NATURE

THURSDAY, APRIL 21, 1921.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.

Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

University Grants in the Civil Service Estimates.

IN view of the recent economy campaign, the debate on the Education Estimates for the present financial year, on April 12, was awaited with interest, but apparently the economists did not get the same support in the House of Commons as was given in certain quarters outside. The Estimates were passed without alteration, and the vote for grants in aid of Universities and institutions of University rank was agreed to without discussion. This means that there is an addition of half a million to the annual University grant, together with a special non-recurrent grant of 500,000*l.* for superannuation purposes.

Under the heads of education, science, and art (Civil Service Estimates, Class IV.) the total estimate for the United Kingdom for the year 1921–22 is 67,038,295*l.*, of which sum 1,500,000*l.* is allocated to Universities and institutions of University rank. That is to say, these higher institutions will receive about one-forty-fourth of the total estimate. On the face of it this seems far too small a proportion, and a closer examination confirms the view. The fact is that the Government has been slow to recognise the necessity of greater financial assistance for the Universities, and perhaps the Universities have not been importunate enough on their part.

While this additional annual grant will be welcomed, it is scarcely necessary to say that it is insufficient to meet the present needs. University teachers are notoriously underpaid, so much so that grave doubts are felt as to the supply of adequately qualified teaching power in the future. Even if the new grant were solely devoted to increases in salaries it would be insufficient. For example, with the same allocation as last year, in the case of one of these institutions it would mean no more than an average all-round increase of about 20 per cent. With University salaries at their present level such an increase would most assuredly not meet the exigencies of the moment. But the salary problem is not the only one with which the University is faced. Other pressing financial needs will have to be met, and, while the new grant will tend to ease the strain, one cannot but feel that it is hopelessly inadequate.

It is illuminating to compare this state of affairs with the provision made by the Government for the Civil Services. On p. 7 of the Estimates will be found a statement regarding the rate of bonus applicable to salaries and wages. This rate ranges from 130 per cent. of the pre-war remuneration in the case of small incomes to 45 per cent. in the case of the larger incomes, the maximum bonus payable being limited to 750*l.* per annum (500*l.* in certain cases). Thus, to take one example, the estimated bonus for the Administrative Staff of the Board of Education for the year 1921–22 is 209,915*l.*, which works out as an average all-round increase of about 67 per cent. upon pre-war salaries and wages. Similarly the bonus proposed under the heads of administration and inspection for the United Kingdom is not far short of half a million, with almost the same percentage increase. This is the sort of provision the Government makes for its own Services. Having in mind the index figure for the cost of living, we are not prepared to say that this provision as a whole is excessive. Our contention is that in the present financial strain it is the duty of the Government to give special assistance to the Universities, and at least to treat them as liberally as its own Services.

If it is argued that the Government has increased its subsidies it must be remembered that the field over which the grants have been distributed has been gradually extending. An inspection of the Estimates on p. 54 shows that four London medical schools are receiving for the year 1921–22 in the aggregate 26,030*l.* over and above what they received in the previous year. If we interpret a footnote correctly, this slice out of the grant is to make provision for clinical units. No doubt this is a necessary object, but it is seriously to be questioned whether it was one of the purposes

contemplated when the grant was originally made. One would think that such provision should be made by special Parliamentary vote. Further, on the same page, it will be seen that the sum of 80,000*l.* is allocated to five institutions which did not receive a penny from this source in the year 1920–21. Two of them—Oxford and Cambridge—are each to receive 30,000*l.* Now we do not for a moment begrudge them these grants. But, by extending the field of the distribution, a large sum, in the cases just mentioned 106,030*l.*, has been diverted from institutions which otherwise would have benefited from it, and this fact ought not to be overlooked.

It cannot be too strongly urged that Universities and institutions of University rank are in an anomalous position in that they are compelled by force of circumstances to look to the Government for assistance. Their financial burdens, largely due to the crisis through which the country is passing, cannot be met from their normal sources of income. Benefactions are problematic. To raise the fees to meet the additional and necessary costs would be to make them so high as to prevent a large number of deserving students from entering the University, with ultimate loss to the community and nation. Already the fees charged are considerably larger than those which prevail in the United States of America. It is facts such as these which make the problem of University finance so difficult and the necessity of further Government assistance so imperative.

If our legislators have any doubt about this necessity, let them examine the figures on p. 54 of the Estimates, and note the relative disparity between the grants for England and Scotland. Six Scottish institutions are to receive 180,000*l.*, whereas forty-two English institutions will get only 591,180*l.*! A footnote makes it clear that the Scottish estimate includes 72,000*l.* awarded by Scottish Acts of Parliament in 1889 and 1892 respectively. The right of Scotland to so large a sum is not questioned, since, no doubt, when these Acts were passed the Scots were willing to forgo other privileges in order to make better provision for their own higher education. Our point, however, is this: whatever may be the genesis of the grant or grants, the total sum is relatively much larger than that assigned to England. If such a sum is necessary for Scotland—and we do not doubt it is—surely the Government should see that a proportionate sum should be given to England.

One other point. The Estimates provide for a sum of 500,000*l.* for superannuation purposes. This is intended to be a special non-recurrent grant in aid of certain Universities, colleges, medical schools, etc., to assist them to provide retrospective benefits for senior members of the staffs under the Federated Superannuation System of the Universities. In a previous issue we have already criticised the proposal and expressed the opinion that this sum will fall far short of the amount necessary for the purposes indicated. Unless a grave injustice is done to the senior members of the staffs, the grant will have greatly to be increased, or an opportunity given them to come under the School Teachers (Superannuation) Act. It is certain that a very large number of University teachers would gladly avail themselves of the latter alternative.

Colloidal Theory.

An Introduction to Theoretical and Applied Colloid Chemistry: "The World of Neglected Dimensions." By Dr. Wolfgang Ostwald. Authorised translation from the German by Prof. Martin H. Fischer. Pp. xv+232. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 11*s.* 6*d.* net.

The Chemistry of Colloids. Part 1, *Kolloidchemie.* By Prof. Richard Zsigmondy. Translated by Prof. Ellwood B. Spear. Part 2, *Industrial Colloidal Chemistry.* By Prof. Ellwood B. Spear. Pp. vii+288. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 13*s.* 6*d.* net.

AFTER reading the books the titles of which stand at the head of this article, one is inclined to ask whether the word "colloid" as it has come to be used does refer to a definable state of matter, or whether it is not, in fact, used as a convenient label for a heterogeneous group of states which have only this in common, that they are not easily assimilated to the ordinary doctrines of molecular physics.

It is agreed that the word refers to systems in which one state of matter is dispersed through another, but it is claimed that there are no natural boundaries between such systems and coarse settling suspensions on one hand, and true molecular solutions on the other.

Having convinced themselves that there are no natural limits, both Dr. Ostwald and Prof. Zsigmondy select arbitrarily certain sizes of particles or degrees of dispersion and define mixtures which lie between as colloidal. This

is a mere confession of weakness, and every step of the argument on which it is based seems open to challenge. It is pure topography, and as such of little value. The colloidal state does, in fact, touch solution on one hand, and suspensions on the other, but it is not a matter simply, or even primarily, of scale. The distinctive quality of the state consists in certain constraints which may fairly be called frictional constraints, from which comes the characteristic inertia of colloidal systems noticed by Graham. An ideal suspension in which the relation between particles and fluid medium was one of simple repulsion would be free from such constraints. Its sole characteristic would be a uniform distribution of the particles—this follows from considerations of entropy—so that, if appropriate external restraints operated, the system would manifest an osmotic pressure.

An ideal suspension of this kind is the ideal gas of colloids, and the distinction between it and the simplest colloidal solution lies in the fact that the particles react with the fluid, the energy associated with the reaction being of the type known as surface energy, but modified by the excessive curvature of the surfaces. Each particle acts as a strain centre, the molecules about it being orientated more or less with respect to its centre, and the total effect is an increase in the rigidity and a decrease in the mobility of the fluid—a decrease that is in the number of molecules which cross unit area of a plane surface in the interior in unit time. Any constraint which the particles exert on the molecules of the fluid will therefore tend to increase their own diffusive energy, and the osmotic pressure would be greater than that of an ideal suspension, just as when true solution is exothermic the osmotic pressure is greater than that given by the gas equation.

The energy peculiar to such systems may be classified as capillary and electrical, namely, a contact potential difference between the particles and the medium. We are ignorant of the quantitative relations between the two, but stability is least when the contact potential difference vanishes—that is to say, at the isoelectric point. This feature is almost always and quite wrongly described by saying that coagulation occurs at the isoelectric point. Coagulation, of course, occurs over a range which is determined by the magnitude of the forces operating to produce agglutination and precipitation.

It is obvious that two particles which come within range of each other will or will not agglutinate according as the variation of surface energy with the distance between their centres is positive or negative. If it be negative there will be a buffer action similar to that which may often be observed between drops of one fluid floating on the surface of another. A finite amount of work must be done to bring about agglutination, and this is an instance of one of the frictional constraints characteristic of colloids. Third components are practically always present in minute amount in actual sols condensed on to the particles. They decrease the chances of agglutination because they decrease the energy of the interface between particle and fluid, and, therefore, help to make the variation of the energy with the distance between centres negative.

We may note in passing that the diffusive energy is concerned only with the distribution of the particles. The size of the particles—that is to say, whether they do or do not agglutinate or completely fuse on "contact"—is determined by the variation of energy mentioned above. A striking example is offered by the system ether–water. If the ether phase be distributed through the water by shaking, the drops are brought into contact again by the external aggregating force gravity, and, once in contact, they immediately fuse. If, however, a trace of iodine be added, gravity brings the drops together; but they do not fuse, because of the local influences of the iodine upon the local variation of energy on "contact."

Having got so far, it does not need much imagination to see that the reason why colloidal particles do not fuse must be essentially the same as the reason why solid faces do not weld when pressed together.

There would be little difficulty in defining the colloidal state if the relations between the components were only those mentioned above. It is at the other end of the scale where sols shade into true solutions in a perplexing way, not because of variation in the size of the particles, but because true solution exists side by side with true colloidal dispersion.

Broadly, there are two types to consider: those in which true solution involves, or seems to involve, the entire colloidal component—*e.g.* silica—and some proteins in water; and those in which the solute is a salt, one ion of which is highly insoluble, in which case the dispersed phase consists of aggregates of this ion with unionised molecules. Such systems are salts of proteins and of fatty acids in water, and the remarkable feature is that though the "colloidal" ion may grow to such a size as almost to reach the limits of microscopic vision, the electric charge it carries is the area of its surface multiplied by a constant.

To return now to the delimitation of the col-

loidal state. It should be such as to include at one extreme bacteria growing in a medium. It has been shown quantitatively that agglutination of bacteria occurs when the contact potential difference at the surface of the bacteria is destroyed. They, therefore, present a characteristic feature. At the other extreme there would be such a system as turned up accidentally during the war at a certain factory. An oil was found to form with water a stable emulsion remarkable for the size of the drops, which averaged nearly 2 millimetres in diameter. When the drops were broken up by violent shaking they slowly grew to the characteristic large size, and at constant temperatures persisted for months, forming a system defined by a distinct curvature of the interfaces fixed probably by frictional constraints. Clearly delimitation can neither be simply dimensional nor is it to be found in the chemical make-up; it must be sought and is to be found in the presence of characteristic constraints.

Both books present in a fair way the contemporary views of colloidal theory. It is to the theory that criticism is directed, not to their presentation of it. Each book has its peculiar merits. Prof. Zsigmondy, for instance, is particularly good and complete in all that refers to the ultramicroscopy of colloids.

Dr. Ostwald's book gives the substance of lectures delivered in America at the invitation of certain universities. It is a good introduction to the elements of the subject. One special feature may be noticed. The book was completed before the war, and the first preface is dated 1914. Publication was deferred for obvious reasons, and the second preface, dated 1915, was written whilst the author was actually at the front. From that agony of unrest the author sends a message of peace, as dignified as it is just, to his colleagues in what were then enemy countries. For that message of goodwill I for one thank him. W. B. HARDY.

The Epistemological Problem.

(1) *A Study in Realism.* By Prof. J. Laird. Pp. xii+228. (Cambridge: At the University Press, 1920.) 14*s.* net.

(2) *Studies in Contemporary Metaphysics.* By Prof. R. F. A. Hoernlé. Pp. ix+314. (London: Kegan Paul, Trench, Trubner, and Co., Ltd., 1920.) 16*s.* net.

(1) "IL faut bien plus de principes que vous ne pensez pour démontrer ce dont personne ne doute," observes Malebranche in his "Entretiens Métaphysiques." This came to mind in reading the quotation from his adversary Arnauld which Prof. Laird has placed at the head of the introduction to his "Study in Realism." There can be no knowledge without object known, is the gist of Arnauld's remark. How undeniable! And yet Prof. Laird has to write a book and hint to us that he finds it difficult to keep his study within reasonable bounds. The realists are all alike; they disarm their adversaries by the *naïveté* of their definition, only to discover that there is no end to the diversity of meanings their professedly obvious affirmation may cover. "If the shade of Reid could visit these regions to-day it would greet Mr. Prichard, of Oxford; but it would be startled by Mr. Alexander, bewildered by Mr. Russell, and distressed by Mr. Holt. Indeed, one is tempted to think that any realism defined to the quick becomes nothing but the definer's private philosophy." Such is one realist's confession.

This troublesome problem of knowledge, however, is one to which searchers for truth, whatever be the scientific direction of their inquiry, cannot be indifferent. It is impossible to avoid its challenge, although it is not one of the great problems of philosophy. It is not, like the immortality of the soul, the nature of the world, and the existence of God, one of the problems which concern the whence, the why, and the whither of human existence. The epistemological problem is in effect the River Styx of the higher world of philosophy, but there is no Charon who can be bribed with a fee to ferry us to the other side.

Why is realism called a theory? It is not a theory in any proper meaning of the term. It is simply an assumption concerning the reality of things and the knowing relation, and the contention that the assumption is consistent with the facts. The assumption is that the object of knowledge is independent of the knowing, and that knowledge is discovery, the independent things or objects being directly revealed or given to the mind. This is the ordinary assumption of common sense, but neither the plain man nor the scientific researcher calls it a theory or requires a theory. It is the philosopher who wants a theory. The argument of the realist seems to be that if the assumption can be proved to be consistent with the facts of perception, memory, imagination, and such like processes, it will then become a theory. To this the reply is, "Can the Ethiopian change his skin?"

Prof. Laird is delightful to read. However difficult and abstruse the argument, it is bright with

witty remarks and humour. He covers a large ground, and every chapter is packed tight with matter. This makes his work easier to recommend to the reader than to describe or epitomise. We may select one or two points of special interest. One of the most awkward of the realist's problems is to determine the exact status of "images." This problem is discussed in a chapter entitled "The Stuff of Fancy." It begins by directing attention to a very serious defect in our vocabulary. We have one and the same word, "imagination," for images of scenes we remember or anticipate, and for fancies. We have, indeed, the two terms "imagination" and "fancy," but they are in ordinary discourse interchangeable. It is a difficulty the present writer has found in trying to present Croce's æsthetic theory in English. Our words "imagination" and "fancy" do not follow the same articulation of meaning as the Italian words "fantasia" and "immaginazione." This reference to Croce is not casual. If anyone is interested in a direct opposition between two philosophical theories of the nature of imagery, he will find it by comparing the first chapter of Croce's "Estetica" with Prof. Laird's theory concerning the "Stuff of Fancy." "Images, in a word, are parts of the physical world *imaged*, and that is what we discover through the fancy," concludes Prof. Laird. "Lo spirito non intuisce se non facendo, formando, esprimendo," says Croce.

Realism is very clear and emphatic in affirming the existence of the object, and that the knowledge of it is the mind's discovery; but there is another kind of existence—namely, that of the mind itself. Does the mind discover this existent? Prof. Laird finds no difficulty in answering "Yes." The argument is given in the chapter entitled "The Mind." In neurological theory he follows Sherrington. In philosophical theory his main contention is that in introspection we inspect awareness, but the act of inspection is different from the act of which it is aware. Our minds, he adds, are rich enough to contain a multitude of awarenesses almost at the same moment.

(2) The same problems are discussed in "Studies in Contemporary Metaphysics," and there is the touch of nature making realist and idealist kin in the underlying motive of Prof. Laird's epilogue and of Prof. Hoernlé's prologue. Both philosophers feel the need of justifying the human instinct to philosophise. Both give practically the same answer, and both have the same distinctly sad refrain. "Is the pursuit of philosophy worth while?" "Those who have devoted themselves to it have found it so, and they alone are in a position to judge."

The idealist's difficulty, unlike the realist's, is not concerned with the first step. The idealist has no initial assumption to negotiate; his difficulty is with the journey's end. The paradox in his case is that knowledge begins with the consciousness of an absence, with a datum the characteristic mark of which is partiality and incompleteness, while it presents to the mind a task to be accomplished. Knowledge is therefore ideality from the start, and its highest attainment in integration—the concrete universal, the absolute—appears elusive, and its objectivity unconvincing.

Prof. Hoernlé criticises, at times with brilliant effectiveness, the various constructive efforts which have been and are being brought to bear on the epistemological problem. His six years at Harvard have evidently been occupied with a vigorous championship of idealism in the homeland of new realism and behaviourism. The most arresting chapter in his deeply interesting book is that entitled "Saving the Appearances." Not only does he there offer us a constructive theory of his own, but he also demonstrates the absolute bankruptcy of realism when face to face with the demands, not of the plain man, but of the scientific worker. It is the physicist and biologist who must have the secondary qualities restored to the objective world. It is the realist who has filched them, and the idealist who alone, in Prof. Hoernlé's view, can restore them.

In these two books we have the controversy between contemporary realism and idealism represented by sturdy champions, though at present neither can claim to be bestriding a prostrate foe.

H. WILDON CARR.

Vertebrate Morphology.

Vertebrate Zoölogy. By Prof. H. H. Newman. Pp. xiii+432. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1920.) 16*s.* net.

THE leading feature of this book is an attempt to interpret the structure of vertebrate animals in terms of the "axial gradient theory." This theory, enunciated by the author's colleague, Prof. Child, is based upon certain facts of vertebrate development. These show that along the three axes of the body—longitudinal, vertical, and transverse—the rate of differentiation is not uniform, but progresses more rapidly in one direction than in the reverse. Thus the head develops faster and farther than the tail; the

dorsal organs (such as the nervous system) than the ventral; and the tissues adjacent to the middle line than the outer tissues. The flow of matter and energy along these axes is apparently faster in certain directions, or the developmental impulses are transmitted more rapidly in these directions, than in others.

In order to test this view, the author has performed a number of experiments. He has placed the developing eggs of certain fish in water to which were added substances, such as alcohol and cyanides, that lessened the rate of natural development, and he placed others under adverse conditions, such as intense cold or diminished oxygen pressure. The results of these experiments, made by Prof. Newman, show that those embryos which survived exhibited most retardation in those regions where normal specimens normally reared undergo their most rapid development. On continuing these experiments, however, he found that a certain number of the experimental animals recovered from this inhibitory effect, and that this recovery is most marked in the very regions which had previously been most depressed. For example, the development of the head was at first retarded, but if the fish survived this first period of life under experimental conditions, then the development of its head was accelerated, and, indeed, to such a degree as to render it incapable of continued existence. These non-viable embryos exhibited the strangest appearance. Some "consisted of nothing but isolated eyes"; others "merely of heads with large rolling eyes and a tiny indifferentiated appendage that stands for the rest of the body"; others, again, "became broad and flat, like a skate, or high and compressed, like a sunfish. In fact, a good assortment of experimental monsters will furnish parallels to most of the stock types of form-distortion seen in the specialised and degenerate groups of fishes" (p. 161). We can only regret that the author has not reproduced figures and descriptions of these interesting monsters, or given references to the literature.

