charge, the report says the most interesting feature of the observational data for the year is the marked decrease in solar radiation intensities and in the polarisation of skylight, which was noticed first at Mount Weather in the observations of June 12, 1912. The intensity of the direct solar radiation with the sun 60° from the zenith averaged only about 85 per cent. of its normal value during the second half of 1912, and but little more than this during the first half of 1913. The polarisation of skylight averaged about 66 per cent. of its normal value during the second half of 1912, and about 75 per cent. of the normal during the first half of 1913.

IN the *Verhandlungen* of the German Physical Society for June 15, Dr. E. Goldstein describes in detail some light effects he first noticed in 1902 about a kathode freely suspended in a gas through which an electric discharge was passing. In addition to the canal rays, which are generally observed by allowing them to pass to the back of the kathode through a small hole in it, Goldstein shows that from a kathode consisting of two regular polygonal plates close together, bundles of canal rays are projected outwards from the middle of the sides or from the angles of the polygons according as they have an even or an odd number of sides. By taking circular electrodes from which strips have been cut at the edges or into the edges of which notches of various shapes have been cut, he is able to show that these outwardly directed canal rays are due to the focussing of inwardly directed canal rays within the two sheets of the kathode and to the strong ionisation produced at the focus. Their direction is that of the minimum path from the focus to the edge of the kathode.

THE Bulletin of the Imperial Society of Naturalists of Moscow for 1913 contains a paper of 225 pages by Dr. Ernst Leyst, entitled "Variations and Disturbances of Earth-magnetism." The first part deals with the results obtained when the arithmetic mean is replaced by the "central value," defined as that having as many positive departures from it as negative. The latter part of the paper discusses disturbance phenomena, mainly at Pavlovsk. Dr. Leyst treats as disturbed all days having a range not less than twice as large as that of the average day of the average year. The qualifying ranges thus obtained were 29·0′ in declination, 130γ in horizontal force and

70γ in vertical force. Attainment of the limit in any one of the three elements qualifies. Taking the twenty-four years, 1885 to 1908, at Pavlovsk, the greatest and least annual numbers of disturbed days were respectively 90 in 1892 and 6 in 1901. The months of greatest and least disturbance were respectively March, with an average of 4·9 days, and December, with an average of 2·2. There is an interesting comparison of the diurnal variation on the days immediately before and after selected disturbed days, the disturbed days themselves, and normal days. The paper is full of tables of numerical results representing much labour, as to the significance of some of which opinions are likely to differ. Dr. Leyst apparently adheres to an earlier conclusion of his that the secular change of declination is least during sunspot minimum years. This conclusion is scarcely likely to obtain general acceptance in view of the remarkably large secular variation of declination observed in western Europe since 1910.

THE artificial preparation of an important plant constituent which has hitherto resisted chemical synthesis has just been accomplished by Messrs. H. Wieland and R. S. Wishart (*Berichte*, 1914, p. 2082) in the case of inositol. This substance, it is shown, can be readily obtained by reducing hexahydroxybenzene with hydrogen gas in presence of finely-divided palladium black. As the potassium compound of hexahydroxybenzene is formed by the action of carbon monoxide on potassium, a simple method exists for the direct synthesis of inositol from its elements. The artificially obtained substance is identical in all respects with the naturally occurring compound.

THE association of vanadium with petroleum and asphalt and its relationship to the formation of asphalt deposits, is dealt with by Messrs. R. M. Bird and W. S. Calcott in a paper published in the Bulletin of the Philosophical Society, University of Virginia. From the experiments recorded in this communication it is suggested that the Peruvian deposits of vanadium sulphide and oxide, which occur in alternate layers with asphalt, are probably formed in the following way. Vanadates in solution in ground water come into contact with oils bearing hydrogen sulphide, and thus yield vanadium sulphide, which may travel with the oil and be deposited by meeting with carbon dioxide. In presence of atmospheric oxygen the vanadium sulphide acts as an oxygen carrier, and converts the accumulating mass of oil into asphalt. That this latter change may rapidly occur is shown by actual experiment in presence of oxygen, but no "asphalting" of mineral oil occurs when oxygen is excluded. The formation of asphalt thus appears to be essentially an oxidation process in which active catalytic agents, such as vanadium, play a part.

THE Carnegie Institution of Washington has now added to its series of "Papers of the Department of Historical Research," which are being produced under the editorship of Mr. J. Franklin Jameson, a volume of 642 pages entitled "Guide to the Materials in London Archives for the History of the United States since 1783," by Dr. C. O. Paullin, of the Carnegie Institution, and Prof. F. L. Paxson, of the University of Wisconsin. The book extends, in respect of almost all portions of the British archives, from 1783 to 1860. The scope of the volume is confined to the Public Record Office, the archives of the offices of the Central Government of Great Britain in London, and the manuscript department of the British Museum. The book is one of a series of guides to the materials for American history in foreign archives which have been published or are to be published by the Carnegie Institution. Volumes relating to the materials in the archives of Canada, Mexico, Cuba, Spain, Italy, and Germany have been issued already, and noticed in these columns from time to time. The group concerned with English archives consists of four volumes, of which the present is in logical order the fourth.

IN the *Bulletin de la Société d'Encouragement* (vol. cxxi., p. 425) Prof. Camille Matignon gives, under the title, "A New Industry—The Rational Utilisation of Distillery Vinasses," an interesting account of the Effront process for the recovery of the nitrogen and potash values of the waste liquors remaining after distillation of the alcohol from the fermented liquors prepared from grain or the molasses of the beetroot-sugar industry. The Effront process has been working experimentally on the large scale during the past three years, and many of the practical difficulties have already been overcome. It consists in subjecting the vinasses to fermentation by a butyric organism isolated from soil. The fermentation takes place in distinctly alkaline solution and converts the whole of the nitrogen of amino-acids or amides, such as glycine, asparagine, or glutamic acid, completely into ammonia; the betaïne is transformed into trimethylamine, and the residues of the acids into free fatty acids, such as acetic acid and its homologues, succinic acid, malic and tartaric acids. Processes have been devised for separating the ammonia and the trimethylamine, the latter of which is decomposed by heating at 1000° into methane and hydrogen cyanide; the methane is used as a source of energy, and the hydrogen cyanide is absorbed as sodium cyanide. The experimental factory already produces 6 tons of acetic acid and 1 ton of butyric acid each day; the latter acid, a new technical product, has already found application in tanneries, and at the moment the demand exceeds the supply.

A COMPLETE set of catalogues of the Société Genevoise pour la Construction d'Instruments de Physique et de Mécanique has been received from Mr. O. Paul Monckton, of 87 Victoria Street, Westminster, who is the sole agent for Great Britain and the Colonies. The seven lists are beautifully produced, excellently illustrated, and arranged in a manner which makes reference to them easy. Among the subjects dealt with in different catalogues may be mentioned: exact measuring machines for industrial and laboratory use, general measuring instruments, including kathetometers, micrometers, dynamometers, goniometers, and so on; apparatus for the study of general physics and mechanics; microscopes, spectrometers; and electromagnets.

OUR ASTRONOMICAL COLUMN.

COMET 1913*f* (DELAVAN).—The following is a continuation of the ephemeris of Delavan's comet (1913*f*) as given by Dr. G. van Biesbroeck in *Astronomische Nachrichten*, No. 4739:—

	R.A. (true) h. m. s.	Decl. (true) ° ′ ″	Mag.
July 23 ...	5 39 42 ...	+36 2 16 ...	6·6
24 ...	42 19 ...	21 24	
25 ...	45 0 ...	40 39	
26 ...	47 43 ...	37 0 2 ...	6·5
27 ...	50 29 ...	19 32	
28 ...	53 18 ...	39 9	
29 ...	56 10 ...	58 54	
30 ...	5 59 6 ...	+38 18 44 ...	6·3

OBSERVATIONS OF HALLEY'S COMET.—The June number of the *Astrophysical Journal* (vol. xxxix., No. 5) contains a communication by Prof. E. E. Barnard on the visual observations of Halley's comet in 1910, made by him at the Yerkes Observatory. Numerous fine illustrations from photographs accompany the text. In the first instance he points out that Halley's comet at its return in 1910, though a brilliant and interesting object to the naked eye, especially in May, was nevertheless a disappointment when considered from a photographic point of view. Photographically its light was relatively slow, and there were few or no remarkable phenomena. After mentioning the probable encounter of the southern branch of the tail with the earth on or about May 18 or 19, he directs attention to the presence of the double tail overlooked by observers in the northern hemisphere. Observations made with the 40-in. are next described, and special attention is directed to the long mass in the tail receding from the head. The appearance is beautifully shown in three photographs taken in June at Yerkes, Honolulu, and Beirut. Prof. Barnard then brings together all his visual observations made from the first to the last appearance of the comet, for he was determined, as he says, "to prepare as faithful an account as possible of its appearance to the naked eye for the benefit of observers at future returns," since he was much disappointed "at the meagreness of the records" at its appearance in 1835, when he was seeking published information concerning its appearance.

REPORTS OF INDIAN OBSERVATORIES.—A recent publication gives the report of the Director-General of Observatories of the Observatories of Kodaikanal, Madras, Bombay, and Alibag for the year 1913, and this includes the reports of the individual directors. As regards Kodaikanal, Dr. G. T. Walker states that the output of this observatory is at present limited by the amount of measuring that can be accomplished, and this is being altered by the training of the new assistants. He also makes the important statement that when Mr. Evershed was in Srinagar in Kashmir in 1913 he found that the air there was extraordinarily good for solar and stellar work, and it is now being considered whether the observatory at Kodaikanal should be totally or partially removed there. The only drawback, apart from the question of cost, is the chief disadvantage of the small amount of sunshine in January and February, the months when other solar observatories are labouring under disadvantages, while at Kodaikanal the seeing is at its best. As the chief astronomical work at the Madras Observatory is the determination and distribution of time this will now be closely associated with the distribution of the time by the new powerful radio-station that is to be erected in India, forming a link between Aden and Singapore. The idea is for the radio-station to be equipped with two good clocks, and to send special time signals to Madras, so that the clock-errors can be determined and wired back to the radio-station previous to the distribution of the general time signals. The usual routine observations were carried out at Bombay (Colaba and Alibag), but damp, and white ants, caused great anxiety regarding the walls for the self-registering variation instruments at Alibag.

