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The Use of Oil Fuel.

THE prolonged coal stoppage has given an impetus to the use of oil fuel for industrial purposes. Conditions were favourable to such a development, and circumstances have helped to expedite it. One may reasonably assume that the coal industry will suffer some permanent loss as a consequence of this step, since fuel consumers, having gone to the expense of adapting their plants for oil burning, are not likely to revert wholly to coal again, especially as by doing so they would be surrendering the advantage of possessing an alternative which business counsels them to retain in view of the unhappy frequency of labour troubles in our coal-fields.

Another aspect of the matter which will influence commercial men is the economies which accrue from replacing coal with liquid fuel. In comparing the two, availability of supplies and prime cost are, obviously, the first factors to be taken into account. As market quotations now stand they do not tell against oil as they used to do. Fuel oil seems to be in good supply, and at the current price of about 6*l.* to 6*l.* 10*s.* per ton is practically as cheap as coal when everything is considered. As two tons of oil have approximately as high a calorific value as three tons of coal, the greater heating power of the former goes far towards equalising the difference in cost. Nor is this comparison in heating properties merely an estimated figure; it has been established by actual test. Oil fuel is, likewise, much cleaner to handle than coal, and the labour costs of operating it are far lower—roughly, about five times less. With it steam can be raised more quickly, and the temperature of furnaces regulated with greater ease. By simply turning the tap of the atomising spray one man controls the fire in an oil-burning furnace, whereas the coal-fed furnace keeps several men employed in shovelling in fuel, levelling fires, and breaking up clinker. Oil does not require any ash-ejecting equipment, which means a saving in plant, nor is the inside of the furnace damaged by "slicers" and "prickers"—and that also effects a saving in working costs.

Oil had been growing in favour before the existing industrial crisis came along to give impetus to its adoption. The British Admiralty was amongst the earliest to investigate its possibilities and to employ it on a large scale. After a lengthy period of experimenting, a flotilla of oil-fired destroyers was added to our Navy in 1909. Since that date oil has been steadily replacing coal as the staple fuel of H.M. ships, until at the present time all our effective warships are oil burners. Most of those retained on the active list also use oil for such auxiliary purposes as cooking the food of the crew.

Prior to the introduction of liquid fuel into the service the Navy was an exceedingly good customer to South Wales. But it now makes only a negligible demand upon the product of the pits there, as will be seen from the fact that during the current financial year the Navy is spending about three times as much upon oil fuel as it is upon coal. For the Navy an oil-fuel flash-point of 175° F. has been adopted. In the mercantile marine the flash-point is 150° F.; and in the latter service there has been a considerable "turn over" from coal to oil fuel during the past couple of years. How serious a matter this may prove for the coal producer is shown by the fact that whereas a ship like the *Aquitania* used to take in 660 ten-ton truck-loads of coal each time she crossed the Atlantic, she now has accommodation for 7000 tons of oil instead. Upon the salt-water highways the future lies largely with the motor ship, which is making its appearance there in ever-growing numbers. Being Diesel-engined, craft of this type have no direct use for coal as a fuel, and every such vessel put into service means a lessening of the demand for the output of the collieries. Looking at the subject comprehensively, one can only arrive at the conclusion that the extending use of oil for fuel purposes constitutes an economic factor that is bound to have a considerable effect upon our coal-mining industry in the future.

The great problem in connection with oil fuel is that of supply. It has been estimated that the world has coal enough to last it for another five hundred years. Nobody can estimate how much oil we possess, for no one knows. So far as Great Britain is concerned, we now have to import most of our stocks of this fuel, and for the time being the supplies are equal to the demand. The shale oils obtained in various parts of the United Kingdom are nearly all suitable for fuel, but the yield is very limited. Hopes are entertained that the new field opened in the Fen district will eventually give large supplies, and it is reported that oil can be obtained there at a cost of 2*d*. per gallon, as compared with the 10*d*. per gallon for Scotch shale. Whether this hope will be fulfilled or not we must "wait and see." However, judging by prices quoted and reports from oil-producing centres abroad, supplies available appear to be sufficient for present requirements. How far they would be equal to meeting a greatly extended demand is quite another matter.

Education as a Science.

Education and World Citizenship: An Essay towards a Science of Education. By James Clerk Maxwell Garnett. Pp. x+515. (Cambridge: At the University Press, 1921.) 36*s*. net.

READERS of Mr. Garnett's papers in the *British Journal of Psychology* and elsewhere will open this stately volume expecting to find substantial fare, nor will they be disappointed. The book is full of vigorous reasoning and independent thought. It is written from a definite point of view, with a definite purpose, which is systematically followed, and it leads to clear-cut conclusions. Its aim is given in its title. It is an attempt to outline a provisional science of education. Mr. Garnett is impressed by the need for an accepted body of scientific principles which will make our educational thought and practice more coherent and efficient. He has therefore made an effort to supply the want, in the modest hope that his attempt may stimulate others to more successful endeavours. The result is one of the few recent discussions of educational theory which deserve to be taken seriously.

Unlike too many writers, Mr. Garnett knows what he means by a science of education. Science, he tells us, is "an organised body of connected facts graded according to their relative importance" (p. 196). Such a body of facts when complete constitutes the "endarchy of science," which is the world of experience scientifically interpreted —"the neat, trim, tidy, exact world which is the goal of scientific thought." This ideal shapes his conception of the science of education, which is a portion of the complete endarchy of science. It also determines the lines upon which he considers education should be organised in practice. The facts upon which a science of education must be based he borrows from psychology, for psychology enables us to formulate "the laws of thought" from which scientific methods of education can be logically deduced. But the aim of education which must synthesise its methods is not given us by psychology. It depends upon the aim of human life. Unfortunately, the latter aim is still uncertain. We may, however, provisionally define it in the light of such agreement as exists, and thus develop a tentative science of education which will be a first approximation to the truth, and may serve as a provisional guide in practice.

Mr. Garnett's pages are so full of matter that points in his argument may easily be overlooked; but, unless we are mistaken, we have in his conception of educational science one of the sources of the dualism which is the great weakness of his book. Speaking roughly, we may say that education as a normative science must interpret facts in the light of values; but Mr. Garnett gets his facts and his values from different quarters, and as a result they will not mix. His facts remain facts and nothing more, and his values either belong to a world apart from facts, or are merely facts of a certain kind. Thus a man's will is the most valuable thing about him (p. 138); but will is unforeseeable, and possesses no quality that characterises its owner except its strength (p. 291). On the other hand, a fact gains value simply by the frequency of its recurrence (p. 217). This dualism is apparent throughout Mr. Garnett's argument. His endarchy of science is essentially a world of facts as such, and preferably of physical facts. Thus it is only unwillingly that he speaks of the mind and its processes. He prefers to speak of the "comparatively simple material aspects of the brain" (p. 8). His first "law of thought," for example, states that, apart from the intervention of the will, our thought activity at any moment is determined "by the neurones that are excited by the degree of their excitement" (p. 66), which is a rather bold statement. The elements of our mental life are "neurograms"—that is, "low resistance paths among the neurones of the brain or among those of other portions of the nervous system" (p. 42). Our purposes, which recent experiment has shown to play so important a part in our thinking, become

parts of our "neurography," compounded of the neurograms of, say, ourselves, some action, and some future time (p. 144 *et seq.*). This failure to do justice to the significance of purpose is evident in the elaborate discussion of the organisation of thought (chap. xi.).

The same tendency to explain values in terms of facts is seen in Mr. Garnett's use of the phrase "æsthetic satisfaction" to "denote the pleasant feeling that results when the instinct of curiosity achieves its end" (p. 253), and in his description of religious faith as "action on an hypothesis with a view to its verification" (p. 307). More important is the effect of his preoccupation with the tidy, exact world of scientific facts upon his conception of the aim of education. "Every citizen ought to develop a tidy and perfectly integrated mind—a single endarchy of neurograms—which should correspond, so far as the time and effort available for his education and his own 'educability' permit, to the endarchy of science" (p. 313). These individual endarchies will vary according to the citizen's special activities in the life of the community; but in all cases they should centre in a single wide interest system. Education must, therefore, aim at the development of an appropriate single wide interest in the mind of each boy and girl. Schools should be so organised as to offer unified courses of training for different classes of individuals, distinguished mainly by the types of callings for which they are prepared.

Mr. Garnett, however, has too keen an interest in ethics and religion to remain entirely content with the endarchy of science. Hence on ethical grounds he holds that human souls are really free, and can influence neural activity by the exercise of will (p. 97). What exactly is meant by the will and how it is related to the soul and to the body does not seem very clear. But it is the principal factor in developing a single wide interest (p. 268). Such interests, indeed, centre in conscious purposes, and we even find the alarming statement that "the possessor of a single wide interest will tend always to be conscious of his supreme and dominant purpose" (p. 244). In an important chapter (chap. vii.) it is argued that strength of will is measured by *g*, the index of general ability, and that *g* can be increased by training. Indeed, the cultivation of strong wills by the formal training of attention is one of the chief ends of education (p. 332 *et seq.*). Again, the world of science is brought into relation with religion, and more particularly with Christianity. "The Christian account of the universe . . . completes the discovered part of the endarchy of science with an hypothesis concerning the hitherto undiscovered central essences, it does so . . . in a manner that enables the corresponding neurography to fulfil the conditions that have to be satisfied by the neurography of the typical citizen of a maximally efficient and progressive community" (p. 355).

This conception of the function of religion is suggestive in many ways, but it is another example of the loss which the deeper things of life must suffer in order to be fitted into the Procrustes bed of the neat and tidy endarchy of science; and, speaking generally, Mr. Garnett's effort to make room in his world of scientific facts for freedom and religion can scarcely be regarded as successful. His system of education is too cut-and-dried, too externally determined and bureaucratic to meet the deepest demands of human nature. It might give us industrious citizens, good officials, and scientific experts, but scarcely prophets, artists, and men of genius. For while a tidy and integrated mind is greatly to be desired, it is not, perhaps, the highest type of mind we know. As Dr. Rivers has recently reminded us, some degree of mental instability is probably a condition of great achievement in art and science, and gives strength to man's deep craving for religion.

It has been impossible in this review even to touch upon many of the important topics which Mr. Garnett discusses with marked ability and wide knowledge. We may mention, for example, his discussion of general ability, cleverness, and purposefulness. It is from no lack of admiration for his achievement that we have dwelt upon an apparent weakness in his argument. That weakness will, we fear, militate against the general acceptance of his special point of view. But he has done us no small service in giving us a book which treats the theory and practice of education in a thoroughly scientific spirit. It is this spirit which matters most, and the book will stimulate and encourage all who hold loose thinking and vague metaphor to be as pernicious in education as they are in any other field of thought.

Advances in the Study of the Yeasts.

The Yeasts. By Prof. A. Guilliermond. Translated and thoroughly revised in collaboration with the original author by Dr. F. W. Tanner. Pp. xix+424. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1920.) 33*s.* net.

OUR knowledge of the yeasts has made great strides within the past twenty years, and for this we have mainly to thank the classical

researches of Emil Chr. Hansen. It is now realised not only that many industrial concerns depend for their success on a maintenance of conditions favourable to the multiplication of the yeast plant, but also that new fields of interest are unfolded to biologists and students of medical research. A book such as this is a timely addition to our literature, for hitherto we have had to be content with books on the subject of yeasts which had a purely industrial bias. In Prof. Guilliermond's book the whole subject is treated in a comprehensive fashion, and the reader will be able to follow the advances in the subject from different points of view.

Prof. Guilliermond's "Les Levures" appeared in 1912, but the present book is not a mere translation of the French edition; it is rather a collaboration of Dr. Tanner with the author to produce an English work in which it would be possible to incorporate the new material which has appeared since 1912. The idea is a happy one, but it has its disadvantages from the point of view of the reader. Thus, in the first chapter, in which the morphology and development of yeasts are discussed, Prof. Guilliermond is referred to in the third person, with the result that he becomes both counsel and judge in the estimation of the value of his own researches. There is little doubt as to the value of his contributions, but some of the points that have been raised are of a controversial nature, and not such that all biologists can accept without supporting evidence from independent investigators. Such, for example, are the heterogamic copulation of yeasts, and the attitude adopted in regard to the nuclear structures of these bodies. Many statements are of an *ex parte* nature, and raise doubts in the reader's mind as to whether he has heard both sides of the question. Incidentally, Mr. Wager is referred to by the name of "Wagner" throughout this section of the subject.

There is a very useful chapter on the nutrition and physiology of yeasts, which concludes with an unexpectedly scanty account of the theories which have been advanced to account for the alcoholic fermentation they induce. This is disappointing, for, after all, alcohol is responsible for having brought yeasts to the forefront, and the subject is honeycombed with tunnels of investigation.

On the question of phylogeny it is not possible to share the writer's optimism that matters are now "more settled." It is well established that particular growths of micro-organisms may be side-tracked into exceedingly minute structures which can in such a condition multiply indefinitely, and apparently never emerge into any other forms. It is a common phenomenon in bacterial cultures, and the present reviewer can vouch for the appearance of the phenomenon among some of the higher bacteria. The probability that yeasts are side-tracked offshoots of modern fungi may not be great, but there is sufficient evidence to make this theory not untenable even if some recent work in this direction must be set aside on account of cultural impurities. The chapters on the practical methods that are adopted for the studying of yeasts are somewhat perfunctory. Undoubtedly the most valuable portion of the book is the short description which is given of all the yeasts known to science. The authors have done for yeasts what Migula in his "System der Bakterien" accomplished for bacteria. We are grateful to them for having accomplished this arduous work. Greater knowledge has resulted in slight changes in the classification, but in essentials no striking changes have been effected.

As a book of reference this publication will remain a standard for some time to come. A warning must, however, be given, due to our imperfect knowledge of the activities of micro-organisms. It must not be taken for granted that the discovery of a yeast in a particular medium *necessarily* credits or discredits it for changes that occur in that medium; nor does it follow that if a name is given to a supposedly new species that species has not been named before. We know that several species of bacteria have received each several names, and it is probable that we are suffering from the same malady in the investigation of the yeasts. This, however, is an irregularity which a general text-book cannot be expected to rectify. We can say in conclusion that this book ought to be in the hands of all those who are interested in yeasts either from the purely scientific or from the industrial point of view.

DAVID ELLIS.

Introduction to the Theory of Curves.

Plane Algebraic Curves. By Prof. Harold Hilton. Pp. xvi+388. (Oxford: At the Clarendon Press, 1920.) 28*s.* net.

DURING the present century there has been a very considerable increase in the number of students of the calculus, and this increase has been accompanied by a change in the character and content of the text-books. In the latter half of last century a considerable section of works on the calculus dealt with the theory of higher plane curves, and students with a liking for geometry were often led on to a fuller study of that theory, as expounded, for example, in Salmon's well-

known treatise. The tendency in more recent times, however, has been so strong in the direction of physics that less and less space is given in text-books of the calculus to the theory of curves, and the number of students of the theory has probably decreased. But investigation and research have, nevertheless, been continuous, and, now that Salmon's treatise is not readily accessible, even if it were abreast of modern developments, the need for a good introduction in English to the theory of curves has become clamant; such an introduction is to be found in Prof. Hilton's book.

A reader of the book is supposed to possess a knowledge of the more elementary portions of the calculus and of pure and analytical geometry, including the theory of cross-ratio, involution, projection, reciprocation, and inversion. Without a good knowledge of the subjects named the student's progress will not be rapid, and occasionally, as, for example, in the study of superlinear branches, some familiarity with the theory of the expansion of algebraic functions is almost a necessity. But any student who is in earnest will find in Prof. Hilton's exposition an excellent guide to the subject of which he treats. The first eight chapters discuss what may be roughly described as the leading principles—singular points, foci, determination of the branches at singular points, and Plücker's numbers. At an early stage a careful treatment of curve-tracing is given, fully illustrated by well-selected equations, while numerous examples, with hints for the more difficult cases, are provided for practice in this very necessary part of the student's training.

A compact but careful discussion of the quadratic transformation is given in chap. ix.; to a student new to the subject this discussion should be very illuminating. A good chapter on curves given by a parametric representation is followed by an interesting chapter on "Derived Curves," among which are included evolutes, inverse curves, pedal curves, orthoptic and isoptic loci, cissoids, conchoids, and parallel curves. This chapter is of special interest, as the geometry of the curves considered figures more prominently than in the chapters which discuss the algebraic developments that are necessarily associated with the subject. Later chapters treat chiefly of cubics and quartics, and probably it would be hard to find anywhere a better discussion; the chapters do not always make easy reading, but they are well worth the most careful study. Two excellent chapters on circuits and corresponding ranges and pencils bring the work to a close.

A valuable feature of the book is the very large number of examples provided for practice; there can be no better training for the student than the careful study of these examples. Hints for their solution are given in many cases, but the chief advantage is that a student is really introduced to the methods of research, and put in a position from which he can undertake independent investigation.

The book is provided with a good index, but it might be considered, in view of a later edition, whether a special list might not be made of the more important curves, and a connected summary given of their leading geometrical properties. Such summaries as are to be found in the recent work of Brocard and Lemoyne on "Courbes Géométriques Remarquables" are very instructive.

Aeronautical Treatises.

(1) *Aeronautics in Theory and Experiment.* By W. L. Cowley and Dr. H. Levy. Second edition. Pp. xii + 331 + plates. (London: Edward Arnold, 1920.) 25*s.* net.

(2) *A Treatise on Airscrews.* By W. E. Park. (The Directly-Useful Technical Series.) Pp. xii + 308. (London: Chapman and Hall, Ltd., 1920.) 21*s.* net.

(1) THE second edition of Mr. Cowley and Dr. Levy's book is now issued, and the authors have seized the opportunity to modify some of the material. This has become possible by the release of official reports for publication. The new items are of an advanced nature, and the book now contains two sections, "Mathematical Theory of Fluid Motion" and "Critical Behaviour of Structures," which are unique in the literature of aeronautics. Both sections are written by the authors as pioneers, for Dr. Levy has a first-hand knowledge of the mathematics of fluid motion and is an original worker in the subject, whilst the "Critical Behaviour of Structures" is the result of joint study by the authors of the complex problems of structural theory.

Throughout the book there is much more theory than experiment, and for the latter the data are, as usual, taken mainly from the reports of the Advisory Committee for Aeronautics. The selection of items in reference to points under consideration is good, and the book can be recommended as sound. It is distinctly a student's book, and is not modelled on the needs of the designer like the great bulk of publications on the subject. In range it covers, sometimes in quite an elementary manner, both the aerodynamic and structural problems connected with the aero-

plane, and should make a good preliminary text-book for a degree in aeronautics.