These results lead the author to seek for a cause which has acted upon growth and development during the course of animal history somewhat in the way that the depressing agency of his experiments has led to modification of form. The problem is to explain the elongated newt and the truncated frog; in other words, the tendency of animal groups to cephalisation, to abbreviation of the abdominal and caudal regions in the more highly organised members of most classes. Here he has nothing to offer us. He speaks, as so many American writers on biology do, of "the ageing of the hereditary chromatin" as an internal factor that has operated in preserving, for example, the neoteric or perennially youthful type of body, or in other ways. He attempts to correlate the elongated form of body with the effect of low temperatures acting as a depressing agent. We are put off with phrases such as "lowered rates of chemical metabolism" and "racial senescence," expressions which really have no scientific content. The moral of all this is that we do not know enough evolutionary physiology to enforce conclusions drawn from our anatomical and developmental records of animal structure by conclusions based on corresponding records of their past and present living processes. The anatomical evidence alone leads to such melancholy exhibitions of inconclusive reasoning as are found in the discussions on animal phylogeny in this book; and if the author has not been successful in applying physiological tests to animal pedigrees, we can but applaud his courage in making the attempt. F. W. G.

Ancient Metal Implements.

Tools and Weapons: Illustrated by the Egyptian Collection in University College, London, and 2000 Outlines from Other Sources. By Prof. W. M. Flinders Petrie. (British School of Archæology in Egypt and Egyptian Research Account, Twenty-second Year, 1916.) Pp. vii + 71 + lxxix plates. (London: British School of Archæology in Egypt; Constable and Co., Ltd.; Bernard Quaritch, 1917.) 35*s*. net.

ONE of the ever-present problems of archæology is the degree of interdependence in which the ancient civilisations stood to one another in the matter of customs, religion, and the material objects of everyday life. Where undoubted importations occur the question becomes simple, but in the early ages of man's civilisation these imports are more often lacking, and the sole evidence available comes from a typological comparison of various classes of objects. In the volume under review Prof. Flinders Petrie has devoted himself to a study of Egyptian implements other than most of the stone types, and by the aid of numerous figures of similar implements from other countries, chiefly in Europe and Western Asia, he has sought to demonstrate the part played by Egypt in the invention and development of the various tools and weapons known to the ancient world.

If one fact emerges more clearly than another from this study, it is the extraordinarily small

measure in which Egypt exerted influence on, or was influenced by, other lands. In the subject of investigation, as in many other respects, Egypt stands apart. At the outset of her metal age it is only natural that she should have borrowed from Cyprus some of the copper forms current there; but, apart from the scalloped axe borrowed from Syria about the Fifth Dynasty, there is no other important instance of the borrowing and subsequent development of any form throughout her history. Other weapons, pins and the like, of European and Western Asiatic forms, are for the most part importations due to commerce or invasions. The non-adaptation of many of the most useful European developments of the middle and late Bronze age, particularly the socket, makes it difficult to accept a Sicilian origin for the recurved knife (K.135). Why is it bronze in Sicily and iron in Egypt, when neither Sicily nor Egypt was using iron, and why is this peculiar form found and not the equally peculiar Sicilian notched razor (X.44)? It is regrettable that no mention is made of the smith's hoard from Cyprus (Dussaud, *op. cit.*, Fig. 180), which contains many parallels to Egyptian types. The idea (p. 30) that the sword or dagger with winged flanks at the top of the blade is a scattered type is probably quite erroneous. D.163, cited as one example, is indubitably a halberd of a form peculiar to Western Europe, and thus the wings served a purpose entirely different from that of the wings of D.161 and D.162. D.162 is certainly Minoan in origin, so that this type is in reality confined to the Ægean and Greece of Minoan times.

Though restricting himself to such classes of implements as actually occur in Egypt, Prof. Petrie has much that is suggestive to say about many European forms. Particularly interesting are his remarks on the pretended Ægean copper ingots of double-axe form, and the very numerous figures of European implements over and above the Egyptian examples provide a valuable *corpus* for archæological study. The work throughout brims over with instances of Prof. Petrie's ingenuity in offering practical explanations of details of form and technique. The paragraphs and plates dealing with bronze-casting and stone-cutting are a useful adjunct to what he has already written on these subjects in his "Arts and Crafts of Ancient Egypt," though even to Prof. Petrie the material used in the latter art as applied to the harder rocks remains a mystery.

A few misprints have been noticed. On p. 20, §48C, C.25 should be C.26; on p. 46, l. 34, "durite" is of course diorite; and the references for K.130 and 137 are M.A. XXI. VI., not V.

Our Bookshelf.

Report of the Ninth Annual Conference of Educational Associations held at the University College, London, 1921. Pp. viii+470. (London: Conference Committee, 9 Brunswick Square, London, W.C.1, 1921.) 5*s*.

IT is stated in the preface to this highly important report that the ninth annual Conference of Educational Associations was even more successful than any of its predecessors. The report includes the proceedings of thirty-seven out of the forty-six various educational associations which are affiliated to the National Conference, which extended from December 29 to January 8. The conference was presided over by Viscount Burnham, whose Committee, under his guidance, has done such admirable work in relation to the financial position of the teachers in elementary and secondary schools. The various associations meet together under the auspices of the Teachers' Guild of Great Britain and Ireland, and some of them take the occasion to hold their annual meetings, and afterwards throw their meetings open to any members attending the conference.

The proceedings of the conference began at Bedford College with an inaugural address by Prof. J. Adams, of the University of London, on "Instinct and Education." Two joint conferences were held. The first discussed "The Use of Psycho-analysis in Education," and was so largely attended that an extra joint conference was afterwards held at which the subject was further considered; while the second dealt with the important question of "How Best Can a Feeling of Professional Solidarity be Created and Maintained among Teachers?" at which Viscount Burnham presided. This was held on the last day of the conference, and was but meagrely attended. It was, unfortunately, held in the absence of any official representatives of the large body of primary teachers.

The conference was attended by 2200 members of the affiliated societies, as well as by nearly 1000 visitors. Arrangements are in course of preparation for the next conference to begin on December 28 or 29 next, when it is expected that further associations will have joined the conference.

In Farthest Burma. By Capt. F. Kingdon Ward. Pp. 311. (London: Seeley, Service, and Co., Ltd., 1921.) 25*s*. net.

CAPT. KINGDON WARD left Myitkyina, the railhead in Upper Burma, in April, 1914, on a journey to the little-known frontier lands around the head streams of the Irrawaddi, with the object of continuing the botanical researches which had previously taken him to Yunnan and the Burmese frontier. His course was by the Nmaihka valley, with a deviation *via* the Ngawchanghka valley and an ascent of Imaw Bum, to the frontier post at Kawnglu. Thence he passed by Langtao to Fort

Hertz, the outlying British station founded in 1914 in response to Chinese designs on this remote part of Burma. Capt. Ward has much to say about the isolated plain of Hkamti Long, where Fort Hertz lies, and the curious dwindling remnant of the Shans who inhabit this fertile plain hemmed in by the Kachins. The narrative, without being thrilling, has a sustained interest throughout, for the author not only shows considerable descriptive power, but he also avoids boring his readers with the details of camp and trail which loom so large in many travel volumes. What Capt. Ward has to say about the routes on the frontier in relation to Chinese policy deserves careful attention, for he writes with knowledge and authority on this remote and neglected corner of the Empire. The illustrations are excellent, but the two maps are disappointing.

Six Papers by Lord Lister, with a Short Biography and Explanatory Notes. By Sir Rickman J. Godlee. (Medical Classics Series.) Pp. vii+194+iv plates. (London: John Bale, Sons, and Danielsson, Ltd., 1921.) 10*s.* net.

DR. CHARLES SINGER, general editor of "The Classics of Medicine" series, has made a good beginning. We are to have, in due time, Ambroise Paré, Laennec, Auenbrugger, Hippocrates, Galen. Meanwhile, we have Sir Rickman Godlee's admirable selection of six of Lister's papers, with a short introductory memoir—too short, indeed, for those of us who are not familiar with Godlee's Life of Lister. Plainly, the difficulty was to decide, in all the wealth of Lister's published writings, what to leave out. It may be that the interest of the paper on anæsthetics (1861) is impaired by the progress of sixty years. But the other five papers, which cover the long period from 1857 to 1890, are of everlasting value. They give us, in Lister's own words, the course and the development of Lister's own work. For the present generation of young physicians and surgeons, they are a sure guide to the principles on which antiseptic and aseptic surgery was founded and built.

But this book is something more than a handful of reprints, for the explanatory notes to each paper are as good as good can be, and the introductory memoir is delightfully written. In short measure, it is perfect. To all of us who knew Lister it recalls with singular vividness the look of his face, the sound of his voice, the temper of his life and work—a man pure in heart, gentle, patient, laborious, self-critical, thankful to be of service to mankind.

A New British Flora: British Wild Flowers in their Natural Haunts. Described by A. R. Horwood. (In six vols.) Vol. i., pp. ix+244; vol. ii., pp. xi+243+xvii plates. (London: The Gresham Publishing Co., Ltd., 1919.) 12*s.* 6*d.* net per vol.

THE first two volumes of this work have appeared. It is evidently intended for the naturalist rather than for the botanist as such, although it aims at dealing with British plants from the ecological point of view. The first volume, which is introductory, includes an account of the origin of the British flora and of the floral regions of the world, geological and altitudinal maps of the British Isles, and chapters on insect pollination, seed dispersal, and similar topics. The second volume deals with plants of the fields and meadows, cornfields, and the sea-coast. The work is illustrated by many coloured plates from drawings by Fitch, and by a large number of photographs of the plants in the field, many of which are excellent. The drawing (vol. i., p. 147) which is supposed to illustrate heterostyly in Primula does not really illustrate anything. Popular names, folk-lore, and points of natural history interest are included with regard to each plant. As a semi-popular work this should serve a useful purpose in directing the attention of naturalists to the ecological point of view with regard to plants.

The Nature of Enzyme Action. By Prof. W. M. Bayliss. Fourth edition. (Monographs on Biochemistry.) Pp. viii+190. (London: Longmans, Green, and Co., 1919.) 7*s.* 6*d.* net.

THE appearance of a fourth edition of this admirable monograph testifies to the fact that the work has earned the suffrage of research workers and students alike. The author has been at pains to keep the successive editions abreast of the rapidly growing knowledge of the subject. The present issue differs from its predecessor chiefly in the fact that the chapter on the mode of action of enzymes has been rewritten.

To those unacquainted with the earlier editions it may be said that the object of the book is not merely to give an account of enzymes, but also to define the relation of these "biocatalysts" to catalysts in general.

The Practical Electrician's Pocket Book for 1921. Edited by H. T. Crewe. Twenty-third annual issue. Pp. lxxii+522. (London: S. Rentell and Co., Ltd., n.d.) 3*s.* net.

THIS pocket-book will prove useful to all engaged in industries in which electricity is employed. It contains the rules and regulations for electrical installations, the standard wire tables, useful hints about electrical machines and apparatus, and *résumés* of the theory of steam and gas engines, photometry and pyrometry. The information given is trustworthy.

A Book of Gardening for the Sub-Tropics. By Mary Stout and Madeline Agar. Pp. 200. (London: H. F. and G. Witherby, 1921.) 6*s.* net.

THIS little book is designed for those who, living abroad, wish to know something about gardening under sub-tropical conditions. It applies particularly to the Cairo district, and includes such topics as propagation, pests, roses, and chrysanthemums, and a calendar for the flower-garden.

Letters to the Editor.

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

The Quantum Theory and Homogeneous Vibrations.

IN the quantum theory as usually presented a finite amount of energy is associated with a periodic disturbance which is called "homogeneous." I desire to raise the question whether the use of that term is defensible. Both in optics and in acoustics the word "homogeneity" has acquired a definite meaning which is inconsistent with its application to quanta. In fact, the affirmation of quanta involves a denial of homogeneity. To avoid misunderstandings and obscurities we must either abandon the hitherto recognised definition of that word as applied to oscillations, or avoid its use in the formulation of the quantum theory. I submit that the second alternative is preferable.

A homogeneous vibration as hitherto understood is unlimited in time, just as a homogeneous wave is unlimited in space; a disturbance having velocities proportional to $\cos nt$ is homogeneous only if it applies to all values of t, however great, on the positive and negative sides. As soon as limits are imposed the oscillation ceases to be homogeneous. The radiation of a quantum, if expressed by a circular function, being necessarily limited in time, it follows that homogeneity is impossible. If the velocity of the oscillator be represented by $e^{-kt}\cos nt$, the exponential factor admits quanta because it allows us to assign a finite value to the total energy, but it destroys at the same time the homogeneity. When analysed practically by the spectroscope or theoretically by Fourier's theorem, *all* frequencies are represented, though when k is small nearly the entire energy is concentrated in a narrow region closely adjoining that of the maximum intensity which takes place at frequency $\sqrt{n^2-k^2}$. We must conclude that the radiation associated with a quantum is not homogeneous, though its effective energy is confined to a narrow region of frequencies. If an expression be required to represent the nearly homogeneous radiation of a quantum, we shall perhaps commit ourselves least to any definite views by calling it simply a "quantum radiation."

ARTHUR SCHUSTER.

Yeldall, Twyford, Berks, April 10.

Variegation in a Fern.

IN the Croonian lecture (Proc. Roy. Soc., B, vol. xci., p. 368) I said that the prothallia of a variegated Adiantum were entirely green, though the ferns which arise from them may be green, or variegated, or white. This statement should be corrected, for I find that though the prothallia look all green when growing on the soil, some of them have lighter, occasionally almost white, patches, which are seen as soon as the prothallia are examined by transmitted light. These patches of cells are sharply defined, usually forming radiating bands widening peripherally. In some cases the light tissue is an island of cells entirely surrounded by the green cells. The plastids in the light cells are at least as numerous as those of the green cells, but they are smaller and pale in colour, being mostly a faint green, though sometimes almost colourless. The development of this kind of variegation will need careful study. It is difficult to avoid the inference that genetic segregation does here occur in haploid tissue, but the process is not necessarily postponed, as I suggested, to the formation of the germ-cells.

W. BATESON.

The John Innes Horticultural Institution,
April 14.

The "Flight" of Flying-fish.

I HAVE recently received the following information on the "flight" of flying-fish from Prof. Wood-Jones, the well-known anatomist and naturalist. His conclusions based on his own observations must carry weight, and, in my opinion, should finally settle the points in dispute.

DAVID WILSON-BARKER.

Many years ago I watched flying-fish daily for hours on end, and I think that observations made, as were mine at that time, from the long overhang of the bow-sheaves of a cable ship are far better than those made by casual observers from the decks of a passenger vessel; for, in the first place, the observation is made many yards ahead of the cut water, and the fish can be observed swimming just below the water and then breaking its surface and taking "flight"; and, in the second, observations can be taken when the ship is steaming no more than 1½ knots. As a result of my spell in cable ships in the Indian Ocean I had no doubt as to the manner of "flight" of flying-fish, and, though directly antagonistic ideas seem prevalent to-day, I still, after a further series of observations, have no doubt that flying-fish gather all their impulse by the lateral movements of their tail as they leave the water and then sustain themselves in the air by what would now be termed "planing."

In order to check my previous conclusions, I made observations and notes on this matter during a journey to Australia last year, and also during a trip to Honolulu and back. On both these occasions I took care to interest any children in the question, for children are commonly good judges in such things. On both occasions I secured a specimen which came aboard, and the accompanying rough figures are made from the dissection of one of these.

These observations may be summarised as follows:

(1) Flying-fish when disturbed by an oncoming vessel dart about beneath the surface with the greatest rapidity. Some members of a shoal seek safety by their speed below water with their *pectoral fins tight adpressed to their sides*; some with a rush break the surface of the water, *spread their pectoral fins, and plane away.*

(2) The impulse is gathered by the final very rapid lateral movements of the tail as the fish leaves the water.

(3) When the fish springs into the air it quivers all over. This quivering is seen in the spread pectoral fins, but this is not a very rapid wing-stroke—as seen, say, in a drone-fly; it is merely the vibration due to the great rush with which the creature cleaves the water.

(4) Once launched in the air the pectoral fins are spread out as planes and remain motionless.

(5) Fresh impetus can be gained from time to time by the tail dropping to the water and powerful lateral movements being produced with the enlarged lower fluke of the caudal fin.

(6) Change of direction can be produced (just as it can in a planing bird) by lateral tilt of the body.

(7) Rise and fall are certainly possible (due to forcing up of air by waves), but I have been unable to observe any cant of the planes which produces this.

(8) The fish can easily outstrip a vessel doing 17 knots.

(9) The majority of fish turn into the wind when launching themselves. On December 12, 1919, simultaneous observations were made by two observers for periods of 1½ minutes upon the windward and leeward sides of the ship. Twice as many fish "flew" to windward as to leeward. In some counts the results were as high as eight to windward without a single fish going to leeward.

(10) They can remain in the air for at least half a minute (I fancy I have seen much longer flights when in the cable ships). On December 18, 1919, the following flights were timed:—10 seconds (three times), 15 seconds (four times), 25 seconds, with tail splashes (twice), 28 seconds (numerous tail splashes, once), and 30 seconds (numerous tail splashes, once).

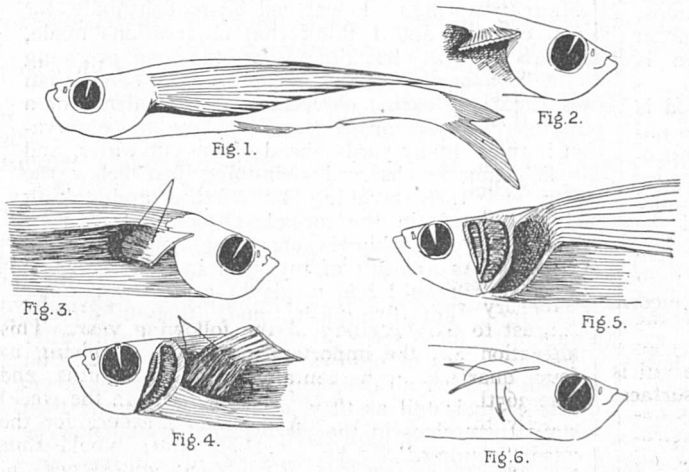

FIG. 1.—General lines upon which the fish is built.

FIG. 2.—The pectoral fin was placed in the position of flight, and the specimen then hardened in formalin. The right fin is represented cut through near its base.

FIG. 3.—Dissection of the dorsal or posterior muscle (tinted), showing the depression in the general longitudinal muscle mass of the body into which the fin fits when hauled up and back by its retractor muscle. The tinted muscles in Figs. 3 and 4 are indicated by the lines ⅄.

FIG. 4.—Dissection of the ventral on anterior muscle (tinted). Numerous tendons pass the fin-rays from small pale muscle. Evidently the muscle hauls the rays and spreads the wing like a fan.

FIG. 5.—The ventral muscle removed to show the depression in the gill base skeleton which it occupies.

FIG. 6.—Diagram to show direction of action of the two muscle masses.

(11) The dorsally situated mouth and the enlarged ventral fluke of the tail-fin tell clearly that the fish is one designed to make rushes *upwards* through the water in search of food.

(12) Its "flight" is only an extension of the flight of the garfish. These fish also launch themselves into the air, and without any planing, but merely by their impetus, travel for a sufficiently long and rapid "flight" to carry them—like a hurled spear—right through the sail of a boat.

(13) Only two main muscle masses are attached to the base of the pectoral fin. The posterior muscle pulls the fin upwards and backwards and folds it into the "slot" for its reception. The anterior muscle pulls the fin downwards and forwards and spreads it as a plane.

(14) These muscles do not produce "flight" movements of the fin, the stroke of the ventral (anterior) muscle being downwards and forwards, and not downwards and backwards.

(15) The structure of these muscles is altogether unlike that familiar in muscles performing the short, quick strokes of flight, but is entirely what would be expected of muscles acting tonically as spreaders of planes.