RECENT PHYSICAL INVESTIGATIONS IN THE NORTH ATLANTIC OCEAN.

TWO recent publications summarise more or less thoroughly our present knowledge of the physical features of the waters of the North Atlantic Ocean. One gives an account by Dr. Fridtjof Nansen of recent researches carried on especially by the Norwegians, and the other, by Prof. Otto Pettersson and Commander C. F. Drechsel, urges united international effort to carry on further research in these waters.[1]

Dr. Nansen gives a detailed account of oceanographical investigations in the north-eastern part of the North Atlantic Ocean made in July, 1910, on board the Norwegian gunboat, *Frithjof*, under the command of Capt. Caspar S. Erlandsen.

Dr. B. Helland-Hansen and Dr. Nansen had noted that "variations in the temperature of the Atlantic current from one year to another, were followed by corresponding variations in the winter climate of Norway, and also by variations in the fisheries of the North Sea and at Lofoten, etc." The question was as to whether the observed annual variations in the volume and temperature of what Dr. Nansen terms the Norwegian Atlantic current "were due to variations in the physical conditions of the North Atlantic, south of the Wyville Thomson Ridge and the Faeroe-Iceland Ridge, or to other causes, *e.g.* variations in the East Icelandic Arctic current."

The cruise of the *Frithjof* lasted fifteen days, leaving Belfast on July 6, 1910, Seydis Fiord, Iceland, was reached on July 13, and Bergen on July 21. On the basis of these observations, which are duly tabulated, five sections have been drawn. These observations were taken with carefully selected instruments supplied by Dr. Nansen. The automatic insulating water-bottle seems to have been at times untrustworthy, but otherwise the instruments gave satisfactory results. Dr. Nansen suggests that it is very desirable always to use two thermometers for the determination of deep-sea temperatures. All water samples were collected in rubber washered bottles with lever fastening, holding 200 c.c. and 500 c.c. each. Titrations were carried out by Dr. Helland-Hansen, or under his supervision at Bergen. The titrations were checked in the ordinary way by "normal water" from the International Bureau in Copenhagen.

The observations made resulted in showing that vertical convection currents reached depths of 600 metres. Dr. Nansen is of opinion that this vertical circulation is of great importance in heating the atmosphere of this region during the winter. It was estimated that direct absorption of heat from the sun's rays may be felt to a depth of 100 metres.

In the region traversed by the *Frithjof* precipitation is greater than evaporation, not only in winter, but evidently also on the average during summer. From the observations of Mr. Donald J. Mathews, as well as those of the *Frithjof*, it appears that in this region the sea-surface has its maximum salinity at the end of the winter or in the spring, and its minimum salinity at the end of the summer or in the autumn. Prof. Martin Knudsen has found similar seasonal variations. Knudsen suggests that the most probable

[1] (1) "The Waters of the North-eastern North Atlantic." By Fridtjof Nansen.
(2) "Mémoire sur des Recherches dans l'Atlantique avec programme By O. Pettersson and C. F. Drechsel.

explanation of this periodical variation would be, that the Gulf Stream has a maximum velocity in the spring and a minimum period in the autumn, but Dr. Nansen is of opinion, that it is self-evident that the dilution of the surface water due to the precipitation during the summer in connection with vertical circulation during the winter, gives the simplest explanation of this seasonal variation.

Krummel has termed that part of the Gulf Stream passing Section I. of the *Frithjof* cruise across the Rockall Channel and the Rockall Bank, the "Irish current." Its waters are easily distinguished by the comparatively high salinities and temperature. "The section proves that the greater part of the water-masses, carried north-eastwards by the Irish current, passes through the Rockall Channel, between the continental shelf off Iceland and the Rockall Bank, while only a small portion of the water with the highest salinities (above 35·30 per cent.) occurs west of the Rockall Bank, and seems to have no distinct northward movement." It is obvious that it is a continuation of this current through the Rockall Channel which flows through the Faeroe-Shetland Channel. Amundsen's observations in June and July also bear this out. These important recent Norwegian observations are confirmatory of the *Porcupine* observations of 1869. Dr. Nansen states that the Scottish series of salinity observations in August, 1910, from the Faeroe-Shetland Channel, taken in the same month, have often some "inaccurate values," and may be too high. Authority for this statement would have been desirable and also for the further criticism of the Scottish stations 19 C and 14 A of May, 1910, for it does not always follow that even "very great irregularities" indicate erroneous observations, however inconvenient they may be to our theories.

It is a fashion of the present day to attempt to obliterate the general term "Gulf Stream," and Dr. Nansen follows this plan, but the fact remains that there is a continuous movement of the surface waters of the sea which is capable of carrying an object from the West Indies to Spitsbergen, and "Gulf Stream" remains a useful name for this continuous flow of water, called by recent investigators by different names in different regions. There is no doubt that the "Gulf Stream" is due to many factors, and not solely due to that initial impulse the waters have as they leave the Gulf of Mexico, but why not continue to use this useful term which defines this remarkable series of phenomena as a whole, at the same time recognising the different factors that cause it to exist. The statement that the Gulf Stream off western British coasts "is to a very great extent a current coming from the south, along the continental slope west of Europe," is by no means new, and does not obliterate the main phenomenon referred to. The point of interest in the Norwegian observations is not that the current described by Rennell in 1793 flows northward, but that this current flows at quite a considerable depth, and not only at the surface, a very important addition to our knowledge of the Rennell current; also, that it seems to consist very largely of Mediterranean water.

But in this connection, it should not be forgotten that about twenty years ago Buchan pointed out that the influence of the warm undercurrent from the Mediterranean is clearly apparent in the Atlantic Ocean at a depth of 500 fathoms, and that "beyond this depth, its great influence is felt over nearly the whole breadth of the Atlantic to at least about 1000 fathoms." [2]

It is a sweeping statement to say that "most leading oceanographers have taken it for granted that the currents of the surface layers were practically the same, at least as to direction, as those of the deeper strata," and that they study chiefly surface observations, and think "that all oceanic currents are chiefly, if not entirely, created by the winds," that they do not understand the effect of the earth's rotation, and have not appreciated the value of vertical sections of the ocean to elucidate horizontal movements of the water." Carpenter, before the *Challenger* sailed, strongly advocated the doctrine of vertical ocean circulation sustained by opposition of temperature, and while Buchanan used vertical sections so early as 1877 [3] in a paper entitled "Distribution of Salt in the Ocean as Indicated by the Specific Gravity of its Waters," where a vertical section through the Atlantic Ocean from 30° N. to 30° S. is given. Subsequently Buchanan used vertical sections in his report on the specific gravity of ocean water, which was published in 1884 in vol. i. (Chemistry and Physics) in the *Challenger* reports. In the same volume there appears a "Report on Deep Sea Temperature Observations," obtained by the officers of H.M.S. *Challenger*, where there are 258 plates all representing vertical sections. In fact, no efficient oceanographer considers these physical questions without the use of vertical sections; neither would he assert that all oceanic currents are entirely created by wind, nor will he deny that they are very largely created by wind. Wind, specific gravity, temperature, and rotation of the earth are all among the many factors which influence oceanic circulation, both vertical and horizontal, and none of these should be considered apart from the others if satisfactory results are to be arrived at.

Dr. Nansen considers it difficult to draw any certain conclusions as regards the annual variations in the temperature of the Irish current owing to insufficient material of observations from previous years. The observations seem, however, to prove that there have been no great variations in those few years.

The temperature of the Irmiger current to the west of Iceland was warmest in 1896, less warm in 1895, 1904, and 1903. There are also similar variations in the sea south of Iceland, but the conclusions are less trustworthy, because the sea is shallower and the frequent variations in depth may have a great influence upon temperature even at short distances. These variations Dr. Nansen considers have an effect on the climate of Iceland.

There appear to be continually very great changes in the position of the waters of the Faeroe-Shetland channel. Drs. Helland-Hansen and Nansen conclude that great sub-surface boundary waves probably occur in the sea, and that "waves" seen in the many vertical sections of the Norwegian Sea may be due partly to such boundary waves, partly to horizontal vortex movements.

The paper is a useful summary of all the observations taken in these waters, besides those of the *Frithjof* expedition.

Prof. Otto Pettersson and Commander C. F. Drechsel urge systematic hydrographical and biological investigations of the whole of the Atlantic Ocean as one of the most important scientific and practical tasks of the future. As a beginning, synoptical reconnaissances at different seasons down to a depth of 1000 metres, are recommended. The programme is drawn up in two heads:—(1) Investigation of coastal seas; (2) Transatlantic investigation cruises. Simultaneous quarterly cruises are recommended, because this method of investigation has been recommended by recent geographical congresses, and has served as a basis for the investigation of northern seas and the Adriatic, for obtaining a comprehensive view of the

[2] Report on Ocean Circulation. By Dr. Alex. Buchan. (*Challenger* Reports, 1895.)

[3] Proc. R. G. S., March 12, 1877.

conditions of the Atlantic in winter and summer. It is pointed out that the opening of the Panama Canal in 1915 gives a great opportunity for the different countries sending vessels to represent them of taking simultaneously an extensive series of observations from Europe to America. It is to be hoped that the different Governments will be induced to take part in carrying out this important work, and thus mark the union of the Atlantic and Pacific Oceans by a unique effort to add to our knowledge of the sea.