(2) In his preface Mr. Park says that his aim has been to consider problems of airscrew design and construction from the point of view of the designer. In so doing he explains methods developed for the Lang Propeller Co., Ltd. A very considerable degree of success has been attained, and the book is not difficult to follow. The items of calculation are given in great detail, but are connected with the main outlines of airscrew theory so closely that the book may be used by later workers even when they are more up-to-date in their theories.

It is very noticeable that the two latest books dealing with the subject of airscrew design adopt the attitude that the oldest theory agrees better with practice than a new and presumably sounder one. Empiricism has to this extent rather retarded the development of the subject. The theory adopted in the early days of aeronautics ignored the influence of previous passages of the airscrew blade and its companions, and the effect was found in a disagreement between prediction and observation. An examination of the theory by Lanchester, De Bothezat, and others indicated a loss of efficiency and of torque which was great for the stationary airscrew or helicopter, and of less importance at the highest speeds of flight of an aeroplane. The most difficult part of design being the production of an airscrew which allows the engine to develop full power at a given speed, it was found that the introduction of an inflow factor indicated by a modified theory was advantageous. In the later periods of development the magnitude of the inflow factor required has been found to decrease to the point at which it may be ignored. It is highly probable that this is an incorrect view of the phenomena, and that it would be much more sound to attribute the change to an opposing change due to the compressibility of the air. The importance of this latter factor depends on the tip speed of the airscrew, a quantity which has been steadily increasing. No one has yet propounded a working theory which is based on the best established theoretical data.

The greater part of the treatise by Mr. Park is independent of the refinements mentioned above, and gives a good analysis of the possibilities of airscrew design. In commending the book to readers, one may suggest that it will cover the immediate needs both of a designer and of a scientific student of sufficient ability. A thesis of considerable value might be produced as a result of the data of the book and the critical faculties of the student.

Our Bookshelf.

Practical Biological Chemistry. By Prof. G. Bertrand and P. Thomas. Translated from the third edition by Hector A. Colwell. Pp. xxxii+348. (London: G. Bell and Sons, Ltd., 1920.) 10*s.* 6*d.* net.

THIS work will be found of great value by students and, perhaps more particularly, by teachers of biochemistry. The object of the authors has evidently been to provide a series of laboratory exercises illustrating the properties of the chief substances of biochemical interest, and at the same time affording examples of the methods used in the various branches of biochemical investigation. A large number of tests, interesting preparations and estimations are described in the first part (Statics), whilst in the second part (Dynamics) the subjects of enzymes, micro-biology, and fermentations are treated experimentally.

Although the whole range of biochemistry is dealt with, and the exercises are chosen quite impartially from the chemistry of animal and vegetable life, the treatment is nevertheless very unequal as regards both the selection of methods and the degree of detail given. For example, as all readers would desire, a very full account of the admirable Bertrand method for the estimation of sugars is given, and, similarly, Duclaux's ingenious distillation method for the estimation of volatile acids is fully described. On the other hand, although several pages are devoted to the amino-acids, and Sörensen's formaldehyde titration method is described, there is no mention of van Slyke's method for the estimation of amino-nitrogen, and, indeed, the name of van Slyke does not occur in the index. Again, the conception of hydrogen-ion concentration is mentioned, but no practical use of it is made in the book. It is on account of this arbitrary element in the treatment that we consider the book as likely to be of greater value for teachers than for students; but whoever uses it will find in it many interesting and unusual experiments, described in a clear and suggestive manner, without too great a load of detail. The translator has done his work well, and has added a few notes, including a detailed description of the use of the Maquenne block for the determination of melting points.

A. HARDEN.

Wireless Telegraphy: With Special Reference to the Quenched-Spark System. By B. Leggett. (The Directly-Useful Technical Series.) Pp. xv+485. (London: Chapman and Hall, Ltd., 1921.) 30*s.* net.

WE welcome this volume, which gives full practical details of the "Telefunken" or quenched-spark system of radiotelegraphy. (We use this word, for we think it will shortly receive international sanction.) Practically all the treatises on this subject published in English concern themselves mainly with the Marconi system, and dis-

cuss very briefly, if at all, the quenched-spark system. In 1906 Max Wien showed that it was possible to quench the oscillations in the primary circuit of the sending station after a few oscillations, leaving the bulk of the electromagnetic energy to be expended in, and radiated from, the antenna circuit alone. Hence the efficiency and the amount of energy radiated are practically doubled. The system is the standard one in Germany, and the author thinks that possibly national prejudice has prevented us from judging its merits fairly.

It is far too early yet to standardise in radiotelegraphy. The Marconi Co. has entered into an agreement with the Telefunken Co., and this will probably eliminate much healthy competition. The United States has adopted the Telefunken system for both land and ship stations, and Messrs. Siemens, of Woolwich, have fitted many stations of this type on both British merchant- and war-ships. We agree with the author in thinking that for marine work radiotelephony will be of limited use except in the unlikely event of all maritime nations agreeing to the simultaneous adoption of some form of Esperanto.

An interesting description is given of the station at Nauen, about 25 miles from Berlin, which is the most powerful radio station in the world. Its normal range is 9000 kilometres, and the messages are regularly received in Australia.

The Coco-nut. By Prof. E. B. Copeland. Second edition, revised. Pp. xvi+225. (London: Macmillan and Co., Ltd., 1921.) 20*s.* net.

THE first edition of this excellent handbook was reviewed in NATURE for February 25, 1915 (p. 695). In the new edition the subject-matter remains substantially the same, and the revision consists chiefly in recording the results of certain scientific work relating to the coco-nut industry carried out in the Philippines during the last six years. Reference is made to the investigations on copra and coco-nut oil by Messrs. Brill, Parker, and Yates in 1917, which dealt mainly with the conditions governing the production of a fine-quality copra of high oil-content. On the cultural side an account is given of the discovery, by Reinking in 1918, that the primary causative organism of bud-rot of the coco-nut palm in the Philippines is *Phytophthora Faberi,* Maub. It would have been useful to mention that a serious bud-rot of coco-nut palms in southern India (Malabar) was described by Shaw and Sundararaman in 1914 as due to *Pythium palmivorum,* Butl. References are also made to interesting work on the growth and behaviour of young and ripening coco-nuts, and to the use of the nuts of young trees as seed. In the foreword the author refers to the impetus given during the war to the export of coco-nut oil from coco-nut-growing countries in place of copra. In his opinion the remarkable advance in this direction made in the Philippines during recent years would have been impossible but for the scientific and educational work on coco-nut cultivation organised by the Philippine Government.

The Early History of Surgery in Great Britain. By Dr. G. Parker. (Medical History Manuals.) Pp. ix+204. (London: A. and C. Black, Ltd., 1920.) 7*s.* 6*d.* net.

DR. PARKER has written a very delightful account of the rise and development of surgery in our country. He is fortunate in his judgment, his sense of proportion, and his style; he is neither dry nor gossipy. The great figures stand out; nothing could be better than his lightly touched portraits of John of Arderne, William Clowes, Richard Wiseman—all strong-willed, practical, shrewd, kindly, observant men. They were hindered at every turn by their lack of more science; but they were splendid craftsmen and good artists of the living fabric of the body. The stories of their deeds and their adventures, their sympathy, their insight, are fresh and vivid, especially in military surgery. Here and there a note of prophecy is in their work; thus we find Henri de Mondeville (1260–1320) making statements which were fulfilled in Lister's work.

Three great periods come into the book: (1) The twelfth century: the rise of universities and of hospitals; (2) the Renaissance; (3) the eighteenth century: the development of hospital schools and of clinical teaching. The book goes no further; we must read elsewhere of the new learning which came with Pasteur and Lister. It came when surgery was in a bad way. The development of surgery is not constant, and the first half of the nineteenth century was a period of arrest, relapse, almost of degeneracy. Happily, this fine art made a complete recovery. Let us hope that the other fine arts, which now are in an equally bad condition, will follow its example.

Fornander Collection of Hawaiian Antiquities and Folk-lore. By A. Fornander. With translations. Edited and illustrated with notes by T. G. Thrum. Third series. Part iii. (Memoirs of the Bernice Pauahi Bishop Museum. Vol. vi., No. 3.) Pp. iii+359–546. (Honolulu, H.I., 1920.)

THE publication of the present instalment of the great collection of materials made by Mr. Abraham Fornander, the author of "An Account of the Polynesian Race," will be of great interest to antiquaries and students of folk-lore. Many of the chants now edited in the original dialect, with an English translation and elaborate explanatory notes, the latter mainly based on the notes by Judge L. Andrews, are comparatively modern. Thus the great Wakea Creation chant is the work of the priest-diviner, Kaleikuahulu, who was born in 1725; but doubtless it is based upon ancient tradition. The notes throughout supply complete comments upon the philology, history, and folk-lore which the volume contains. Merely as a collection of materials for linguistic study, the volume, published in admirable style, must be of great value to the philologist.

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 Aurora of May 13–15.

IN pursuance of the programme outlined in my letter to NATURE of March 31, p. 137, I have been photographing the spectrum of the night sky every night. On the night of May 13–14, and also of May 14–15, a strong auroral spectrum was obtained, showing the aurora line $\lambda 5578$, and also the negative bands of nitrogen, which were much stronger than the aurora line. Ten heads of these bands were shown on the photograph of May 14–15, though only six appear within the same spectral range in Vegard's investigation made on a special expedition to the Arctic.

That these nitrogen bands should be actually stronger than the aurora line is very remarkable. On ordinary nights it is generally possible to photograph the aurora line, while the nitrogen bands have never been photographed in the course of about 100 nights except on these two consecutive occasions.

It is of interest to note that the aurora apparently ceased before the magnetic storm was over, according to the data given by Dr. Chree in NATURE of May 19, p. 359. On the night of May 15–16 the aurora line was barely, if at all, visible on the plate, and below its average intensity on ordinary nights. Nothing could be seen of the nitrogen bands.

RAYLEIGH.

The Gravitational Field of an Electron.

IN the Proceedings of the Royal Society for February last (vol. xcix., A, p. 123) is an interesting paper by Dr. G. B. Jeffery, in which he applies an extension of Einstein's theory to ascertain something about the state of the æther close to an electron—though perhaps he might not express it in that way. He obtains independently, and then discusses, a result recently published by Nordström, namely, an extension of the now well-known γ of Schwarzschild's equation,

$$ds^2=\gamma^{-1}dr^2+\text{etc.}-\gamma c^2dt^2,$$

by adding to it a mixed gravitational and electrical term, so that it becomes

$$\gamma=1-\frac{2Gm}{rc^2}+\frac{Ge^2}{Kr^2c^4};$$

wherein, while the old second term involves the gravitational potential, the new third term involves the square of the electrostatic potential.

I have introduced the dielectric constant of the æther into the denominator so as to keep dimensions right, and if we now choose to make use of the familiar "J. J. T." (1881) expression for the inertia of an electric charge, $m=2\mu e^2/3a$—which is reasonable, inasmuch as the gravitation constant is dominant over both the second and third terms—we may write the above value of γ thus:

$$\gamma=1-\frac{2Gm}{rc^2}\left(1-\frac{3}{4}\frac{a}{r}\right).$$

This expression attains a minimum value when $r=\frac{3}{2}a$; and it is unity both at infinity and at $r=\frac{3}{4}a$. This last probably means that the electric and mass terms just balance at the surface of an electron (for we may probably ignore the $\frac{3}{4}$ factor as unlikely to be accurate so close to a charge), or else it means that the gravitational effect at an electron-boundary is reduced to one-quarter of its normal value. The formula does not apply in the interior of an electron, if an electron has any interior; though if it is a geometrical point, as Dr. Jeffery evidently thinks possible, then γ may rise to a very high value within what is commonly thought of as the boundary.

It is not to be thought that the new term is merely the natural consequence of electromagnetic mass, for it is opposed in sign; the electrical and the mass effects tend to neutralise each other; but nowhere do they succeed except at or near the boundary of an electron. For all distances large compared with the size of an electron γ has its customary Einstein value, so the third term has no astronomical significance whatever.

But a study of what happens to radiation when it impinges on, or penetrates between, the ultimate elements of matter—in fact, a study of the whole behaviour of a stream of radiation at its two ends, the source and the sink—is obviously of great importance. An immense amount of work has been done on the emission end of radiation, but less on the absorption end. By the two together we may ultimately hope to get some information as to the structure of an electron. It may be pardonable to mention some small papers of my own in this connection, in the *Philosophical Magazine* for April and probably for June and July this year, though the full working out is not attempted.

It must be emphasised that the e^2, above, means the square of the unbalanced charge only—it is $(\Sigma e)^2$ not $\Sigma(e^2)$—and that all neutralised charges are provided for by the second term. The conclusion that unbalanced electric potential and neutralised or mass potential oppose each other in their warping effect on the æther appears rather suggestive. I confess I should have expected a third term which did not involve the gravitation constant; and perhaps there may be a reconsideration on this point, for the present manner of obtaining the expression is far from easy—in fact, is abstruse.

OLIVER LODGE.

The Magnetic Storm of May 13–17.

THE magnetic storm which began soon after 1 p.m. on May 13 presented several unusual features beyond that of almost unprecedented magnitude. As recorded on the Eskdalemuir magnetographs, it showed a "sudden commencement" at 13h. 1½m. G.M.T. on May 13. The phenomenon known by this name usually takes the form of a sharp change in value of the horizontal components of terrestrial force, frequently including as its first part a temporary drop in value lasting for about a minute, but always exhibiting a rise in value immediately thereafter. In the vertical component the change, when appreciable, is very much slower and is in the direction of the zenith. In the case of the storm now described the change in the north component was too quick for the photographic paper to receive a visible impression of the light spot. On the west component a drop in value is shown at first, amounting to 29γ (0·00029 C.G.S.) and extending over two minutes. There then followed a rise of 94γ, occupying 2½ minutes. On the vertical component the "sudden commencement" assumed an unusual form. There is quite clear evidence of a preliminary increase in value of the vertically downward directed force amounting to 8γ, followed immediately by a reverse change of 31γ, the latter being much more rapid than is generally the case. These preliminary phases having passed, the main features of the disturbance were quickly developed. This is quite in accord with the results of

previous experience, which shows that, as a rule, when a "sudden commencement" occurs not far from noon of local time the principal maxima and minima of the storm occur within the next twelve or fifteen hours, but that if the "sudden commencement" occurs late in the day the full development of the disturbance is postponed until the *post-meridiem* hours of the following day.

The changes in the horizontal components of force throughout the disturbance were on a very large scale, and took place with a rapidity so great that the photographic traces are in some parts too faint to read. But the most unusual feature of the storm was the remarkable series of changes in the value of the vertical component of force. In most magnetic storms the general course of events comprises (1) a gradual increase in V to a maximum (in some cases two successive maxima) reached about 18h. local time, (2) a gradual fall until midnight, (3) a rapid fall to a minimum which is reached about 1h., (4) a gradual recovery to nearly the undisturbed value, which recovery is completed by about 8h., and is sometimes accompanied by (5) a series of short-period pulsations. The whole sequence is frequently repeated on a modified scale later on in the second day. In the storms now described this course of events was followed so far as the first twenty-four hours are concerned. The first maximum on May 13 was reached at 20h. 37m., and was 152γ above the undisturbed value at the time of the "sudden commencement." One or two falls in value succeeded until 21h. 24m., when a rapid fall of more than 350γ in six minutes carried the light spot off the paper. The principal minimum which then occurred took place at an unusually early hour (see "British Meteorological and Magnetic Yearbook," 1915, part iv., p. 89, and plate vi.). According to the theory which would account for magnetic storm phenomena by assigning them to the earth's rotation in a beam of particles emanating from the sun, this sudden drop in the value of V might be supposed to take place at or soon after midnight of local time, but not so early as 9 p.m. The rate of change in V during the descent to the minimum referred to was large, but by no means the largest recorded at Eskdalemuir. For example, the storm of March 23, 1920, showed a case of V changing at the rate of 160γ per minute. The gradual recovery which followed the minimum was accompanied, particularly between 6h. and 8h., by pulsations of about four minutes' period and of amplitude averaging about 4γ. It is, perhaps, unsafe to generalise, but there is some evidence to show that such pulsations in vertical force do not occur in a magnetic storm unless the total range of disturbance in V exceeds a certain amount.

The second twenty-four hours of the storm showed even more remarkable developments than the first. After several maxima and minima had been passed the value of V began to fall about 23h. on May 14, and the light spot went off the paper at midnight. Between 1h. and 6h. on May 15 at least a dozen extensive and rapid changes in V took place, swinging the light spot alternately beyond the upper and below the lower edge of the paper. The most clearly marked of these occurred between 2h. 40m. and 2h. 44m. on May 15, and involved a change during that interval at the rate of 138γ per minute. Repeated oscillations of this character and magnitude have not hitherto been recorded at Eskdalemuir. The course of the disturbance during May 16 was remarkable in that the fall in the value of V during the early hours of the morning continued until nearly 7h.

The storm had practically died down by noon on May 17, but soon after 23h. on that day another "sudden commencement" was recorded, and the sheet which will be taken off the recording drums to-morrow morning will probably show a recurrence of disturbance.

A. CRICHTON MITCHELL.

Eskdalemuir Observatory, May 18.

Ocean Tides.

THE article in NATURE of March 10, p. 33, on oceanographic problems by "J. J." prompts one interested in tides to direct attention to the services which a new *Challenger* expedition might render to the general theory of ocean tides at relatively little cost either in time or in money.

There are numerous localities for which tidal information is either inadequate or wholly lacking. Sir George Darwin directed attention to some of these places by publishing in the *Geographical Journal* of November, 1909, a memorandum prepared by the late Dr. R. A. Harris, of the U.S. Coast and Geodetic Survey. The "dozen or so landing parties placed here and there over the world" suggested by "J. J." could undoubtedly use to advantage as their bases of operations some of these places for which tidal observations are needed. These suggested landing parties could therefore, in connection with their other observations, secure tidal data of great value.

It may not, perhaps, be amiss here to point out that such tidal observations would serve two important purposes. In the first place, they would increase our geographical knowledge of the regional distribution and local characteristics of the tides; and in the second, they would furnish further data of an accurate character to test the merits of the various tidal theories that attempt to interpret mathematically the terrestrial phenomena of the tides. Thus some of the places for which tidal information is desired are of critical importance to the so-called "stationary wave" theory of tides, which appears steadily to be gaining in favour.