F. WOOD-JONES.

University of Adelaide.

"Space" or "Æther"?

PROF. EDDINGTON (NATURE, April 14, p. 201) challenges those of us who have asserted that "relativity does away with the æther" to defend our statement. He himself provides our defence. He tells us that *his* æther—the æther that relativity does *not* do away with—"has not . . . density, elasticity, or even velocity." But *our* æther—the æther of pre-relativity days, which relativity *has* done away with—has all those properties. In particular, it has the last. The nineteenth-century æther simply was a system relative to which light had the normal and invariable velocity c; so that the velocity of light relative to a system which had, relative to the æther, the velocity v was $c+v$. That statement conveys the very meaning and essence of the old æther; deny it, and the Fizeau and Michelson-Morley experiments lose all significance.

Prof. Eddington's word "æther" has neither the denotations nor the connotations of the old word. His use of it will receive the support of Humpty-Dumpty, but not of those who consider that accuracy of thought is intimately dependent upon the constancy of the meaning of the words used to express it.

NORMAN R. CAMPBELL.

I AM indebted to Prof. Eddington (NATURE, April 14, p. 201) for pointing so decisively to the full issues of my argument (NATURE, April 7, p. 171). The position may be clinched thus:—The relativists may take away *pure space* as an objective entity, but in so doing they are "ætherising" or materialising the space of the physical universe. So the physicists get back their "æther" with something more; and "space," a fundamental fact of human experience which has been such a metaphysical enigma right down the ages, at least becomes intelligible as the substratum of matter. The identification of æther and space provides a mechanism of the universe, and will enable us to picture physically what is meant by such phrases as "world-lines" and "twists in space."

Prof. Eddington's reason why the quality of beauty is not included in physical science and my own are metaphysically identical, and the two propositions, very differently framed, confirm one another.

April 16. L. C. W. BONACINA.

Meteors on the Moon.

THE reported failure of Prof. Goddard to obtain pecuniary support for his project to discharge a giant rocket at the moon leads me to ask a question which astronomers may answer. Why is it that no observer has ever reported the descent of a meteor upon the surface of our satellite? It seems reasonable to suppose that meteoric falls must occur there as upon the surface of the earth. According to the accepted estimate, the earth receives about 20,000,000 meteorites per diem. If that holds good, *mutatis mutandis* for

the moon, our luminary must receive about 2,000,000 in twenty-four hours. The great majority of these would necessarily be invisible. One-half of the number would fall on her averted face. Of the remainder more would fall during sunlight than during the hours of darkness. Of those that fell during hours of darkness the greater number would be concealed by terrestrial cloud. Of those that were not so concealed one-half would fall on the illuminated part of the moon's disc, and, perhaps, be rendered invisible by the lunar brightness. It is easy to see that large abatements must therefore be made from the number of falls if we wish to estimate the probability of making a successful observation. This consideration has a bearing, by the way, on the reasonableness of expecting to be able to witness the arrival of Prof. Goddard's projected rocket if the aim were good and a hit secured; but that is by the way.

If, in consideration of all these adverse contingencies, we reduce the estimate of impacts to 1 per cent. of the above-quoted figure, we have 20,000 hits on an average moonlight night. Why has not one of them ever been observed? Among the number of meteorites must be a certain proportion weighing one or two hundredweight or more. When masses of that magnitude enter our atmosphere they grow incandescent and light up a whole countryside, it may be for some seconds. That is the result of impact upon our yielding atmosphere. If they reached the surface of the earth, as presumably they do that of the moon, with cosmic velocities ranging up to 40 miles a second, would they not break up there with an outburst of light like that of a nova among the stars? Furthermore, as these impacts must include not only single masses of considerable size, but also meteoric showers, the areas affected must presumably at times be large enough to be quite observable through a good telescope. It may be suggested that when the fall is normal, or at any large angle to the moon's surface, the projectile buries itself too deeply in the substance of the moon to be visible. But among the arrivals must be some that arrive at grazing, or something like grazing, incidence on the moon, penetrating little, or not at all, beneath its surface. Why are their glowing paths never seen and the furrows which must so have been ploughed, in the course of ages, upon the moon's ancient surface never described to us?

Probably there is an easy answer to these questions, but, even if easy, it would be interesting to those of us who are not astronomers.

J. W. GORDON.

11 King's Bench Walk, Temple, E.C.4, April 12.

THE question of meteors on the moon is not now raised for the first time. In my article on astronomy in "Science in Modern Life," vol. i., p. 35 (I give this, not as being the first mention of the subject, but because it is the most accessible source), I wrote:—"There is one puzzling question raised by Prof. Shaler, *i.e.* how is it that the fall of meteors on the moon, which must be as dense as those falling on the earth, has not covered all the markings with a veil and obliterated the differences of tint? It has, however, been calculated that even if the atmospheric density at the surface be only 1/10,000 of that on earth (a quantity which it may well exceed), then, since the rate of decrease is so much slower than on the earth, at a height of something over 40 miles the densities of the atmospheres would be equal, and at still greater heights that of the moon would be the denser. Now most of the meteors that enter our air are completely burnt up at greater heights than this, so that the thin lunar atmosphere may actually be as effective for stopping meteors as our own."

It is comparatively rarely that meteors reach the earth's surface, and when they do so the speed has been so diminished by friction that there is no intense flash. The above reasoning makes it quite possible that the conditions on the moon are similar. If so, an impact-flash bright enough to be seen from the earth would be extremely rare, and then it would be seen only if an observer with a powerful telescope happened to be looking at the right spot at the right moment. There are also very few meteors the flash of which in the atmosphere of the earth would be bright enough to be seen from the moon. Some furrows on the Mount Wilson lunar photographs might, however, possibly be due to meteor falls.

ANDREW C. D. CROMMELIN.

Calendar Reform.

THE simplified calendar proposed by the Rev. E. Fanfani and described in NATURE of March 17, p. 88, is apparently inspired by a sound principle, viz. to make the minimum of change in existing conditions. It is, however, very desirable, if the months are otherwise to remain unchanged, to secure that the existing inequality in the lengths of the half-years and quarters should be corrected.

The late Prof. Millosevitch, of Rome, with whom I corresponded on the subject, expressed the view that this was the greatest—indeed, in his opinion, the only great—defect of the present calendar. This object can be effected by taking a day from August and adding it to February—a change which was suggested in NATURE of February 23, 1911, although its value was not, I think, fully appreciated at the time. This change can be made without altering the date of the vernal equinox (as fixed by the Papal Bull of February 23, 1582) by adding the day taken from August to the February of the following year. This alteration has the important advantage of giving us four quarters each containing three months and (the 365th and 366th days being apart from the week) exactly thirteen weeks. A common measure for the relation of monthly and weekly values would thus be available—a matter of much importance in accounting.

As regards the exact relation to be established between month-day and week-day, if, as M. Fanfani proposes, the leap day is to be left in its present position, which is in several respects desirable, facilities should be provided for terminating a quarterly period at the end of February. This is best accomplished by beginning with a Sunday on December 1. That would be the permanent date of Advent Sunday—the true *beginning* of the ecclesiastical year. The *central* day of the ecclesiastical year would then be May 31, which might be most appropriately selected for exclusion from the weekly series.

Of the five (or for the next 279 years four) dates of Easter Sunday possible under such a calendar one would be April 12. When Easter Sunday fell on that day Pentecost would fall on May 31. If Easter Sunday were fixed for that day, May 31 would be the annual permanent Pentecost, the founders' day of the Christian Church.

If Easter Day were allowed to oscillate over the four possible Sundays, it would be ascertained by the existing Easter tables without disturbance, and still always fall during evening moonlight.

Ecclesiastically, I submit that these proposals are equally simple with, and present superior advantages to, those suggested by M. Fanfani. From the point of view of legal administration, commerce, and accounting they are effective in removing the defects in the working of our present calendar.

The above changes could be introduced without any disturbance or interruption in 1924–25.

March 19. ALEXR. PHILIP.

The Hall of the Age of Man in the American Museum.[1]

By PROF. HENRY FAIRFIELD OSBORN.

AN important event in the American Museum of Natural History is the approaching completion of the Hall of the Age of Man. This hall has been planned as a climax to the series of collections in invertebrate and vertebrate palæontology, arranged so that the student or visitor will begin with the Hall of Invertebrates, dating back to the Cambrian, and pass in geologic and palæontologic sequence through a series of five halls surrounding the south-east court, to be devoted to the Age of Fishes; the Age of Amphibians, of Permian and Triassic Reptiles; the Age of Jurassic Reptiles, including the giant Sauropoda; to the Cretaceous Reptiles; into the Age of Mammals; and finally into the Hall of the Age of Man. This will afford effective exhibition of the collections in vertebrate palæontology which began in 1891 and extend from the first appearance of vertebrate life to the very close of the Pleistocene of North America. These collections now include about 25,000 catalogued specimens, chiefly from North and South America, but there are also specimens from Eurasia, Africa, and Australia, obtained either by museum expeditions or by exchange.

The Hall of the Age of Man is of especial interest because it affords the first opportunity of working out in palæontology the general theory of exhibition which prevails throughout the American Museum—namely, to present animals, extinct as well as living, in their environment. In this hall what is actually known of the history of man is presented in a series of ten central cases arranged in ascending order from an introductory genealogical tree of the Primates to the races which overran Europe in Neolithic times. On the floor space surrounding these central cases are shown some of the chief types of mammals of the four continents, Africa, Eurasia, North and South America, which was also the great theatre of human evolution during late Pliocene and Pleistocene times.

Around the walls, above the cases, is a series of four large mural paintings which present the mammalian life of these continents during the final period of maximum glaciation and the close of the immediately preceding Third Glaciation period. This is the reindeer and mammoth period in Central Europe, of the late loess period of northern France, of the loess deposition of the Pampean region of South America, and of the loess deposition on the Missouri River in the latitude of Kansas, where the native American horse appeared for the last time on the American continent. These murals represent the four seasons of the year in mid-Glacial time. Thus the woolly rhinoceros, the saiga antelope, and the woolly mammoth are shown (Fig. 1) in a midwinter steppe scene of northern France. The succeeding mural (Fig. 2) represents early spring, herds of mammoth and of reindeer migrating northward. This is the most authentic of the murals, because it is based upon the painting, drawing, and sculpture of the contemporary Crô-Magnon race (Fig. 4). Midsummer is depicted on the Missouri River in the latitude of Kansas (Fig. 3); the least-known animal in this stage is *Bison regius*, which is represented in the American Museum by a gigantic head and horns, the only

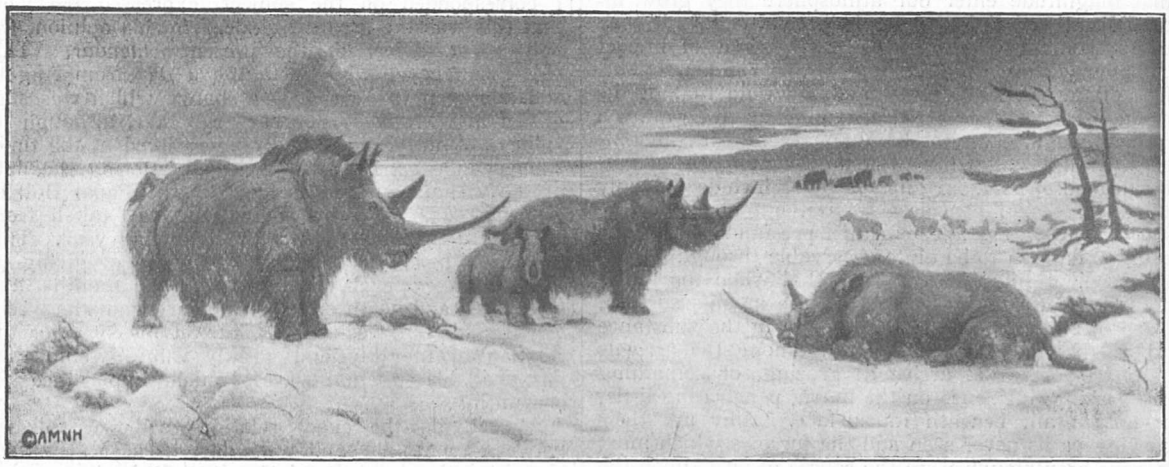

FIG. 1.—The most common of the many extinct rhinoceroses is the *Rhinoceros antiquitatis* or woolly rhinoceros of Europe and Siberia. This species was most like the square-mouthed or white rhinoceros of Africa nearly extinct to-day. It was protected from the wintry blasts by a heavy coat of long hair and a thick undercoat of fine wool. This brown wool was found in a good state of preservation on the side of the face of one specimen discovered in the ice-fields of Siberia, and is now in the Museum of Petrograd. In the distance can be seen a group of mammoths and a line of saigas—an extinct species of antelope. The rhinoceros kept closely to the ice-sheet and never wandered so far south as did the mammoth. It was a plains-dweller, living on grass and small herbs.

[1] The present article was prepared at the request of the Editor as an abstract from an article with the same title which appeared in the popular journal of the American Museum, *Natural History*, vol. xx., May–June, 1920, No. 3.

FIG. 2.—Early spring—"The Reindeer and Mammoth on the River Somme, France."—It is thought not improbable that herds of mammoth, rhinoceroses, and reindeer migrated northward and southward with the seasonal changes. This mural represents a northward march in the spring. As the mammoth was faithfully depicted by the Cro-Magnon artists—especially in the cavern at Font-de-Gaume—and as mammoth skeletons have been well preserved, there can be little doubt that the present representation by Knight is a close likeness of this huge proboscidean. The woolly mammoth resembled greatly an Indian elephant, but was somewhat larger, was covered with coarser hair, and had larger and differently curved tusks. Whole carcasses of these beasts have been found frozen in the ice-fields of Siberia, where they probably survived later than in Europe

type of this species thus far found. The autumn scene of this series is in northern New Jersey, the place of discovery of the deer-moose, or Cervalces, of the northerly range of the tapir, and of the North American coypu type of rodents known as Castoroides.

On the opposite side of the hall, facing the four seasonal series, are other murals, which represent the life of the Pampean region, the ground sloths, glyptodonts, toxodonts, and macrauchenias, in a series of groups. Very careful studies of the superb fauna of southern California are now being made for murals, which will depict the life discovered in the tarpools in the vicinity of Los Angeles, where occurs the most remarkable collection of extinct mammals so far found in the whole history of palæontology, since the entire fauna of early and middle Pleistocene times is represented, including the three types of mammoth—the imperial, the Columbian, and the woolly—the bison, the horse, the camel, the sabre-toothed tiger, and the giant lion, *Felis atrox*. It is intended to show here the entire mammalian and avian fauna of the period. Studies upon the animals in these murals now extend over eight years, and other years of additional study will be needed. The restorations themselves are preceded by models. The naturalness of the scenes is aided by kinema reproductions secured by recent museum expeditions of similar scenes among existing large mammals of Africa and from drawings made in early days in Africa, when the mammals were still in their primitive number and variety.

Materials in the central cases devoted to human prehistory are placed in ascending order, beginning with replicas of the Trinil man of Dubois, the Piltdown man of Smith Woodward, and the Heidelberg man of Schoetensack. In the final arrangement each will occupy an entire case showing the geologic position of the find, replicas of the original materials, the author's restorations, and museum restorations by Prof. McGregor. It is noteworthy that a hundred years of fossil hunting in various parts of the world have yielded only these three individual types of human and prehuman ancestors. As soon as the period of human burial begins, in the closing centuries of the long period when the Neanderthal race covered western Europe, skeletal remains become very abundant, and it will require two large cases to exhibit replicas and restorations of the Neanderthal species of man successively discovered near Gibraltar, Neanderthal, Spy, Krapina, at many points in the Dordogne Valley, and most recently in Spain. The masterly work of Boule on this race is supplemented by the exhaustive anatomical studies of McGregor and other anatomists which form the materials on which the first of the murals depicting life in the Old Stone age is founded; this is the beginning of the Cave period, and a group of Neanderthals is represented in a flint quarry in front of the Grotto Le Moustier, which gives its name to the whole period of Mousterian culture.

The second of the human murals (Fig. 4) is that for which the evidence is most authentic, inasmuch as we have several complete skeletons of Crô-Magnon man, giving us the entire anatomy; also the lamps, the ornaments, the insignia of the chieftains, the materials showing the methods of preparing the paints, and, still more remarkable, the actual painting of the procession of the mammoths, which is taken as the central feature of this restoration. It would appear that the highly evolved Crô-Magnon race entered Europe from the east and drove out the Neanderthals. There is little evidence of intermarriage between these two widely distinct races, although two of the skeletons of the burial at La Ferrassie show characters which may be so interpreted. The contrast between the Crô-Magnon heads and those of the Neanderthals is as wide as it possibly could be. The Crô-Magnons are people like ourselves in point of evolution, and the characters of the head and cranium reflect their moral and spiritual potentialities, while the body skeleton points to a physically perfect race.

The concluding mural of the human series represents a group of stag-hunters depicted as men of the northern fair-haired race living along the southern shores of the Baltic in the earliest phase of the Neolithic—the stage known as the Campignian from the remains of huts and rudely finished implements found near Campigny, in France. If of Nordic affinity, this race was courageous, warlike, hardy, and probably of lower intelligence than the Crô-Magnons. It is still, however, an open question to what primary branch of European stock this race of Campigny belonged.

In each of the central cases the culture element is associated with the skeleton wherever it has been found to show correlation between the mental development and the industrial or artistic stage. The tests of a museum exhibition series are, first, that it meets the specialist's demand for accuracy; secondly, that the exhibits are arranged in such a way as to attract and arouse the interest of the people; and thirdly, that the aroused interest leads to a more careful examination of materials and to at least a dawning comprehension of what they signify. The central cases and the models and murals which seek to interpret them appear to stand all three tests admirably. They arouse the interest of increasing numbers of visitors,[2] and it is noticeable that the Old Stone age and the cave man are finding their way into the current intellectual life of the American people, who, in general, are far behind their European contemporaries in their general knowledge of the rudiments of anthropology and archæology. This exhibition series presents the facts of human evolution in a simple and convincing way.

The collections of original fossils brought together in the Hall of the Age of Man are worthy of supplementing the human series found in the

[2] The annual attendance is now above a million. Sunday attendances during January, 1921, averaged 12,500. By its contract with the City of New York the museum now receives 350,000 dollars annually from the Municipality of New York.