W. S. B.

ORNITHOLOGICAL NOTES.

THE spring number (vol. vi., No. 1) of *Bird Notes and News* is devoted exclusively to the Plumage Bill, and its effect, if passed on workers in the feather-trade in this and other countries. It includes a good report of the debate which took place when the Bill came up for second reading, together with the division-list on that occasion. Individual opinions from various persons on the matter, as well as the views of scientific bodies, are also quoted. It is added that the vast number of bird-skins (many of them representing rare species of the paradise group) offered for sale at auctions in London affords fresh testimony of the need for prohibitive legislation.

The March-April number of *Bird-Lore* records some of the steps which are being taken to enforce the recent regulations of the U.S. Federal Government with regard to the slaughter of game-birds and their transport from one State to another, special attention being directed to the seizures of long guns carrying half a pound of powder and a pound of shot. One of the illustrations shows the costly monument recently erected in Salt Lake City to commemorate the gulls which saved the crops of the first Mormon settlers by devouring the grasshoppers by which they were being devastated. As the gulls had "the time of their lives," it is not apparent why a monument was required.

The roseate spoonbill (*Ajaia ajaja*) of tropical America forms the subject of an article, illustrated by a coloured plate, in the issue of *Bird-Lore* for May and June. So long ago as 1858 it appears that the pink curlews, as they are locally called, on Pelican Island, Florida, were the prey of plume-hunters, some of whom are reported to have killed upwards of sixty a day, and from that time to this these beautiful birds have been persecuted by every man who could lay his hands on a shot-gun. Now, however, the National Association of Audubon Societies has succeeded in establishing reservations in Florida, where the spoonbills may breed unmolested.

An article on the stilt and another on the moorhen are among the more noteworthy contents of the April number of *Wild Life*, the former an account of the author's success in photographing such a rare and shy species, and the latter for the beauty of the pictures.

In view of the probable extermination of the species at no very distant date, owing to the introduction of foxes, an article by Mr. J. G. O'Donoghue, in the *Victorian Naturalist* for May, 1914, on the habits of the Victorian lyre-bird has a claim to more than ordinary interest.

A paper by Prof. J. E. Duerden, published in the Agricultural Journal of the Union of South Africa for October, 1913, deals with the mode of development of the feathers of ostriches, and the entire absence of cruelty to the birds in clipping them, at the proper season, for market.

Bird-lovers in South Africa owe a debt of gratitude to Mr. Alwin Haagner for the issue of the first part of a concise descriptive list of South African birds, published as No. 3 of the bulletin series of the publications of the South African Ornithologists' Union. This part includes the ostrich, of which the South African representative is regarded as a distinct species, the penguins, divers, petrels, gulls, and terns, cormorant tribe, ducks and geese, and the plover group.

An article by H. W. Henshaw on birds commonly to be seen in town or country in the United States, illustrated by sixty-four small portraits in colour, forms one of the most attractive features of the May number of the *National Geographic Magazine*. Of more general interest are two pictures, taken by Mr. R. E. Croker, representing a colony of something like 100,000 pelicans on the easternmost island of the Lobos de Afueva group, off Peru. Unhappily this vast colony, which had been unmolested for several years, has not escaped the attention of the guano-seekers, and, on a second visit, Mr. Croker found scarcely any pelicans near the old colony. "It is one of the tragedies," he remarks, "of the guano-industry that this important bird has received so little consideration."

It has been asserted that the Australian short-tailed petrel, or "mutton-bird" (*Puffinus brevicaudus*), takes no fewer than eight weeks to incubate its eggs. According, however, to a a note by Mr. J. Gabriel in the April number of the *Victorian Naturalist*, one out of a clutch of eight eggs placed under a domesticated hen was hatched in forty-six days, the remainder of the clutch being either broken or infertile.

In his annual summary of bird-life in Norfolk, published in the May number of the *Zoologist*, Mr. J. H. Gurney records that spoonbills were seen last year at Breydon Broad at intervals from May 1 to August 16. As the result of a comparison of previous observations, it appears that these birds generally reach Norfolk during the prevalence of north-east winds, which are probably unfavourable to their northward migration.

As the result of an exhaustive study of the extensive series of cuckoos' eggs and the foster-clutches with which they were associated (some three hundred in number) included in the fine collection of eggs recently presented by Mr. R. H. Fenton to Aberdeen University, Dr. J. Rennie, in an article published in vol. xix., No. 5, of the Proceedings of the Royal Physical Society of Edinburgh, arrives at the conclusion that the theory of the existence of different strains of cuckoos, severally characterised by laying eggs of distinctive types of colouring, will not hold good. According to this theory, as enunciated by the late Prof. A. Newton, one of these strains—"hedge-sparrow cuckoos"—generally lays eggs assimilating in colour to those of hedge-sparrows in the nests of that species; while "wagtail-cuckoos" act in an analogous manner in the case of the species from which they take their name, and so on. In the opinion of the author, the clutches in the Fenton collection lend no support to the theory of the existence of such strains, at all events in this country. This conclusion, it is urged, receives further support from the polyandrous habit of female cuckoos, as individual hens may mate at one time with a cock of the "hedge-sparrow," and at another with one of the "wagtail" strain. The author, it may be added, alludes to these supposed strains as "subspecies," which is certainly a misuse of that term.

The remarkable changes in the length and colouring of the beak and in the colour of the plumage undergone by the white ibis (*Guira alba*) during its development from the nestling to the adult stage are graphically illustrated in a coloured plate accompanying an article by C. W. Beebe, forming No. 12 of the first volume of *Zoologica* (New York Zool. Soc.). In the nestling the short beak has dark barrings, and

the head and neck are darker than the back; later on the head and neck become lighter than the back, but by the time the bird has become adolescent the whole body is almost completely white, the head and neck alone being flecked with brown; the beak has increased inordinately in length, with the assumption of a pink tinge. Finally, in the case of the cock, the whole plumage becomes pure white, while the long, sickle-shaped beak, together with a large bare area at its base and in the orbital region, has become brilliant crimson. Although the article is headed "Notes on the ontogeny of the white ibis," no clue to the real meaning of these changes in form and colouring is suggested.

In the June number (vol. viii., p. 2) of *British Birds*, Messrs. Hans Stadler and Cornel Schmidt direct attention to the general neglect of the study and interpretation of the notes of birds in Great Britain, as compared with what is being done in Germany. Apart from the lack of musical appreciation or musical education, three main difficulties—namely, the determination of the pitch, the admixture of non-musical sounds with the notes of birds, and the "colouring" of these notes, which is often widely different from that of the human voice or ordinary musical instruments—have hitherto materially hindered this branch of study. The authors now demonstrate how these difficulties may be overcome.

Prof. R. Ridgway is to be congratulated on the publication (after an interval of three years since the appearance of its predecessor) of the sixth volume (Bull. U.S. Nat. Mus., No. 50) of his invaluable monograph of the birds of North and Middle America. This volume not only completes the Passerines, but also includes the Picarians and related groups, as well as the owls. In the latter group it is a matter for regret to see the barn-owls figuring as Tyto, while Strix, following the classification of the late Prof. Newton, is transferred to the tawny owl. This is eminently a case for the intervention of the "fiat" of the International Commission on Zoological Nomenclature. In most other respects Prof. Ridgway's latest effort is worthy of high commendation.

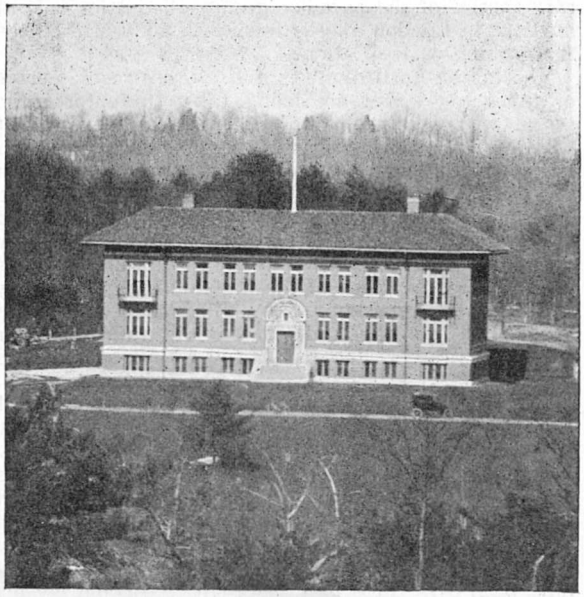
In a handbook and guide to the British birds exhibited in the Lord Derby Museum, Liverpool, it is claimed that a coot mounted amid an imitation of its natural surroundings in 1865 was the first exhibit of this kind shown in this country, if not in the world. Groups of all species nesting in the Liverpool district, together with a few others, are now exhibited in the museum, and of a dozen of these groups photographs are reproduced in the guide. The nomenclature is much the same as in Newton's "Yarrell," but it seems illogical to use the name *Lagopus lagopus* for the willow-grouse, and yet to retain *Perdix cinerea* for the partridge.

We have to acknowledge the receipt of a copy of a paper from the March number of the *Ottawa Naturalist*, by Dr. C. G Hewitt, on local bird-protection; also of a catalogue of more than 1400 publications on ornithology offered for sale by Messrs. John Weldon, 38 Great Queen Street, London, W.C. R. L.

TERRESTRIAL MAGNETISM.