The use of automatic or self-recording tide gauges would, of course, be most desirable. In this connection it is to be noted that such tide gauges may now be had in small and inexpensive types that require no elaborate installation and may be expeditiously set up. It cannot, however, be too strongly emphasised that valuable additions to our knowledge of the tides at out-of-the-way or infrequently visited places may be secured by recording hourly the height of the tide as registered on a naked tide-staff graduated to feet and tenths. The longer the series of observations, the better; but even a day or two will furnish considerable information.

The value of the tidal observations would be greatly enhanced if bench-marks of a permanent character were established and the relation of the zero of the tide-staff to these bench-marks determined. This would make possible correlation with any future tidal observations at the same places, and might even permit a quantitative determination of the local rate of elevation or subsidence of the land relative to the sea.

A fertile and almost virgin field is offered to the investigators of a new *Challenger* expedition in the study of the tides of the open sea, the importance of which is obvious. Several forms of automatic tide gauges adapted for offshore tidal observations appear to have given satisfactory service. Recently an offshore hydrographic party secured an excellent series of tidal observations by means of an improvised tide gauge consisting of a graduated tide-staff secured to a float and confined in a float-tube made up of sections of 2-in. pipe, the lowest section of which was cast into a block of cement. It also appears that satis-

factory results may be obtained by means of a sounding wire attached to a heavy block of concrete or box of stones (see *Science*, vol. xlii., 1904, p. 704).

Those members of the new *Challenger* expedition whom fortune may choose to be responsible for the tidal observations have it in their hands to make all tidal workers using their data everlastingly grateful. This gratitude they may secure by insisting that the tidal observations should be made in Greenwich mean civil time, reckoning the hours from 0 to 23. Apart from the many advantages for purposes of computation resulting from such procedure and the ease with which time comparisons of the tide at different places may be made, there is one outstanding advantage—it will remove all uncertainty as to the kind of time used. Many otherwise excellent tidal observations are of little use because there is no certainty as to the kind of time employed, whether mean local civil, mean local astronomical, local apparent or standard time for some unknown meridian. The use of Greenwich mean civil time should prove further desirable in view of the change to this kind of time soon to be made in the Nautical Almanac published by the British Admiralty.

H. A. MARMER.

U.S. Coast and Geodetic Survey, Washington, D.C., April 15.

The Physical Status of "Space."

To answer all Mr. Bonacina's points (NATURE, May 5, p. 300) is not possible in a single letter. I agree with him that no rigid boundary can be drawn between the provinces of the older physics and metaphysics. Concepts are freely introduced into both which are not known to experience, and are never used either in describing past experience or in inferring future experience. Some hypotheses are necessary in any science, but hypotheses that are never used are neither necessary nor useful. The elastic solid æther forms an excellent example of these. It is assumed that electric and magnetic forces satisfy certain differential equations, and this is the only assumption required for the theory of the propagation of electromagnetic waves. The æther theory, however, introduces the additional hypothesis that one of these forces is a displacement in an elastic solid the properties of which differ from those of any ordinary solid. This assumption is never used, has no basis in experience, and cannot be tested experimentally. Accordingly I say it should not be made, for the introduction of additional hypotheses decreases the probability of the theory. The other assumption, which is valuable and leads to much new knowledge, makes no mention of an æther. It appears to be the case that all so-called explanations of physical laws by means of the æther are really based on some mathematical assumption that makes no reference to an æther at all.

I cannot see Mr. Bonacina's difficulty about "empty space." I have advanced no theory involving any such entity, and think that space is as useless a concept in physics as æther. To construct a space with suitable properties may be an aim of physics, but it is certainly not the starting point. The existence of entities incapable of being objects of experience is a thorny problem even to metaphysicians, and I think that physicists would do well to postpone its consideration so far as possible until they have some idea of the basis in their knowledge of the propositions to which they attach high probabilities.

Dr. Campbell's point (May 5, p. 301) is dealt with in the article (NATURE, February 17) of which I was part author. Geometry is *not* the measurement of the earth, and never was; it was pointed out in the article that that excellent idea in nomenclature was never carried out. Euclid's geometry was, from the nature of its constructions and postulates, quite inapplicable to earth measurement. If anyone doubts this, let him consider the definitions and axioms as they stand and see how many of them are verifiable in even a few cases on a scale such as occurs in surveying. Further, Euclid's treatment assumes that the postulates are true in all cases. To suggest that this can be known by experiment is ridiculous. It is at best an inference to which a high probability can be attached. I know of nobody but Einstein and his followers who has used the word "geometry" in any other than the mathematical sense. The measurement of the earth is always known as "geodesy," and has been for more than a century; and measurement in general is "mensuration," the most important and least discussed of all sciences. Constancy in terminology requires that these meanings should be retained. Dr. Campbell would scarcely claim that measurement in general should be called "geometry" in *his* sense.

HAROLD JEFFREYS.

The Reparation Act and Scientific Research.

PROF. GARDINER (NATURE, May 19, p. 359) is one of many British men of science who are helping to pay the German war indemnity. One does not obtain goods from Germany unless one is compelled; it is difficult to see how standard German books and new publications can be procured from home industries, and they are necessary to research. In other cases the goods might be expected to be made by British firms. For many months I have been trying to obtain Wollaston wire of a certain diameter from a well-known British firm. At first I was informed that it could not possibly be made. I had bought it before in Germany, so they tried to make it. Several samples were unsatisfactory, and finally I was told that the British firm did not wish to make any further attempts. I then ordered some of the German wire, which I was required to pay for in advance, for the reason stated by Prof. Gardiner. This was reasonable, as the price charged by the German firm, *plus* indemnity which I pay, is less than I have been paying for unsatisfactory wire in England. The wire was on the way for several weeks. Meanwhile work was delayed. The Customs officials know nothing of the reduction of the tax from 100 per cent. to 26 per cent., announced by Mr. Chamberlain. Another order for new books, given in February, was dispatched from Bonn on March 4, and arrived in London on April 12 and April 16. Notice from the Customs was received a month later. After two days spent at the Customs filling up forms, and five letters requesting delivery, I still await the latter.

The condition of the British man of science who elects to do research will soon become impossible. Perhaps that is really the idea behind all this. The extension of the "key industry" idea will finish us altogether.

J. R. PARTINGTON.

East London College, University of London, May 20.

The Resonance Theory of Hearing.

I SHOULD like, in the first place, to take this opportunity of thanking Dr. Perrett for his reply in NATURE of May 5 (p. 301), but I feel difficulty in accepting the explanation he there advances on the displacement hypothesis, because it does not seem to me to fit in

with the following observations. When a short interruption is made in a musical note it is not a beat (*i.e.* a short silence) that is heard, but, on the contrary, a short noise which appears to add itself to the uninterrupted note. The way this short interruption is produced and an explanation of the noise that results according to the resonance theory of hearing will be found in the *British Journal of Psychology* (vol. xi., 1921, p. 277).

If, then, in order to change the phase of a note by π, the usual interval between successive impulses is altered from τ to $\tau \times \frac{3}{2}$, the beat (*i.e.* the silent interval) which the observer hears cannot be due to the mere interruption in the sequence of the waves, because experiment shows that such an interruption would be heard as a short noise. But, further, even if Dr. Perrett's explanation could be accepted for the case where the interval is increased from τ to $\tau \times \frac{3}{2}$, it clearly could not, I think, apply to the case where, in order to introduce a change of phase of π, τ is reduced to $\tau/2$; for on Dr. Perrett's reasoning no beat should be evident in this case, whereas experiment shows it to be present. H. HARTRIDGE.

King's College, Cambridge.

Hæmoglobin in Mollusca.

SIR RAY LANKESTER will find some interesting experiments on the usefulness of hæmoglobin to Planorbis and Chironomus larvæ in a paper by Leitch in the *Journal of Physiology* (vol. l., 1916, p. 370), in which the author indicates that its respiratory value comes into play only when the oxygen pressure is quite low. This does not, of course, solve the problem as to why there should be various closely allied mollusca (Limnæa) living side by side with Planorbis, and with apparently equal success, which have no hæmoglobin beyond a trace in the muscles of their lingual apparatus. The possession of a considerable quantity of hæmoglobin seems to be a generic character, since it is present in all the species of Planorbis, which differ a good deal among themselves in their habits and in their capacity to live in clean and dirty water, and absent in all sorts of Limnæa. Sir Ray Lankester seems to have forgotten what he taught me in his elementary class twenty-six years ago: that hæmoglobin has come to have secondary (decorative) uses in man; but he will perhaps be as loath to admit an æsthetic sense in snails and their companions as he has been to accept the selective intelligence of Earland's foraminifera in building their tests. But the albino form of *Planorbis corneus* found by Mr. W. T. Webster near Barnet, in which the colour of the hæmoglobin is not obscured by black pigment, is certainly a gorgeous spectacle. A. E. BOYCOTT.

17 Loom Lane, Radlett, May 14.

Physiological Reactions in the Protozoa.

IT would be deplorable if the letter by Mr. Ludford, and with the address of a zoological laboratory (NATURE, May 12, p. 332), should be thought by anyone to represent the attitude of zoologists in general or of protozoologists in particular towards physiological problems. It would be hard to find a more individualistic reaction than the "grouping" of Protozoa in direct response to a particular chemical or physical stimulus. Typical experiments are described in every physiological or protozoological text-book, and it requires some imagination to see in such behaviour "the dawn of a gregarious instinct."

It is difficult to understand how any student of zoology or biology could have written the sentence beginning "On the part of Protozca, protection against toxins in the water is a necessary *precaution that has to be taken* to safeguard the individual" (italics mine). Do the Protozoa really practise sanitary science, and are they no longer subject to natural selection? J. S. DUNKERLY.

Zoology Department, The University, Glasgow.

Picture-hanging Wire.

IN reference to Mr. Marston's letter upon the above subject (NATURE, May 19, p. 362), I have for many years past used and advocated the use of plain copper wire in preference to any other means of suspension. The only matter that calls for careful attention is avoidance of "kinks." With heavy pictures my practice is to have two entirely independent suspensions —screw-eyes, wire, and wall nail or hook—the duplicate being entirely screened by the picture, and either actually or so nearly sharing the weight that should the other suspension fail it could take the whole load at once without jar.

If I use a (nailed-on) wall-hook I put a stout nail immediately beneath to provide against failure of the brass hook, and I have found it a good plan when using a brass-headed nail to drive in a wire nail at a steep angle beneath it so that the head of the wire nail lodges beneath the brass head. The wire nail acts excellently as a strut. A. J. STUBBS.

Anode Rays of Beryllium.

THE method of anode-ray analysis which was used to determine the isotopes of lithium (NATURE, February 24, p. 827) has recently been applied to the case of beryllium. A well-marked parabola was found corresponding to a single charge and an atomic weight $9{\cdot}0 \pm 0{\cdot}1$ (Na=23). No second line was observed which could with certainty be attributed to beryllium, but the parabola at 9·0 was not so strong as that at 7·0 for lithium, and it is doubtful if one of a tenth the intensity could be observed. On one plate a scarcely perceptible indication of a line was found in the neighbourhood of 10, but as more recent photographs, in which the line at 9 was stronger, did not show it, it seems likely that it was not due to beryllium. No indication was found which would suggest that the atom of beryllium can lose two electrons under the conditions of these experiments.

G. P. THOMSON.

Cavendish Laboratory, Cambridge, May 23.

The Colours of Primroses.

MAY not Dr. Heslop Harrison's experiences of primulas (NATURE, May 19, p. 359) be due to the influence of cold and somewhat resemble what is seen in our so-called copper-beech in the spring and early summer? Few seem to be aware that during the summer its characteristic colour entirely disappears and it then has the ordinary green foliage. Other plants, too, *e.g.* some varieties of roses, show the same sensitiveness. G. ABBOTT.

May 24.

The Japanese Artificially Induced Pearl.

By DR. H. LYSTER JAMESON.

ON May 4 a London evening paper announced that quantities of artificially produced Japanese pearls, of perfectly spherical shape, but containing in their centres beads of mother-of-pearl, had found their way into the London market and had deceived experienced pearl merchants in Hatton Garden, who had bought and resold them as naturally produced gems. Since that date many inaccurate, misleading, and contradictory announcements have appeared in the daily papers, leaving the public, both lay and scientific, in some confusion. The following statement of the position, so far as it can be judged from the scientific point of view, may therefore be useful.

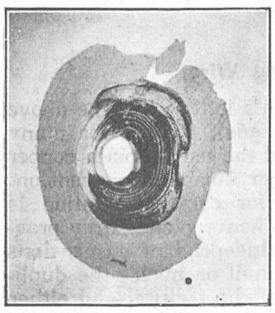

FIG. 1.—Section through the centre of a natural pearl, × 6½. (Ordinary light.) Preparation and photo by Mr. A. Brammall.

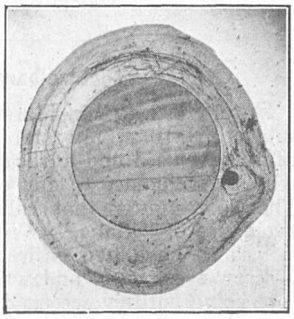

FIG. 2.—Section through the centre of a Mikimoto pearl, × 6½. (Ordinary light.) Mr. A. Brammall.

For some years Mr. K. Mikimoto, the pioneer in the application of scientific knowledge to the pearl oyster on a commercial scale, has been producing in Japan, and selling under the name of "Mikimoto pearls," pearls of this description. There was no secret about this. Mr. Mikimoto not only sold them as artificially produced pearls, but also published in one of his catalogues (No. 33) a short description and diagram explaining his process.

Ever since 1898 Mr. Mikimoto (who began his work in collaboration with the late Prof. K. Mitsukuri in 1890) has been marketing half-pearls or "blisters," pearly excrescences formed by inserting a mother-of-pearl bead between the body of the oyster and the shell, and allowing the oyster to coat it over with nacre. This was, of course, merely a development of the very old operation by which the Chinese produce, in fresh-water mussels, the well-known mother-of-pearl images of Buddha, and of Linnæus's classical experiments in the eighteenth century. These products were known as "culture pearls," and have long been familiar in this country, set in brooches, tie-pins, rings, etc. Their value, compared with real pearls of corresponding sizes, was, of course, quite small.

For many years Mr. Mikimoto experimented with a view to the production of a complete pearl, not attached to the shell, by a modification of this process, and obtained his first successful results about 1912, as announced by me at the Dundee meeting of the British Association in that year. From information supplied to me by Mr. K. Ikeda, one of Mr. Mikimoto's staff, in a letter from Tokyo dated May 30, 1914, it appears that the first considerable crop of these "round cultivated pearls" was harvested in the autumn of 1913. Their production is now an important part of the original Japanese industry.

Apart from the purely financial question as to the degree to which the advent of artificially induced pearls is likely to affect the price of natural pearls, two questions seem to have been agitating the public: Are these products "pearls"? and Can a test be devised by which, without destroying them, they can be distinguished from pearls of natural origin?

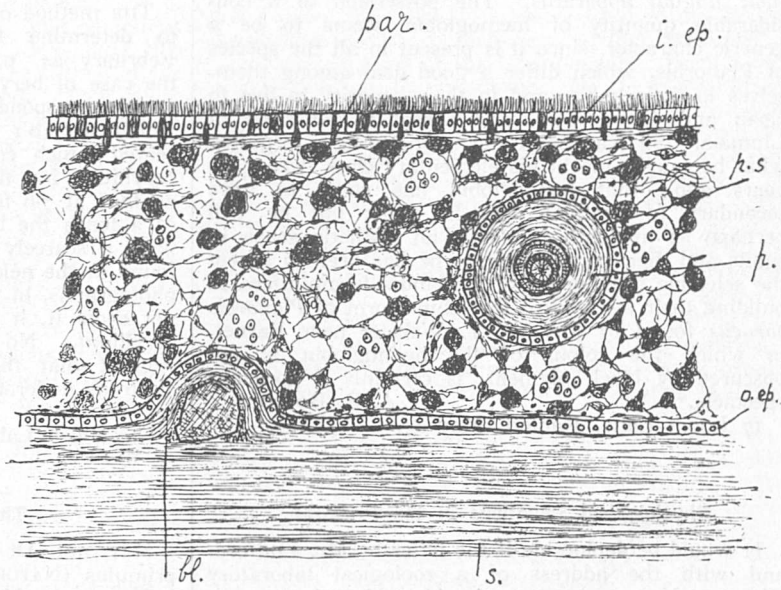

FIG. 3.—Diagram illustrating the difference between a pearl (*p.*) and a blister (*bl.*). *s.*, substance of shell; *o.ep.*, outer shell-secreting epidermis; *p.s.* pearl-sac, formed of shell-secreting epidermis; *i.ep.*, inner ciliated epidermis of mantle cavity; *par.*, parenchymatous connective tissue of mantle.

Of course, when a slice is cut across a natural pearl and a Mikimoto pearl the distinction is obvious. A natural pearl, except in those (in my experience exceptional) cases where a nucleus of foreign origin and of sufficient size to be identified

(such as a grain of sand) is present, consists throughout of concentrically deposited layers, which differ in degree of transparency or opacity in different specimens (Fig. 1). The Mikimoto pearl, in its outer layers, has the same structure as the natural pearl, but has an artificially manufactured bead of mother-of-pearl, composed of flat parallel laminæ of nacre, in its centre (Fig. 2). (These preparations and photos were made under the supervision of Mr. Brammall, to whose investigations reference is made below.)

The method by which Mr. Mikimoto produces these pearls has been patented by him in Japan and other countries, and an application for a British patent has already been filed, and is open for inspection at the Patent Office. The information here given was obtained from this specification, from a short description and figure published in one of Mr. Mikimoto's catalogues, and from facts supplied by Mr. Toranosuke Kato, his London representative. The process involves the most delicate and skilful manipulation, and it could be carried out, presumably, only by carefully selected and trained workers. The shell is removed from one pearl oyster, and a bead of nacre or other suitable nucleus is laid on the outer shell-secreting epidermis of the mantle. This epidermis, which is composed of a single layer of cells of microscopic size, is then dissected off the oyster, and made to envelop the nucleus as a sac, the neck of which is ligatured. This sac is then transplanted into a second oyster and embedded in its sub-epidermal tissues, the ligature is removed, certain astringents or other reagents are applied to the wound, and the second oyster, with its grafted pearl sac containing the mother-of pearl bead, is returned to the sea, where it has to remain for several years before a coating of pearl of sufficient thickness is secreted around the introduced bead. (In his letter of May 30, 1914, Mr. Ikeda stated that it took seven years.)