FIG. 3.—Midsummer—"The Mastodon, Royal Bison, and Horse on the Missouri River, in the Latitude of Kansas. —This mural presents a summer scene in a region of North America south of the farthest advance of the ice-sheet. The great mastodon (left) with flat, elongated head and extremely short, massive legs survived in America to a time contemporary with man in Europe, but no mastodons lived in Europe at such a late period. In the centre of the picture are seen the royal bison (*Bison regius*), the gigantic forerunners of our present bison. On the right is a group of the last species of native American horse (*Equus Scotti*), which disappeared before the appearance of man on the North American continent.

central cases. They cover the complete evolution of the Proboscidea, from the early stages in the life of this great order described by Andrews in the genera Phiomia and Palæomastodon from the Fayûm region of northern Africa. This collection carries us back into an early period in the Age of Mammals, the Oligocene, for it has been deemed wise to present here the entire history of the evolution of the Proboscidea, which, taken altogether, is the most majestic line of evolution thus far discovered. It is possible that the ancestors of man were the companions of the proboscidean race from the beginning, because the Propliopithecus, the companion of the Palæomastodon in the Fayûm, is at least structurally ancestral to the higher apes and man—in other words, it is a possible prehuman link, for it is conceivable that the true *Mastodon americanus* of the eastern American forests in the late Pleistocene. This race reaches its climax in the massive *M. americanus,* represented in the famous specimen known as the Warren mastodon, which was presented to the museum by the late J. Pierpont Morgan. Nearby is the complete skeleton of the American woolly mammoth, *Elephas primigenius,* above which towers the partial skeleton of the imperial mammoth, *E. imperator.*

The south-west quarter of the hall is devoted to the Cope Pampean Collection, chiefly consisting of mounted skeletons of the ground sloth family and the glyptodonts, and of the sabre-toothed tiger of the Pampean region. With these are casts of the skeletons of three other characteristic South American animals, the Macrau-

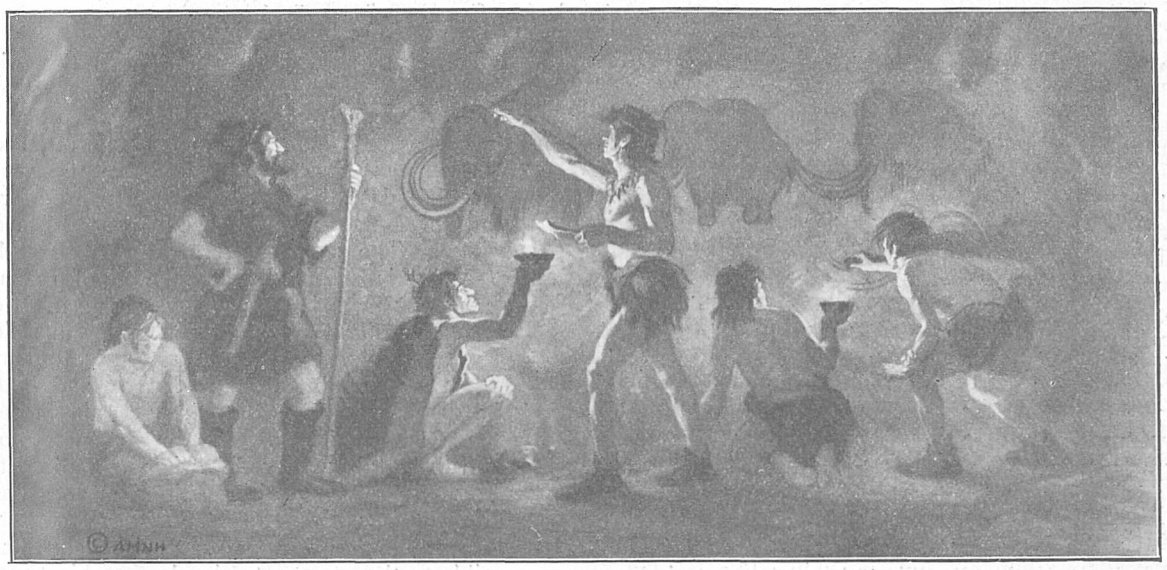

FIG. 4.—Contemporaneously with the disappearance of the last Glacial period in Europe, a highly evolved race in no respect inferior to modern man entered that continent from the east and drove out or exterminated the Neanderthal race, of which they were both the mental and physical superiors. Their cultural capacity is indicated not alone by their physiognomy and the cubic content of their brain, but has also been demonstrated by the handiwork and especially the artistic productions which they have left in the caves of southern Europe. The Palæolithic murals and sculptures in relief found on the walls of limestone grottoes in France and Spain indicate greater artistic sense and ability than have been found among any other uncivilised people. The mural above, painted by Knight for the Hall of the Age of Man, represents four Crô-Magnon artists at work on the famous procession of mammoths as found in the cave of Font-de-Gaume, Dordogne, France. The two half-kneeling figures are holding lamps made of hollowed-out stones. The artist standing half erect is engaged in incising the outlines of a mammoth on the limestone wall with a sharp flint; the other artist is laying on the colours, employing a shoulder-bone for a pallet. The kneeling figure is preparing colours from red or yellow ochre. The clothed man to the left is a chieftain who carries a *bâton de commandement* on his staff as an insignia of his rank

from such an animal the anthropoids and human lines diverged.

The higher Proboscidea include two complete skeletons and several skulls of the superb race of long-jawed mastodons which have recently been shown by the studies of Dr. Matsumoto to be the true descendants of Phiomia of northern Egypt through the classic narrow-toothed mastodon, *M. angustidens,* of Central France in Miocene times. This very vigorous and successful race, starting from Egypt, reached North America at the close of the Miocene, spread all over the present region of the United States during Pliocene times, and then became entirely extinct.

It now appears that the Egyptian form of Palæomastodon is, as its happily chosen name indicates, actually an ancient mastodon which gave rise to chenia, Toxodon, and Hippidium.[3] To demonstrate the American migration of both the sloths and glyptodonts into North America in late Pliocene times, there is also a series of North American ground sloths and glyptodonts, chiefly derived from the explorations of the museum in Texas and Mexico, and from the region of the Rancho La Brea tarpools of southern California, where the sloths occurred in very great abundance.

This scheme of arrangement whereby interest is centred in the fauna fits in with that of the remainder of the hall showing the wonderful climax in the Age of Mammals, when a similar mammalian fauna covered the tem-

[3] The valuable collections obtained from the Miocene of Patagonia and certain early Tertiary North American fossil mammals are also assembled here as affording light on the origin and early history of this marvellous Pampean fauna of South America.

perate regions of the entire northern hemisphere as far south as North Africa and Mexico, which appear to have been the southern limit of the great waves of migration of the various types of mammoths from Central Asia. This is, in fact, the climax in the history of such diverse families as the proboscideans, camels, horses, bison, and the great carnivora that preyed upon them. The impression created by the collection in a single hall of all these various types is that the period just preceding the final great glaciation of the northern hemisphere witnessed the assemblage of the most superb land mammals that the earth has produced. It is virtually the climax of the Age of Mammals, and marks the beginning of what has since proved to be the close of the Age of Mammals, because the elimination which began from natural causes during the early stages of human evolution, and reached the dimensions of a cataclysm as the Ice age progressed, has now been accelerated by the introduction of firearms. By the middle of the present century man will be alone amid the ruins of the mammalian world he has destroyed. The period of the Age of Mammals will have entirely closed, and the Age of Man will have reached a numerical climax, from which some statisticians believe it will probably recede, because we are approaching the point of the over-population of the earth in three of the five great continents.

The Rise and Development of the Sussex Iron Industry.

A PAPER of considerable interest on this subject was recently read before the Newcomen Society (formed two years ago for the study of the history of engineering and technology) by Mr. Rhys Jenkins. He pointed out that although the industry in Sussex has been extinct for a hundred years, the district is historically one of great importance, for it was here that the blast-furnace was first used in England, and afterwards spread to what are now the chief iron-making districts in the Midlands, the North, and South Wales. Although it is customary to speak of the district as Sussex, it embraces parts of Kent, Surrey, and Hampshire; in fact, it is the Weald between the North and South Downs. Sites of old iron works exist from a little beyond Haslemere on the west to Sissinghurst on the east.

It appears that iron was manufactured in the Weald in early times, and there are clear indications of the existence of the industry during the Roman occupation. It is supposed to have waned with the coming of the Anglo-Saxons, and the indications of its existence are very scanty until Norman times are reached. Down to about the fifteenth century the iron was made by a direct process—*i.e.* the ore was reduced directly to malleable iron. Its production must have been on quite a small scale. At some period in the latter half of the fifteenth century, however, the blast-furnace was introduced into Sussex, and proved to be the forerunner of the modern process in which the ore is first smelted with the production of fluid pig-iron, and afterwards converted either into wrought iron or into one of the many varieties of steel. It was the blast-furnace which started the Wealden iron industry on its career of prosperity, and soon Sussex became the premier iron-producing district of England. It must not be imagined that there was ever anything in the nature of a "black country," for, although there were a great many works, they were scattered over a wide area, and they were small. The only fuel employed was charcoal, and the power was derived from the streams.

Mr. Jenkins reviewed at some length the evidence available, and came to the conclusion that the blast-furnace, together with the finery process for converting cast iron into malleable iron, had been introduced into England before the year 1500; by that date there were certainly three furnaces at work—namely, at Buxted, Hartfield, and Newbridge. The iron workers were of French origin, and this points to the method of manufacture having been borrowed from France. No doubt the old direct method of manufacture did not disappear at once, but it is probable that by the middle of the sixteenth century it had been entirely displaced. By that time a number of native workmen had been trained in the new process, and the total number of works in the district, according to a return made in the year 1548, was fifty-three, of which about half were furnaces. The new works were established as near as possible to the sea-coast; clearly the object was to reduce, so far as possible, the expensive land transport. Every reduction in the cost of carriage placed the Sussex maker on a more favourable footing, as against the foreigner, in the London market.

The direct process had been carried out on a small scale, and produced a bloom weighing from 100 lb. to 200 lb. at a time. The manufacture could be carried on with few appliances and inexpensive erections, and entirely by human labour. It needed only a small capital outlay; obviously it was the industry of the small man. All this was changed with the coming of the blast-furnace. The furnaces, with the finery, chafery, and hammer, were comparatively expensive structures. The furnace bellows and the hammer called for more power than could be conveniently applied by workmen, so water-power was pressed into service. This meant the acquisition of an existing mill, possibly of a number of water rights, and the construction of dams or bays to form the furnace and hammer ponds, once so common a feature in Sussex. All this required an outlay of capital, probably in many cases the ownership of land, etc.; in short, iron-making was transformed

from a craft, such as that of the blacksmith, to something approaching modern capitalistic production.

In 1543 occurred a great event in the history of the industry—the founding of the first cast-iron gun at Buxted. The makers were Ralph Hogge and Peter Bawde. Hogge was the owner of the furnace, and Bawde one of the founders of bronze guns in the service of the king. The former knew how to work a furnace, and could furnish the molten iron; the latter was an expert gun-founder in bronze, and was learned in the proportions of the various pieces. The guns thus cast were very successful. As compared with bronze guns there was an enormous saving in cost, even after the founder had made a good profit and paid the carriage to London. The manufacture of these guns rapidly became a prominent feature in the Sussex trade. It seems to have been the first manufacturing industry in which the English distinguished themselves. During the reign of Elizabeth and onwards to the time of Charles II. English cast-iron guns were in demand all over the Continent. The historian Hume remarks: "Shipbuilding and the founding of iron cannon were the sole 'arts' in which the English excelled. They seem, indeed, to have possessed alone the secret of the latter, and great complaints were made every Parliament against the exportation of English ordnance." Mr. Jenkins considers that the most likely explanation of this is that the Sussex men had invented some better and cheaper method of making the moulds than that which had been in use by the founders of bronze guns.

About the middle of the sixteenth century a public outcry against the consumption of wood by the iron works was raised, and in Parliament repeated objections were urged against the works both on this ground and on the impolicy of exporting ordnance.

Mr. Jenkins carries his survey down to the time of the Protectorate, from which it appears that in 1658 there were thirty-five furnaces and forty-five forges operating in the Weald, of which twenty-seven furnaces and forty-two forges were in Sussex. This appears to have been the culminating point of the iron trade of the Weald. Consideration of the further progress and decline of the industry in later years is reserved for another occasion.

Long-distance Telephony.

THE progress which is being made in long-distance telephony is exemplified in the interesting demonstration last week under the direction of Col. Carty in which conversations were carried on over a composite route of more than 5500 miles made up of a 115-mile section of submarine cable from Havana to Key West, overhead lines through Washington and New York, and right across the continent through San Francisco to Los Angeles, and, for the sake of completeness, including a 29-mile stretch of "wireless" to St. Catalina Island, in the Pacific.

There is, of course, nothing remarkable in the last-mentioned section in the point of distance, as wireless telephony is in some ways less handicapped by distance than line working; but the fact that the wireless apparatus was successfully linked up with so long a land line is noteworthy. The cable section, on the other hand, is of a length which has hitherto been beyond the limits of submarine telephony, for, as is well known, the capacity effects inseparable from such cables produce a distortion of the current waves which, when their amplitude is sufficient for audibility, renders articulation unrecognisable. The earlier telephone cables relied upon artificially introduced inductance to counteract this effect of capacity, but, in the circuit we are speaking of, the problem has been further solved by the use of thermionic repeaters, so that waves of much smaller amplitude can be employed in the cable. The *Times* points out that the Havana-Key West cable is of British manufacture, and is arranged to carry, in addition to one telephone communication, four simultaneous telegraph messages.

The capacity effect of overhead land lines is also present, but is not nearly so serious as that of cables. Inductance coils, or Pupin coils, as they are called after their inventor, were employed in the New York-San Francisco line when American trans-continental telephony was first accomplished before the days of the thermionic valve; but it has now been found possible to remove them altogether by establishing repeater stations at 250-mile intervals along the line. The same method can be, and is being, applied to assist speech over the shorter underground cables used for trunk lines in England; but, even with such assistance, it is only by the use of overhead lines that distances of thousands of miles can be bridged over by line telephony.

The demonstrations show that there is nothing technically impossible in telephoning between England and India or the Cape, for example, where only short submarine connecting links are required; but whether it would be commercially possible, owing to the great expense and difficulty of patrolling and maintaining so long an overhead line passing through every kind of territory, is another matter.

The problem of transmitting speech over such long, uninterrupted lengths of cable as across the Atlantic is not yet solved, nor does its solution appear likely in the near future. The only possibilities in this direction are those of wireless telephony, which, in the case of communication between Europe and America, is already within

the range of physical, if not of commercial, practicability. Indeed, there are many fields where wireless telephony already rivals telephony over the metallic circuit, especially now that methods of linking up the two have been perfected, and we look forward with interest to the results of the experiments now being made with the view of establishing a commercial wireless telephone service between London and Birmingham, and the competition which appears likely between cable and wireless telephony from England to Holland.

Obituary.

BY the death at Cambridge, on April 9, of DR. RICHARD HENRY VERNON, at thirty-six years of age, the younger generation of chemists in this country has suffered a serious loss. The elder son of the late Hon. William Vernon, Dr. Vernon was educated abroad and took the degree of Ph.D. at the Zurich Polytechnic. At the close of his course at Zurich the war broke out, and although his health had always been delicate he hastened to offer his services and enlisted as a private, receiving later a commission in the Dorset Regiment. After having been invalided home, he worked for the Chemical Warfare Committee, first at the Imperial College of Science, and afterwards in the University Chemical Laboratory, Cambridge. He was then sent to the Shell Filling Factory at Chittening, where his health became seriously affected. After the armistice he returned to Cambridge, and was appointed to the official position of assistant to the professor of chemistry. Dr. Vernon possessed in a remarkable degree the special sense of the organic chemist, and his manipulative ability was quite exceptional. His work on tellurium, which led to the discovery of the isomeric dimethyltelluronium iodides, had an important bearing on the stereochemistry of elements of higher atomic weight and impressed all who had seen it with his powers. He had a personality of singular charm and attractiveness that rapidly won the friendship of all with whom he was brought into contact.

WE notice with much regret the announcement of the death, on April 13, of MR. HOWARD PAYN in his eighty-first year. In his early life Mr. Payn qualified as a barrister, but never practised. In middle life, after some years' service on a Sugar Commission, he became greatly interested in astronomy, and in 1899 entered Sir Norman Lockyer's laboratory at South Kensington as a volunteer worker. Mr. Payn took part in the eclipse expedition to Santa Pola, Spain, in 1900, and obtained a fine series of photographs of the corona and prominences with a lens of 16-ft. focal length. In 1905 he was with Sir Norman Lockyer's eclipse party at Palma, Majorca, but the spectroscopic photographs which he had planned to take were only partially successful, on account of clouds. In collaboration with Prof. Fowler, he was among the first to investigate the vacuum arc spectra of metallic elements, and to show that enhanced lines are strongly developed under these conditions. Mr. Payn also rendered considerable assistance to Sir Norman Lockyer in his work on "Stone Circles." He died in a nursing home at Hounslow after a long illness, and will be greatly missed by his many friends.

THE sudden and unexpected death, from heart failure, of DR. HERBERT HAVILAND FIELD, at the age of fifty-two, is a great loss to scientific workers. Some thirty years ago Field, then an American student at Paris, left the path of biological research for the less inviting road of bibliography. His aim was to provide a bibliographic service by cards of standard size. Each card carried numbers according to a modification of the Dewey decimal system, enabling it to be sorted mechanically into place according to the classification desired. Later he became associated with the bibliographic section of *Zoologischer Anzeiger*, and eventually founded at Zurich the well-known Concilium Bibliographicum, which has had the support of the Swiss Government and of various American funds. There he died at his work. It is to be hoped, especially in the present circumstances of the International Catalogue, that the institution he founded will continue and expand.

WE much regret to announce the death, on Monday, April 11, at the age of seventy-seven years, of PROF. ARNOLD WILLIAM REINOLD, F.R.S., lately professor of physics in the Royal Naval College, Greenwich.

WE regret to record the death, on April 9, of MR. BERTRAM BLOUNT, the well-known chemist, at fifty-four years of age; and, on April 13, of MR. R. A. ROLFE, of the Royal Botanic Gardens, Kew, at sixty-five years of age.

Notes.

WITH the intention of saving the lives of numberless birds of bright plumage slaughtered in foreign lands for no better purpose than unnatural decoration, a "Bill to prohibit the importation of the plumage of birds and the sale or possession of plumage illegally imported" has again been introduced in the House of Commons, and on April 13 passed the second reading by a majority of 143 votes against 25. The scope of the Bill is wide. As it stands, it prohibits the importation of all birds' plumes excepting those of African ostriches and eider-ducks, of birds imported alive, of birds ordinarily used in the United

Kingdom as articles of diet, and such plumes as have been imported by a passenger for personal use. A special proviso allows the Board of Trade to grant a licence permitting the importation of plumage "for any natural history or other museum, or for the purpose of scientific research, or for any other special purpose." Opinions in the House of Commons varied as to the probable efficiency of the Bill in its aim of protecting decorative birds. It is obvious that such a decree cannot approach in effectiveness measures of strict protection which might be enforced in the countries which the birds themselves inhabit, nor can it compare with a possible international agreement regulating the use of bird-plumages, but in at least two ways it should make for a reduction of the massacre of birds. In the first place, it should to a very great extent banish the use of imported birds' plumes for decoration in the United Kingdom, and to that extent the actual demand would be reduced. It may also, by dislocating the centre of dispersal in London, permanently disorganise the world-market, and so reduce opportunity for the disposal of skins, and with this the activities of the plume-hunters. In the second place, the moral effect of the final adoption of the Bill would probably be great, and other countries would follow the United Kingdom in endeavouring to protect, without as well as within their own boundaries, "birds attractive in appearance," and perhaps it may be added (as the Nebraskan law adds) "cheerful in song."

THE Corn Sales Bill came up for second reading in the House of Commons on April 14. Its object is to provide for greater uniformity in the weights and measures used in the sale of corn and other crops. At the present time in different districts the quarter of wheat might be 480 lb., 496 lb., 500 lb., 504 lb., or 588 lb. in weight, and even greater variations exist in the case of rye and oats. The Bill provides that all dealings in corn should be made by weight in terms of the hundredweight of 112 imperial standard pounds, the result of this being that the ordinary sack of wheat would be reduced from 18 to 16 stone. Opposition was raised on the grounds that the whole of the futures market in this country is based on the decimal system, and that inconvenience would be caused if all dealings in centals had to be transformed into the 112-lb. measure. It was suggested that the unit of 100 lb. should be substituted for that of 112 lb. proposed in the Bill, but this amendment could not be made until a later stage. The second reading was agreed to without a division.

DR. W. EAGLE CLARKE retired on March 14, under the Civil Service age-limit, from the keepership of the Natural History Department of the Royal Scottish Museum. During his service of thirty-three years he has been mainly responsible for the growth of this museum, and the period of his keepership, to which he was promoted on the retirement of Dr. R. H. Traquair in 1906, has been specially fruitful in the development of the natural history collections as regards both cabinet and exhibited material. Under his supervision the exhibited systematic collections have been entirely rearranged and revised with the view of increasing their æsthetic and educational as well as their scientific value, and many biological groups of birds and mammals have been introduced with great effect. Dr. Eagle Clarke has now been appointed honorary supervisor of the bird collections in the museum. He intends to devote his leisure to the editing of new editions of Saunders's "Manual of British Birds" and Yarrell's "History of British Birds." The vacancy caused by the retirement of Dr. Eagle Clarke has been filled by the promotion of Dr. James Ritchie, who entered the service of the museum, after competitive examination, in 1907.