THE present activity of the department of terrestrial magnetism of the Carnegie Institution of Washington and the largeness of its future aims are alike illustrated in the annual report for 1913, by the director, Dr. L. A. Bauer, and in a "progress report" which he contributes to the latest (March) number of *Terrestrial Magnetism*. The department, which has lately entered on its eleventh year, has under construction new buildings at an estimated cost, including site and equipment, of about 25,000*l*. The main structure, which is already completed, is shown in the accompanying figure. It has a length of 102 ft., a width of 52 ft., and from basement to roof a height of 62 ft. Besides ample accommodation for observers and computers, engaged on the reduction and discussion of observations, it includes several laboratories, an instrument-maker's shop, and store places for instruments. A detached building for tests and researches requiring a non-magnetic environment will shortly be completed.

Of late years the energies of the department have been mainly devoted to a magnetic survey of the earth, including the oceans. In the financial year which ended on October 31, 1913, the expenditure of the department, apart from building, reached 22,000*l*. In addition to important work at sea by the surveying vessel *Carnegie*, it had land observations in progress in many quarters of the world. One party observed at seventy-two stations in the Sahara between Algiers and Timbuctoo. Another party in Australia observed in Queensland, Victoria, and New South Wales. A



Main building of the Department of Terrestrial Magnetism, Carnegie Institution of Washington.

third journeyed some 2000 miles by canoe in remote parts of Canada. South America engaged three parties, observing in Peru, Bolivia, Chile, Venezuela, British Guiana, Brazil, Argentina, Paraguay, and Uruguay. It is expected that by 1915 data will have been obtained adequate for the construction of satisfactory magnetic charts for the epoch January 1, 1910, extending from 50° N. to 50° S. latitude.

The work of the department is not confined to terrestrial magnetism. In future more attention is to be given than in the past to atmospheric electricity. Dr. W. F. G. Swann, late of Sheffield University, has been engaged as chief physicist, and is devoting special attention to this subject. One of the objects to which much attention continues to be devoted is the improvement of magnetic instruments. Dr. Bauer's article in *Terrestrial Magnetism* is largely devoted to a discussion of the degree of accuracy reached with existing types of magnetometers, and the prospects of obtaining superior results with electrical methods of measuring the direction and intensity of the earth's field. While

recognising the high accuracy now attained in electrical measurements, he concludes that much experiment will be necessary before we can hope to introduce electrical methods with advantage in place of magnetometers, more especially for field work.

C. CHREE.

TIMBER FOR RAILWAY SLEEPERS.[1]

A VALUABLE contribution to the literature on Indian timber trees, containing the preliminary results of experiments and inquiries initiated at the Dehra Dun Institute some three years ago, has lately been issued. Research work on timber from an economic point of view is necessarily a slow business, and years must elapse before final conclusions can be reached, but the information already obtained during this inquiry indicates clearly that the final results are likely to prove of great economic value.

The memoir is divided into five sections, which deal in turn with the physical and mechanical properties of Sál timber, its durability, its uses, as well as those of the minor products of the tree, the quality of the charcoal and fuel, and the yield and prices. One point of special interest will illustrate the nature of the work in progress and its prime importance. Sál is one of the chief timbers employed for railway sleepers, and in these days it is surprising to find that the majority of the sleepers on Indian lines undergo no previous treatment with preservatives—all the more so, when one knows how abundant are the insect and fungus pests, and how rapid their powers of growth and reproduction. This apparent indifference on the part of Indian railways to the great economy effected in other countries by treatment of the sleepers is not easy to explain. It may in part be due to the methods used in temperate climates having proved less satisfactory when the sleepers are exposed to the hot sun of India. But it is also probably due to the natural durability of sál, teak, deodar, pyinkado, and other woods of this class, which last so long in the natural condition, that any extension of their lives by treatment with preservatives would probably result in the resistance to decay becoming greater than the resistance to mechanical wear and tear, and in this event a large proportion of the cost of treatment would be money thrown away.

But it is open to question whether such valuable woods should be employed for sleepers at all. During the past forty years it has been pointed out again and again that India possesses several species of lower-grade timbers which appear to possess all the necessary qualifications for sleepers. Their natural durability is low, but this defect can be overcome by artificial methods. The fact brought out at the end of this memoir, that India is now beginning to import Jarrah sleepers from Australia, shows the urgent need for testing these lower-grade timbers to see whether by treatment they can be rendered equally as serviceable as sál, teak, deodar, etc. This question is being investigated at Dehra Dun on a practical scale, and if any of these timbers can be brought into general use the economic value of the work will be enormous. India will not only be enabled to continue the production of her own sleeper requirements, and to employ timbers for the purpose which have no special outlet in other directions, but she will also economise her more valuable forests of sál alone to the extent of some two and a half million cubic feet per annum, to say nothing of teak, deodar, pyinkado, and the jarrah from Australia.

[1] "On the Economic Value of *Shorea robusta*, Sál." By R. S. Pearson. Indian Forest Memoirs, Economy Series, vol. ii., part 2. Pp. 70. (Calcutta: Superintendent Government Printing, 1913.) Price 3*s*.

Although there is at present little market for sál outside India, the steady diminution of the world's timber supply renders it certain that there will be a market in the future, when the sál forests recover from past maltreatment, and come into full bearing. These facts indicate the importance of the work at Dehra Dun, which is being organised on lines that must appeal to everyone who has the country's interest at heart.

E. R. B.

OFFICIAL GUIDES FOR GEOLOGICAL TRAVELLERS.

THE International Geological Congress of 1913 was indeed fortunate in the reception and support accorded to it by the official geological surveys of Canada. The guide-books issued for the excursions were in reality memoirs on the districts traversed, and formed, with their coloured maps and illustrations, works of reference for scientific libraries. They have now been re-issued for the general public, and seven of these handy volumes have reached us from the Department of Mines in Ottawa.

No. 1, in two parts, covers Eastern Quebec and the Maritime Provinces, and is largely of stratigraphical interest. No. 2 deals with the eastern townships of Quebec and eastern Ontario, including the amphibolites and limestones of the Bancroft area. The metamorphic origin of amphibolites from both igneous rocks and limestone, as recognised by Lacroix and others in Europe, is here concisely described. No. 3 is concerned with the neighbourhood of Montreal and Ottawa, including areas of interesting igneous alkali-rocks, and the original locality of the serpentinous marble known as Eozoön. No. 4 describes excursions in south-western Ontario (where the interest for most geological visitors centres in Niagara Falls) and the history of the great lake system. No. 5 deals with Ordovician and Gotlandian beds in the western peninsula of Ontario, and contains a fine illustration of a mass of bedded limestone overthrust by ice-pressure on the flank of a Glacial drumlin. We are informed that Nos. 6 and 7, on the Toronto region and the rich mining districts of Ontario respectively, are issued by the Bureau of Mines, Toronto. The Dominion Department of Mines in Ottawa, however, is also responsible for No. 8, in three parts, and No. 9, which describe the whole transcontinental routes from Toronto to Victoria, and for No. 10 on Northern British Columbia, the Yukon Territory, and the North Pacific Coast. Nos. 8 and 9, on the Canadian Pacific, Grand Trunk, Canadian Northern, and National Transcontinental lines, should meet with especial appreciation.

Such guidance as is here provided for those who may be styled "post-graduate" visitors shows how official surveys may aid in opening up a country Seeing that conference with workers from other fields is highly stimulating to those who must devote themselves to special areas of their homelands, the encouragement given to strangers is sure to bring a full reward. Even in our well-explored islands, descriptions of districts which have become classical in the history of geology might with advantage be issued for those visitors who can devote only a few days to the ground. We are apt to leave some clever teacher or some local enthusiast to extract such matter from our detailed official memoirs, and thus to produce a compact and reasonable guide. The union of our geological surveys, both in Great Britain and in Ireland, with departments concerned with public education suggests that the encouragement of geological travel may well lie within their scope.

PLANT-AUTOGRAPHS AND THEIR REVELATIONS.[1]

IN answering the question whether there is a fundamental unity in the response of plant and animal, we have first to find out whether sensitiveness is characteristic of only a few plants or whether all plants and every organ of every plant is sensitive. Then we have to devise apparatus by which visible or invisible reactions are detected and recorded. Having succeeded in this, we have next to survey the characteristic reactions in the animal, and observe whether phenomena corresponding to these may also be discovered in the plant.

Thus, when an animal is struck by a blow, it does not respond at once. A certain short interval elapses between the incidence of the blow and the beginning of the reply. This lost time is known as the latent period. In the plant is there any definite period which elapses between the incident blow and the responsive twitch? Does this latent period undergo any variation as in the animal, with external conditions? Is it possible to make the plant itself write down this excessively minute time-interval?

Next, is the plant excited by various irritants which also excite the animal? If so, at what rate does the excitatory impulse travel in the plant? In what favourable circumstances is this rate of transmission enhanced, and in what other circumstances is it retarded or arrested? Is it possible to make the plant itself record this rate and its variation? Is there any resemblance between the excitatory impulse in the plant and the nervous impulse in the animal?

The characteristic effects of various drugs are well known in the case of the animal. Is the plant similarly susceptible to their action? Will the effect of poison change with the dose? Is it possible to counteract the effect of one by means of another?

In the animal there are certain automatically pulsating tissues like the heart. Are there any such spontaneously beating tissues in the plant? If so, are the pulsations in the animal and the plant affected by external conditions in a similar manner? What is the real meaning of spontaneity?

Growth furnishes us with another example of automatism. The rate of growth in a plant is far below anything we can directly perceive. How, then, is this growth to be magnified so as to be rendered instantly measurable? What are the variations in this infinitesimal growth under external stimulus of light and shock of electric current? What changes are induced by giving or withholding food? What are the conditions which stimulate or retard growth?

And, lastly, when by the blow of death life itself is finally extinguished, will it be possible to detect the critical moment? And does the plant then exert itself to make one overwhelming reply, after which response ceases altogether?

Plant-Script.