Now Mr. Mikimoto's success is based on the fact, which follows from my work in 1902,[1] and was further demonstrated by Alverdes's remarkable experiments ten years later,[2] that *it is not the presence of an irritating intrusive body that determines the formation of a pearl, but the presence in the sub-epidermal tissues of the oyster of a closed sac of the shell-secreting epidermis,* the secreting surface of which is not continuous with the secreting surface of the epidermis which lays down the shell; and that unless this epidermal sac is introduced by transplantation (as in Alverdes's and Mikimoto's methods), or is induced by the specific stimulation of a particular kind of parasite (as in the pearls in Mytilus caused by the trematode Gymnophallus), or arises by some still unknown cause or causes (as in the Ceylon pearl oyster), no irritating body introduced into the shell or tissues can be expected to become the nucleus of a pearl. In my 1912 paper[3] I showed that the vast majority of pearls from the true pearl and mother-of-pearl oysters have no recognisable nuclei of foreign origin, the bodies so often taken for such, like the dark portion of the pearl shown in Fig. 1, and the centre of the pearl diagrammatically shown in Fig. 3, being composed of a kind of shell substance of pathological origin, identical with that with which the oyster repairs an injury to its shell.[4] On the other hand, some of the natural pearls I have examined contained foreign bodies which (apart from the special case of the trematode which causes pearl sacs to form in Mytilus) ranged from diatoms and fragments of radiolarian shells and sponge spicules to quartz grains measuring, in one case, as much as 0·8 mm. in diameter. I propose to outline a theory attempting to account for the presence of these bodies in a later paper.

From the biological aspect there are two classes of pearly bodies. For the first of these, to distinguish them from true pearls, I adopted the name "blisters," familiar to pearl fishers, in 1902. Blisters (Fig. 3, *bl.*) are excrescences on the interior of the shell formed to close holes made by shell-boring animals, or to coat over intrusive objects such as grains of sand, small crabs, Fierasfer, etc., and, in the case of the Buddha "pearls," Linnæus's "pearls," and the "half pearls" originally produced by Mr. Mikimoto, metal images or beads. Over such a blister the epidermis forms a little pocket, directly continuous with the shell-secreting epithelium. A pearl, on the other hand (Fig. 3, *p.*), is formed in a closed sac of shell-secreting epidermis, which is embedded in the tissues of the oyster, and the nacre-secreting surface of which is not continuous with that of the epidermis that lays down the shell itself. A blister is a more or less hemispherical body passing over on all sides into the shell substance; a pearl is a concentrically deposited body, the substance of which is nowhere continuous with that of the shell. A pearl may, in the course of time, be ejected into the space between mantle and shell, and become more or less buried in the shell, forming the core of a blister; but in that case it can be dissected out from the shell layers deposited over it.

The trade distinguishes different kinds of pearls according to shape and size (fine pearls, baroque pearls, seed pearls, etc.), just as biologists distinguish certain classes according to where they arise (parenchyma or mantle pearls, muscle pearls), or to the kind of shell material of

[1] Jameson, Proceedings of the Zoological Society, 1902, vol. i., pp. 140–66, and NATURE, January 22, 1903, p. 280.

[2] F. Alverdes, "Versüche über die künstiche Erzeugung von Mantelperlen ber Susswassermuscheln," *Zool. Anzeiger*, vol. xlii., No. 10, 1913, pp. 441–58.

[3] Jameson, Proceedings of the Zoological Society, 1912, pp. 260–358.

[4] It is astonishing how the "foreign nucleus" theory of pearl formation sticks, as witness the utterances of scientific men of standing which have been called forth by the recent announcement.

which they are composed (nacreous pearls, columnar pearls, hypostracum pearls, periostracum pearls, hinge pearls). All these classes, some valuable, some worthless, are, from the biological point of view, *pearls*. Biologically speaking, the Mikimoto pearl satisfies all the conditions which go to make up a pearl as defined above. It differs from a natural pearl only in that it contains a foreign nucleus larger than any foreign nucleus which I have so far encountered in a natural pearl, and in that this nucleus is a bead of mother-of-pearl such as does not occur in Nature. Both these points could easily be remedied. A smaller nucleus could be introduced; or the nucleus might be removed after grafting the sac in the oyster; or a small natural pearl of inferior quality, or a concentrically crystallised bead of carbonate of lime, could be used as a nucleus. A trade in the worthless pearls of Mytilus might even be revived for this purpose; according to Garner they were once exported from this country to China for the manufacture of "medicine." The somewhat greater transparency, on the average, of Mikimoto pearls, when compared with natural pearls, could be remedied by either of these processes.

With regard to the question of distinguishing the Mikimoto pearl without cutting it, much vague talk as to scientific investigations has appeared in the daily Press. Some of these investigations remind me of the little boy who, having learned that trains were propelled by steam, lighted a fire in his go-cart, put a kettle on it, and expected it to run by itself. Undoubtedly experienced pearl merchants, and, indeed, any zoologist who is familiar with the shells of the different species and geographical races of pearl and mother-of-pearl oysters, can usually distinguish pearls from the Japanese pearl oyster (*Margaritifera Martensii*) from the pearls of other species, just as they can distinguish Ceylon, Australian, Central American, etc., pearls from each other by slight differences in colour and lustre; but this test only reveals that the pearls come from the Japanese pearl oyster, and cannot be used to distinguish naturally and artificially produced Japanese pearls from each other; and it would be useless for distinguishing pearls produced by the Japanese process in other species of pearl oysters from pearls naturally produced by the same species.

This natural difference is greatly intensified when the pearls are examined in ultra-violet light, for which purpose an apparatus has been designed and is already on the market. I hope shortly to be able to examine some naturally produced Japanese pearls with this apparatus. I anticipate that they will agree with the artificially produced Japanese pearls, and not with natural pearls from other localities, as this test, like the rule-of-thumb test based on the general colour and lustre, appears to depend on the minute differences in the structure of the nacre in different species and races of pearl oysters.

Immediately on the first announcement of the presence of these pearls in the market being made, I suggested to a Press representative who called upon me that polarised light was the most hopeful line along which to seek a test that would reveal the presence of the artificial nucleus, and this suggestion was published in one of the daily papers on May 5. Immediately afterwards I got into communication with Mr. A. Brammall, of the Imperial College of Science and Technology, South Kensington, who has since been engaged upon experiments which aim at determining whether polarised light can be applied to whole pearls in such a way as to furnish a test.

The behaviour of polarised light when passed through *sections* of the natural and the Mikimoto pearl respectively was a foregone conclusion from our knowledge of the structure of their centres. When examined with polarised light between crossed Nicols, the section of a natural pearl, of course, shows throughout the cross of extinction characteristic of concentrically crystallised bodies (except in those parts which are too opaque to transmit light). A section of a Mikimoto pearl, on the other hand, shows the four arms of the cross in the outer part, which is concentrically laid down; but the mother-of-pearl bead appears alternately dark and light as the slide is rotated, according as the part of the exterior to which its laminæ are parallel is in a dark or a light sector. Mr. Brammall is not yet in a position to make a definite statement as to the practicability or otherwise of applying some modification of this process to the whole pearl. He will, of course, publish his results as soon as they are completed.

However, whether or not the pearls, produced by the Mikimoto process, which are now on the market, can be distinguished from naturally produced pearls, without destroying them, by virtue of their containing a large bead of mother-of-pearl, which behaves differently towards polarised light or towards some other variety of light, Mr. Mikimoto can easily remedy this in future by a modification of his process, such, for example, as one of those suggested above. That being so, and having in view the fact that, in the appropriate localities, "Oriental," Australian, Central American, and other varieties of pearls could be produced by the same process, it is probable that, as time goes on, more and more of the pearls coming into the market will have been produced, not by the old-fashioned methods of fishing for the "wild" pearl oyster, some of which methods have existed almost unchanged from time immemorial, but by such applications of scientific knowledge to cultivated pearl oysters as that in which Japan has given so conspicuous a lead.

The Recent Magnetic and Electrical Disturbances.

By DR. C. CHREE, F.R.S.

THE recent magnetic and electrical disturbances have been remarkable for both their intensity and their persistence. Magnetic disturbance went on without any considerable interlude from shortly after 13h. (G.M.T.) on May 13 to 4h. or 5h. of May 17. This was followed by notable disturbances on May 19 and following days. There was, however, a distinctly quieter interval between May 17 and 19. Thus the storm was really less persistent than one presenting very similar features which began late on November 11, 1882, and continued practically without a break for nine or ten days.

As regards aurora, much depends on the season of the year, the age of the moon, and the amount of cloud. In the North of Scotland, the principal auroral region of the United Kingdom, twilight lasts so long in May that the chance of aurora being visible is but small. During the recent magnetic storm, aurora, if not generally brilliant, has been seen in a number of places. At Cambridge, aurora was seen to rise as high as the zenith on the night of May 13, and in the early morning of May 15 aurora was observed with a bright red colour. Aurora was also reported from London and other stations in southern England, where it is a rare event even at the equinoxes. Large earth-currents have been observed in the Post Office telegraph system at stations in England, Scotland, and Ireland.

The magnetic disturbances recorded at all the magnetic observatories have been of a quite exceptional nature. They reached a climax on the night of May 14–15. Almost all large magnetic storms show shorter-period oscillations superposed on changes having a more or less persistent direction for a considerable time. But the extent to which short-period oscillations prevail varies much in different storms. Also in many cases, while the disturbance of the horizontal components is considerable, the vertical force (V) shows little disturbance, and rapid oscillations of any size in that element are very rare. During the recent disturbances the persistence and size of the short-period oscillations were remarkable, and during the night of May 14–15 this characteristic was shared by V to a quite exceptional extent. The magnetic storm of November, 1882, already referred to, also showed this phenomenon, so that, though rare, it is not absolutely unique. The year 1882, it may be noted, like 1921, was not characterised as a whole by abnormal sun-spot development.

The storm has received unusual attention in the newspapers. The writer of a leading article on the subject in the *Times* of May 19 has referred to the difficulty of providing the large store of energy required, seeing no alternative to the acceptance of the estimate made many years ago by Lord Kelvin other than the giving up of the principle of the conservation of energy. As the storm considered by Lord Kelvin was very trifling compared with the recent one, the conservation of energy may appear in a hopeless case. It may thus comfort the general reader to know that a recent estimate by Prof. S. Chapman gives a result which is nearly one million-million-million times less than Lord Kelvin's. When Lord Kelvin made his estimate his position resembled that of an eighteenth-century engineer consulted as to the possibility of warming London by burning coal in the Midlands. The better the engineer of that epoch, the deeper the pessimism to be expected. But the modern engineer, familiar with high-tension electrical transmission, whatever he might think of the scheme as a financial proposition, would not consider its realisation fatal to the conservation of energy.

If, as some modern theorists have suggested, atmospheric electric potential at the earth's surface should show some response to magnetic disturbance, the morning of May 15 was the time when the phenomenon should have declared itself. Unfortunately, some rain fell that morning in London, and a decisive answer to the question must be sought elsewhere.

The Recent Large Sun-spot Group.

By H. W. NEWTON, The Royal Observatory, Greenwich.

THE large sun-spot which appeared on May 8 is remarkable in several respects. The sun-spot cycle reached its maximum in 1917, and the occurrence of a large group some four years later, though by no means unique, is a matter of interest apart from its association with an intense magnetic storm. The spot group has been photographed daily at Greenwich, and reproductions of some of the photographs are given. Fig. 1 shows the disc of the sun on May 13, on which day the magnetic storm commenced. Fig. 2 illustrates the group in detail and the considerable changes taking place in a few days. The most interesting features of the group are (*a*) its position exactly on the sun's equator; (*b*) its abnormal development; (*c*) its position at the time of the magnetic storm.

(*a*) It is a well-established fact that the change in latitude of the sun-spots is cyclical in the same eleven-year period as their frequency. Soon after the commencement of a new cycle, spots appear mainly about latitude 25° north and south of

the sun's equator. As the cycle progresses they become most numerous in successively lower latitudes, while at the present phase of the cycle they are found most frequently in latitude 10°. Very large groups on the equator are rare, however, and the present one is the largest which has appeared in this position during the last half-century. Looking at Fig. 1, it is necessary to bear in mind that at the middle of May the north end of the sun's axis of rotation is about 21° west of the north point, and that the sun's equator passes $2\frac{1}{2}$° north of the centre of the disc. Spots are carried by the sun's rotation from the east to the west limb in about thirteen days. The centre of this group of spots was nearest the centre of the disc on May 14d. 16h., when it was within 3°. It was then most nearly in line with the earth, but the magnetic storm commenced twenty-seven hours earlier. The spot group was visible to the naked eye for eight out of the thirteen days it could have been seen with the telescope. Its area averaged 1/1500th part of the sun's surface, or about eight times the area of the earth, but it was only half as large as the group of spots of March, 1920.

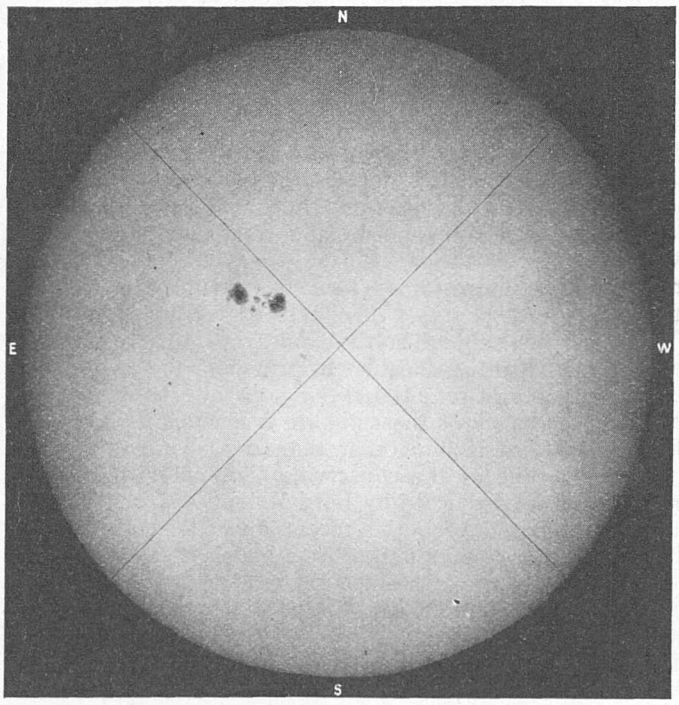

FIG. 1.—Photograph of the sun's disc on May 13d. 9h. G.M.T. Original scale $7\frac{1}{2}$ in. to sun's diameter. By kind permission of the Astronomer Royal.

(*b*) Sun-spots are nearly always to be found in continual change, especially for a few days following their formation, and it is evident from earlier photographs that this group developed after April 25, and was, therefore, of recent origin. It was first seen at the east limb of the sun on May 8 as a long, irregular spot, nearly 80,000 miles in length, with two principal nuclei; by May 13 these had become the centres of two spots 7° apart in longitude, while the mid-portion of the original spot had changed into a cluster of small ones. It is unusual for a large spot to split up in this manner. Pairs of spots often appear, but they have generally been evolved from two small nuclei. On the photograph of May 9 it will be noticed that the spot is surrounded by bright faculæ. The amount is unusually small for so large a spot, but by the time the group had reached the west limb of the sun the area of faculæ had extended considerably.

(*c*) The magnetic storm commenced suddenly at 13h. 10m. on May 13. At this time the leading spot was $11\frac{1}{2}$° east of the sun's central meridian and the following spot 19°. The greatest intensity of the disturbance was about 5h. on May 15, at which time the following spot was 3° past the central meridian, while a

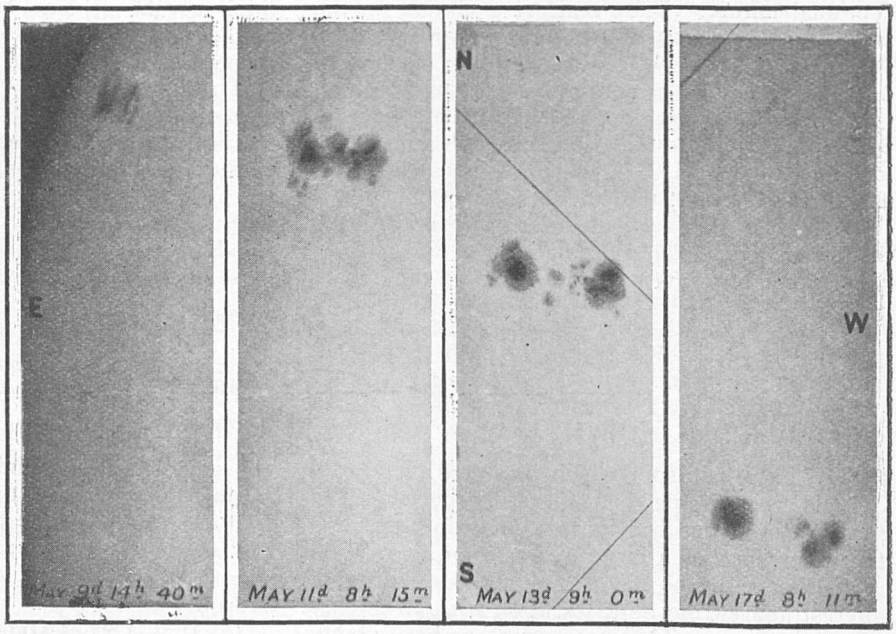

FIG. 2.—Original scale $7\frac{1}{2}$ in. to sun's diameter. Note the foreshortening of the spot near the sun's limb. By kind permission of the Astronomer Royal.

secondary maximum followed at 8h. on May 16. It does not seem possible to associate the disturbance with one or other individual spot, but rather with the group as a whole. In this connection it is of interest to note that minor magnetic disturbances occurred on April 18 and March 21. Some years ago Mr. Maunder showed that magnetic storms tend to recur at intervals of about twenty-seven days, which corresponds to the time taken for the sun to make one rotation relative to the earth. If this sequence is continued we may expect a further disturbance on June 9, when the spot group, if still visible, will be in the same relative position on the sun's disc as on May 13, when the storm commenced.