THE inaugural meeting of the Indian Botanical Society, established "for uniting the botanists and promoting the botanical interests of India," was held under the historic banyan-tree in the Calcutta Botanic Garden at the time of the eighth Indian Science Congress in January last. A booklet has been issued describing the origin of the society, its aims and its provisional constitution, and giving a list of the original members, eighty-one in all. The president for the year is Dr. Winfield Dudgeon, of the Ewing Christian College, Allahabad; the vice-president, Dr. W. Burns, of the College of Agriculture, Poona; and the secretary and treasurer, Mr. Shiv Ram Kashyap, Government College, Lahore. The society does not contemplate any official publication, but members are encouraged to support the *Journal of Indian Botany*. Meetings will be held annually in conjunction with the Indian Science Congress, and the programme for the meeting will be prepared by the executive council in co-operation with the officers of the botany section of the congress. The membership is widely representative of botany and its applications to agriculture and forestry throughout the Empire.

WE learn from the *Pioneer Mail* of March 4 that on February 23 the Viceroy inaugurated the Institution of Engineers (India) in Calcutta. The institution was formed last September as a result of the desire of engineers in India to form a corporate body to safeguard their interests and to provide a means of exchange of views on engineering questions; the institution was open to professional engineers of all nations. In declaring the institution duly inaugurated, the Viceroy emphasised the importance of such a body to a country like India with a growing industrial side, and congratulated the members on the form of their constitution, by which provision was made for the admission of junior members to the council, so that there should be little risk of the council getting out of touch with the aspirations of the younger generation of engineers. The relation of the new institution to the Government of India was also enlarged upon, and its importance as an unofficial advisory body, both as regards industrial questions and with reference to technical education, was discussed.

DURING the interval that has elapsed since the publication of the Report of the Empire Cotton Growing Committee considerable progress has been made towards the establishment of a permanent organisation competent to carry into effect the recommendations contained in the report. The permanent body

will be known as the Empire Cotton Growing Corporation, and will be incorporated under Royal charter. Meanwhile, the present Committee has been making careful inquiry from the Governments of the Dominions, Colonies, and Protectorates as to the means by which the development of cotton-growing within the Empire may best be promoted. From more than one of the Governments approached the suggestion has been made that specially qualified men should be appointed to advise the local Agricultural Departments on matters connected with cotton-growing within their respective areas. To assist the proposed corporation the Empire Cotton Growing Committee is prepared to receive now from suitably qualified persons statements of their scientific attainments and/or experience of tropical agriculture, with the view of compiling a register of men whose services overseas may be useful in the development of cotton-growing, either in consultation or by appointment as cotton experts. The register is intended to be available for reference by the corporation now in course of formation, but it is unlikely that appointments can be made for the next few months. All communications, which will be regarded as confidential to the members of the council of the corporation, should be addressed to the Secretary, Empire Cotton Growing Committee, Board of Trade, Great George Street, London, S.W.1.

THE Civil Service Commissioners announce that an open competitive examination for not fewer than twenty situations as assistant examiner in the Patent Office, Department of the Board of Trade, will be held in London in July next, commencing on July 12. The limits of age are twenty and twenty-five, with extension for service in H.M. Forces. Regulations and forms of application will be sent in response to requests by letter addressed to the Secretary, Civil Service Commission, Burlington Gardens, London, W.1, on and after April 25.

"THE Early Chronology of Sumer and Egypt and Similarities of their Culture" is the subject of a lecture to be delivered by Prof. S. Langdon at the Royal Society's rooms at Burlington House on Wednesday, April 27, at 8.30. The lecture is arranged by the Egypt Exploration Society, and tickets can be obtained gratis on application to the Secretary, 13 Tavistock Square, W.C.1.

PROF. G. H. PARKER has been appointed director of the Harvard Zoological Laboratory in succession to Prof. E. L. Mark, who will retire at the close of the academic year after having spent forty-four years in the service of the University. The new director has been a member of the teaching staff at Harvard since his graduation in 1887, and has held a full professorship of zoology since 1906.

THE Government has accepted the invitation of the Spanish Government to participate in the third International Fishery Congress, which will be held at Santander on July 31–August 8, and has appointed as its representative Mr. H. G. Maurice, Fisheries Secretary.

DON JOSÉ RODRIGUEZ CARRACIDO, Rector of the University of Madrid, has been elected president of the Spanish Association for the Advancement of Science.

THE fourth Silvanus Thompson memorial lecture of the Röntgen Society will be delivered on Thursday, May 19, by Prof. A. V. Hill, of the University of Manchester. The subject will be "Electrical Instruments and Phenomena in Physiology."

IN the Journal of the Royal Anthropological Institute (vol. l., January–June, 1920) Prof. A. C. Haddon contributes an elaborate monograph on the outriggers of Indonesian canoes. The present focus of outrigger canoes is the Moluccas, and it is suggested that from Indonesia, if not actually from the Moluccas, migrations took place at various times, each with its special type of canoe or with some partial modification, the earliest types of canoes or outriggers being those that went furthest, while those that started last have a more limited distribution. The paper is well illustrated with woodcuts, and furnished with an ample bibliography of the subject.

MR. T. SHEPPARD has republished from the Transactions of the East Riding Antiquarian Society (vol. xxiii., 1920) a paper on the origin of the materials used in the manufacture of prehistoric stone weapons in East Yorkshire. Curiously enough, for a considerable distance in any direction this area does not produce a single rock *in situ* which is suitable for making stone implements. The Yorkshire Chalk, which surrounds Holderness and forms the Wold area, has furnished many thousands of implements, but, though it contains flints, it produces only a form of this material which, owing to its brittle nature, is useless for the purpose. Holderness, on the contrary, a rubbish-heap deposited at the close of the Great Ice age, contains boulders, large and small, derived from Scotland, the Lake District, Teesdale, the coast of Durham and Yorkshire, and even Scandinavia, which supply large quantities of black and pink flints, excellent material available for the ancient flint-workers. Mr. Sheppard's paper, which is supplied with numerous good illustrations, gives full details of this ancient industry.

FOR the moment smallpox has sunk almost to vanishing point, but this is just the time to read the carefully prepared pamphlet by Dr. Mary Scharlieb on vaccination (Research Defence Society, 1s.). Last year's experience in Scotland shows that smallpox is once more "on the move." During demobilisation thorough inspection of soldiers and civilians stopped many cases at the ports, but now that the Baltic and the Mediterranean are both open the chances of fresh importations have multiplied enormously. Under the new regulations the port sanitary authorities will be better equipped for handling the ordinary infections, including smallpox, at the ports; but the danger of outbreaks, now that the numbers of susceptibles have grown to be a large fraction of the community, will increase as foreign trade increases. Dr. Scharlieb gives an orthodox *résumé* of the historical facts about vaccination, and the whole pamphlet is an appeal to

the reason of the anti-vaccinationists. "It would appear," she says, "to be advisable to substitute argument for compulsion." She deals in some detail with the "Leicester experiment." "The Leicester method, as advocated by Dr. Millard, includes vaccinations as general as possible when an outbreak occurs." When Dr. Scharlieb says, "The incubation period of vaccinia is shorter than that of variola, eight or nine days as against twelve," the words imply that these are two distinct diseases. The modern view is that "vaccinia" is simply the effect of inoculating the cow or calf with smallpox virus, and is not any more a separate disease than human tuberculosis inoculated on a cow would be. But the virus, cultivated on the calf through several generations, loses its capacity to produce general infection. As this is a cardinal point in the anti-vaccination argument, the Research Defence Society might well devote a special paper to it. The "portion of the Gloucester cemetery" shown as frontispiece is an eloquent comment on Nature's way with the unvaccinated.

WE note with much satisfaction that Major Stanley Flower's efforts to restore the well-nigh exterminated cattle-egret to Egypt have been abundantly rewarded. Mr. J. L. Bonhote, in the Report on the Zoological Service for the Years 1914–18, published in connection with the Giza Zoological Gardens, gives a long and able summary of the steps taken to bring about this much-to-be-desired end. When this apparently hopeless task was begun the bird had been all but exterminated by plume-hunters. Mr. Bonhote is now able to report colonies numbering several thousands, and the birds appear to be still extending their range. In this achievement, made possible by the enlightened action of Lord Kitchener when British Agent and Consul-General, Major Flower has rendered a signal service to Egypt, for the cattle-egret as a destroyer of ticks on cattle and of noxious insects of many kinds has no rival, and therefore the establishment and preservation of large colonies of this bird are of vital importance to the country.

THAT the woodcock will, on occasion, transport its young by carrying them in mid-air is now a well-established fact. A few other species are said to have been seen performing this feat. Mr. J. H. Gurney in the April issue of *British Birds* writes to say that on May 12, 1920, he found a long-eared owl covering four young ones under a gorse bush. "The situation was somewhat unusual, and so was her subsequent behaviour, for she carried two of her nestlings, in consequence of their being looked at, more than twenty yards and deposited them on a pair of young Scotch firs, where they presented a very comical appearance." It would be interesting to know whether she carried off the remaining nestlings to the trees or transferred the two in the trees back to the nest when the cause of her alarm was removed. In the same communication—"Ornithological Notes from Norfolk for 1920"—Mr. Gurney shows that at least two pairs of bitterns reared young in Norfolk during that year. This, indeed, demonstrates the efficiency of the protection afforded to rare breeding birds in Norfolk.

IN an article entitled "Facts about Rattlesnakes," published by the *Los Angeles Times*, and copied by the *Dallas Saturday Night* of June 26, 1920, Mr. W. S. Griswold describes many of the peculiar habits of these snakes. The commensal trait in *Crotalus cerastes* is certainly the most interesting. The horned rattlesnake, the author observes, takes up its abode in the burrow of a prairie-dog, which burrow is also sometimes shared by the small prairie-owl, all these three creatures living amicably together. He explains that the prairie-dogs' holes form the only possible shelter in the arid plains, and that being always near water they make doubly attractive retreats. "In return for this hospitality the rattlesnake," it is remarked, "takes charge of the census, and thoughtfully prevents the prairie-dog from accumulating a larger family than he can conveniently support." According to Dr. Gadow, this instance of commensalism is an exaggeration, the original inhabitants deserting the hole when the rattlesnake intrudes. Mr. Griswold's version is, however, quite credible when one considers the case of the Tuatara lizard, which excavates a hole which it shares with a petrel, and, although invariably tolerant of the petrel and its family, will not allow a second Tuatara to enter.

A CORRESPONDENT who travels frequently from the south-west of England to London states that, in his opinion, at this time of year vegetation, notably the flowering-trees, is generally more advanced as the metropolis is approached, and he asks whether others have made similar observations. Mr. J. Edmund Clark, who is largely responsible for the phenological reports of the Royal Meteorological Society, has very kindly forwarded us some particulars bearing upon the subject which do not appear to support our correspondent's statement except in the case of the hazel. The following are, for example, the dates of flowering for some trees during 1919 in south-west and south-east England:

	Hazel	Blackthorn	Horse-chestnut	May	Rose
S.W. England ...	Feb. 9	March 31	May 2	May 10	June 6
S.E. ,, ...	,, 3	April 5	,, 7	,, 11	,, 6

Records for 1920 are not yet available. The figures, of course, give no trustworthy indication of the time of flowering of cultivated fruit-trees, which probably constitute the greater part of the flowering trees in the neighbourhood of London.

IF segregation of Mendelian factors is determined by the separation of pairs of chromosomes during germ-cell formation, then there should be no Mendelian segregation in parthenogenetic eggs in which the full chromosome complement is retained. Prof. W. E. Agar has adduced further evidence on this point (*Journal of Genetics*, vol. x., No. 4) in a continuation of his breeding experiments with the Cladoceran Daphnia, which reproduces for the most part parthenogenetically. In a cross between *D. obtusa* and *D. pulex*, one of the hybrid offspring was bred parthenogenetically for ten generations. The most conspicuous difference between the species is in the relative lengths of two of the abdominal spines. The F_1 hybrid was intermediate as regards this ratio, and statistical treatment of the measurements of its

parthenogenetic offspring failed to show any segregation towards either parent. It is concluded that in such a clone segregation does not take place. The results would be more complete if it were also shown that in sexual reproduction of this hybrid segregation did take place in F_2 or later generations. Such a result would also be interesting as indicating whether the difference between the parent species depends on a single factor or on a larger number of genetic differences. Prof. Agar has shown that each species contains a large number of clones, each of which will perpetuate its differences in parthenogenetic reproduction.

THE 1920 report of the council of the British Research Association for the Woollen and Worsted Industries has just been issued. The chief feature in the report is a fully illustrated description of the research laboratories and workshops at present being fitted up in Leeds. In addition to paying 5400*l.* for the property upon which the central laboratories are being installed, 2000*l.* has been advanced for the purchase of a site for an experimental carding installation in Huddersfield. The director, Major H. J. W. Bliss, is gradually building up staffs for the physics and colloid chemistry, chemistry, engineering, and biology departments, and, although fundamental soundness is not being sacrificed to the too prevalent desire for quick returns, useful researches have already been taken in hand. Thus four publications (Nos. 7, 8, 9, and 10) on important problems have been issued to subscribers, and there are indications of useful work nearing completion on spinning, oils, scouring and milling, and last, but not least, those fundamental problems which no private firm can be expected to undertake. The sheep-breeding experiments, from the wool point of view, in which the association is collaborating with other bodies—notably the Agricultural Departments of England and Scotland—are deemed so important that a special pamphlet has been issued as an appendix to the annual report. Many useful breeding experiments are being made this season—largely under the stimulating influence of Prof. Cossar Ewart, of the University of Edinburgh—and it is hoped from these comparatively small-scale experiments to obtain useful data for others on a much larger scale. It is evident also from this appendix that, in addition to producing new crosses, the association is anxious to improve the present breeds, and in conjunction with the Royal Agricultural Society and other show committees it is about to engage in battle against "grey hair," "kemps," and a deterioration in "wool quality," following mistaken ideas on the relationships of wool and physique.

AN interesting point is made in Water-Paper 418 of the U.S. Geological Survey, on "Mineral Springs of Alaska," where it is remarked that permanent ground-frost surviving in the region from the Glacial epoch has an important influence in diminishing the mineral content of surface-waters. In Seward Peninsula alluvium has been found frozen to depths of more than 200 ft., while on hill slopes facing northward ice occurs within 2 ft. of the surface. Erosion, moreover, is prevented by the general covering of moss, grass, and forest. A. H. Brooks, the author of this section of the paper, indicates a more normal composition for river-waters derived from the mountainous regions, where streams flowing from the snows cut deeply into rock.

THE noble genus Nelumbo is now represented by two species only, the Indian lotus of Asia and northern Australia and the American lotus or great water-lily, found in eastern America from Ontario to 7° S. lat. in Brazil. E. W. Berry (U.S. Geol. Surv., Prof. Paper 108–E) describes a new species from the Eocene of Meridian, Mississippi, resembling some of the European fossil forms, and he gives a world-map showing how the long history of the genus is revealed by its Cretaceous, Cainozoic, and present distribution. The author attributes the southward migration of Nelumbo to the inclemency of the Glacial epoch, and its entire disappearance from the Old World west of the Caspian to the natural obstacles presented by European structure, which prevented its escape southward into Africa.

THE *Meteorological Magazine* for March contains an article by Dr. J. S. Owens on London smoke-fogs. The method adopted by the Atmospheric Pollution Committee for measuring the impurities deposited from the air by large open-topped gauges is acknowledged as insufficient. It has now been supplemented by a method of ascertaining the quantity of suspended matter in the air. An automatic instrument is made to filter a fixed volume of air through a small disc of white filter-paper at short intervals, and a measure is made of the impurities left behind on the filter-paper. Continuous records have been obtained from three stations in different parts of London during the past winter. The records for foggy days are kept separate from days with ordinary weather, and the records for ordinary week-days, excluding Saturdays and Sundays, are kept separate from the results for Saturdays and Sundays respectively. The air is purest between midnight and early morning, and the amount of impurity rapidly increases at about 6 or 7 a.m., reaching its maximum at about 11 a.m. on week-days and at noon on Sundays. A subsidiary maximum is shown at about 5 p.m., after which the impurities rapidly decrease. It is shown, with probably some approximation to truth, that the impurities are due to domestic smoke rather than to industrial furnaces. The author acknowledges that at present the data are scanty, but expresses the hope that further results will prove instructive.

THE discovery by Sir E. Rutherford two years ago that α-particles from radium C on their passage through nitrogen or oxygen produced a small number of particles with range 1·3 times that of the original particles made it possible that the swift particles from thorium C discovered by Rutherford and Wood in 1914 might have been produced by the passage of the α-particles of range 8·6 cm. through the mica screen used in the experiments. In the April issue of the *Philosophical Magazine* Dr. Wood shows that this is not the case, and Sir E. Rutherford describes how he has obtained, by the aid of a powerful source of thorium C presented to him by Dr. H. McCoy, of Chicago, a sufficient number of the long-range par-

ticles to determine their bending in a magnetic field. By this means he shows that these swift particles are ordinary α-particles of mass 4, and not doubly charged particles of mass 3, such as are produced by the passage of α-particles through nitrogen and oxygen.

MESSRS. PASTORELLI AND RAPKIN, of 46 Hatton Garden, E.C.1, have issued a new list of their glass and metal hydrometers and specific-gravity instruments for use in chemical laboratories and for industrial purposes. The list includes not only all the hydrometers generally used in laboratory and technological determinations, those of Twaddell being particularly well represented, but also an extensive variety of salinometers and saccharometers. It is interesting to see that hydrometers have now a wide application in industry, being no longer confined to brewing and distilling, but required for petrol and other oils; by electricians for accumulators; in the meat-pickling trade; in laundries for testing starch; as "lactometers" for milk; by tanners, who call them "barkometers"; while there is even a special hatter's hydrometer for shellac solutions.

MR. JOHN MURRAY is to publish for Lord Haldane a work entitled "The Reign of Relativity," in which the principle of relativity will be dealt with in its philosophical aspect, and not merely as interpreted in mathematical physics. The departments of biology, psychology, the State, and religion will be considered in the investigation, and illustrations of the principle of relativity in this wider application will be drawn from literature, art, religion, and recent physical and natural science. Another book in Mr. Murray's new announcement list is "The Great Malaria Problem and its Solution," by Sir Ronald Ross. The work will be largely an autobiographical record of the inception, progress, and ultimate success of the campaign against malaria.

MR. R. F. GRANGER, of Lenton Fields Climatological Station, Nottingham, who made naked-eye observations of the partial eclipse of the sun on April 8, writes to say that he saw Venus clearly, though he could see no stars. He noticed that faint cloud formed at 8.15 and disappeared at 9.0; "it probably lay in the damp layer at the top of the turbulent region, and appeared to be formed by direct cooling." Daisies closed, but chickens took no notice of the darkness.

ERRATUM.—NATURE of April 14, p. 218, 1st col., line 6 from bottom: *For* F. C. Cruikshank *read* F. G. Crookshank.

Our Astronomical Column.

PONS-WINNECKE'S COMET.—The following provisional elements of Pons-Winnecke's comet have been deduced with the aid of the recent observations.

T 1921 June 13·950 G.M.T., ω 177° 41′ 37″, node 93° 24′ 19″, incl. 19° 11′ 31″, log a 0·51403, e 0·69138, q 1·008.

Ephemeris for Greenwich Midnight.