The plant is acted upon by storm and sunshine, warmth of summer and frost of winter, drought and rain. What coercion do they exercise upon it? What subtle impress do they leave behind? These internal changes are entirely beyond our visual scrutiny. The possibility of these being revealed to us lies in the detection and record of the actual response of the organism to a questioning shock. By the invention of different types of recorders, I have succeeded in making the plant itself write an answering script to a testing stimulus. Thus the plant attached to the recording apparatus is automatically excited by a stimulus absolutely constant. In answer to this it makes its own responsive records, goes through its period of recovery and embarks on the same cycle over again, without assistance at any point from the observer (Fig. 1).

The Resonant Recorder.

In obtaining the actual record of responsive movements in plants we encounter many serious difficulties. In the case of muscle-contraction, the pull exerted is considerable and the friction offered by the recording surface constitutes no essential difficulty. In the case of plants, however, the pull exerted by the motile organ is relatively feeble, and in the movement of the very small leaflets of *Desmodium gyrans* or the telegraph plant, for instance, a weight so small as four-hundredths of a gram is enough to arrest the pulsation of the leaflets. Even in the leaf of Mimosa the friction offered is enough to introduce serious errors into the amplitude and time-relations of the curve. This error could not be removed as long as the writer remained in continuous contact with the writing surface. I was finally able to overcome the difficulty by making an intermittent, instead of a continuous contact. The possibility of this lay in rendering the writer tremulous, this being accomplished by an invention depending on the phenomenon of resonance.

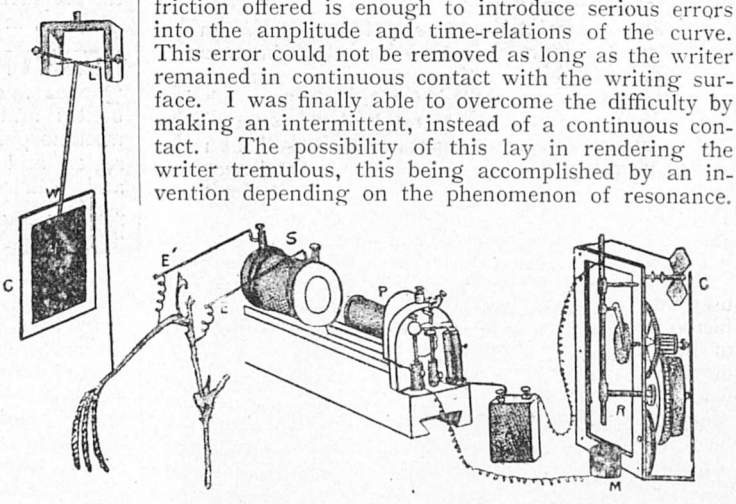


FIG. 1.—Diagrammatic representation of automatic plant-recorder. Petiole of Mimosa, attached by thread to one arm of lever L; writing index W traces on smoked glass plate G the responsive fall and recovery of leaf. P, primary, and S, secondary, of induction coil. Exciting induction shock passes through the plant by electrodes E, E'. A, accumulator. C, clockwork for regulating duration of tetanizing shock. Primary circuit of coil completed by plunging rod K dipping into cup of mercury M.

The principle of my resonant recorder depends on sympathetic vibration. If the strings of two violins are exactly tuned, then a note sounded on one will cause the other to vibrate in sympathy. We may likewise tune the vibrating writer V, with a reed C (Fig. 2). Suppose the reed and the writer are both tuned to vibrate a hundred times per second. When the reed is sounded the writer will also begin to vibrate in sympathy. In consequence of this the writer will no longer remain in continuous contact with the recording plate, but will deliver a succession of taps a hundred times in a second. The record will therefore consist of series of dots, the distance between one dot and the next representing one-hundredth part of a second. With other recorders it is possible to measure still shorter intervals. It will now be understood how, by the device of the resonant recorder, we not only get rid of the error due to friction, but make the record itself measure time as short as may be desired. The extraordinary delicacy of this instrument will be understood when by its means it is possible to record a time-interval as short as the thousandth part of the duration of a single beat of the heart. In find-

[1] From a Friday Evening Discourse delivered at the Royal Institution on May 29, by Prof. J. C. Bose.

ing the best mode of applying quantitative stimulus to the plant an interesting discovery was made about the extreme sensitiveness of certain plants to the stimulus of electric current. The most sensitive organ by which an electric current can be detected is our

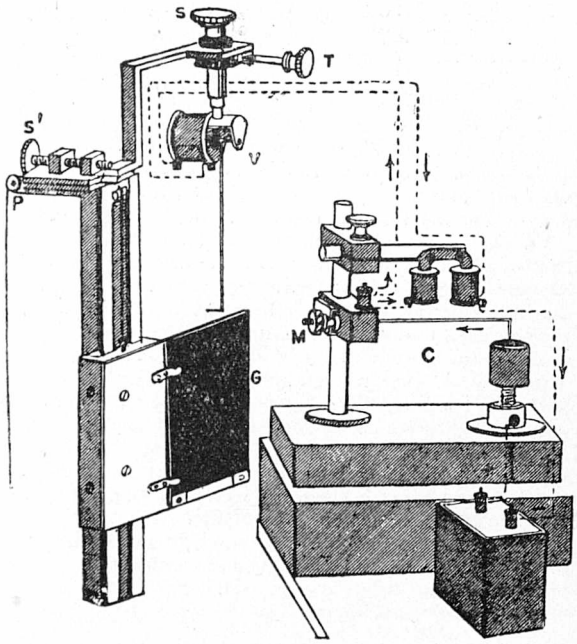


FIG. 2.—Upper part of resonant recorder (from a photograph). Thread from clock (not shown) passes over pulley P, letting down recording plate. S', screw for adjustment of distance of writing-point from recording plate. S, screw for vertical adjustment. T, tangent screw for exact adjustment of plane of movement of recorder, parallel to writing-surface. V, Axis of writer supported perpendicularly at centre of circular end of magnet. C, coercer. M, micrometer screw for adjustment of length of coercer.

tongue. An average European, according to Laserstein, can perceive by his tongue a current as feeble as 6·4 microamperes—a microampere being one-millionth part of the unit of current. This value might be subject to certain variation, depending on racial characteristics. One might expect that the tongue of the Celt would be far more excitable than

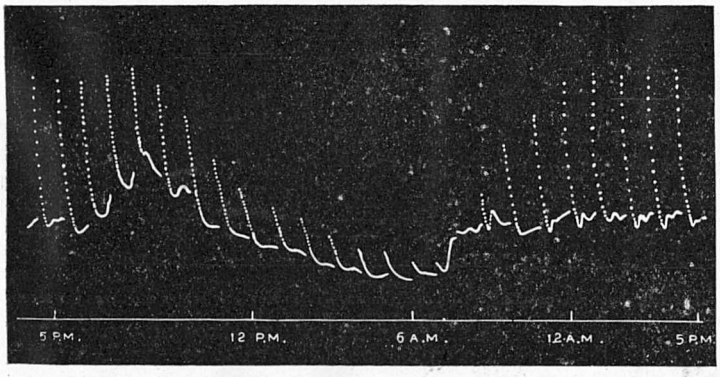


FIG. 3.—Hourly record for twenty-four hours, exhibiting diurnal variation of excitability (spring specimen).

that of the stolid Anglo-Saxon. In any case, the superiority of man has to be established on foundations more secure than sensibility; for the plant Biophytum, I find, is eight times more sensitive to an electrical current than a human being. With regard to the stimulus of induction shock, Mimosa is ten times as sensitive.

The Sleep of Plants.

In studying the effect of a given change in the external condition, an assumption has to be made that during the time of experiment there has been no spontaneous variation of excitability. Is the plant equally excitable throughout day and night? If not, is there any particular period at which the excitability remains uniform? Is there again a different time during which the plant loses its sensibility—going, as it were, to sleep? On these points no definite information has been available. The fanciful name of

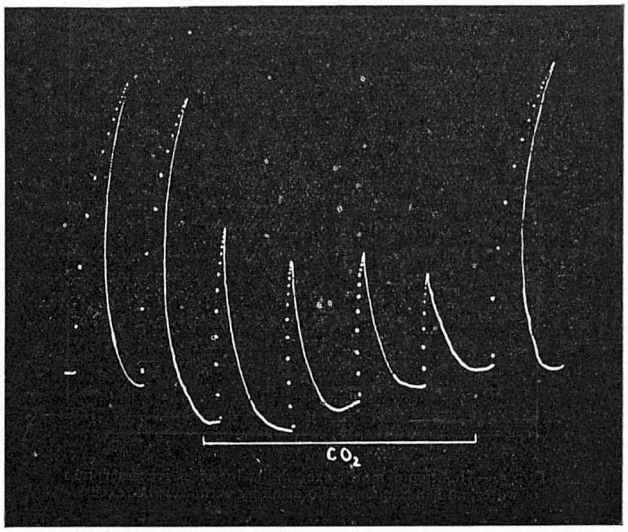


FIG. 4.—Effect of carbonic acid gas.

sleep is often given to the closure of leaflets of certain plants during darkness. These movements are brought about by variation of turgor, and have nothing whatever to do with true sleep; for similar closure of leaflets takes place under the precisely opposite condition of strong light.

In order to find out whether Mimosa exhibits diurnal variations of sensibility, I made it record its answer to uniform questioning shocks, repeated every hour of the day or night. The amplitude of the answering twitch gave a measure of the "wakefulness" of the plant during twenty-four hours. The results obtained were quite unexpected. The plant is found to keep up very late, and fall asleep only at the early hours of the morning. It makes up for its late hours by gradually waking up by noon (Fig. 3). It then remains in a condition of uniform sensibility all the afternoon. This period of uniformity is chosen for investigations on the effect of changed external conditions on excitability.