The general relation between the diurnal variation of the earth's magnetic elements and the sun-spot cycle cannot be doubted. It is better termed the *solar* cycle, for it is well known that the solar prominences, the faculæ and flocculi, and the shape of the corona vary also with the sun-spots in the same eleven-year period. The causes, however, of this terrestrial and solar relation are still obscure, and the magnetic storms in particular offer other difficulties on account of their anomalous occurrence, although on the whole they follow the sun-spot curve. The theory which in general seems best to fit the observed facts is that which assumes a directive stream of charged particles ejected from a restricted area of the sun, most probably in the region of a sun-spot. Opinions differ as to the exact nature of the stream and as to its action on meeting the earth. It is, of course, admitted that such a stream, though it may be a requirement, is not the sole factor in the production of a magnetic storm, the energy of which is to be traced to the earth's own magnetic system, and ultimately to the earth's rotation.

At Mount Wilson Observatory the magnetic polarities of sun-spots are now investigated daily. It will be interesting to see whether this group of spots is associated with exceptionally strong or otherwise abnormal magnetic fields.

Obituary.

DR. G. B. LONGSTAFF.

DR. G. B. LONGSTAFF died on May 7, after a long period of failing health, at his residence, Highlands, Putney Heath. Dr. Longstaff was born on February 2, 1849, and educated at Rugby and at New College, Oxford, where he obtained a scholarship and a first class in natural science. At a very early age his attention was attracted to the study of insects, mainly through the influence of his uncle by marriage, William Spence, of "Kirby and Spence's Introduction to Entomology"; and he was already recognised as one of the most energetic and successful of the younger lepidopterists of his time, when a regrettable accident in the second term of his residence at Oxford, which resulted in the loss of an eye, put an end to his activities in this direction for many years. His later career at St. Thomas's Hospital, where he was awarded the Mead medal, was highly distinguished, and in later life, besides taking an active part in philanthropic and municipal work, he represented Wandsworth on the London County Council for fourteen successive years.

Much attention also was devoted by Dr. Longstaff to the scientific aspect of statistics, and his well-known work on this subject ("Studies in Statistics") was published in 1891. His long-dormant interest in entomology was revived by a tour in India and Ceylon in the winter of 1903–4; and in later years flying visits were made by him to almost every accessible part of the world in company with his accomplished second wife (*née* Mary Jane Donald, well known as an authority on recent and fossil mollusca). The energy and acumen with which insects were collected and observed on these trips may be estimated by the fact that Dr. Longstaff enriched the museum of his old university by at least 14,000 specimens, and the value of this generous contribution is greatly enhanced by the full and accurate data attached to every one of them.

The gratitude of all entomologists is also due to Dr. Longstaff for the finely illustrated and most pleasantly written narrative of these collecting trips which appeared in 1912 under the title of "Butterfly Hunting in Many Lands." The numerous and valuable observations on the bionomics of the butterflies met with in the regions visited—their flight, resting habits, seasonal forms, mimicry, and sexual scents, to which last-named subject Dr. Longstaff devoted special attention—are embodied in the last chapter of this fine book, which is supplemented by an equally valuable series of papers on the same questions by the late Fritz Müller, here presented for the first time in English.

Dr. Longstaff was a highly appreciated member of many learned bodies, and had been vice-president of the Royal Statistical Society and of the Entomological Society of London; and the loss of his commanding presence and genial address at their meetings will long be regretted by his fellow-members, as well as by his numerous friends in private life.

WE notice with much regret the announcement in the *Times* of the death of DR. EDWARD B. ROSA on Tuesday, May 17, at the age of fifty-nine years. Dr. Rosa had been connected with the U.S. Bureau of Standards since 1901, and from 1910 onward he held the position of chief physicist at the bureau.

Notes.

AT a special meeting of the Institution of Electrical Engineers, to be held on May 31, a proposal will be submitted to the members that the institution shall petition the Privy Council for a charter of incorporation. More than forty years ago, when the institution was a small and struggling society, it applied for a charter, but the application was successfully opposed by the Institution of Civil Engineers. Now that the importance of electrical engineering to the community is recognised, and the good work that the institution has done in developing electrical science and its applications is well known, there is no reason to anticipate that there will be any opposition to the grant of a charter. The only point where discussion is likely to arise is in connection with the clause which proposes to confer upon corporate members of the institution the right to use the designation "chartered electrical engineer." We take it that the object of this clause is to distinguish between an electrical engineer and a man who, having some slight technical qualification, calls himself one. We think the proposal unnecessary. The public recognises that the letters M.I.E.E. are a complete qualification.

TELEPHONIC communication has now been established between Cuba and the United States by three separate cables, each of which is more than a hundred miles in length and is submerged to a depth of 1000 fathoms. Owing to the large electrostatic capacity of submarine cables distinct speech through them would be impossible were not the circuit made inductive so as to secure the practically "distortionless circuit" first described by Oliver Heaviside. In the submarine portion of the London-Paris telephone circuit "lumped inductance" is added by inserting Pupin inductance coils at short intervals. In the Havana and Key West cables the copper core is surrounded by a continuous spiral of fine iron wire insulated by a sheathing of gutta-percha. The inductive loading is thus continuous, and so the necessary mathematical conditions can be more accurately fulfilled. Above the gutta-percha is wound a copper tape as a protection against the attacks of the teredo. Over this shield is wound a further copper tape, which forms the return half of the telephone circuit of each cable. The specifications for the cables were prepared by Sir William Slingo, formerly Engineer-in-Chief of the British Post Office, in conjunction with the Western Electric Co.

WE learn from the publication, *Radium*, that Mme. Curie left France on May 7 on a visit to the United States, the main purport of her visit being to receive a gift of one gram of the element radium from the women of the United States. The gift was organised by Mrs. William Brown Meloney, the editor of the *Delineator*, and carried into effect by the Marie Curie Radium Fund Committee. From a report in the *Times* of May 21 it appears that this presentation was made to Mme. Curie at the White House, Washington, at the hands of President Harding. In an eloquent and felicitous address the President referred to the benefits conferred upon humanity by discoveries in science. It is, as he said, given to relatively few to make great discoveries, and the recognition given to those who do so is often meagre enough. In a happy phrase he reminded his audience that "the great things achieved by great minds would never have been wrought without the inspiration to successful effort, and success in turn enables the outgiving of benefits to millions whose only contribution has been the power of their united appeal." We understand that Mme. Curie is to be the recipient of several honorary degrees on the occasion of her visit to America.

THE importance of regular meteorological reports from Greenland for the forecasting services of Western Europe, and, indeed, for that of Canada also, has been recognised for some years. The question of these reports was discussed at the meeting of the International Commission for Weather Telegraphy which was held in London in November last, and the Commission decided unanimously that "the establishment at the earliest possible date of a high-power radio-telegraphic station in Greenland is of the utmost importance to the meteorology of Western Europe, and, further, it is of such importance as to warrant the international provision of funds for maintaining it." It is probable that the provision of such a station by the Danish Government will be made at an early date. When this station has been provided it will be possible to make a definite use in weather forecasting in Europe of meteorological observations from Canada and the United States. Hitherto the gap between the European and American observations has been so great that meteorologists have been unable to justify the expense which would be involved in regular cable messages from America to England.

DR. E. J. RUSSELL, director of the Rothamsted Experimental Station, has been appointed a foreign corresponding member of the Reale Istituto Lombardo di Scienze e Lettere di Milano.

DR. F. L. GOLLA will deliver the Croonian lectures of the Royal College of Physicians on Tuesdays and Thursdays, June 9, 14, 16, and 21, at 5 o'clock, upon the subject of "The Objective Study of Neurosis."

NOTICE is given by the Institute of Physics that the first examination of candidates for the associateship of the institute will be held at the latter end of September next. Forms of application are obtainable from the Secretary, 10 Essex Street, W.C.2. Applications for entry must be received before June 15.

A PUBLIC meeting arranged by the National Union of Scientific Workers will be held in the Botanical Theatre, University College, Gower Street, on Monday next, May 30, when Prof. L. Bairstow will speak on the subject of "The Administration of Scientific Work." The chair will be taken at 8 p.m. by the Right Hon. Viscount Haldane.

THE Principal Trustees of the British Museum have appointed Dr. W. T. Calman to be deputy keeper in the department of zoology. Dr. Calman, who

graduated as a Doctor of Science at St. Andrews University, has been in charge of the Crustacea at the Natural History Museum since 1904, and is the author of "The Life of Crustacea" and of numerous articles on this group.

A MEETING on the subject of "Constructive Birth Control: Its Ideals and Helpfulness to the Individual and to the Race" will be held at Queen's Hall on Tuesday next, May 31. The chair will be taken at 8.30 by the Right Hon. G. H. Roberts, and among the speakers will be Dr. Jane L. Hawthorne, Dr. C. Killick Millard, the Right Hon. J. M. Robertson, Admiral Sir Percy Scott, and Dr. Marie Stopes.

THE Ottawa Field-Naturalists' Club has decided to open a subscription list for a permanent memorial to the late Prof. John Macoun, naturalist of the Geological Survey of Canada, who died at Sidney, British Columbia, on July 18, 1920. The wide field of work to which Prof. Macoun devoted his life is known to many naturalists. He specialised particularly in botany, and was the founder of the Canadian National Herbarium. Other sciences, however, especially zoology, were also greatly enriched by him. He will be remembered as the great pioneer in Canadian natural history. The memorial will take the form of a portrait to be hung in the Victoria Memorial Museum, which will be executed by Mr. Franklin Brownell, of Ottawa. The expenses in connection therewith will be about 700 dollars, and subscriptions, which should be forwarded to Mr. Arthur Gibson, Dominion Entomologist, Ottawa, are invited.

THE third meeting of the Council of Agriculture for England, constituted by the Ministry of Agriculture and Fisheries Act, 1919, will be held at the Middlesex Guildhall, Westminster, S.W., on Friday, May 27. The proceedings will begin at 11 a.m. and will be open to the public. The Earl of Selborne, K.G., will be in the chair. The purpose of the council is to provide an opportunity for the discussion of matters of public interest relating to agriculture and other rural industries by persons representing the various interests of the industry from all parts of the country. Several interesting resolutions will be considered, among which may be mentioned two to be moved by Sir Douglas Newton, dealing with the facilities of railway goods stations for the rapid transit of soft fruit and other perishable produce. The question is especially difficult at the present time, when railway services have to be curtailed.

IN connection with the presentation on June 29 of the John Fritz medal to Sir Robert Hadfield, which was announced in NATURE of May 5, it may be of interest to record the events which led to the institution of this medal. In 1902 a number of friends and associates of John Fritz, the American engineer who brought about great changes in the iron and steel industry in the United States, decided to celebrate his eightieth birthday by establishing a fund, the income from which should be used to strike annually a John Fritz medal for scientific and industrial achievement in any field of pure or applied science. A committee consisting of representatives of the American Societies of Civil and Mechanical Engineers and the American Institutes of Mining and Electrical Engineers was appointed, and an impression of an appropriate design was presented to John Fritz at a great dinner given in the Waldorf Hotel, New York. After the die had been completed the committee continued in existence as the John Fritz Medal Fund Corporation. One member of each of the societies instrumental in founding the fund is now elected annually to serve on the committee for a period of four years; the members of the committee also act as a board of award. The medal, which is of gold, is awarded annually, without restriction on account of nationality or sex, and it is accompanied by a diploma reciting the origin of the medal and the specific achievement for which the award is made. The first award, in 1902, was made to John Fritz, and the second, in 1905, to Lord Kelvin, "for work in cable telegraphy and other general scientific achievements." Since then an award has been made every year with the exception of 1913, and the list of recipients contains such well-known names as George Westinghouse, Dr. Alexander Bell, Thomas A. Edison, Sir William H. White, and Elihu Thomson.

THE second issue, that for April, of the *Antiquaries' Journal*, the journal of the Society of Antiquaries of London, is fully up to the level of the first number, and the publication marks a distinct advance in the popularisation of the science of archæology. Mr. A. Leslie Armstrong announces the discovery of engravings found at Grime's Graves, Norfolk, on flints associated with a series of flint implements of Le Moustier type, bone tools, and pottery, on a level immediately overlying glacial land. One is a naturalistic representation on flint-crust of a stag or perhaps an elk. The authorities at the Natural History Museum regard this animal as an elk, known in America as "moose." In the discussion which followed, the president suggested that the art of the engravings seemed to be of the same character as the French cave series, though he would not say the resemblance was conclusive. "In recent years discoveries at Grime's Graves, Northfleet, and elsewhere had reduced the sequence of prehistoric periods to a state of flux. If type, material, and coloration, singly or collectively, meant nothing at all, the whole structure of prehistoric study was undermined. In any case, the Grime's Graves industry did not seem to belong to the ordinary Neolithic period."

IN the April issue of *Man* Sir Ray Lankester describes, with illustrations, a remarkable flint implement found lying on the surface of a field within ten yards of the gravel-pit in which the jawbone of Eoanthropus was discovered in 1912. He proposes to call this specimen "the Piltdown batiform," and he expresses the hope that it may be placed with the other Piltdown flints in the Geological Department of the British Museum. He thus sums up the question:—"In my opinion the facts hitherto ascertained do not justify the identification of the period at which Eoanthropus lived with the period at which any of the flint implements discovered in the Piltdown gravel were fashioned, nor do we know enough

to make the assertion that implements of Mousterian or Acheulæan or Chellæan or pre-Chellæan workmanship were *not* manufactured or in use when Eoanthropus flourished. Assuredly we are not in a position to assume either that Eoanthropus manufactured flint implements, or, on the other hand, that he did not do so. To me it seems improbable that Eoanthropus had anything to do with flint implements at all, although more likely that he suffered from them rather than that he benefited by their use."

IN an article on the conditions of cellular immortality (*Sci. Monthly*, vol. xii., No. 4, p. 321) Prof. Raymond Pearl discusses artificial parthenogenesis and tissue culture and the views regarding senescence to which they lead. The life of the unfertilised egg-cell can be prolonged only by fertilisation or by some other stimulus to development. The experiments of Leo Loeb, Harrison, Burrows, Carrel, and others in the culture not only of embryonic, but also of adult, tissues *in vitro* show that the phenomena of senescence do not originate in the cells themselves; for all the essential body-tissues, including heart-muscle, nerve-cells, spleen, connective tissue, and kidney-cells, have been shown to be capable of multiplication indefinitely by mitotic division outside the body. With improved methods Carrel has kept a strain of connective tissue from the chick's heart alive and growing for nine years. There is, therefore, a potential immortality not only of germ-cells, but also of tissue-cells, and senescence is a phenomenon of the differentiated body as a whole, due to the effects of the various types of cells upon each other.

IN the Journal of the Quekett Microscopical Club (vol. xiv., November, 1920) Mr. G. T. Harris describes the Desmid flora of a small area in East Devon, and compares it with that of Dartmoor in order to elucidate the influence of geological beds on the species density of the Desmid flora. Dartmoor is a Palæozoic, semi-mountainous area of extensive peat deposits, great rainfall, and deep bogs; the other, a Triassic, low-land area, with no peat-bogs, moderate rainfall, and unimportant bogs. The numerical results from each area were surprisingly similar, indicating that the factors influencing the richness or poverty of Desmid floras must be sought elsewhere than in the geological beds upon which the habitats stand; and a recent investigation of the Desmid flora of a district on Eocene beds confirms this statement. The species density of the two districts is also practically the same. A systematic list of the species and varieties from the Triassic area, 429 in number, is given. This adds 122 forms to the Desmid flora of Devonshire, bringing it up to a total of about 500 species and varieties. From gatherings made during the winter it would appear that most species in a southern county like Devon pass the winter in the vegetative state.

THE Forestry Commission in a recent report states that up to April it had acquired for planting 97,160 acres of land, of which 36,682 acres are in England and Wales, 54,972 acres in Scotland, and 5506 acres in Ireland. The area of 1586 acres planted under favourable conditions in 1919–20 continues to show satisfactory growth. During the 1920–21 season 6257 acres were planted at seventeen centres in England and Wales, nine centres in Scotland, and twelve centres in Ireland, while new nurseries have been established in various parts of the country. The Commission has published a report of the British Empire Forestry Conference held in London last July, which can be obtained through any bookseller or from H.M. Stationery Office (*7s. 6d.*). Leaflets on forest pests—No. 2, *Chermes Cooleyi*; No. 3, The Pine Shoot Beetle; and No. 4, *Hylastes ater*—can be obtained free on application to the Commission at 22 Grosvenor Gardens, London, S.W.1.

THE disposal of the débris from hydraulic mining and its influence on the lower courses of rivers have been urgent problems in California for the last half-century. A monograph on the subject by the late Dr. G. K. Gilbert is published by the United States Geological Survey entitled "Hydraulic Mining Débris in the Sierra Nevada" (Professional Paper 105). The material washed from the hillsides is carried by the creeks and rivers, and eventually finds lodgment in the lower reaches of the streams and during floods on the riparian lands, thus doing a considerable amount of harm to navigation and agriculture. For these reasons hydraulic mining has been severely restricted for many years. The bays of the San Francisco system have been sounded and mapped more than once, and comparisons made between early and recent maps show that the areas of the bays have been much reduced by the seaward growth of muddy shoals. Since the discovery of gold and the beginning of hydraulic mining more than 1,000,000,000 cubic yards of material have been deposited in the various bays. Dr. Gilbert made careful researches on the effect of this shoaling and diminution of area on the tidal currents and depths of water on the Golden Gate bar. The crest of the bar shows a retreat towards the land, but no reduction in depth since 1855, and the navigability of the bar has apparently not yet been affected.

IN the Journal of the Franklin Institute for April Mr. A. H. Armstrong considers the economic aspects of railway electrification in the United States. He points out that at the present time we are facing the facts of an eight-hour working day with overtime costing 50 per cent. more, greatly increased wages, fuel prices at levels never before reached, and maintenance costs at almost prohibitive values. With no immediate prospect in sight of any material reduction in the price of labour, its output must be increased, and electric operation effects this both on the railway line and in the workshop. The electrification of railways is a very costly operation, but the saving in operating expenses enables a reasonable return to be obtained on the capital expended. The argument for electrification, however, rests on a broader foundation than this. The national prosperity of America is bound up with the future growth of its transport system, and this growth depends on the adoption of electrification. An incidental advantage of electrification is that it would save one-sixth of all the coal mined in the United States.