		R.A. h. m. s.	Decl. ° ′	Log r	Log Δ
April	18	16 12 43	39 36 N.	0·1050	9·6378
	20	16 17 59	40 21	0·0996	9·6213
	22	16 23 32	41 6	0·0942	9·6043
	24	16 29 30	41 53	0·0889	9·5868
	26	16 35 52	42 42	0·0836	9·5696
	28	16 42 38	43 18	0·0783	9·5505
	30	16 50 6	44 0	0·0731	9·5313
May	2	16 58 13	44 39	0·0680	9·5114
	4	17 6 49	45 19	0·0630	9·4911
	6	17 16 26	45 54	0·0580	9·4699
	8	17 26 56	46 28	0·0532	9·4481
	10	17 38 32	46 56	0·0486	9·4253
	12	17 51 25	47 18	0·0440	9·4017

The comet will be nearest the earth (distance 12,500,000 miles) on June 6. The earth passes the node on June 25, about nine days after the comet.

REID'S COMET.—This comet was on the verge of naked-eye visibility more than a week ago. It should be easily so visible when the moon is out of the way. M. Ebell has computed new elements from which the following ephemeris (for Greenwich midnight) is taken. The elements differ only slightly from those given in NATURE for March 31. T is May 10·01 and log q 0·00403:

		R.A. h. m. s.	N. Decl. ° ′			R.A. h. m. s.	N. Decl. ° ′
April	22	20 41 54	33 44	May	2	21 16 10	68 24
	24	20 45 20	40 16		4	21 38 8	74 53
	26	20 49 36	47 11		6	22 24 22	80 37
	28	20 55 22	54 20		8	0 31 22	84 49
	30	21 3 32	61 29		10	4 27 37	84 50

Values of log r, log Δ: April 22, 0·0223, 9·8292; April 30, 0·0096, 9·8017; May 8, 0·0042, 9·8640. The high north declination will facilitate observation.

Mr. W. F. Denning writes:—"Reid's comet was faintly visible to the naked eye on the morning of April 16 at 3.20 G.M.T. The comet's perihelion will occur on May 10 next, and when the moon leaves the evening sky about April 24–25 the comet should be easily visible. It will then be situated in Cygnus and a few degrees south of α Cygni. Its motion is carrying it rapidly northwards, so that on May 2 the comet will be found 2° or 3° south-west of β Cephei. It should be readily found with a field-glass, and will probably be easily within reach of the unaided eye."

FIXED CALCIUM LINES IN EARLY TYPE STARS.—Since the discovery in 1904 of the fact that the H and K lines of calcium in the star δ Orionis did not share in the large displacements common to all the other lines, a similar effect has been observed in many other stars. A considerable amount of literature has thus accumulated on this subject of "fixed" calcium lines, which has now been collected and discussed by Mr. R. K. Young in a very useful summary published in the Journal of the Royal Astronomical Society of Canada (vol. xiv., p. 389). It appears that nearly all the stars having this peculiar characteristic are of early B type, and this forms a strong argument against the theory that the stationary calcium lines have their origin in a cloud of vapour lying between us and the star. It is also difficult to account for their origin by assuming an extended nebulosity enveloping the star and not partaking in its motion, since in a very close pair of stars observed by Plaskett only one showed this effect; and in the Pleiades, which are known to be surrounded by such a nebula, the effect is not seen at all. The author holds the opinion that the calcium vapour giving rise to the fixed lines forms part of the star's own atmosphere, but is much more extended than the proper reversing layer.

The New Star of 1912—Nova Geminorum II.[1]

By MAJOR WILLIAM J. S. LOCKYER.

THOUGH new stars are of comparatively rare occurrence, several have appeared during the past few years, and much attention has been devoted to their study. Many observatories which have now taken up the spectroscopic examination of celestial objects, and are therefore equipped with spectroscopic apparatus of various kinds, have together secured a great amount of material which was lacking for the study of the earlier novæ.

Such was the case with the new star which was discovered by Enebo in Norway on the evening of March 12, 1912. This star appeared in the constellation of Gemini and is known as Nova Geminorum II., since it is the second nova that has shown itself in that constellation.

The star was, fortunately, discovered before it had attained its greatest brilliancy, as was also the case with the most recent new star, Nova Cygni III. (1920). On March 10, 1912, Nova Geminorum was less than a star of the eleventh magnitude, and it attained its maximum on March 14, being then of magnitude 3·37. After that it faded very rapidly, diminishing with fluctuations which were irregular in both period and amount.

The Solar Physics Observatory at Cambridge was fortunate enough to secure a very fine series of photographs taken by Mr. Stratton during the months of March and April, 1912—so good a series, in fact, that it required only a few photographs from other observatories to fill up the gaps. Most of these were supplied from the Allegheny and Bonn Observatories. Other photographs were taken of the later stages of the nova's career, but longer intervals between these only were required, as the spectral changes were slow. The measurement of all the photographs was completed in 1914, but owing to the outbreak of war the work of discussion could not be taken up until Mr. Stratton's return to the observatory in February, 1919. His discovery of the identification of many lines in the nova's spectrum with nitrogen, oxygen, and helium lines, which were greatly displaced from their normal positions, facilitated the work.

A discussion of all these photographs has now been published, and Mr. Stratton, who undertook it, has presented us with a work which gives a valuable insight into the nature of the changes which the spectrum of this nova underwent. The volume will thus greatly assist other workers who are discussing their observations of later novæ, and will possibly give them clues as to what kind of changes may be expected or how to look for them.

Since the spectrum of a nova is changing constantly, and sometimes with very considerable rapidity, especially about the time of maximum brilliancy, every photograph of its spectrum, wherever taken, may prove useful in the elucidation of the nova problem. Since the puzzling changes in the spectra are much more likely to be understood if the time interval between successive spectrograms can be greatly reduced, the author puts forward the view that for a complete elucidation of the problems involved all the spectra secured for any one nova should be placed at the disposal of a single investigator. There should be no difficulty in carrying out such a suggestion, provided that each observatory which takes some of the photographs and wishes to discuss them may do so prior to handing them over for the final inquiry.

One marked feature of this research is that it deals with photographs of the nova taken with instruments giving both large- and small-scale spectra. As the spectra of novæ at some stages consist of a mixture of broad, diffuse bands, together with very sharply defined lines, the former are seen and measured at their best in the small-scale spectra, while the latter are practically seen only in the large-scale spectra.

The discussion of the observations has led the author to differentiate between seven different stages in the spectrum of this nova. One cannot do better than quote from p. 9 the summary he gives of the different stages, as space forbids one to elaborate the information:

"(1) An absorption spectrum of type A5 displaced, with weak radiations undisplaced (1912 March 13).

"(2) An absorption spectrum of type A2*p* (α Cygni) displaced, with radiation spectrum undisplaced and with many absorptions doubled (1912 March 15–21).

"(3) Superposed absorption spectra of types A2*p* (α Cygni) and B2 (γ Orionis) displaced by separate amounts, together with an α Cygni radiation spectrum undisplaced. The γ Orionis absorption spectrum increases in strength compared with the α Cygni absorption spectrum, and accompanying bright bands of γ Orionis type gradually appear and increase in strength (1912 March 22–31).

"(4) α Cygni and γ Orionis radiation spectra undisplaced (1912 April 8).

"(5) γ Orionis and nebular radiation spectra undisplaced (1912 April 22).

"(6) Nebular radiation spectrum (1912 December 6).

"(7) Nebular and Wolf-Rayet radiation spectra (1914 February 22)."

The author enters fully into the method he adopted for differentiating between the types of spectra referred to in Nos. (1) to (3) above, and shows how by employing a displacement factor from known lines he was able to tie up lines of other elements, the displacement factor varying according to the date of the photograph examined. Thus, to take one instance, out of 108 strong lines in α Cygni, 79, according to this method, appeared displaced in the nova on March 15; reasons are given for the absence of many of the remaining lines.

As to the cause of the outburst of the new star, based on the spectroscopic evidence here brought together, the author does not commit himself, for he says that a final theory of novæ cannot yet be written. With regard to the most hopeful theory at present put forward, suggesting the collision of a star with a dark nebula and the consequent terrific action causing a tremendous outstreaming of glowing gases from the central body and the final formation of a planetary nebula with a Wolf-Rayet star as nucleus, the author says we "must await modification as further facts come to light."

In his preface Prof. Newall states that this vol. iv. of the Annals will be followed by memoirs on Nova Persei (1901) and on Nova Aquilæ III. (1918). The latter star, he says, "seems likely to afford more insight into the nature of the outburst of a nova than all the other new stars that have been studied with the help of the spectroscope."

While reference has only briefly been made to some of the main points in this volume on Nova Geminorum II., there are many other features in the nova's spectrum which Mr. Stratton has discussed very minutely, such as the undisplaced calcium lines, the structure of bright bands, etc. Two plates accompany the volume illustrating the spectra both as a whole and in parts.

[1] Annals of the Solar Physics Observatory, Cambridge. Vol. iv., part i.: "The Spectrum of Nova Geminorum II." By F. J. M. Stratton. Under the direction of Prof. H. F. Newall. Pp. viii+71+ii plates. (Cambridge: At the University Press, 1920.)

Gold-coloured Teeth of Sheep.

IN a paper "On Dental Encrustations and the So-called 'Gold-plating' of Sheep's Teeth," published in the Proceedings of the Linnean Society of New South Wales (August 25, 1920), Mr. Thos. Steel gives an account of the so-called "gold-plating" and encrustations on the teeth of sheep and other animals. He states that the popular idea is so strong that the jaws of sheep are still taken from time to time to the Sydney Mint with the object of selling them for the gold supposed to be present.

Mr. Steel refers to papers published in the Proceedings of the Royal Society of New South Wales and of the Sydney Section of the Society of Chemical Industry in 1905, in which Prof. Liversidge showed that the encrustation is due to tartar deposited from the saliva in thin films. The golden colour and appearance are proved to be due to the reflection of light from the overlapping of the thin films, and in composition the deposit consists of impure calcium phosphate and organic matter, and not of iron pyrites, as confidently asserted by correspondents in NATURE (vol. xcix., 1917, pp. 264, 284, 290, and 306, and vol. c., 1917, p. 106), to account for which various "fantastic" explanations are given. Prof. Liversidge stated that the deposit can be easily separated in thin flakes like mica with the point of a penknife, or even a pin, and that if a flake held on the point of a pin be placed in a match- or candle-flame it blackens, inflames, and leaves a white fusible residue; hence neither a knowledge of chemistry nor the use of any chemical apparatus is necessary to prove the absence of gold and of iron pyrites.

Mr. Steel has unearthed a forgotten statement by the late Dr. George Bennett in his "Wanderings of a Naturalist" (1834, p. 294) that the yellow "metallic substance" sometimes found on the teeth of sheep, oxen, and kangaroos, and frequently mistaken for gold, is simply tartar deposited from the saliva. Dr. Bennett quotes an analysis of the ordinary deposit on human teeth by Berzelius, who obtained results very similar to those of Mr. Steel. Mr. Steel had exceptional opportunities for obtaining large quantities of the coating, and was able to make quantitative analyses of the encrustations from the teeth of sheep, oxen, horses, etc., taken from the stocks of bones passing through a large bone-charcoal factory in Sydney; from other sources he obtained sufficient material from the teeth of the camel, dromedary, rhinoceros, and even man. They consist mainly of calcium phosphate, with small amounts of magnesia, carbon dioxide, a little sand, from 16·20 per cent. to 24·65 per cent. of organic matter, and from 3·85 per cent. to 11·65 per cent. of water. Mr. Steel gives a table of the percentage composition of the encrustation from the teeth of man, sheep, ox, camel, dromedary, and rhinoceros and, for comparison, the analyses of the cement layer (crusta petrosa) of the teeth of the babirussa, ox, and camel. He points out the very interesting fact that the tartar has much the same composition as mammalian bone.

The rhinoceros and babirussa encrustations differ from the others by containing very little calcium phosphate, although in lustrous flakes like that of the sheep and ox; in man it is chalky-looking without the metallic or nacreous lustre.

The coating may vary from a thin film to a quarter of an inch in thickness; the black coating common on the teeth of sheep and oxen has the same composition as the "metallic" deposits. The teeth of carnivora and rodents are usually very clean except when old, and so are those of pigs; those of snakes, lizards, and fish are free from deposit; it is present on the teeth of the crocodile and killer-whale, and also on teeth of the tapir, eland, bison, bears, and most of the Australian marsupials, including the fossil marsupial teeth from the Wellington Cave, New South Wales. Mr. Steel refers to the huge projecting teeth observed by Miklouho-Maclay in natives of Taui or Admiralty Islands (NATURE, vol. xvi., 1877, p. 251), due to an enormous deposit of tartar caused by chewing betel-nut and lime; the percentage of lime found in it by Salkowski was more than 45 per cent. (*Nehr. Berlin. Ges. Anthrop.*, 1881, p. 219).

The investigation shows a large amount of very careful and painstaking work, and should be of interest to anatomists and dentists, especially as the alleged occurrence of gold or pyrites on teeth has been reported again and again for centuries, and will probably continue to be so reported from time to time.

The History of Metamorphic Insects.

REFERENCE has been made in NATURE to most of the series of remarkable entomological papers which Dr. R. J. Tillyard has communicated during the last few years to the Linnean Society of New South Wales, and which have been published in that society's Proceedings (vols. xli.–xliv.). These papers are worthy of the most careful attention of students of insects, because the author combines the power of intensive research into details of structure with a true instinct for those details that are of real importance in the elucidation of relationships, and with a broad morphological outlook on the group under consideration. He has the faith—which many of our younger naturalists, shut in to the study of the inheritance of varietal and specific characters, lack—that a knowledge of the phylogeny of large systematic groups is attainable, but he realises that such knowledge can come only through a careful comparison of recent adult and immature with extinct forms. Thus his evolutionary speculations are raised on surer foundations than those which contented many of his predecessors.

Attention may be especially directed to Dr. Tillyard's exposition of the wing-venation of the group of orders which he terms the "Panorpoid complex" (Proc. Linn. Soc., N.S.W., vol. xliv., part 3, 1919), this group comprising the Neuroptera (Planipennia and Megaloptera), Mecoptera, Trichoptera, Lepidoptera, and Diptera, together with three extinct (Permian or Triassic) orders, the Paramecoptera, Protomecoptera, and Paratrichoptera, the types of which were described by the author from Australian fossils. Wing-venation has been generally regarded as a trustworthy guide to the affinities of the families and orders of insects, but entomologists lacked a reasonable morphological interpretation of the complicated array of facts until Comstock and Needham showed how the correspondence of the main series of longitudinal nervures could be traced through members of various orders, the detection of homologies being greatly facilitated by a study of the tracheal tubes which provisionally mark out the venation in the nymphal or pupal wing. Dr. Tillyard adopts generally the Comstock homologies and nomenclature, but his opportunities of studying archaic

Australasian forms of the Neuroptera and Mecoptera, both in the adult and pupal stages, have enabled him to suggest amendments which may be expected to win general acceptance. His insistence on the importance of the earliest pupal tracheation, and on the recognition of the longitudinal nervures by the presence of characteristic strong bristles (the *macrotrichia*), which are absent on the cross-nervules, and the scars of which can be distinguished in fossil wings, is particularly weighty.

The three extinct orders mentioned above are regarded by Dr. Tillyard as arising collaterally with the Mecoptera and Neuroptera in Permian times, one Permian fossil (Permochorista) from the coal-beds of New South Wales being definitely referred to the Mecoptera, and another (Belmontia) from the same beds to the new order Paramecoptera (see Proc. Linn. Soc., N.S.W., vol. xliv., part 2, 1919); while Protopsychopsis and Archepsychops from the Upper Trias of Queensland are classed with the planipennian Neuroptera, the Lower Triassic Triadosialis—a European (German) fossil—standing near the base of the megalopteroid group. The extinct Paramecoptera are believed by Dr. Tillyard to be ancestral to both the Trichoptera and the Lepidoptera, while Upper Triassic fossils from Queensland (Aristopsyche, etc.) belonging to the Paratrichoptera suggest that this latter order gave rise to the Diptera (see *t.c.*, part 1, 1919).

From this summary it will be realised that all the principal orders of metabolous insects (the Endopterygota of Sharp), with the exception of the Coleoptera and the Hymenoptera, are brought into a series of reasonably probable relationships. Even if later discoveries may compel some modifications in the details of Dr. Tillyard's genealogical scheme, it seems impossible to doubt that he is on the track of real affinities, and that the other two great metamorphic orders, the beetles and the Hymenoptera, will ultimately be shown to have such relationship to this "Panorpoid complex" that the whole endopterygote assemblage cannot but be regarded as forming a natural monophyletic group. G. H. C.

Oil in Western Sinai.

By H. B. MILNER.

THE opening up of a new petroliferous region in any country is usually a matter of more than ordinary interest, not only to oil technologists, but also to the general business public. In Western Sinai we recognise one of the latest developments of oilfield enterprise, and from our knowledge of the Egyptian fields (to which this new region is geologically similar), as well as from the data published by the Petroleum Research Expedition of Egypt in a Preliminary General Report on Western Sinai (Cairo: Government Press, 1920), the prospects in this part of the peninsula would seem to be exceedingly promising.

For some time past it has been known from surface and other indications that the tract of country stretching southwards from Suez along the western coast of Sinai is petroliferous in many places, but it has remained for Dr. Hume and his staff of geologists to carry out the necessary geological investigations in elucidation of the structure of the country and for the selection of the most favourable localities for drilling test wells.

The actual belt of country examined lies between Suez and El Tor, a distance of about 220 km. along the coast. Of the various localities at which oil indications are promising those of Abu Durba and Gebel Tanka seem to be pre-eminent, and in the former instance a well-site has already been fixed; in the Gebel Tanka area there are three separate oil prospects which have received attention, and two sites for deep test wells are indicated at present.

With regard to the relative geological positions of the various oil horizons within the belt, from the information supplied in the report it is evident that there are at least two of these, an upper situate between the Middle Eocene limestones and Lower Miocene marls and a lower occurring at the junction of the Cretaceous beds with the underlying Nubian sandstones. In the Gebel Tanka area both the upper and lower horizons are present, but drilling to the lower oil-bearing strata is advocated, as the Eocene limestones are not deemed here to be profitable commercially. In the Abu Durba area only the lower horizon is present, but drilling would not be to such a depth as in the former case, as the Tertiary beds are absent.

Tectonically, so far as present evidence shows, two definite systems of folding have been established within this region, one known as the Hammam Faraûn-Useit anticline and the other as the Gebel Araba anticline. The former is the more important feature from the oil point of view, since many of the reported indications (including those of the Gebel Tanka area) are associated with it. The latter is more doubtful in this respect, as the surface indications are less numerous, but it is evident that with progress in mapping a great deal more information will be obtained which should define the system with more precision, and thus indicate the chances of future exploration for oil in the sediments affected thereby.

Not only has the Petroleum Research Expedition done valuable work in reporting on the oil potentialities of this region; it has also made an important contribution to our geological knowledge of Western Sinai which, even if the oil prospect prove unfavourable, well warrants the survey made. Two other reports of the expedition (Bulletins 3 and 4) deal in greater detail with the oil occurrences at Gebel Tanka and Gebel Nezzazat (Sinai), and should be read in conjunction with the general report (Bulletin 2) described above.

Genetics of Cereals.

SINCE the well-known experiments of Biffen, in which the rust resistance of wheat to *Puccinia glumarum* was shown to behave as a simple Mendelian recessive character, numerous amplifying investigations have taken place. In Swedish experiments Nilsson-Ehle obtained less regular results, finding usually a lack of dominance and segregation in indefinite ratios. In the meantime, extensive studies have been made of the black stem-rust, *Puccinia graminis tritici*, which causes enormous losses in American wheat crops. It has been shown that numerous biologic forms of this fungus exist

which differ in their action on particular wheat varieties. Rust nurseries have been established for isolating, and experimenting with the effects of, various races of rust. It was found that numerous biologic forms of this fungus sometimes existed in the same locality, a wheat variety being susceptible to some and resistant to others. This greatly complicates the work of breeding for rust resistance, but an emmer wheat from India has been found to be resistant to all forms of rust yet encountered. The conception of bridging species, or the modification in virulence of a fungus by growth on an intermediate host, is being discredited by the further investigation of these biologic races.