Effect of Air, Food, and Drugs.

The plant is intensely susceptible to the impurities present in the air. The vitiated air of the town has a very depressing effect. According to popular science, what is death to the animal is supposed to be life for the plant; for does it not flourish in the deadly atmosphere of carbonic acid gas? The record (Fig. 4) shows that, instead of flourishing, the plant gets suffocated just like a human being. Note the gasp of relief when fresh air is introduced. Only in the presence of sunlight is this effect modified by photosynthesis. In contrast to the effect of carbonic acid, ozone renders the plant highly excitable. Sulphuretted hydrogen,

even in small quantities, is fatal to the plant. Chloroform acts as a strong narcotic, inducing a rapid abolition of excitability. The ludicrously unsteady gait of the response of plant under alcohol could be effectively exploited in a temperance lecture! The record (Fig. 5) is in the nature of an anticlimax, where the plant has drunk (pure water!) not wisely but too well. The gorged plant is seen to have lost all power of movement. I was, however, able to restore the plant to normal condition by extracting the excess of liquid by application of glycerin.

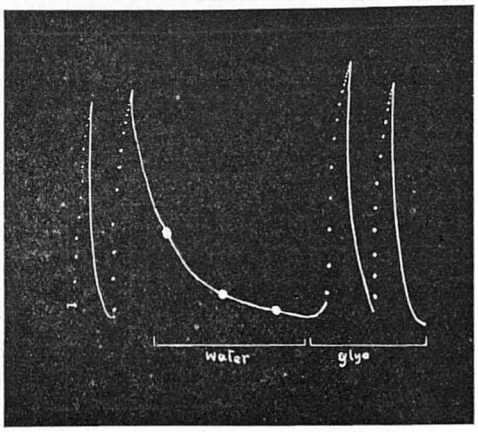


FIG. 5.—Abolition of motile excitability by excessive absorption of water, and subsequent restoration by withdrawal of excess.

It may be urged that the various reactions of irritability may hold good only in the case of the particular plant Mimosa, and that the majority of plants were quite insensitive. I have, however, been able to demonstrate in this very hall thirteen years ago, through my discovery of electric response in ordinary plants, that every plant and every organ of the plant is sensitive.[2] The difficult problem of finding the time taken by the plant to perceive and respond to a blow was solved by the employment of my resonant recorder, in which the writer was tuned to vibrate two hundred times a second. The successive dots are thus at intervals of 1/200 part of a second apart. In a particular experiment there are 15·2 intervals between the application of stimulus, represented by a vertical line, and the initiation of response (Fig. 6). The latent period, therefore, in this case is 0·076 of a second. The reaction time of the plant becomes very sluggish under fatigue.

Excitatory Impulse in Mimosa.

I next take up the question of transmission of excitation in plants. It has hitherto been supposed in Mimosa the impulse caused by irritation is merely hydro-mechanical, and quite different from the nervous impulse in the animal. According to this hydro-mechanical theory, the application of mechanical stimulus is supposed to squeeze the tissue, in consequence of which the water forced out delivers a mechanical blow to the contractile organ of the plant. Such hydromechanical transmission is in no way affected by any physiological agencies as warmth or cold, or the application of various anæsthetics or poisons.

In strong contrast to this is the transmission of nervous impulse, which is a phenomenon of passage of protoplasmic disturbance from point to point. Here under favourable physiological conditions, such as warmth, excitatory impulse is transmitted with a quicker speed. There are certain agents again which paralyse the conducting tissue for the time being, causing a temporary arrest of the impulse. Such agents are known as anæsthetics. There may again be poisonous drugs which permanently abolish the conducting power. The nature of an impulse may thus be discriminated by several crucial tests. *The impulse must be physiological, or of a nervous character, if physiological changes affect the rate of conduction; absence of such effect, on the other hand, proves the mechanical character of the impulse.*

Of the various physiological tests, Pfeffer employed that of the narcotic drug. Chloroform applied on the *surface* of the stem of Mimosa failed to arrest the impulse. This result, at first sight, appears most convincing, and has been universally accepted as a disproof of the existence of nervous impulse in Mimosa. A little reflection will, however, show that under the particular conditions of the experiment, the conducting tissue in the interior could not have been affected by the external application of the narcotic, the task being, in fact, as difficult as narcotising a nerve-trunk lying between muscles by the application of chloroform on the skin outside.

The question of nervous impulse in plants has thus to be attacked anew, and I have employed for this purpose twelve different methods. They all prove conclusively that the impulse in the plant is identical in character with that in the animal. Of these I shall give a short account of two different modes of investigation. It is obvious that the transmitted impulse in Mimosa must be of an excitatory, or nervous character :—

(1) If it can be shown that physiological changes induce appropriate variation in the velocity of transmission of the impulse.

(2) If the impulse in the plant can be arrested by different physiological blocks by which nervous impulse in the animal is arrested.

For the last two investigations the research resolves itself into the accurate measurement of the speed with which an impulse in the plant is transmitted, and the variation of that speed under changed conditions. A portion of the tissue at C may, for example, be subjected to the action of cold, or of a poisonous drug (Fig. 7). In order to find the speed of normal transmission, we apply an instantaneous stimulus, say, of an electric shock, at B, near the pulvinus. A short interval, the latent period, will elapse between the application of stimulus and the beginning of responsive movement. After the determination of the latent period, we apply stimulus once more at A, and observe the time which elapses between the application of

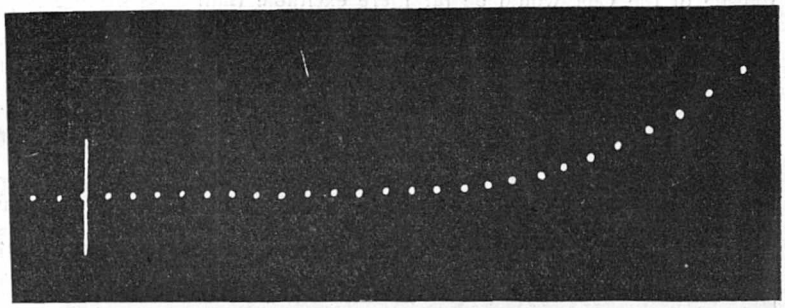


FIG. 6.—Record showing the latent period of Mimosa. The recorder vibrates 200 times per second. The time-interval between successive dots is here 0·005 sec.

[2] Bose: Friday evening discourse, May 10, 1901.

stimulus and the response. The difference between the two periods gives us the time required for the excitation to travel from the point of application of stimulus at A, to the responding organ at B; hence we obtain the speed of impulse in the plant. The experiment is repeated once more, after the application of a given agent at C. If the speed undergoes any variation, it must be due to the action of the given agent.

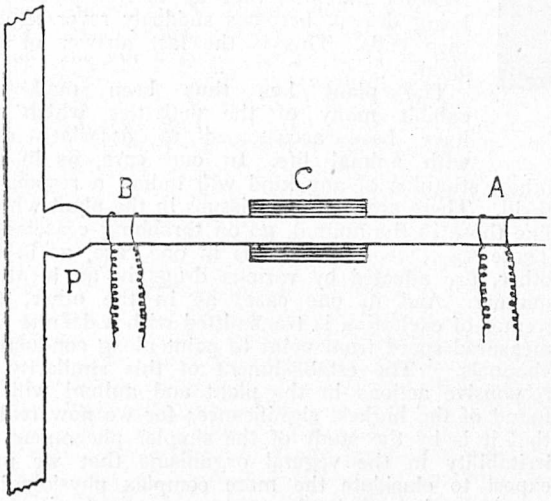


FIG. 7.—Experimental arrangement for determination of velocity of transmission and its variation. Record is first taken when stimulus is applied near the pulvinus at B (latent period) and then at a distant point on the leaf-stalk at A. Difference of two gives time for transmission from A to B. The band of cloth C is for local application of warmth, cold, anæsthetics, and poison.

Determination of Speed of Excitatory Impulse in Plants.[3]

As relatively long intervals have to be measured in the determination of velocity, the recorder has its frequency adjusted to ten vibrations per second; hence the space between successive dots represents an interval of one-tenth of a second. In Fig. 8 is given a record for determining the velocity of transmission.

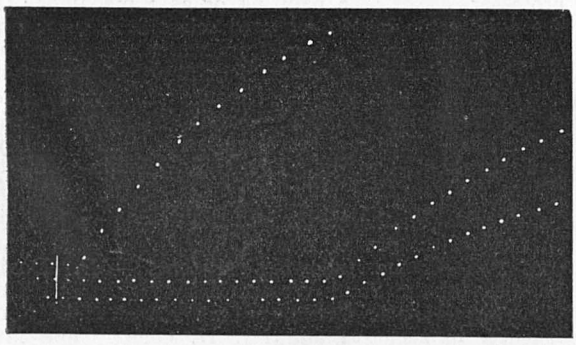


FIG. 8.—Determination of velocity of transmission in Mimosa. The two lower records are in response to stimulus applied at a distance of 30 mm.; the upper record exhibits latent period in response to direct stimulus applied on the pulvinus. Successive dots in this and following records are of intervals of one-tenth part of a second.

The two lower figures give practically identical results of successive experiments when stimulus was applied at a distance of 30 mm. The uppermost is the record for direct stimulation. From these it is seen that the interval between stimulus and response is 1·6 seconds, and that the latent period is 0·1 second. Hence the true time for the excitation to travel through a distance of 30 mm. is 1·5 seconds, the velocity being 20 mm. per second.

The velocity of nervous impulse in the plant is slower than those of higher, but quicker than those of lower animals. The speed of the impulse is, however, subject to variation under different conditions. One significant result that came out was that while a plant carefully protected under glass from outside blows looked sleek and flourishing, yet as a complete and perfect organism it proved to be a failure. Its conducting power was found atrophied or paralysed. But when a succession of blows rained on this effete and bloated specimen, the stimulus canalised its own path of conduction, and it became more alert and responsive, and its nervous impulses became very much quickened.