THE fourth annual general meeting of the Society of Glass Technology was held at University College, London, on April 20, when Dr. Morris W. Travers was elected president in succession to Mr. S. N. Jenkinson. The new president delivered an address on the importance of quantitative investigation in dealing with technical glass problems. The speaker directed attention to the fact that the late Lord Moulton, who was to have presided at the society's dinner that evening, had brought about a great improvement in the efficiency of explosives factories by applying quantitative investigation to the processes conducted in them. The energy balance-sheet of a factory was as important as its financial balance-sheet, and the efficiency of a furnace, for instance, should be accurately known so that a full account could be given of all heat which entered it. This principle was illustrated by application to several furnace problems. There was also a wide field for investigations bearing on the nature of glass, and recent work had shown that glass in the solid condition resembled the elastic gels rather than the liquids. A paper on automatic glass-feeding devices was communicated by Messrs. G. Dowse and E. Meigh, and the society's third annual dinner followed. During the course of the evening the president referred to the proposed legislation affecting the industry, and maintained that the total prohibition of the importation of all chemical glassware except under licence was essential to that branch of the industry. Electric lamp bulbs should also have been included in the Bill. Assistance would be necessary if the manufacture of these articles were to be continued in this country.

MESSRS. G. E. STECHERT AND CO., 151 West 25th Street, New York (London: 2 Star Yard, Carey Street, W.C.2), have sent us a copy of their catalogue (New Series, xl.) of second-hand books relating to natural history. It contains some hundreds of titles, and is classified as follows:—General Natural Science; Agriculture, Forestry, Farming; Botany; Zoology; Ornithology; Ichthyology; Entomology; Gardening; and Supplement. The prices asked (in American dollars) appear to be very moderate.

AN interesting little catalogue (No. 414) of nearly four hundred works (books and engravings) on the topography of Kent and Sussex has just been issued by Mr. F. Edwards, 83 High Street, Marylebone, W.1. It will doubtless appeal to residents in the two counties named and to many others.

Our Astronomical Column.

COMETS.—It appears that Dubiago's comet was discovered by him at Kasan on April 24, and observed at Pulkovo a few days later. It has now been observed in England by Dr. Steavenson, whose observations enable the orbit to be improved. This has already been done approximately with the following result:—

T 1921 May 7·177 G.M.T., ω 100° 13′, Ω 65° 58′, i 22° 20′, log q 0·0481.

Ephemeris for Greenwich Midnight.

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
May 28	9 38 57	35 52	0·0680	0·0172
June 1	10 0 27	33 18	0·0756	0·0179
5	10 20 55	30 30	0·0840	0·0203
9	10 40 22	27 32	0·0933	0·0250
13	10 58 42	24 27	0·1032	0·0318
17	11 16 3	21 20	0·1137	0·0406

Its total light is probably equal to a 9th magnitude star; it should be readily visible in an ordinary telescope in the absence of the moon.

The errors of the ephemeris of comet Pons-Winnecke have become so large that it is well to give the revised orbit lately received from Prof. Crawford and Miss Levy, with the ephemeris, for Greenwich midnight, deduced from it.

T 1921 June 12·95 G.M.T., ω 170° 34′, Ω 97° 51′, i 18° 50′, log q 0·01703, e 0·6779, period (assumed) 5·8 years.

	R.A. h. m. s.	Decl. ° ′	Log r	Log Δ
May 27	19 35 27	43 16 N.	0·0272	9·2698
31	20 16 47	39 36	0·0230	9·2226
June 4	21 0 39	33 52	0·0198	9·1818
8	21 44 21	26 4	0·0178	9·1537
12	22 24 42	16 37	0·0170	9·1446
16	23 0 20	6 50 N.	0·0175	9·1572
20	23 31 5	2 14 S.	0·0192	9·1881
24	23 56 42	9 55 S.	0·0221	9·2295

After this the comet will travel south rapidly; it should be observable in the southern hemisphere until September.

THEORY OF JUPITER'S SATELLITES.—Prof. Sampson's tables of Jupiter's satellites have been in use in the national ephemerides for several years, but the theory on which they were based has only just appeared in print, being vol. lxiii. of Memoirs of the Royal Astronomical Society. The author commences with a review of the work of Laplace, Delambre, Damoiseau, and Souillart; he explains that the discordances that still exist between the tables and observation are due to the fact that in deducing the fundamental elements with the aid of the older theories it was assumed that only the leading terms of these would be involved. It was discovered (too late to alter the tables) that some secondary terms in the older theories were so seriously wrong that the tables are sensibly affected. One such error may affect the time of an eclipse of Satellite IV. by 140s.

The elements at the present day were derived chiefly from the Harvard photometric observations of eclipses. These permit of the deduction of an exceedingly accurate value of the equatorial semi-diameter of Jupiter; the mean of the Harvard and Durham discussions is 18·927″.

The adopted value of Jupiter's mass is 1/1047·35, but it is noted that a discussion of recent measures and photographs in conjunction with the theory leads to the value 1/1047·0. It would, however, be rash to alter the accepted value, which rests largely on the perturbations of minor planets and the comet Pons-Winnecke.

One advantage of the delay in publishing the theory is that it has enabled a list to be given of the errata and omissions that have been detected. One such was found soon after the tables were printed, and a supplementary page was issued.

Mr. Innes directed attention to two omitted terms; one, due to the effect of the sun on Satellite IV., has a coefficient of 7·6″. The other is a long-period term; period for III. 26½ years, coefficient about 6″. The values for IV. are not very different.

An Early Chellean Palæolithic Workshop-site at Cromer.

AT a meeting of the Royal Anthropological Institute held in the rooms of the Royal Society, Burlington House, on May 3, Mr. Reid Moir exhibited a large collection of ochreous flint implements, cores, and flakes recovered upon a limited area of foreshore exposed at low water at Cromer, Norfolk. These specimens are remarkable not only for their brilliant and arresting ochreous coloration, but also because of the large and massive size of many of the artefacts. Many of them are evidently fashioned for comfortable prehension, but it is clear that the hands of the ancient Cromerian people must have been much larger than those of modern man. Several examples of Early Chellean implements, with coarse flaking upon the upper and lower surfaces, have been found at the Cromer site, associated with rostro-carinates, choppers, scrapers, points, partly finished specimens, cores, and flakes.

It is evident that an actual workshop-site of Early Chellean age is represented at Cromer, and from its position appears to be referable to the lowermost stratum of the Cromer Forest Bed series of deposits. The Cromer Forest Bed strata are generally regarded as of Upper Pliocene age, and it seems, therefore, that the earliest Chellean implements—such as are usually found in river-terrace gravels—must in East Anglia be regarded as of Pliocene date. It is of interest to note that the massive human fossil jaw-bone found at Heidelberg, in Germany, was supposed to be of about the same antiquity as the Cromer Forest Bed. The individual represented by this jaw-bone would appear to have been of almost gorilla-like size and strength, and it may be that the massive Cromer implements which have been found were made by people of the Heidelberg type.

An animated discussion followed the reading of the paper. Prof. Arthur Keith, past-president, who was in the chair, said that while it would be impertinent for him to attempt to criticise Mr. Reid Moir's communication, he considered it of outstanding importance in the study of the antiquity of man in this country. This site would appear to be the most ancient workshop-floor which had yet been discovered. Sir William Boyd Dawkins said that no geological evidence had been brought forward for the relation of the flints on this site with the Forest Bed series; they were no more than a foreshore accumulation of flints which differed in no way from other flints found on the foreshore along the whole East and South Coast. Further, it was assumed that the Forest Bed fauna was Pliocene; but it had been shown more than forty years ago that the Forest Bed series included recent mammalia absent from the Pliocene deposits of France and Italy, and, therefore, they should be regarded as Early Pleistocene.

Sir E. Ray Lankester said that the use of the terms "Pliocene" and "Pleistocene" was purely arbitrary, and did not affect the facts. These specimens were quite unlike foreshore flints in their large size, their flaking, and their coloration. Mr. S. Hazzledine Warren denied that any evidence had been brought forward in support of the very definite assertion of date, and it was his opinion that if a boring were made at the base of the cliff, as had been suggested, nothing similar to the conditions on the foreshore would be found at the base of the Forest Bed series. Mr. Haward considered the site represented merely an outcrop of one of the zones of flints which are found sloping down to the sea in the neighbouring cliffs. Mr. Barnes said that the case was not made out. The number of implements was small, while a flake afforded little as a criterion of human manufacture. It was essential that a boring should be made at the base of the cliff. Mr. Reginald Smith, on the other hand, maintained that Mr. Reid Moir had made out a *prima-facie* case; it was only the question of provenance which gave rise to doubt. In referring to the disproportionate number of flakes on the site, he mentioned one of the floors investigated at Swanscombe, on which no implements, but only a large number of flakes, had been found.

The series of humanly fashioned flints collected by Mr. Reid Moir is to remain on exhibit for one month in the rooms of the Royal Society, Burlington House, where the specimens can be seen and examined by those interested.

Hydrology of the Western States of North America.[1]

By DR. BRYSSON CUNNINGHAM.

THREE Water Supply Papers, prepared under the direction of the United States Geological Survey, contain features of interest respecting the natural conditions which prevail in the undeveloped territory between the 108th and 118th meridians of west longitude.

(1) A sequence of devastating floods which swept the counties of southern California in January, 1916, is described in Water Supply Paper No. 426, with records of the precipitation, run-off, and attendant phenomena. The rainfall was heaviest and its effects most disastrous in San Diego County, which for nearly a month after the storm was cut off from communication with the rest of the State. The mean precipitation for the period January 14–30, in different parts of the county, ranged from 20 in. to 30 in. The normal annual rainfall at San Diego is in the neighbourhood of 10–15 in. As a result of the downpour the Lower Otay Dam, forming part of the reservoir system for the city of San Diego, was swept away and the Sweetwater Reservoir developed serious fractures. Twenty-two lives were lost in the flood from the former reservoir. A huge wall of water, variously described as from 6 ft. to 20 ft. in height, rushed down the valley, covering the distance from the dam-site to Palm City (about ten miles) in forty-eight minutes, and carrying everything before it. An impressive idea of the devastated area is obtained from the photographs which illustrate the report. There is also a large-scale map of the district.

(2) Upon the borders of the States of Utah, New Mexico, and Arizona lies an area of reservation, known as the Navajo Country, set aside for indigenous Indian tribes. It is a region of which very little hitherto has been known, and it remains more or less in a primitive condition. The area is considerable, about 25,725 square miles; it is the most exten-

[1] (1) "Southern California Floods of January, 1916." By H. D. McGlashan and F. C. Ebert. Water Supply Paper No. 426. (2) "The Navajo Country." By Herbert E. Gregory. Water Supply Paper No 380. (3) "Geology and Water Resources of Big Smoky, Clayton, and Alkali Spring Valleys, Nevada." By Oscar E. Meinzer. Water Supply Paper No. 423. (Washington: Government Printing Office 1917.)

sive tract of undeveloped reservation land within the United States. This area forms the subject of a geographical and hydrographical reconnaissance by Mr. Gregory, whose report is embodied in Water Supply Paper No. 380.

The exploration of a little-known region has considerable attractions for the adventurous, and Mr. Gregory in a personal introductory note confesses to its powerful appeal. The Navajo country, he points out, contains the remnants of an almost extinct race whose long occupation of the district is recorded in ruined dwellings and abandoned fields. It is true that roads have been established along selected routes, but by far the larger portion of the territory is accessible only by trails, and in the rougher areas no recognisable tracks are to be found.

The country contains many extremely interesting features, topographical, geological, and hydrographical. The 200 pages of the report are replete with valuable notes on the natural resources of the district, and indicate a careful and painstaking investigation. Topographically, the country forms part of the Colorado plateau, a region of flat-lying or slightly tilted rocks, cut by cañons and surmounted by mesas and buttes. "So numerous and so closely interlaced are the cañons in some portions of this singular region that they have displaced all but scattered remnants of the original plateau, leaving narrow walls, isolated ridges, and spires so slender that they seem to totter on their bases, shooting up to an enormous height from the vaults below."

The most inaccessible, least known, and roughest portion of the reservation is a region of bare red sandstone rock forming a plateau, known as the Rainbow Plateau, intersected by innumerable cañons, some of which are bridged by natural arches. One of them is a symmetrical semi-circular curve with a span of 274 ft. It gives its name of "The Rainbow" to the plateau.

The Navajo Indian is given a fairly good character; he is vigorous, intelligent, and capable of hard work provided it be not too continuous. He is, however, independent towards those who engage his services, and liable to take himself off. "He will help himself to interesting trinkets and to food, but may be trusted with valuable things and with important missions."

The report is well illustrated by photographs and maps.

(3) Big Smoky Valley, the subject of Water Supply Paper No. 423, is a typical Nevada desert valley—a plain hemmed in by mountain ranges and underlain by porous rock-waste eroded therefrom. It once contained two large lakes, one 40 miles long and 9 miles in maximum width in the upper part of the valley, and the other about 22 miles long by 5½ miles wide in the lower part. The depth of the former ranged to as much as 170 ft., and of the latter to 70 ft. The existence of these lakes is deduced from shore features which are still in existence. The climate is distinctly characteristic of an arid tract, the annual rainfall being generally about 6 in. or 7 in., or even less. The valley is but sparsely populated, and the settlers are principally engaged in mining or milling. The report contains maps, diagrams, and photographs.

The Plaice Fishery in the Belt Sea and Neighbouring Waters.[1]

THE sea-fisheries of Great Britain, though perhaps of less importance to the prosperity of the country than the supply of coal, are nevertheless of vital interest in more ways than one. Consequently, anything bearing on the problems connected with them, especially as to their permanence, ought to awaken interest in all who have practically studied this intricate subject, as well as to arrest the attention of the legislators and the public. Few nations have done more in proportion to their populations than the Danes in unravelling various problems of the sea-fisheries, and were it only for the single case of the remarkable life-history of the eel as elucidated by Dr. Johs. Schmidt, their labours merit careful attention as well as commendation.

The Report of the Danish Biological Station for 1920, by the experienced expert Dr. Petersen, who is well known in fisheries researches and for transplanting so successfully the plaice into the Limfjord, discloses a new feature in the plaice-fishery of the Belt Sea and neighbouring waters. No fish in the North Sea, indeed, has given more solicitude to scientific investigators and the fishing industry than the plaice, which, after the twenty years' labours of the International Fisheries Council, was singled out as the only form requiring legislation. Dr. Petersen, the author of the Danish report, hitherto has held the belief that it was possible to produce impoverishment of certain areas by over-fishing, though at the Dundee meeting of the British Association in 1912, when "impoverishment" was challenged, he declined to give an opinion, nor did anyone present support it. Dr. Petersen, indeed, had in former years pointed out the decline of a Danish plaice-fishery, but, as Dr. H. M. Kyle afterwards proved, that was a misapprehension. Now in this report of 1920 we have the remarkable admission that the intensive plaice-fishing, first by gill-nets and then by seines with otter-boards (which increased greatly from 1912 to 1919) worked from motor-boats in the Belt Sea and neighbourhood, has resulted, not in the impoverishment of the area, but in the more rapid growth of the plaice of to-day. The plaice now fished are younger, larger, and better fishes than formerly, though they are fewer on a given hectare, but the yearly yield is larger. Further, in the words of Dr. Petersen, "the plaice got formerly we did not care to eat . . . now we regard them as delicacies."

Dr. Petersen supports his views by the Fiskerei-Beretnings statistics for twenty years, which show that this intensive fishery has had the effect of increasing the weight of plaice from an average of 5 kg. per score to 10 kg. per score. The original dense old stock has been fished out, and a new, quick-growing race, fewer in number per hectare, has fortunately appeared. "It is like a lawn which is cut many times a year in lieu of once every second year; the latter method produces old, bad grass only, the former gives much more and better grass, but calls for much more work." Instead of 500 tons before 1900, the fishery of the area now produces 1000 tons; indeed, in 1912, 1913, and 1919 the yield was about 3000 tons, and valued at 3,000,000 kroner.

In 1900 the fishing in the Great Belt at 22 m. produced many undersized plaice amongst the larger forms of 40 cm., and there was a majority of males. In 1920 there were few undersized forms, and generally they were larger and heavier than before, the larger being similar to the larger in 1900, and

[1] "On the Stock of Plaice in Relation to the Intensive Fishing of the Present Times in the Belt Sea and other Waters." Report of the Danish Biological Station to the Danish Board of Agriculture, xxvii., 1920. By Dr. C. G. J. Petersen. (Copenhagen: G. E. C. Gad, 1921.)

the females were in the majority. The three- and four-year-olds were on an average larger than the old plaice of former times, the latter being slow-growing and consuming the available food without much increase in bulk. Thus the intensive fishing had improved the growth of the plaice in the area. Further, in the small waters of the Belt the young plaice have but a short distance to travel to reach places where rapid growth occurs, whereas in the Kattegat and the North Sea it is otherwise. In these deep basins of the Belt, moreover, gill-net fishing south of Faaborg has hindered over-population. The food of the plaice in the area consists largely of *Macoma baltica, Abra alba,* and the annelid Nephthys.

Dr. Petersen anticipates that similar results to the foregoing in larger areas might be attained by transplanting, and he would recommend prohibition against landing plaice in the spawning season. He places much weight on the supply of food for the plaice, old and young, for he thinks this is variable and possibly deficient; but it has long been demonstrated that the supply of food on the bottom, in mid-water, and near the surface is everywhere both persistent and ample, and no effort of man can, as a rule, modify it beyond low water. The contrast between the sea and the fresh-waters in this respect is often misunderstood. Taking a broad view of Dr. Petersen's observations, and without placing undue weight on the effects of intensive fishing in the Belt Sea, they simply bear out the marvellous ways of Nature in the ocean, especially in connection with the food-fishes, the recuperative powers of which are independent of artificial interference. Some may clasp and nurse the phantom of "impoverishment" of this or that place (seldom located), but Nature, unheeding, quietly answers by her annual swarms of young and by the rich and perennial harvest of food-fishes which everywhere rewards industrial energy. W. C. M.

The Melbourne Meeting of the Australasian Association.

I.

IT was arranged that the fifteenth meeting of the Australasian Association for the Advancement of Science should be held at Hobart on January 5–11 last, when, on December 18, passenger communication with Tasmania was cut off by a strike, and eventually it was decided to hold the meeting at Melbourne. By this unavoidable decision a grave disappointment was inflicted on the Tasmanian executive, who had worked for months at the organisation of the meeting, and also on Australians who desired to combine a holiday with participation in the science congress. Further, it meant that a great strain was placed upon the Melbourne officials, who had to arrange local details at short notice after a particularly strenuous time during midsummer. Nevertheless the meeting was one of the most successful ever held, and members have especial reason to be grateful to the president of the association (Sir Baldwin Spencer) and to the local secretary (Dr. Georgina Sweet), who, at the head of a band of devoted assistants, worked early and late and thus secured the fine results obtained.