In a recent paper by Messrs. H. K. Hayes, J. H. Parker, and C. Kurtzweil (*Journ. Agric. Research*, vol. xix., No. 11) the authors studied the inheritance of rust resistance and its correlation with botanical characters in crosses between *Triticum vulgare* and varieties of *T. durum* and *T. dicoccum*. To eliminate the presence of different biologic races of the fungus, all barberry bushes were eradicted and the wheat-plants sprayed with spores from the rust nursery. The common wheats, such as Marquis, were susceptible, the durums, such as Kubanka, "commercially resistant," while the emmer varieties were practically immune. In crosses between emmer and common wheats resistance was found to be partially dominant, while in crosses between durum and common wheats susceptibility was completely dominant. In F_2 and F_3 generations segregation occurred, with indications of linkage between durum or emmer head characters and rust resistance. Some of the resistant types obtained were more resistant than the original parents. This study contains a number of other valuable observations.

In connection with the work of Engledow (referred to in NATURE of September 30, 1920, p. 158) on the lateral florets of barley, it was shown that *Hordeum intermedium Haxtoni*, which is intermediate between two-rowed and six-rowed barley in the fertility of its lateral florets, occurs as a homozygous form which will breed true, and that it represents a unifactorial difference from *hexastichum*. The production of *Haxtoni* in a number of crosses is described by H. V. Harlan and H. K. Hayes (*Journ. Agric. Res.*, vol. xix., No. 11), and an explanation of the difference between two-rowed and six-rowed barley on a two-factor hypothesis is suggested. The six-rowed barleys are believed to be homozygous for the presence of an epistatic factor, the *intermedium* homozygous for the absence of the epistatic factor and for the presence of the hypostatic factor, the two-rowed barleys being homozygous for the absence of both factors. R. R. G.

University and Educational Intelligence.

MR. A. R. HINKS, the Gresham lecturer on astronomy, will deliver a course of four free public lectures on "Recent Work on the Nebulæ" at Gresham College, Basinghall Street, E.C.2, on April 26–29 at 6 o'clock.

THE Vienna correspondent of the *Lancet* states that by an Order of the Austrian Board of Education the fees payable by students of the medical faculties of Austrian universities have been increased in such a way that for this summer term and onwards foreigners will have to pay more heavily than Austrians. For graduation the increase for foreigners is 1000 per cent. of the present fee, while for tuition, etc., an increase of 2500 per cent. is to be made; the general increase for Austrian students will be 50 per cent. The object of this preferential treatment is to compensate in part for the rate of exchange, which is now so favourable to foreigners, but the foreign student will still be able to study at a very small expenditure, for it is calculated that classes of four and six hours weekly will cost only 8*s*. and 12*s*. respectively per term. The increase was also rendered necessary by the action of the Rockefeller Foundation in making their grant of 60,000 dollars conditional on increasing the fees of foreign students. It was considered unjust that an impoverished State should enable foreign students to obtain a first-class medical education at a cost far below that of equivalent education in their own countries.

THE foundation-stone of the new University of Lucknow was laid on Saturday, March 19, by Sir Harcourt Butler, Lieutenant-Governor of the United Provinces (*Pioneer Mail*, March 25). An address of welcome was presented by the Vice-Chancellor, Rai G. A. Chakravarty Bahadur, in the course of which it was mentioned that an attempt would be made to resuscitate national ideals in the new University. After laying the foundation-stone Sir Harcourt Butler delivered an address, paying eloquent tribute to the generosity of the people of Oudh which had made possible the foundation of a university. He said that whereas at the convocation speeches at Allahabad University he had urged the importance of scientific training and research, at Lucknow, an ancient centre of literature and poetry, he made a special plea for the study of the humanities. The University should be organised according to modern ideas, which in many particulars, such as in teaching and residence, conform with indigenous ideals of education. On March 21, when the first annual meeting of the court of the University was held under the presidency of the Vice-Chancellor, it was announced that a sum of nearly 30 lakhs of rupees had been promised in subscriptions.

THE President of the Board of Education has constituted an Adult Education Committee to promote the development of liberal education for adults, and in particular to bring together national organisations concerned with the provision of adult education, so as to secure mutual help and prevent overlapping and waste of effort; to further the establishment of local voluntary organisations for the purpose and of arrangements for co-operation with local education authorities; and to advise the Board of Education upon any matters which the Board may refer to the Committee. The members of the Committee are:—The Bishop of Manchester (chairman), Dr. J. G. Adami, Alderman F. Askew, Mr. C. W. Bowerman, M.P., the Rev. D. H. S. Cranage, Lord Gorell, Mr. B. S. Gott, Prof. J. A. Green, Miss Grace Hadow, Mr. Alfred Holmes, the Rev. F. E. Hutchinson, Prof. F. B. Jevons, Prof. J. Harry Jones, Mr. C. L. Kingsford, Mr. John Lea, Mr. J. M. Mactavish, Mr. Albert Mansbridge, Prof. J. H. Muirhead, Sir Isambard Owen, the Rev. R. St. J. Parry, Lt.-Col. H. A. Powell, Mr. W. R. Rae, Sir Harry R. Reichel, Mr. Arnold Rowntree, Mr. A. L. Smith, Mr. R. H. Tawney, Mr. G. Thompson, Mr. H. Pilkington Turner, Dr. R. Mullineux Walmsley, Miss Phœbe Walters, and the Rev. Basil A. Yeaxlee. Mr. C. O. G. Douie, an assistant principal under the Board of Education, is secretary. Mr. E. K. Chambers and Col. M. Earle will attend meetings on behalf of the Board of Education and the Army Council.

Calendar of Scientific Pioneers.

April 21, 1793. John Michell died.—A fellow of Queens' College, Cambridge, Michell became a clergyman, and in 1762 was appointed Woodwardian professor of geology in the University of Cambridge. Magnetism, electricity, and astronomy all engaged his attention, and shortly before his death he devised the apparatus afterwards used by Cavendish to measure the density of the earth.

April 21, 1825. Johann Friedrich Pfaff died.—The friend of Schiller and the rival of Gauss, Pfaff studied mathematics under Kästner and worked at astronomy with Bode. His original researches were mainly in the domain of the calculus and differential equations. Pfaff was born in 1765. From 1788 to 1810 he was professor of mathematics at Helmstadt, and from 1810 onwards held the chair of mathematics at Halle.

April 23, 1874. John Phillips died.—In his youth the constant companion of his uncle, William Smith, the geologist, Phillips held the chairs of geology at King's College, London, at Dublin, and at Oxford. For his contributions to geology and palæontology he received the Wollaston medal from the Geological Society, which he served as president during 1859–60.

April 25, 1840. Siméon Denis Poisson died.—Poisson all his life—first as student, then as professor and examiner—was connected with the Ecole Polytechnique, where he gained the friendship of Lagrange, Laplace, and Legendre. Besides his separate works he published some three hundred memoirs, the chief of which are on the theory of electricity and magnetism and on celestial mechanics. Always working, he replied to one who urged him to rest: "La vie: c'est le travail."

April 25, 1882. Johann Carl Friedrich Zöllner died.—Well known for his investigations in photometry, spectrum analysis, and the constitution of the sun, Zöllner from 1872 was professor of physical astronomy at Leipzig.

April 25, 1914. Eduard Suess died.—Born in London in 1831, Suess was educated at Prague and at Vienna, where at the age of twenty he entered the Imperial Museum. In 1867 he became professor of geology in Vienna University. His great treatise, "Das Antlitz der Erde," which occupied him twenty-five years, was a comprehensive survey of all that had been accomplished in elucidating the geological structure of the earth. He held various public offices, and served as president of the Academy of Sciences of Vienna.

April 26, 1835. Henry Kater died.—Joining the Army as an ensign in 1794, Kater for a time assisted Lambton on the Trigonometrical Survey of India. Placed on half-pay in 1814, he devoted himself to scientific pursuits, and was especially known for his pendulum experiments, his work on weights and measures, and his invention of the floating collimator.

April 26, 1920. Srinivasa Ramanujan died.—Distinguished for his researches in pure mathematics, Ramanujan was the first Indian fellow of the Royal Society. A Brahmin by caste, he was born at Erode in 1887, became a student at Madras University, and was enabled to spend the years 1914–19 in England, where his brilliant work led to his being elected F.R.S. in 1918. He died at Chetput, Madras.

April 27, 1521. Ferdinand Magellan died.—The contemporary of Columbus and Vasco da Gama, Magellan—or Magalhães—came of a noble Portuguese family. Sailing from Portugal in September, 1519, towards the end of 1520 he discovered the strait that bears his name and so reached the Pacific. He met his death in a fight with natives in the Philippines.

E. C. S.

Societies and Academies.

LONDON.

Royal Microscopical Society, March 16.—Prof. John Eyre, president, in the chair.—J. H. **Pledge**: The use of light-filters in microscopy. The advantages gained are: control of contrast in the stained and the coloured preparations from both the visual and the photographic points of view; aid in resolution of fine structure; improvement in the definition given by ordinary achromatic objectives; modification of the unpleasantness to the eye of artificial-light sources by "equivalent daylight" filters; and the possibility of moderating the intensity of illumination of the microscopic field by light-filters of neutral tint of suitable density. Forms of light-filters mostly in use are chiefly dyed gelatine cemented between protecting cover-glasses, but dye solutions in glass-cells are also used. To obtain maximum contrast a light-filter complementary in colour to that of the preparation should be used.

Faraday Society, March 22.—Prof. A. W. Porter, president, in the chair.—Prof. A. W. **Porter**: Presidential address: Some aspects of the scientific work of the late Lord Rayleigh. The experimental part of Rayleigh's work could be divided into that requiring elaborate apparatus and laborious application, and investigations in which the apparatus was of the simplest kind. The latter was a type of investigation in which Rayleigh specially delighted. His mathematical work was always looking forward to its applications. Illustrations were given of the great use he made of the method of dimensions when problems (especially those in hydrodynamics) cannot be yet solved in any other way. His work on intrinsic pressure was outlined and contrasted with more recent work of the Dutch school of physicists. Finally, his mentality was further characterised by references to his excursions into problems dealt with by the Society of Psychical Research. His position was summed up by saying that although Rayleigh founded no school, yet he so advanced knowledge of physics in all its branches as to stand out as one of the leaders in scientific achievement.—S. **Field**: The electrolytic recovery of zinc. Abundant supplies of low-grade and complex ores are available in Great Britain which are not amenable to distillation, but respond readily to electrolytic treatment. Sulphide ores are calcined to oxide and a predetermined proportion of sulphate. The calcine is leached with acid zinc sulphate liquors from the electrolytic cells. Special treatment avoids gel formation, and admits of high extraction and easy filtration. The zinc sulphate solution is too impure for efficient deposition. The methods of purification worked out are given in some detail. Ni and Co constitute two commonly met and insidious impurities. The purified liquors containing not more than 3 to 5 parts Co and 0·2 part Ni per 1,000,000 are acidified and electrolysed between lead anodes and aluminium cathodes. The cells, arranged in cascade, absorb 3·35 volts and give a current efficiency of 90 per cent., representing about 3200 k.w.h. per ton of zinc cathodes. Subsidiary power is amply covered by 800 k.w.h. per ton; 4000 k.w.h. covers all power. At 0·33d. per unit, power costs are 5*l.* 11*s.* per ton of cathode zinc. The cathodes are melted and yield ingots assaying at least 99·95 per cent. of zinc.—Prof. A. **Findlay** and V. H. **Williams**: Note on the electrolytic reduction of glucose. The authors have studied the electrolytic reduction of glucose under varying conditions of temperature, current density, and current concentration, and using both graphite and lead electrodes. No appreciable amount of hexa-

hydric alcohol was obtained, the reduction being apparently interfered with by the production of formic acid and a pentose.—W. E. **Hughes**: The forms of electro-deposited iron and the effect of acid upon its structure. Part i.: Deposits from the chloride bath. Structures found in iron deposits formed in chloride baths are varieties of two general types, the normal and the fibrous. The type obtained depends upon conditions prevailing during deposition, the fibrous type being characteristic of deposits formed in (*a*) acid and (*b*) agitated solutions. Macroscopic features correspond to definite microscopic structure.

Zoological Society, April 5.—Prof E. W. MacBride, vice-president, in the chair.—G. J. **Arrow**: A revision of the Melolonthine beetles of the genus Ectinohoplia.—J. H. **Lloyd**: Abnormalities in the common frog (*Rana temporaria*).—S. **Hirst**: Some new and little-known Acari, mostly parasitic in habit. The author illustrated his paper by exhibiting under microscopes (1) a preparation of a Sarcoptid mite (*Otodectes cynotis*, var. *cati*) showing the well-developed system of tracheal tubes, and (2) a preparation of the mite (*Tarsonemus Woodi*) from bees affected with Isle of Wight bee disease.—Dr. C. F. **Sonntag**: The comparative anatomy of the tongues of the Mammalia. III., Fam. 2, Cercopithecidæ: with notes on the comparative physiology of the tongues and stomachs of the Langurs.

Linnean Society, April 7.—Dr. A. Smith Woodward, president, in the chair.—H. W. **Monckton**: The distribution of *Taraxacum erythrospermum*, Andrz., in the south-east of England. The author explained that he had for some years noticed a small form of dandelion with deeply cut leaves and red seed growing abundantly on a football ground at Wellington College, Berkshire. It belongs to the group of varieties named *erythrospermum*. The geological formation is Upper Bagshot Sand (Barton Beds). He had seen the same variety on the similar sandy soil of Puttenham Heath, Surrey (Lower Greensand), on the Thames Gravel near Old Windsor, Berkshire, and on walls at West Drayton and other places. It is not confined to areas of sand or gravel, for the author exhibited specimens from the London Clay of Ashtead Common, near Epsom, Surrey.—R. A. **Malby**: A miniature alpine garden from January to December. Amongst the subjects shown in lantern-slides by the lecturer may be mentioned *Saxifraga Burseriana*, *S. Grisebachii*, *S. Striburyi*, *S. longifolia*, *S. Cotyledon*, var. *islandica*, *Anemone vernalis*, *A. sulphurea*, *Nymphaea Mooreana*, *Primula frondosa*, *P. denticulata*, *P. marginata*, *P. Juliae*, *Iris sibirica*, *I. gracilipes*, *Campanula Allionii*, *C. pusilla*, *C. garganica*, *Shortia galacifolia*, *S. uniflora*, *Petrocallis pyrenaica*, *Crocus speciosus*, *Narcissus Johnstoni*, *N. monophyllus*, *N. triandrus*, *N. minimus*, *Oxalis enneaphylla*, and *O. lobata*.

Physical Society, April 8.—Mr. W. R. Cooper in the chair.—Dr. W. J. H. **Moll**: A new registering microphotometer. A diminished image of a slit, on which the filament of a half-watt lamp is focussed, is projected by a microscope objective on the photographic plate or other object of which the absorption is to be measured. A second similar objective focusses an image of the slit, magnified up to its original size, on a second slit behind which is mounted a sensitive thermopile of the author's own design connected to an improved D'Arsonval galvanometer. The photographic plate is given a slow motion at right angles to the beam of light, and the spot from the galvanometer is focussed on a rotating drum of photographic paper. The arrangement is dead beat and so quick in response that intensity curves of close spectrum lines, Zeeman triplets, etc., are accurately recorded.—Sir W. H. **Bragg**: Application of the ionisation spectrometer to the determination of the structure of minute crystals. Crystals in the form of powder can be examined by the ionisation method. The powder is pasted on a flat surface and placed on the spectrometer table in the position ordinarily occupied by the face of a single crystal. A bulb current of 1 milliampere is sufficient to give satisfactory records.—H. **Parry**: A balance method of using the quadrant electrometer for the measurement of power. The method involves the use of a potential-divider across the supply circuit, and a standard non-inductive resistance in series with the load. An ammeter and a voltmeter are employed to measure the supply voltage and the load current.

DUBLIN

Royal Dublin Society, March 22.—Dr. F. E. Hackett in the chair.—H. A. **Lafferty**: The "browning" and "stem-break" disease of cultivated flax caused by *Polyspora lini*, n. gen. et sp. In the "stem-break" phase of the disease the stems of affected plants become partially or entirely broken across a little above ground-level comparatively early in the season, and affected plants generally fall over and die prematurely. In "browning" the upper portions of the plants in particular exhibit numerous diseased areas; this takes place about pulling time. A fungus, *Polyspora lini*, n. gen. et sp., was isolated, and proved to be the cause of both phases of the disease. The seed is also attacked, and transmission of the disease occurs by sowing infected seed. The fungus is widely distributed. No means of carrying out seed disinfection on a practical scale have been devised.—H. H. **Poole**: The electrical conductivity of some dielectrics. A large, steady potential difference obtained by thermionic rectifying valves was applied to the opposite faces of a thin sheet of the dielectric which was kept at a constant known temperature in an oven. The potential difference was measured by a rotating contact-maker, alternately charging a small condenser and discharging it through a dead-beat galvanometer. The conduction current was measured by a sensitive galvanometer. The logarithm of the electrical conductivity when plotted against the potential gradient gave a set of right lines, corresponding to different temperatures, in the case of glass. With mica a greater range of gradient was available, and the lines exhibited slight curvature.

PARIS.

Academy of Sciences, March 29.—M. Georges Lemoine in the chair.—M. **Hamy**: The approximation of functions of large numbers.—C. **Depéret** and P. **Fallot**: The age of the lignite formations of the Island of Majorca.—C. E. **Guillaume**: The compulsory adoption of the metric system by the Japanese Empire. The metric system has been legal in Japan since 1893, and is now compulsory. The system will also be adopted shortly in China and Siam.—C. E. **Traynard**: Certain singular hyper-elliptic surfaces.—J. **Andrade**: The optical determination of rolling resistance.—P. **Le Rolland**: The movement of a pendulum with elastic suspension.—L. and E. **Bloch**: Some spark spectra in the extreme ultra-violet. The ultra-violet spark spectra of zinc, cadmium, and lead are given for wave-lengths between the limits 1850 and 1400.—M. **de Broglie**: Corpuscular spectra. The laws of photo-electrical emission for high frequencies.—L. **Bull**: The brightness of the electric spark. The photometric method based on the photographic comparison with an electric arc is used, taking the duration of the spark exposure as 1/500,000 second. The actinic

intensity of the spark is not less than 160 times that of the electric arc.—M. **Dussaud**: An apparatus for projecting an image of any object on a screen 3 metres square in a lighted room, with a current of 3 amperes.—P. **Jolibois**: A photographic method of registering chemical reactions accompanied by a variation in pressure. The mercury manometer tube has a fine platinum wire stretched throughout its length, and the variations in the resistance of this wire serve as a measure of the height of the manometer. The temperature at which the reaction under study is proceeding is measured by a thermo-couple, and the double galvanometer of Le Chatelier and Saladin is employed to record the temperature and pressure simultaneously. Some possible applications are described.—H. **Joly**: The geology and physical geography of the Rio Guadiato depression (Sierra Morena, Spain). This depression is due to the tectonic structure of this part of the Sierra Morena, which recalls that of the Franco-Belgian coal basin.—A. **Carpentier**: Discovery of the genus Plinthiotheca in the Westphalian in the north of France.—J. **de Vilmorin**: The crossing of peas with coloured pods.—A. A. **Mendes-Corrêa**: Some sexual differences in the skeleton of the superior limbs. A discussion of the problem of determining the sex of a skeleton.—M. **Doyon**: The physiological properties of the nucleic acids of the lymphatic ganglia and of the thymus. The conditions for obtaining a thymo-nucleic acid very active on blood. The lymphatic ganglia of the ox and the thymus glands of the calf are specially recommended as sources of nucleic acids. Full details of the technique of extraction are given.—J. **Legendre** and A. **Oliveau**: The *rôle* of the domestic rabbit in the attraction and nutrition of *Anopheles maculipennis*. This Anopheles during its period of activity in the spring seeks the blood of mammals as food, with a marked preference for the blood of the domestic rabbit. In the presence of man, cattle, horses, pigs, fowls, and rabbits, the preference for the rabbit amounts to protection for man and other animals.