Effect on Physiological Agencies on Velocity.

A decisive experiment to discriminate between the theories of mechanical and nervous transmissions, consists in the determination of the effect of temperature on the speed of transmission. Temperature has no effect on mechanical propagation, whereas a moderate variation of it profoundly affects the rate of nervous transmission. In the case of the plant, I find that the velocity is doubled by rise of temperature through 9° C. When a portion of conducting petiole is subjected to cold the speed of conduction is retarded. Excessive cold temporarily abolishes the conducting power.

As an after-effect of the application of intense cold, the conducting power remains paralysed for a considerable length of time. It is a very interesting and suggestive fact that I have been able to restore the conducting power quickly by subjecting the paralysed portion of the plant to a measured and moderate dose of electric shock.

Various physiological blocks can be made to inhibit the excitatory impulse in the plant, precisely as in the case of animal nerve. The nervous impulse in plants may thus be arrested by electrotonic block or by the action of poisons. By applying solution of potassium cyanide I have been able to abolish the conducting power in the plant in a time as short as five minutes. This investigation on the simplest type of plant-nerve is expected to cast a flood of light on the very obscure phenomenon of nervous impulse in general, and the causes operative in bringing about the degeneration of the normal function of the nerve.

Spontaneous Pulsation.

In certain animal tissues, a very curious phenomenon is observed. In man and other animals, there are tissues which beat, as we say, spontaneously. So long as life lasts, so long does the heart continue to pulsate. There is no effect without a cause. How then was it that these pulsations became spontaneous? To this query, no fully satisfactory answer has been forthcoming. We find, however, that similar spontaneous movements are also observable in plant tissues, as in *D. gyrans*, or the telegraph plant, the leaflets of which dance up and down. The characteristics of the automatic pulsations in the plant could not be determined on account of the apparent impossibility of obtaining a record. The leaflets are too minute and the pull exerted too feeble to overcome friction of the recording surface. This difficulty has been obviated by the device of my oscillating recorder (see pulse-record, Fig. 9). From the records thus obtained, I am enabled to say that the automatic movements of both plants and animals are guided by laws which are identical. Thus I find, as

[3] For a more detailed account consult:—
Bose: "An Automatic Method for the Investigation of Velocity of Transmission of Excitation in Mimosa." Phil. Trans. Royal Society, Series B, vol. cciv.
Bose: "Plant Response." (Longmans, Green, 1906).
Bose: "Researches on Irritability of Plants." (Longmans, Green, 1913.)

with the pulsating heart, so also with the pulsating leaflet, the rhythmic frequency is increased under the action of warmth, and lessened under cold, increased frequency being attended by diminution of amplitude, and *vice versâ*. Under ether, there is a temporary arrest, revivai being possible when the vapour is blown

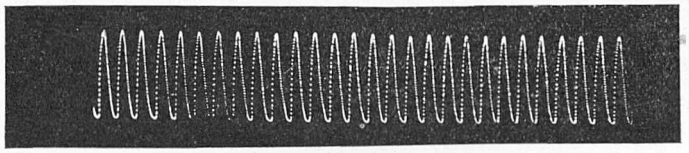


FIG. 9.—Record of automatic pulsations in *Desmodium gyrans*.

off (Fig. 10). More fatal is the effect of chloroform. The most extraordinary parallelism, however, lies in the fact that those poisons which arrest the beat of the heart in a particular way, arrest the plant-pulsation also in a corresponding manner, the arrest produced being either at systole or diastole, depending on the

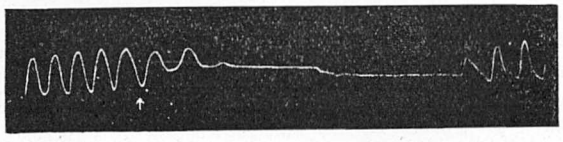


FIG. 10.—Arrest of pulsation of Desmodium under ether; restoration of pulsation on blowing off ether. The arrow indicates the time of application.

characteristic reaction of the poison. Taking advantage of the antagonistic reactions of specific poisons, I have been able to revive a poisoned leaflet by the application of another counteracting poison

Instantaneous Record of Growth.

As a further example of automatic activity we may take the phenomenon of growth. The rate of growth is so extremely slow that even the proverbial pace of the snail is two thousand times quicker! It would take an average plant two hundred years to cover the short distance of a mile. This extreme slowness is a serious drawback in the investigation on growth. For even with the existing magnifying growth-recorders it would take many hours for the variation of growth to be recorded under a changed condition in the environment. The results thus obtained are subject to errors brought about by the variation of growth which takes place spontaneously in the course of a few hours. Growth can be assumed to remain constant only for a short time; on this account it is necessary to conclude an experiment in the course of a few minutes.

The difficulties have been overcome in my high magnification crescograph, which records the absolute rate of growth in a time so short as the single beat of the pendulum. The various magnifications available are a thousand or ten thousand times. For demonstration purposes I have been able to secure a magnification of a million times. The infinitesimal growth thus becomes magnified so as to appear rushing forward as if in a race. The actual rate of growth and its variations under the action of drugs, of food-materials, of various electrical and other forms of stimuli, are thus recorded in the course of a few minutes. The great importance of this method of investigation in agriculture is sufficiently obvious.

The Plant's Response to the Shock of Death.

A time comes when, after an answer to a supreme shock, there is a sudden end of the plant's power to give any further response. This supreme shock is the shock of death. Even in this crisis there is no immediate change in the placid appearance of the plant. Drooping and withering are events that occur long after death itself. How does the plant, then, give this last answer? In man, at the critical moment, a spasm passes through the whole body, and similarly in the plant I find that a great contractile spasm takes place. This is accompanied by an electrical spasm also. In the script of the death-recorder the line, that up to this point was being drawn, becomes suddenly reversed and then ends. This is the last answer of the plant.

The plant has thus been made to exhibit many of the activities which we have been accustomed to associate only with animal life. In one case, as in the other, stimulus of any kind will induce a responsive thrill. There are rhythmic tissues in the plant which, like those in the animal, go on throbbing ceaselessly. These spontaneous pulsations in one case, as in the other, are affected by various drugs in an identical manner. And in one case, as in the other, the tremor of excitation is transmitted with a definite and measured speed from point to point along conducting channels. The establishment of this similarity of responsive actions in the plant and animal will be found of the highest significance; for we now realise that it is by the study of the simpler phenomena of irritability in the vegetal organisms that we may expect to elucidate the more complex physiological reactions of the animal.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The recent endowment of the Poynting chair of physics by Sir George Kenrick fulfils the purpose of perpetuating the memory of the late Prof. Poynting; but it is known that a number of friends and admirers would welcome the opportunity of contributing to a memorial of a somewhat more personal kind. A circular is, therefore, being issued by a representative committee, inviting contributions to a Poynting Memorial Fund. The proposed objects of this fund are (*a*) the execution of a portrait of the late professor, either as a painting or as a medallion; (*b*) the publication of his collected scientific papers; and (*c*) the formation of a fund from which assistance can be given to research students in physics. Donations and promises to the amount of about 350*l*. have been received already, but it is hoped that at least 1000*l*. will be realised. The hon. secretary is Mr. G. H. Morley, and the hon. treasurer Dr. G. A. Shakespear, to whom contributions may be sent.

LONDON.—At the meeting of the Senate on July 15, the last of the present session, the D.Sc. degree was conferred on the following students:—Mr. David Segaller, of the South-Western Polytechnic, in chemistry; Mr. J. H. Orton, of the Royal College of Science, in zoology; and Mr. H. Chatley and Mr. G. S. Coleman, external students, in engineering.

Mr. T. S. Moore was appointed to the University chair of chemistry tenable at Royal Holloway College. Since 1907 Mr. Moore has been tutor in chemistry at Magdalen College, Oxford.

In response to a request from the Board of Control for suggestions as to methods of encouraging scientific research into the causes and treatment of mental diseases and mental defect, it was decided to recommend that individual grants should be given to a few thoroughly trained observers for the investigation of fundamental problems.

A FURTHER gift of 10,000*l*. has been made to the Medical School of University College, Cardiff, by the

anonymous donor who has already undertaken the erection of the Medical School Buildings. The gift is conditional on certain contributions by the Treasury to the upkeep.

MR. H. S. ROWELL has been appointed to the position of senior lecturer in mechanical engineering at Bradford Technical College, and will commence his duties in September next.

MR. FREDERICK SODDY, lecturer in physical chemistry in the University of Glasgow, has been appointed to the chair of chemistry at the University of Aberdeen, in succession to Prof. F. R. Japp.

PROF. J. S. MACDONALD, professor of physiology in the University of Sheffield since 1903, has been appointed Holt professor of physiology in the University of Liverpool, in succession to Prof. C. S. Sherrington.

DR. T. J. JEHU, lecturer on geology at the University of St. Andrews, has been appointed Murchison regius professor of geology and mineralogy in the University of Edinburgh, in succession to Prof. James Geikie, who lately resigned the chair.

THE Extension Lecture scheme of the Selborne Society has become so successful that it has been found possible this year to issue a handbook of fifty pages giving particulars of nearly two hundred lectures. The addresses are mainly of a popular character, and are by lecturers who command high fees as well as by those who will accept a small honorarium, or in exceptional cases merely their travelling expenses. The society hopes that in this way it may be of considerable assistance to societies and schools, whether large or small, by enabling them to secure the services of competent lecturers. There are many local societies which cannot afford big fees, and plenty of county people who are glad to arrange lectures in their villages, and to these the handbook should prove most useful. The Selborne Society during the coming winter will arrange courses of these lectures in London and the provinces. Particulars can be obtained from the Extension Lecture Secretary, Mr. Percival J. Ashton, 37 Walbrook, London, E.C.