A feature of the meeting was the number and importance of the sectional and intersectional discussions, many of the papers being taken as read in order to afford an opportunity for the interchange of ideas on subjects which are of special importance to the Commonwealth.

During the transaction of business it was decided that the invitation of the New Zealand Institute to hold the next meeting in January, 1923, at Wellington, New Zealand, should be accepted. It was also resolved that meetings in New South Wales, Victoria, or Tasmania shall in future alternate generally with those in the more remote States.

The permanent honorary secretary, Mr. J. H. Maiden, asked to be relieved of the duties of his office as from December 31, 1921, and on the motion of the president a resolution was unanimously carried recording the council's deep appreciation of Mr. Maiden's valuable services to science and to the association during the past fourteen years.

The council made a formal offer of the presidency for the Wellington meeting to Mr. J. H. Maiden, who gratefully acknowledged the compliment, but asked to be excused acceptance of the honour. The name of Mr. G. H. Knibbs, Commonwealth Statistician, vice-president, was then submitted, and he was unanimously elected. Mr. Knibbs has rendered the association invaluable service during a long period of years. Mr. E. C. Andrews, Government Geologist of New South Wales, was unanimously elected to the office of permanent honorary secretary as from January 1, 1922.

The council recorded its deep sense of the value of the experimental work in aeronautics of the late Laurence Hargrave, which has led to such remarkable results in the evolution of aviation, and proved of such immense importance during the recent war.

Mueller Memorial Medals.—It was decided to award two medals, as follows:—(1) Mr. R. T. Baker, curator of the Technological Museum, Sydney, in acknowledgment of his eminent services to botany, particularly in regard to Eucalyptus; and (2) Prof. C. Chilton, professor of biology, Christchurch, New Zealand, in acknowledgment of his eminent services to zoology, particularly in regard to the crustacea.

Australian National Research Council.—In 1919 Australia was invited to take part in the formation of an International Research Council. Two representatives of various branches of science were appointed to form a provisional committee, and it was decided to refer the matter of the constitution of the permanent body to the council of the association at the Hobart (Melbourne) meeting. A sub-committee of the latter was appointed to draw up a scheme, which was adopted by the council. It provides that a National Research Council for Australia shall be instituted, consisting of not more than one hundred members, representative of the following branches of science: (1) agriculture; (2) anthropology; (3) astronomy; (4) botany; (5) chemistry; (6) economics and statistics; (7) engineering; (8) geography; (9) geology; (10) mathematics; (11) mental science and education; (12) metallurgy; (13) meteorology; (14) pathology; (15) physics; (16) physiology; (17) veterinary science; (18) zoology. The present provisional council is to meet in Sydney in May of this year to co-opt additional members, and the council so constituted will meet as soon afterwards as is possible. It is empowered to appoint (*a*) such office-bearers as it may determine; (*b*) such standing and special committees as it may deem necessary for national or international purposes; and (*c*) a number of associate members chosen from among the scientific workers in Australia who are deemed likely to confer benefit by their researches. The council will submit a full report of its work and proceedings to the Australian Association for the Advancement of Science at

each meeting of the latter. Until other arrangements are made for the upkeep of the council each member thereof will contribute the sum of two guineas per annum, and each associate member one guinea.

Resolutions of the General Council.

Section A (*Astronomy, Mathematics, and Physics*).—"That as regards the following committees: Solar Physics, Seismology, Terrestrial Magnetism, Tidal Survey, Physical and Chemical Constants, and Longitude—since their methods of working involve international co-operation, these committees should be allowed to lapse, and that the responsibility for carrying on these researches be transferred to the Australian National Research Council."

"That the sum of 50*l.* referred to in the report of the secretary of the Physical and Chemical Constants Committee be approved, and forwarded to Dr. Marie."

Macquarie Island Committee (Sir T. W. Edgeworth David, secretary).—The report was adopted, and the names of Sir Baldwin Spencer, Sir Douglas Mawson, and Capt. J. K. Davis were added to it. The question of re-opening the wireless station at Macquarie Island established there originally by the Australasian Antarctic Expedition under Sir Douglas Mawson with the co-operation of the Commonwealth Meteorological Office has given rise to some difference of opinion, and the meteorologists now give precedence to the establishment of stations at Kerguelen or the Island of St. Paul. The question of re-establishing the wireless station on Macquarie Island must therefore be for the present postponed. The question of creating a zoological and botanical preserve at Macquarie Island is considered to be worthy of favourable consideration.

Committee for the Study of Earth Movements by Horizontal Pendulums (formerly the Committee for Determination of Gravity in Certain Critical Localities).—A preliminary account of the installation and working of the pendulums at Burrinjuck was read before the Royal Society of New South Wales (Journ. Roy. Soc. N.S.W., 1915). The observations have been systematically carried out by Mr. A. Goodwin since the pendulums were first established. Dr. L. A. Cotton, of the University of Sydney, furnished a report; the examination of the records since the preliminary account already referred to has served to explain in large measure the movement which was then regarded as being secular in character. It now appears that the movement is chiefly, if not wholly, seasonal in character and a function of the underground temperature. It is, of course, essential for this work, as well as for the main investigation, to have a detailed geological and topographical survey of the area. This work was taken up about two years ago, and, though far from completion, has yielded important information with regard to the lithographical characters and rock structures of the area under investigation. The general council voted the sum of 105*l.*, already expended in anticipation, together with 50*l.* for the future work of this committee.

The Samoan Observatory at Apia.—The observatory was founded by the Germans in 1902, and is described in the *New Zealand Journal of Science and Technology* (vol. iii., p. 157, 1920) by Dr. C. E. Adams and Prof. Marsden. It is considered most desirable that it should be maintained at pre-war efficiency, and that the cost of it be contributed to by Great Britain, New Zealand, and Australia. A resolution was passed urging upon the Federal and State Governments the importance of the work of the observatory in Samoa and the desirability of contributing 1000*l.* per annum as the Australian share of the cost of upkeep of this institution as an Imperial observatory.

Section C (*Geology and Mineralogy*).—It was decided to form a committee for the classification and correlation of the Carboniferous and Permian rocks of Australia in the place of a committee bearing the name "Permo-Carboniferous of Australia," and another committee, under the title "For the Investigation of the Structural Features and Land Forms in Australasia," to supersede the two committees on "Structural Features in Australasia" and "Physiographic Features of Australasia." The Glacial Phenomena Committee was re-appointed, with Sir Edgeworth David as secretary. The report of the committee was adopted. It consisted chiefly of observations by Mr. Loftus Hills, Government Geologist of Tasmania, on Glacial cirques and moraines in Tasmania, together with "Glacial Notes from New Zealand" by Mr. R. Speight, and brief remarks concerning South Australia by Prof. W. Howchin.

The Kainozoic and Quaternary Climate of Australasia Committee was re-appointed, with Mr. R. Speight as secretary. The Alkaline Rocks of Australasia Committee was also re-appointed, with Prof. E. Skeats and Dr. H. C. Richards as secretaries, and the sum of 50*l.* was voted for expenses.

A report was submitted by Prof. E. Skeats, which embodies references to the work of Prof. H. C. Richards in south-eastern Queensland, and recorded by him in the Journ. Roy. Soc. Queensland (vols. xxvii. and xxx.). As regards Tasmania, Prof. Skeats has supplied a note on the age of the alkaline rocks of Port Cygnet, etc. (Proc. Roy. Soc. Vict., vol. xxix.). The same author wrote a note on the Tertiary alkaline rocks of Victoria for the British Association at its Melbourne meeting in 1914. Since then he has made a number of additional observations which are detailed.

A committee was appointed to collect information in regard to the occurrence of artesian water in Australia, with Mr. S. A. Ward, Government Geologist of South Australia, as secretary.

Section D (*Biology*).—It was decided that a resolution be sent to the Premier of South Australia emphasising the great national and scientific importance of the preservation of native fauna and flora, and congratulating the Government on the legislation recently passed constituting Flinder's Chase, on Kangaroo Island, a national reserve for fauna and flora. Immediate steps should be taken to give full effect to that legislation. The Government is further urged to give full consideration to the unique importance which attaches to the constitution of the whole of Kangaroo Island as a national fauna and flora reserve, as well as to the protection of the land, fresh-water, and sub-aquatic fauna and flora of all the islands in South Australian waters other than Kangaroo Island which are actively used for farming pursuits.

The Ecology Committee was re-appointed with some additional names (Dr. C. S. Sutton, secretary). It was further resolved that a committee be appointed to collect data and initiate a reasonably detailed ecological map of Australia marking out the distribution of the salt-bush and other type-flora.

It was further resolved, on the motion of Sir Baldwin Spencer, that in order to carry out immediately a co-ordinated investigation into the land and fresh-water fauna and the flora of Australia and Tasmania the societies and institutions in the various States be requested to co-operate in the work, and to take such steps as they may deem advisable for carrying out this work, especially in securing in each State the active assistance of

specialists in different branches of botany and zoology.

It was resolved to prepare a bibliography of the botany of those Pacific islands of special interest to Australia under the auspices of a committee consisting of the Government Botanists of Queensland, New South Wales, and Victoria, Mr. J. H. Maiden to be the convener. The sum of 50*l.* was voted in aid of the work.

A brief report was furnished by the Committee for the Biological and Hydrographical Study of the New Zealand Coast (Prof. C. Chilton, secretary). The war has hindered the examination of the collections and the publication of the results.

Section E (*Geography and History*).—It was resolved to urge on the Federal Government that, in the interests of historical and geographical research, it is desirable that steps be taken to continue the work of obtaining translations of all available journals of the early French navigators in Australian waters. It was also resolved to subsidise the work of the investigation of ocean currents, tides, and sand movements on the Australian coasts which has been undertaken, at his own expense, by Mr. G. H. Halligan, late Hydrographic and Supervising Engineer for New South Wales.

Section F (*Ethnology and Anthropology*).—It was resolved that the need for the formation of a Federal Museum for Australia and its territories, and the immediate necessity for securing specimens, historical and ethnological, while they are yet available, be urged on the Federal Government.

Also, that the Federal Government be pressed to endow a chair of anthropology, especially in view of its value in the government of subject races, and that attention be directed to the desirability of investigating and recording the ethnology of the northern part of Western Australia.

Section H (*Engineering and Architecture*).—The council welcomed the general recognition gradually being extended towards the movement for the better planning and development of cities and suburbs, and affirmed that great economic waste exists, and is increasing, consequent upon the ill-planning and absence of regulation for the proper development of cities and suburbs, which will lead to many and costly resumptions to make necessary improvements. The hope was also expressed that State Governments, following the lead of South Australia, may initiate suitable legislation on the subject, including provisions for ensuring full inquiry by means of civic surveys into the needs of existing urban areas.

Section I (*Sanitary Science and Hygiene*).—The Anthropometric Committee (Dr. Mary Booth, secretary) was re-appointed. On the joint recommendation of this Section and Section G (Social and Statistical Science), a committee was appointed to investigate and report on industrial fatigue in Australia.

In connection with Dr. Jean Greig's paper on the problem of the special child and the special school, it was resolved that, in view of the existence of feeble-minded persons and their economic cost to the community, it is desirable that the Government be asked to establish farm colonies and residential homes for the accommodation of these cases, and that in the case of New South Wales the proceeds of the Randwick Orphanage, specially reserved for the care of mentally deficient children, be forthwith applied for that purpose.

It was further resolved that medical inspection be extended so as to include all schools.

Section K (*Agriculture*).—It was decided that the Commonwealth Government be asked to provide funds for the encouragement of the cultivation of cotton in such parts of the Commonwealth as are suitable climatically for its production.

In response to the request of the president of the Agricultural Section of the International Congress of Meteorology, it was decided to appoint a committee to report on the climatic control of wheat production in Australia.

Section L (*Veterinary Science*).—At a joint meeting of the Sections of Hygiene and Sanitary Science, Agriculture, and Veterinary Science Prof. J. Douglas Stewart, dean of the faculty of veterinary science at the University of Sydney, read a paper on "Animal Tuberculosis," the chief object of which was to revive interest in a resolution adopted at the fourteenth meeting of the association recommending the Governments of the States of Australia and of the Dominion of New Zealand to hold a conference of the chief medical and veterinary officers to discuss and report on uniform measures for the control of tuberculosis in cattle and pigs. Owing to the intervention of the war, the council of the association was unable to proceed with the matter.

Abstract of Presidential Address by Sir Baldwin Spencer.

The main part of the address dealt with some aspects of the cultural anthropology of Australian aboriginals, especially with their tribal and social organisation, as illustrating an early stage in the development of human society. In the remainder of the address the origin of the aboriginals and their relation to other races were discussed and a theory of the origin of their complex culture was suggested.

The question of the independent origin of similar inventions, beliefs, and customs was dealt with, and evidence from both the zoological and anthropological sides was brought forward to show the possibility of this. The remarkable homogeneity of all Australian tribes, even with regard to the details of their social organisation, gives no suggestion of outside influence. This homogeneity, existing side by side with the most remarkable differences in skull measurements, customs, beliefs, and arts revealing an extraordinary range of variability, presents a difficult problem quite insoluble on the theory of interactions of various immigrant peoples reaching Australia at different times.

The statement of Prof. Keith and others that the Australian race might have served as common ancestors for all modern races may be understood on the theory that it is the survivor of such a one that has been isolated for long ages in Australia, and has been practically uninfluenced by contact with other peoples. In conclusion, reference was made to the suggestion of Bateson that perhaps "the course of evolution may be regarded as an unpacking of an original complex which contained within itself the whole range of diversity which living things present," and it was suggested that in the characteristic marsupial fauna and in the aboriginals of Australia we have a remarkable example of such an unpacking. This has led, without any outside influence, to the development, on one hand, of mammalian forms along lines parallel with those pursued by higher forms so far as fundamental features are concerned, but controlled at the same time by some factor or combination of factors that has determined the retention of their marsupiality; on the other, it has led to the independent development of a race of human beings along lines parallel with those pursued by other early races of humanity from Mousterian to Aurignacian times, but again always controlled by some factor or combination of factors that has prevented them from developing into anything higher than men of the Stone age.

(*To be continued.*)

University and Educational Intelligence.

CAMBRIDGE.—Honorary degrees are to be conferred on the Prince of Wales, Marshal Foch, Admiral Sims, and Lord Plumer on May 31. The Crown Prince of Japan received an honorary degree on Wednesday, May 18.

The voting on the alternative schemes—(1) admitting women to membership of the University with limited rights or (2) granting them merely titular degrees—is to take place on June 16.

A lecturer is to be appointed in physics as applied to medical radiology.

The first Ph.D. degree has been approved, Mr. C. G. L. Wolf, of Christ's College, being the first successful candidate.

The examination in anatomy in the Natural Sciences Tripos is to be on a wide scale to cover the general morphology of vertebrates, a general knowledge of vertebrate (including human) embryology, and a special knowledge of the morphological side of human anatomy.

EDINBURGH.—The following lecturers have been appointed as readers in the Faculty of Science: Dr. H. S. Allen in physics, Dr. R. Campbell in petrology, and Dr. L. Dobbin in chemistry.

Dr. Beard, lecturer in comparative embryology, has resigned for reasons of health, and Dr. Balsillie, on being transferred to the Royal Scottish Museum, has resigned his lectureship in chemistry.

It has been resolved to re-institute the special tutorial course in German for students of science.

It was reported that the new Ordinance for Degrees in Pure Science (Ordinary and Honours) had been approved by his Majesty in Council, and had now come into force.

LONDON.—A lecture will be given at King's College on Thursday, June 9, at 5.15 p.m., by Prof. Einstein on "The Development and Present Position of the Theory of Relativity." The chair will be taken by Viscount Haldane. A charge of 2*s.* 6*d.* will be made for admission, and the proceeds will be given to the Imperial War Relief Fund. The lecture will be delivered in German. Tickets can be obtained on application to the lecture secretary at the college.

The following advanced lectures addressed to students of the University and to others interested in the subjects have been arranged. Admission is free, without ticket:—A course of four lectures on "Recent Developments in Legislation for the Prevention of Disease," by Dr. Charles Porter, at University College at 5.30 p.m. on May 30 and June 3, 6, and 10. A course of four lectures on "Some Actions of Foodstuffs in the Production and Treatment of Disease," by Prof. E. Mellanby, at the Royal College of Surgeons, Lincoln's Inn Fields, W.C.2, at 5 p.m. on June 6, 7, 13, and 14. A course of three lectures on "Recent Advances in Experimental Embryology," by Prof. E. W. McBride, at the Imperial College, Royal College of Science, Exhibition Road, S.W.7, at 5 p.m. on June 7, 8, and 9. A lecture on "Permeability in Physiology and Pathology," by Prof. H. J. Hamburger, at the rooms of the Royal Society of Medicine, 1 Wimpole Street, W.1, at 5 p.m. on June 8 (this lecture is the last of a series of six arranged under the scheme for the exchange of lecturers in medicine between England and Holland). A course of four lectures on "The Therapeutic Use of Digitalis," by Prof. F. R. Fraser, in the surgical lecture theatre, St. Bartholomew's Hospital Medical School, West Smithfield, E.C.1, at 5 p.m. on June 13, 15, 17, and 20.

MR. H. J. DAVIS has been appointed to a lectureship in mathematics in the Bradford Technical College. He is at present senior lecturer in mathematics in the University College, Southampton, and has specialised on the theory of statistics.

THE Secretary of State for India in Council has made the following appointments to the Indian Educational Service:—To be professor of physics in Presidency College, Madras, Dr. Shankar Rao Ullal Savoor; to be professor of biology in the University of Rangoon, Dr. J. Brontë Gatenby.

PROF. E. G. COKER, professor of civil and mechanical engineering, University College, London, has accepted invitations from the Universities of Ghent and Louvain to lecture there next week on "Recent Researches in Photo-Elasticity," and also one from the Société Belge des Ingénieurs et des Industriels to lecture in Brussels on "The Applications of Photo-Elasticity to Engineering."

THE Anglo-Swedish Society (10 Staple Inn, W.C.1) has awarded two scholarships of 50*l.* each to be spent on travelling in Sweden: one to Miss Dorothy Cridland, to enable her to study the industrial economy of the country; the other to Mr. G. R. Carline, to aid his study of the open-air and folk museums of Sweden and their influence on national life. Similar scholarships will be awarded in the spring of each year.