ROME.

Reale Accademia nazionale dei Lincei, January 2.—Prof. V. Volterra, vice-president, in the chair.—G. **Ciamician** and C. **Ravenna**: Influence of organic substances on plant development. The substances experimented on include pyrocatechin, guaiacol, morphine, codeine, theobromine, caffeine, atropine, and cocaine.—B. **Grassi**: Can Anopheles propagate malaria directly? At Fiumicino a baby a few months old caught malaria in a house visited eight days previously by an infected youth. In another case a woman recovering from the fever was visited by two friends, who stayed only a few hours in the house, but developed symptoms on returning to Rome. From examinations of the Anopheles in the district the author considers it doubtful whether infection could have taken place otherwise than by direct transmission, and hopes to test the matter by experiment with some individual who is willing to undergo the necessary tests.—F. **Bottazzi**: The posterior salivary gland of the Cephalopod, iv. Secretive activity of the gland under various experimental conditions.—O. **Lazzarino**: Equations of rotation about a fixed point of a solid with cavities filled with viscous liquids.—C. **Severini**: Integral equations.—L. **Tonelli**: Two propositions of Lindeberg and Levi in the calculus of variations, i.—V. **Sabatini**: Unity of the Vulsinio system. This system consists principally of two large craters, one of Latera and the other of Bolsena, the latter having no equally large counterpart in Europe. The probability of these having a common focus or communicating foci appears better justified than in the parallel case of the Cimini system.—G. **Cotronei**: Causal morphology of eye development in the toad.—E. **Remotti**: Variations in the specific weight of eggs of Teleosteans during development in shallow or deep water.—S. **Sergi**: Vertebro-medullary topography of chimpanzee, ii.—Prof. Castelnuovo was elected secretary of the Academy.

January 16.—Prof. F. D'Ovidio, president, in the chair.—G. **Pellizzari**: Synthesis of *o*-phenylenedicyanoguanidine from *o*-phenylenediamine.—A. **Comessatti**: Geometric theory of binary forms, iv. Typical representation of co-variants.—S. **Lefschetz**: "Sur le théorème d'existence des fonctions abéliennes."—G. **Castelnuovo**: Abelian functions, i. Intermediary functions.—E. **Bompiani**: Metric invariants and co-variants in deformations of surfaces, iv.—R. **Serini**: Dirichlet's symmetrical cylinder problem.—N. **Parravano** and C. **Mazzetti**: Transformation of light into heavy magnesia. It is found that the change takes place at comparatively low temperatures, but the rate of transformation increases continuously with increase of temperature.

February 6.—Prof. V. Volterra, vice-president, in the chair.—Original contributions by fellows:—C. **Segre**: Foci of second order of infinite systems of planes, and hyperspatial curves with a double infinity of plurisecant planes.—G. **Ciamician** and R. **Ciusa**: Constitution of benzol and heterocyclic nuclei.—G. **Bruni**: Solubility of crystalline substances in caoutchouc. Caoutchouc can be regarded as a thick liquid and its solvent power varies, being greatest for the aromatic series and least for minerals. Vulcanised rubber has the character of a saturated solution of sulphur in presence of free sulphur.—F. **Millosevich**: Minerals of Latian province. During excavations in the Peperino at Albano melilite was discovered in some blocks in crystals of somewhat exceptional purity.—Papers communicated by fellows:—Prof. A. **Lo Surdo**: Synthetic helium and neon.—Dr. M. **Ferrari**: Beryl from Piona (on the left bank of the Lake of Como near Colico).—C. **Jucci**: Uratic deposits in the fat of Termites.—The chairman, Prof. Volterra, announced the death of Prof. Giuseppe Colombo on January 16. The Academy has also lost the foreign fellows, Profs. Waldeyer and Federow. Prof. Mattirolo contributed a notice of the work of the late Prof. Pier Andrea Saccardo. For the Royal prize for astronomy four candidates submitted lists of papers. The chairman announced that a prize had been offered by the King in commemoration of the late Prof. Augusto Righi for the best work on experimental physics contributed by one of Prof. Righi's former pupils at Bologna.

Books Received.

Tidal Power. By A. M. A. Struben. (Pitman's Technical Series.) Pp. xii+115. (London: Sir I. Pitman and Sons, Ltd.) 2*s*. 6*d*. net.

Continuous Wave Wireless Telegraphy. By Prof. W. H. Eccles. Part i. Pp. vii+407. (London: Wireless Press, Ltd.) 25*s*. net.

Social Decay and Regeneration. By R. Austin Freeman. Pp. xx+345. (London: Constable and Co., Ltd.) 18*s*.

The Alpha, Beta, Gamma Navigation Tables. By H. B. Goodwin. Pp. iv+54. (London: J. D. Potter.) 8*s*.

Annuaire de l'Académie Royale des Sciences, 1921. Pp. 452. (Bruxelles: M. Lamertin.)

Diagnosis of Protozoa and Worms Parasitic in Man. By Prof. R. W. Hegner and Prof. W. W. Cort. Pp. 72. (Baltimore, Md.: Johns Hopkins University.)

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report: Zoology. Vol. iii., No. 7, Crustacea. Part v., Ostracoda. By R. W. Barney. Pp. 175–90. 4*s*. 6*d*. Vol. iii., No. 8, Crustacea. Part vi., Tanaidacea and Isopoda. By Dr. W. M. Tattersall. Pp. 191–258+xi plates. 21*s*. Vol. vi., No. 1, Protozoa. Part i., Parasitic Protozoa. By Dr. H. M. Woodcock and Olive Lodge. Pp. 24+3 plates. 9*s*. (London: British Museum (Natural History).)

Relativity, the Electron Theory, and Gravitation. By E. Cunningham. (Monographs on Physics.) Second edition. Pp. vii+148. (London: Longmans, Green and Co.) 10*s*. 6*d*. net.

A Text-book of Botany for Medical and Pharmaceutical Students. By Prof. J. Small. Pp. x+681. (London: J. and A. Churchill.) 25*s*. net.

Chromium Ore. By W. G. Rumbold. (Imperial Institute Monographs on Mineral Resources, with Special Reference to the British Empire.) Pp. ix+58. (London: J. Murray.) 3*s*. 6*d*. net.

Freshwater Fishes and How to Identify Them. By Dr. S. C. Johnson and W. B. Johnson. Pp. 64. (London: The Epworth Press.) 1*s*. 9*d*. net.

Ministry of Public Works, Egypt: Physical Department. Meteorological Report for the Year 1915. Pp. x+122. (Cairo: Government Press.) P.T.30.

Department of Agriculture and Technical Instruction for Ireland: Fisheries Branch. Scientific Investigations, 1920. No. 2, Sponges of the Coasts of Ireland. By Jane Stephens. II.: The Tetraxonida (concluded). Pp. 75+vi plates. (Dublin and London: H.M. Stationery Office.) 3*s*. net.

Studies in the History and Method of Science. Edited by Charles Singer. Vol. ii. Pp. xxii+559+lv plates. (Oxford: Clarendon Press.) 48*s*. net.

Parallaxes of 260 Stars derived from Photographs made at the Leander McCormick Observatory. By Prof. S. A. Mitchell and others. Pp. v+695. (New York: Columbia University Press.)

The British Freshwater Rhizopoda and Heliozoa. Vol. v., Heliozoa. By G. H. Wailes. Pp. xi+72+plates lxiv–lxxiv. (London: Ray Society.)

A Handbook on Cotton and Tobacco Cultivation in Nyasaland. A Guide to Prospective Settlers. By J. Stewart J. McCall. Pp. 85. (Zomba: Government Printer.)

British Museum (Natural History). No. 7, Report on Cetacea Stranded on the British Coasts during 1919 and 1920. By Sir S. F. Harmer. Pp. 18. (London: British Museum (Natural History).) 4*s*.

Primitive Society: The Beginnings of the Family and the Reckoning of Descent. By Dr. Edwin S. Hartland. Pp. v+180. (London: Methuen and Co., Ltd.) 6*s*. net.

Electrical Engineering. By Dr. T. F. Wall. Pp. xi+491. (London: Methuen and Co., Ltd.) 21*s*.

Vocational Chemistry for Students of Agriculture and Home Economics. By Prof. John J. Willaman. (Farm Life Text Series.) Pp. ix+294. (Philadelphia and London: J. B. Lippincott Co.) 8*s*. 6*d*. net.

Agricultural Economics. By Prof. James E. Boyle. (College Texts: Agriculture.) Pp. ix+448. (Philadelphia, Chicago, and London: J. B. Lippincott Co.) 12*s*. 6*d*. net.

Ministry of Munitions and Department of Scientific and Industrial Research. Technical Records of Explosives Supply, 1915–18, No. 1. Recovery of Sulphuric and Nitric Acids from Acids used in the Manufacture of Explosives: Denitration and Absorption. Pp. viii+56. (London: H.M. Stationery Office.) 12*s*. 6*d*. net.

The Dynamics of the Airplane. By Prof. Kenneth P. Williams. (Mathematical Monographs, No. 21.) Pp. viii+138. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 13*s*. 6*d*. net.

The Elements of Theoretical and Descriptive Astronomy. By Charles J. White. Eighth edition, revised by Paul P. Blackburn. Pp. xi+309+ix plates. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17*s*. 6*d*. net.

Handbuch der Pharmakognosie. By A. Tschirch. Band III., Lieferung i. Pp. 64+i plate. (Leipzig: C. H. Tauchnitz.) 10 marks.

The Story Book of the Fields. By J. H. Fabre. Pp. 271. (London: Hodder and Stoughton, Ltd.) 8*s*. 6*d*. net.

The Tin Resources of the British Empire. By N. M. Penzer. (The Raw Materials of Industry.) Pp. x+358. (London: W. Rider and Son, Ltd.) 15*s*. net.

An Introduction to the Psychological Problems of Industry. By Frank Watts. Pp. 240. (London: G. Allen and Unwin, Ltd.) 12*s*. 6*d*. net.

University of London: Galton Laboratory for National Eugenics. Eugenics Lecture Series, xiii.: Side Lights on the Evolution of Man. By Karl Pearson. Pp. 27+vii plates. (London: Cambridge University Press.) 3*s*. net.

Kritische Bemerkungen zu den Grundlagen der Relativitätstheorie. By Prof. H. Dingler. Pp. 29. (Leipzig: S. Hirzel.) 3 marks.

Diary of Societies.

THURSDAY, APRIL 21.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. H. S. Foxwell: Nationalisation and Bureaucracy.

ROYAL SOCIETY, at 4.30.—Prof. J. Joly: A Quantum Theory of Colour Vision.—Prof. A. V. Hill: The Energy involved in the Electric Change in Muscle and Nerve.—H. M. Kyle: The Asymmetry, Metamorphosis, and Origin of Flat Fishes.—T. L. Prankerd: Studies in the Cytology of the Statolith Apparatus in Plants, viewed in Relation to their Habit and Biological Requirements.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.

LINNEAN SOCIETY, at 5.—Prof. E. Newstead: Some Observations on the Natural History of the Upper Shiri River, Nyasaland.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—L. J. Mordell: Note on Papers by Mr. Darling and Prof. Rogers.—Pandit Oudh Upadhyaya: (1) Cyclotomic Quinquesection; (2) A Generalisation of a Theorem of Booth.—C. Krishnamachary and M. Bhimasena Rao: Properties of Eulerian and Prepared Bernoullian Numbers.

INSTITUTION OF MINING AND METALLURGY (Annual General Meeting) (at Geological Society), at 5.30.—F. W. Harbord: Presidential Address.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. J. E. Borland: The Musical Training of Children.

THE CHEMICAL SOCIETY, at 8.—F. Challenger and C. F. Allpress: Organo-derivatives of Bismuth. Part iv.: The Interaction of the Halogen Derivatives of Tertiary Aromatic Bismuthines with Organo-derivatives of Magnesium and Mercury.—J. A. N. Friend: A Colloid Theory of the Corrosion and Passivity of Iron and of the Oxidation of Ferrous Salts.—G. T. Morgan and J. D. Smith: Researches on Co-ordination and Residual Affinity. Part iv.: The Constitution of Simple and Complex Cobaltic Quinoneoxime Lakes.—G. T. Morgan and H. Burgess: Non-aromatic Diazonium Salts. Part vi.: 3:5-Dimethyl*iso*oxazole-4-diazonium Salts and their Azo-derivatives.—E. de B. Barnett and J. W. Cook: Studies in the Anthracene Series. Part i.—J. B. Firth: Some Factors governing the Sorptive Capacity of Charcoal. Sorption of Ammonia by Coconut Charcoal.—N. V. Sidgwick and E. K. Ewbank: The Influence of Position on the Solubilities of the Substituted Benzoic Acids.—N. V. Sidgwick and W. M. Aldous: Influence of Position on the Solubility and Volatility of the Mono- and Di-nitrophenols.—N. V. Sidgwick and H. E. Rubie: The Solubility and Volatility of the Chloro- and Nitro-anilines and their Acetyl Derivatives.—G. A. R. Kon: The Formation and Stability of *spiro*-Compounds. Part iv.: The Formation of Ketones derived from Open-chain and Cyclic Glutaric Acids by the Thermal Decomposition of their Calcium Salts.—W. J. Jenkins: Interaction of Acetylene and Mercuric Chloride.

Part ii.—J. Read and H. G. Smith: Researches on Piperitone. Part i.: The Occurrence, Isolation, and Characterisation of Piperitone.

INSTITUTE OF METALS (at Sir John Cass Technical Institute), at 8.—Dr. W. R. Ormandy: Refractories.

RÖNTGEN SOCIETY (in Physics Theatre, University College), at 8.15.—Prof. A. M. Tyndall and E. G. Hill: A New Form of Stereofluoroscope.—Descriptions and Demonstrations of New X-ray, Electrical, and Photographic Apparatus.—The British Thomson-Houston Co., Ltd.: A New Current Stabilising Device for Use with the Coolidge Tube: The Potter-Bucky Diaphragm.—H. B. Gough: Investigation in the Measurement of High Tension Currents.—Solus Electrical Co.: Rotating Deep Therapy Tube-holder; New Centrifugal Mercury Gas and Paraffin Interrupter; Pneumatic Cassette.—C. Andrews: X-rays and Propaganda.—R. S. Wright: The Episcope.—Dr. L. Levy: Further Points in the Manipulation of Impex Plates.—A. E. Dean: New Interrupter.

FRIDAY, APRIL 22.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science), at 2.30.—W. A. Millard: Green Plant Matter as a "Decoy" for Actinomycetes Scabies in the Soil.—E. H. Richards: The Action of Bacteria and Protozoa in Conserving the Nitrogen in Sewage.—G. P. Wiltshire: The Methods of Infection of the Apple Canker Fungus.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Lt.-Col. Sir Edward W. M. Grigg: The Common Service of the British and Indian Peoples to the World (Sir George Birdwood Memorial Lecture).

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section), at 5.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof A. Keith: Demonstration on the Contents of the Museum.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—W. N. Bond: The Effect of Viscosity on the Flow through an Orifice.—Dr. A. Griffiths and Constance H. Griffiths: The Viscosity of Water at Low Rates of Shear.—G. F. Partridge and B. S. Smith: A Method of Measuring Frequencies.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir Richard T. Glazebrook: Limit Gauging.

SOCIOLOGICAL SOCIETY, SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES, AND REGIONAL ASSOCIATION (Joint Meeting) (at Linnean Society), at 6.—G. Morris: The Saffron Walden Survey.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Section) (at Finsbury Technical College), at 6.30.—R. C. Hawkins: Searchlights as used for Coast Defence Work.

TECHNICAL INSPECTION ASSOCIATION (at Royal Society of Arts), at 7.30.—A. S. E. Ackermann: Physical Properties of Clay.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—H. P. H. Anderson: Construction and Working of Marine Water-tight Doors.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.30.—Dr. W. M. Willoughby: Collated Experiences of Plague on Ships.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir James Walker: Electro-synthesis in Organic Chemistry.

SATURDAY, APRIL 23.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Y. Oldham: The Great Epoch of Exploration; (1) Portugal.

MONDAY, APRIL 25.

ROYAL SOCIETY OF MEDICINE (Special General Meeting), at 5.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. S. G. Shattock: Demonstration on Pathological Specimens in the Museum.

INSTITUTE OF ACTUARIES, at 5.—C. W. Kenchington: Modern Developments in the Methods of Industrial Assurance Valuations.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) (at Chartered Institute of Patent Agents), at 7.—C. L. Lipman and Others: Engineering in Russia.

ROYAL SOCIETY OF ARTS, at 8.—Dr. S. J. Lewis: Recent Applications of the Spectroscope and the Spectrophotometer to Science and Industry.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—G. G. Campion and J. Millard: Some Notes on the Growth of the Face.

TUESDAY, APRIL 26.

ROYAL INSTITUTION, at 3.—Prof. A. Keith: Darwin's Theory of Man's Origin in the Light of Present-Day Evidence.

INSTITUTION OF CIVIL ENGINEERS.—Special General Meeting, at 5.15. Annual General Meeting, at 5.30.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Chapman Jones: Memorial Lecture on the Life and Work of the late Sir William de Wiveleslie Abney.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 8.—W. J. Jones: Ship-lighting in Relation to Comfort, Safety, and Efficiency.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—A. Grimble: From Birth to Death in the Gilbert Islands.

WEDNESDAY, APRIL 27.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. H. S. Foxwell: Nationalisation and Bureaucracy.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. T. O. Bosworth: The Oilfields of Northern Canada.

ROYAL SANITARY INSTITUTE, at 5.30.—Col. C. H. Melville: Some Lessons of the War.

INSTITUTE OF PHYSICS (at Institution of Civil Engineers) (Inaugural Meeting), at 6.—Sir J. J. Thomson and Others: Addresses.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Mechanical Engineers), at 7.—H. L. Heathcote: The Ball Bearing—in the Making, under Test, and on Service.

ROYAL SOCIETY OF ARTS, at 8.—Sir James P. Hinchliffe: Research in the Wool Industry.

EGYPT EXPLORATION SOCIETY (at Royal Society), at 8.30.—Prof. S. Langdon: Early Chronology of Sumer and Egypt and Similarities of their Culture.

THURSDAY, APRIL 28.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.

ROYAL SOCIETY, at 4.30.—*Probable Papers.*—Prof. H. Lamb and R. V. Southwell: The Vibrations of a Spinning Disc.—Dr. W. Rosenhain: The Hardness of Solid Solutions.—W. Hartree and Prof. A. V. Hill: A Method of Analysing Galvanometer Records.—F. H. Newman: A New Form of Wehnelt Interrupter.—T. L. Ibbs: Some Experiments on Thermal Diffusion.—B. N. Chakravarty: The Diffraction of Light Incident at Nearly the Critical Angle on the Boundary between Two Media.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Discussion on Tariffs.—J. R. Blaikie: Electricity Supply—Present Conditions and the Hopkinson Principles.—J. W. Beauchamp: Multi-Part Tariffs for Domestic Electricity Supply.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.

FRIDAY, APRIL 29.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Keith: Demonstration on the Contents of the Museum.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Section) (at City and Guilds (Engineering) College) (Annual General Meeting), at 6.30.—A. C. Warren: Radio-telegraphic Transmitting Apparatus.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Frank W. Dyson: Advances in Astronomy.

SATURDAY, APRIL 30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Y. Oldham: The Great Epoch of Exploration; (2) Spain.

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