AN appeal on behalf of the Equipment and Endowment Fund Committee of University College, Gower Street, W.C., has been issued by the Hon. Rupert Guinness, M.P., who is the chairman of the executive committee. The committee has been engaged for some years in endeavouring to collect funds to meet the capital expenditure which has become necessary for the proper development of several departments of the college work. These efforts have already met with much success. The London County Council has made a grant of 30,000*l.*, and this grant has encouraged the committee to renew the endeavour to obtain the money required to complete work already in hand and necessary to enable the college to discharge with proper efficiency its present functions. The sum immediately required is about another 30,000*l.* The money is wanted for four main purposes:—(i) About 10,000*l.* to complete the equipment of the new chemical laboratories, especially that for physical chemistry. (ii) A large hall to serve as an examination room, for ceremonial assemblies and for public lectures. For this, about 12,000*l.* is required. (iii) A benefactor has erected, at a cost of 35,000*l.*, buildings to accommodate the University School of Architecture and the Department of Applied Statistics and Eugenics. To complete this part of the college about 6000*l.* is required. (iv) The college libraries contain about 130,000 books and more than 17,000 pamphlets, but the proper custody and arrangement of the books and manuscripts, as well as the use of them by readers, are interfered with by want of space. To remedy these disadvantages will cost 2500*l.* The current work of the college is hampered badly, and much-needed developments are arrested, until these four objects are provided for fully. The Equipment and Endowment Fund Committee, of which Prince Arthur of Connaught is president, consequently feels that, in urging the claims of University College on the favourable consideration of all who recognise the importance of providing facilities for advanced study and investigation, it is doing work of national value. We trust the efforts of the committee in their public-spirited work on behalf of higher education in London will soon be rewarded, and that the funds needed so urgently will be speedily forthcoming. Contributions may be sent to the president or to the chairman of the executive committee, at University College, Gower Street, London, W.C.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 13.—M. P. Appell in the chair.—Paul **Sabatier** and Léo **Espil**: The reduction of the oxides of copper, lead, and nickel. Using calcium carbide as an indicator of the production of water, the reduction of cupric oxide in dry hydrogen is clear at 120° C. For lead dioxide, the corresponding temperature is 150° C. Nickel oxide, NiO, on reduction at low temperatures gives a mixture of metallic nickel and a suboxide of doubtful composition.—A. **Haller** and Mme. **Ramart-Lucas**: Syntheses by means of sodium amide. The oxide of propylenedimethylacetophenone and some of its derivatives. A new method of preparation of the γ-ketonic acids.—Charles **Moureu** and Georges **Mignonac**: Additional examples of the class of compounds described in a recent paper, and containing the grouping $RR'C=N-CRR''$. On hydrolysis, ammonia and a ketone are the products.—M. **Calmette** and L. **Massol**: The preservation of cobra poison and its antitoxin. Cobra poison slowly loses its toxic power on keeping; the antitoxin is absorbed not only by the toxic substance of the snake poison, but also by other substances accompanying it. The antitoxin serum preserves its power for at least six years.—Ph. A. **Guye** and F. E. E. **Germann**: The analysis of very small quantities of gas; application to the analysis of air. The apparatus illustrated is based on the application of a modified MacLeod gauge. An example of an analysis of air with the apparatus is given, in which the initial volume was only 0·25 c.c.—Maurice **Paschoud**: Application of the method of Walther Ritz to the problem of the uniform *régime* in a tube with square section.—J. **Boussinesq**: Observations on the preceding note of M. Paschoud.—Farid **Boulad bey**: A new theorem on elastic displacements and its application to the simplification of the direct calculation of reactions of the supports of continuous beams.—E. **Estanave**: The exteriorisation of the photographic image by the autostereoscopic plate.—P. Le **Rolland**: The determination of the ratio of the times of oscillation of two pendulums. A modification of the photographic method described by Lippmann in 1897. For a period of comparison of only three minutes the ratio of the times can be determined with an accuracy of one part in a million. The photographic method possesses several advantages over the method of coincidences, especially if the difference between the times of oscillation of the two pendulums is small.—C. G. **Bedreag**: Electrification by the X-rays. The square of the maximum velocity of the electrons emitted is proportional to the frequency of the incident X-radiation.—G. **Millochau**: A new pyrometric method based on the absorption of some substances for the integral radiation. The determination of a tempera-

ture with the Féry pyrometer is extended to cases in which the image of the opening in the hot body is smaller than the blackened disc fixed to the thermo-electric couple. Readings are taken of the deviations with and without the interposition of absorptive plates of mica, glass, or celluloid.—MM. **Massol** and **Faucon**: The ultra-violet spectra of aqueous solutions of nitric acid, metallic nitrates, and particularly of copper nitrate.—P. **Chevenard**: The expansion of ferro-nickels over a large range of temperature. Measurements were made of the expansion between −195° C. and 750° C., for a series of alloys containing increasing proportions of nickel. The results are given in the form of diagrams.—B. **Bogitch**: The ternary alloy of zinc, silver, and lead.—F. **Taboury**: Glucinum sulphate and its hydrates.—J. **Clarens**: The chlorometric method of Penot.—Marcel **Guichard**: A new method of determination of the atomic weight of iodine. The method is based on the use of purified iodine pentoxide, and its decomposition into iodine and oxygen by a high temperature. These elements are weighed separately. The general mean of the experiments was, for O=16, I=126·92, identical with the value currently accepted.—L. **Tschugaeff**: A new method of preparation of the complex compounds of bivalent platinum.—André **Brochet** and Maurice **Bauer**: The addition of hydrogen to aliphatic compounds with ethylene linkages in presence of nickel under moderate pressure. The reactions were carried out at the ordinary temperature under hydrogen pressures of fifteen atmospheres or less. Descriptions of the reduction of *l*-octene, cinnamic acid, sodium cinnamate, methyl cinnamate, piperonylacrylic acid, eugenol, sapol, and isoeugenol are given.—Maurice **Lugeon**: The autochone strata below the Morcles layer.—Emile **Haug**: New observations on the tectonic of the valley of Saint Pons, near Gémenos (Bouches-du-Rhône).—P. **Idrac**: The irregularities of the wind.—Julien **Loisel**: The nomographic representation of the reduction of the barometer to sea-level.—O. **Lignier**: New contributions to the knowledge of the flower of the Fumarieæ and the Cruciferæ.—Edgar **Zaepffel**: The distribution of the stomata in the plantules of some graminaceous plants.—E. **Chuard** and R. **Mellet**: Nicotine in the by-products of the culture of tobacco. The waste products of tobacco culture contain sufficient nicotine to be of commercial value in the preparation of insecticides.—J. Künckel **d'Herculais**: Correlation between the mortality of *Ailanthus glandulosa* and the disappearance of *Samia cynthia*.—Em. **Bourquelot** and Al. **Ludwig**: The biochemical synthesis of the β-monoglucosides of meta- and para-xylene glycols.

BOOKS RECEIVED.

Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere. Band i. Die Wasserstoffionen-Konzentration. By Prof. Dr. L. Michaelis. Pp. xiv+210. (Berlin: J. Springer.) 8 marks.

Journal of Genetics. Vol. iv. No. 1. June. Pp. 107. (Cambridge University Press.) 10*s.* net.

The Biochemical Journal. Vol. viii. No. 3. June. Pp. 217–280. (Cambridge University Press.) 7*s.* net.

Grundzüge der Mengenlehre. By Prof. F. Hansdorff. Pp. viii+476. (Leipzig: Veit and Co.) 18 marks.

Catalogue of the Ungulate Mammals in the British Museum (Natural History). Vol. iii. Artiodactyla, Families Bovidæ, Subfamilies Æpycerotinæ to Tragelaphinæ (Pala, Saiga, Gazelles, Onyx Group, Bushbucks, Kudus, Elands, etc.) Antilocapridæ (Prongbuck) and Giraffidæ (Giraffes and Okapi). By R. Lydekker. Pp. xv+283. (London: British Museum (Natural History), and Longmans, Green and Co.) 7*s.* 6*d.*

Quarterly Journal of the Royal Meteorological Society. Vol. xl. No. 171. July. Pp. 185–256. (London: E. Stanford, Ltd.) 5*s.*

Botanische Jahrbucher für Systematik Pflanzengeschichte und Pflanzengeographie. Edited by A. Engler. Band li. 3 u. 4 Heft. Pp. 225–512. (Leipzig and Berlin: W. Engelmann.) 18 marks.

Gegenbaurs Morphologisches Jahrbuch. Edited by Prof. G. Ruge. Band xlix. Heft 1. Pp. 178. (Leipzig and Berlin: W. Engelmann.) 13 marks.

Zeitschrift für wissenschaftliche Zoologie. Edited by Prof. E. Ehlers. Band cix. Heft 3. Pp. 349–530. 13 marks. Band cix. Heft 4. Pp. 531–696. 11 marks. Band cx. Heft 1. Pp. 149. 15 marks. Band cx. Heft 2. Pp. 150–301. 10 marks. (Leipzig and Berlin: W. Engelmann.)

Woburn Experimental Fruit Farm. Fourteenth Report of the Woburn Experimental Fruit Farm. Pp. 151. (London: Amalgamated Press.) 2*s.* 9*d.*

Department of Commerce. U.S. Coast and Geodetic Survey. Hypsometry. Fourth General Adjustment of the Precise Level Net in the United States and the Resulting Standard Elevations. Special Publication No. 18. By E. Bowie and H. G. Avers. Pp. 328. (Washington: Government Printing Office.)

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