THE Ramsay Memorial Trustees will at the end of June consider applications for two Ramsay Memorial fellowships for chemical research. One of the fellowships will be limited to candidates educated in Glasgow. The value of the fellowships will be 250*l.* per annum, to which may be added a grant for expenses not exceeding 50*l.* per annum. Full particulars as to the conditions of the award are obtainable from Dr. Walter W. Seton, secretary, Ramsay Memorial Fellowships Trust, University College, London, W.C.1.

THE Science Masters' Association, in response to an invitation to co-operate with the staff of the Rothamsted Experimental Station, Harpenden, has issued to its members, representing upwards of three hundred schools, a circular outlining the types of research work in which it is believed that school science and natural history clubs can best give the assistance solicited by the Rothamsted experts. The lines suggested are:—(1) The weed-flora of arable land, its relation to the type of soil, to the geological formation, to the system of manuring, to the crop rotation, and so on; (2) the physical properties (texture, pore-space, water-content, etc.) of the soil; and (3) the carbonate-content and the nitrogen-content of the soil. These have the merit of presenting a certain degree of finality that is within the reach of a boy in the course of one or two school terms. The weed-flora problems should appeal to the field club, while the other two should be attractive to boys whose bent is chemical and physical rather than biological. It is a step entirely in the right direction thus to link up the work of those still *in statu pupillari* with that of experts seriously engaged in research. The moment is very opportune for bringing home to the minds of boys that their amateur efforts in research may speedily be of real benefit to mankind and add to the sum of knowledge relating to the complex problems of plant-life. The work is of high educational value, and also of very practical utility; it deserves warm encouragement for both educational and utilitarian reasons. It is not beyond hope that industries other than agriculture may ere long enlist the services of schools in their several research problems.

Calendar of Scientific Pioneers.

May 27, 1914. Sir Joseph Wilson Swan died.—A partner in a firm of chemical manufacturers at Newcastle, Swan became famous by his invention of the carbon process in photography and by his pioneering work on the incandescent electric lamp. His first carbon filament lamp was shown at Newcastle in 1879. He received many honours, and in 1898–99 was president of the Institution of Electrical Engineers.

May 28, 1893. Charles Pritchard died.—Graduating as a Wrangler in 1830, Pritchard from 1834 to 1862 was headmaster of a successful grammar school at Clapham. In 1870, at the age of sixty-three, he became Savilian professor of astronomy at Oxford. He was a pioneer in the photographic measurement of stellar parallax, invented the wedge photometer, and in 1885 published his "Uranometria Nova Oxoniensis."

May 28, 1906. Rudolf Knietsch died.—A native of Silesia, Knietsch in 1884 became a director of the Badische Anilin- & Soda-Fabrik at Mannheim, where he played an important part in the manufacture of artificial indigo and in that of sulphuric acid by the contact process.

May 29, 1829. Sir Humphry Davy died.—Already famous for his discovery of nitrous oxide, in 1801 at the age of twenty-three, and at a salary of 100*l.* a year, Davy became the first professor of chemistry at the Royal Institution. His great discoveries of sodium and potassium were made there in 1807. In 1815 he invented his miners' safety-lamp. Knighted in 1818, he was president of the Royal Society from 1820 to 1827. His death occurred at Geneva.

May 29, 1896. Gabriel Auguste Daubrée died.—Trained in Paris as a mining engineer, Daubrée became professor of geology in the Musée d'Histoire Naturelle and Director of the School of Mines. He carried out an important series of experimental researches in geology.

May 29, 1897. Julius von Sachs died.—Professor of botany at Würzburg from 1868, Sachs contributed to all branches of botany, and especially to plant physiology. His well-known text-book was published in 1865 and his "History of Botany" ten years later.

May 29, 1898. Sir Lyon Playfair, first Baron Playfair of St. Andrews, died.—Chemist to the Geological Survey and the School of Mines, Playfair from 1856 to 1869 was professor of chemistry at Edinburgh. He entered Parliament, held public office, and did much to further the study and application of science. He was knighted in 1883 and raised to the peerage in 1892.

May 31, 1867. Théophile Jules Pelouze died.—Joint author with Frémy of an important treatise on chemistry, Pelouze made researches in organic chemistry, lectured at the Collège de France and the Ecole Polytechnique, and became President of the Mint.

June 1, 1812. Richard Kirwan died.—Of independent means and possessing many accomplishments, Kirwan was the correspondent of many scientific men, and in 1799 became president of the Royal Irish Academy. His "Elements of Mineralogy" (1784) was the first systematic treatise on that subject in English, and his essay on Phlogiston (1787) was one of the last attempts to defend Stahl's theories. Kirwan acknowledged his conversion to Lavoisier's views four years later.

June 1, 1903. J. Peter Lesley died.—Born at Philadelphia and educated for the ministry, Lesley assisted in geological work and ultimately became professor of geology in the University of Pennsylvania, and from 1874 to 1893 directed the Geological Survey of that State.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, May 12.—Prof. C. S. Sherrington, president, in the chair.—G. W. **Walker**: The problem of finite focal depth revealed by seismometers. Observations of the emergence angle of P waves at Pulkovo suggest that the depth of focus is of order one-fifth of the earth's radius. Important modifications are necessary in the interpretation of seismograms and in the attempt to determine how speed of propagation depends on depth. A test of the accuracy of the Pulkovo values can be made by a scrutiny of seismograms for distances $>11{,}000$ kilometres. Corresponding measures of the angle of emergence of S waves by means of three component seismometers are required.—E. A. **Griffiths**: A liquid oxygen vaporiser. The liquid oxygen is contained in a metal vacuum vessel. The emission of gas is governed by bringing a flexible portion of the outer wall into contact with the inner; the degree of contact determines the rate of transmission of heat. Any desired rate of gas evolution can be obtained up to 10 litres per minute, and the delivery remains constant.—Dorothy M. **Palmer** and W. G. **Palmer**: Some experiments on the catalytic reduction of ethylene to ethane. The hydrogenation of ethylene in the presence of nickel has been quantitatively examined. The mixture of ethylene and hydrogen was brought into contact with nickel in motion in an electrically heated tube. The rate of hydrogenation was measured by the rate at which a mixture of ethylene and hydrogen in equal proportions by volume had to be passed into the tube to maintain the gas therein at constant pressure. The effects of varying conditions were studied. The curves showing rate of reaction against time display "induction" periods during which no hydrogenation took place, varying in duration from a few seconds to many hours, according to the conditions of the experiment. Then the rate of reaction increases rapidly to a sharp maximum, and decreases less rapidly to a lower value, which decreases slowly. A theory is advanced to account for these effects.—W. G. **Palmer**: The catalytic activity of copper. Part ii. The activity of copper when prepared from oxide by reduction with carbon monoxide and methyl alcohol vapour is discussed. Constant-boiling mixtures of several alcohols with water were used as reactants. Water acts as a positive, and hydrogen as a negative, auxiliary catalyst when adsorbed on the copper. The activity-temperature curves for a catalyst prepared by carbon monoxide obey a simple exponential law. Between 270° and 280° C. the activity curves generally undergo a sudden change of direction corresponding to a great reduction of the temperature coefficient. This is attributed to the diminution in the thickness of the adsorbed alcohol layer to at most two molecular diameters. The activity of the catalyst does not increase continuously, as the temperature of its preparation from oxide is lowered.—Prof. C. F. **Jenkin** and D. N. **Shorthose**: The total heat of liquid carbonic acid. The total heat of carbonic acid between temperatures of +10° C. and +100° C. and between pressures of 900 lb. and 1800 lb. per square inch was measured. The values hitherto accepted, based on the assumption that the specific heat at constant volume does not change over this range, require slight correction.—Dr. A. O. **Rankine**: The viscosity and molecular dimensions of gaseous cyanogen. The viscosity of gaseous cyanogen has been measured at 15° C. and 100° C., the values obtained being, respectively, $0{\cdot}986\times10^{-4}$ and $1{\cdot}264\times10^{-4}$ C.G.S. units. Assuming Sutherland's law of temperature variation, the data have been used

to calculate Sutherland's constant (C. = 280) and the viscosity at 0° C. ($\eta_0 = 0{\cdot}935 \times 10^{-4}$ C.G.S. units). The mean collision area of the molecule of cyanogen deduced, $-1{\cdot}31 \times 10^{-15}$ cm.^{2}, proves to be practically the same as that of a bromine molecule, $1{\cdot}28 \times 10^{-15}$ cm.^{2} This is consistent with the evidence from crystal examination, for the molecular volumes of KBr and KCN are nearly equal. If X-ray crystal examination should prove that KCN and KBr are strictly isomorphous, the results here obtained are consistent with the Lewis-Langmuir view that the cyanogen molecule has a size and shape nearly the same as those of two nitrogen molecules linked together by sharing one pair of outer electrons.

Linnean Society, May 5.—Dr. A. Smith Woodward, president, in the chair.—Prof. A. **Dendy**: Hexactinellid sponges. The origin on certain elongated siliceous spicules of discs at regular intervals corresponds almost exactly with the nodal points of a vibrating body as determined by Prof. J. W. Nicholson.—Six papers dealing with various groups of insects collected by the Percy Sladen Trust Expedition:—C. G. **Lamb**: Diptera (iii.). A report chiefly on the Dolichopodidæ, a large family of small- or middle-sized flies, usually of beautiful metallic green or golden colours. The general affinities of the Seychelles forms are discussed. Most of them belong to a subfamily largely represented in the tropics, the Chrysosomatinæ or Psilopinæ; some of these flies, with dazzlingly brilliant golden-green bodies, settle in bright sunlight on broad leaves; another group of smaller and much duller-coloured species is almost entirely confined to the damp, shady mountain forests. A new genus, characterised by the males having at the base of the abdomen a pair of remarkable hollow spherical bulbs, with a round opening at the top through which can be seen a rod rising from the bottom of the bulb, is described. The bases of the wings are also highly modified. The Asilidæ and the Syrphidæ are also discussed.—H. **Gebien**: The Tenebrionidæ. A large family, mostly of large- or middle-sized beetles. The known Tenebrionid fauna of the island is increased from twelve to forty-one species; of these twenty-one are probably endemic, and eleven belong to endemic genera. The endemic genera are isolated and specialised forms. The idea previously advanced by Kolbe, that certain of these peculiar forms indicate relationships between the fauna of the Seychelles and those of New Zealand and South America, is not upheld, for the endemic species which do not belong to endemic genera present Oriental affinities. There is a much less pronounced Madagascan element, while the African element is represented only by a single widespread form.—Mr. **Schenkling**: The Cleridæ. A strong affinity exists with the fauna of Madagascar, four out of the six Seychelles species being new and having strongly Madagascan affinities, while the two remaining species are cosmopolitan. One of the new Seychelles forms has a superficial resemblance to an Anthribid beetle from the same islands. Both belong to new genera, Cleranthribus and Anthriboclerus. There are no data to show relationship between them.—Dr. M. **Bernhauer**: The Staphylinid beetles. The known Staphylinid fauna of the Seychelles is increased from twenty-eight to eighty-one species. The report also includes one species from the Chagos Islands and two from Aldabra. The conclusions of earlier writers were that the affinities of the Seychelles Staphylinidæ were, on the whole, Oriental, but that a smaller Madagascan element and a very small African element were included. These conclusions are in the main upheld, but generalisations must be accepted with reserve, for the smaller forms are still practically unknown in surrounding continents, and it is not known which species have reached the islands by natural means and which through human agency. A summary of observations on habits is given.—Dr. H. **Scott**: Clavicorn and other beetles. A great deal of fine work on the external anatomy was done in describing these forms. Numerous interesting points in the structure of tarsi, antennæ, mouth-parts, etc., and some remarkable secondary sexual characters, came to light. The geographical distribution is shown by a tabulated comparison of the numbers of representatives of these families in the Seychelles with the faunas of the Hawaian and of the Atlantic islands. The Seychelles have a great number of families and genera, usually represented by a few clearly separable species. The Hawaian islands have several families altogether wanting, while in other groups they possess great "endemic complexes."—Florence E. **Jarvis**: The Hydroids of the western Indian Ocean. An account of the collections obtained during the voyage of H.M.S. *Sealark* at varying depths to 130 fathoms and of some shallow coastal collections made by Mr. C. Crossland off East Africa. There are eleven Gymnoblastea and seventy-four Calyptoblastea. The number of new species is relatively small, the influence of depth and currents being emphasised as having a marked effect on the habit of colonies. All the larger families are represented, the group being practically cosmopolitan; there are no new genera, but the species comprise a number of new Plumularians.—Dr. C. I. **van der Horst**: Madreporaria, Agariciidæ. Twenty-nine species are recorded belonging to the genera Agaricia, Pavona, Podabacia, Leptoseris, Siderastrea, Coscinaræa, Psammocora, and Pachyseris. The type-specimens of previous authors have generally been consulted. Three species are described as new. The examination of the collection has resulted in many species, previously described as different, being shown to be connected by transitional forms.—E. R. **Speyer**: Insects in relation to the reproduction of coniferous trees. The destruction of the cones of *Pseudotsuga Douglasii*, Carr., *Pinus ponderosa*, Dougl., and *P. echinata*, Mill., by various insects was discussed.

Zoological Society, May 10.—Dr. A. Smith Woodward, vice-president, in the chair.—R. I. **Pocock**: The auditory bulla and other cranial characters in the Mustelidæ (martens, badgers, etc.).—G. S. **Thapar**: The venous system of the lizard, *Varanus bengalensis*, Daud.

Royal Meteorological Society, May 18.—Mr. R. H. Hooker, president, in the chair.—J. E. **Clark** and H. B. **Adames**: Report on the phenology of the British Isles, December, 1919, to November, 1920. The abnormal mildness and wetness up to mid-April ruined fruit-tree crops through too early blooming. Field crops suffered through drought in May and June and the cold sunlessness of July and August, with excessive wet in the former month. After June, in England, the accumulated temperature above 42° (that at which wheat will grow) fell more and more behind the mean until October, which, by its warmth, sunshine, and dryness, gave a wonderful seeding time in earlier districts and helped to save crops in the later. In 1920 the four spring flowers were, in England and Wales, 13½ days early (February 27); 10 days (March 3) for the whole of the British Isles. The latter date for 1919 was March 15. The succeeding flowers became less and less early, until the two of July were just average. From 1921 on observers are asked to include the Devil's-bit scabious in order to

extend the records into August. The mean date of all is 8·2 days earlier, or the earliest in the thirty years except 1893 (14 days). The latest were 1891 (9½ days late) and 1917 (7½ days). Two charts show by isohels, isotherms, and isophenes the relation between lines of equal sunshine, equal temperature, and equal appearance of flowers. The correspondence is closest between the last two. Thus the average flowering date ranges from April 19, in the south-west, near the isotherm of 50°, to May 31 on the isophene lying between isotherms 45° and 44°, 7° further north, which represents a rate of change of 6 days for each degree. In continental districts, European and North American, the rate is nearer 4 days. Bird migrations and appearances of insects confirm the plant records. The former were 3½ days earlier than the mean of the seven years available.—Dr. E. J. **Salisbury**: Phenology and habitat, with special reference to woodlands. The observations of Klebs and Lakon have shown the importance of conditions of nutrition in determining periodic phenomena. Raun Kaier has, moreover, shown that earliness or lateness in foliar development is an hereditary character. Probably no less important is the influence of habitat. The flowering period of chalk-down plants is, on the whole, early, whilst that of aquatics is late, but the close relation between phenology and habitat is best illustrated by woodland plants. Here we find there is a definite sequence from below upwards. Taken as a whole, woodland species develop earlier than non-woodland, but this is especially true of the shade flora. The average date for the inception of foliar development of woodland herbs, which lose their leaves during the winter, is February 19. Many, however, retain all or part of their foliage throughout the "light-phase." The leafage of the shrubs begins about a month later (average date March 19), and that of the trees towards the end of April (average, April 21). This upward sequence and its early inception are clearly correlated with the diminished light (7 to 1 per cent. of that in the open) in the interior of the wood from the end of May to the beginning of November. Such facts emphasise the importance of choosing species for phenological observation belonging to similar habitats and possessing aerial and underground organs of a similar nature. Further leafage appears to be more susceptible to meteorological changes than the flowering period, which is the usual subject of meteorological observation.

PARIS.

Academy of Sciences, May 2.—M. Georges Lemoine in the chair.—J. **Boussinesq**: Rectification and completion of a note of April 18 on the flattening of a rotating liquid drop.—T. **Bonnesen**: An improvement of the isoperimetric inequality of the circle and the demonstration of an inequality of Minkowski.—M. **Alayrac**: The movement of the centre of gravity of a solid symmetrical with respect to a vertical plane displacing itself in a resisting medium.—H. **Godard**: Observations of Winnecke's comet (1921*b*) made at the Bordeaux Observatory with the 38-cm. equatorial. Apparent positions and positions of comparison stars given for April 26, 28, and 29. The comet was of the 12th magnitude.—J. **Malassez**: The use of the lamp with three electrodes for the measurement of ionisation currents.—F. **Guéry**: Some consequences of the Lorentz contraction from the point of view of cohesion, of gravitation, and of electromagnetism.—G. **Contremoulins**: The protection of third parties against X-rays. The range of the radiations emitted by a Coolidge tube is considerable, and the effects have been traced up to a distance of 80 metres.—C. **Raveau**: Saturated solutions of two or more substances. The application of Le Chatelier's principle.—E. **Darmois**: The specific dispersion of hydrocarbons.—A. **Damiens**: Tellurium tetraiodide. An account of the preparation, purification, and physical and chemical properties of the iodide TeI_4. It is a well-defined compound, and will serve as a raw material for the preparation of numerous derivatives of tellurium.—A. **Mailhe**: The catalytic hydrogenation of the phenylhydrazones. The phenylhydrazones of aldehydes carried over nickel at 180° C. by a current of hydrogen split up into aniline and nitriles; the reduction to fatty amine and aniline is secondary. Phenylhydrazones of ketones behave differently, the reduction with production of fatty amine being the main reaction.—P. **Palacios**: Observations on a note on the tectonic of the western Pyrenees. Remarks on a recent communication by P. Stuart-Menteath.—F. **Kerforne**: The age of the oldest strata of the Armorican massif.—P. **Bonnet**: Liassic volcanic eruptions and their relations with the distribution of the facies in the Caucasian geosynclinals.—M. **Dort**: The variations of the solar radiation during the eclipse of the sun of April 8, 1921, at Bagnères-de-Bigorre, observatory station on the Pic du Midi. Observations were made with an actinometer of the Violle type and reduced to 15-minute intervals between 8 and 10.15 a.m. The figures are compared with the mean of corresponding measurements made on April 7 and 11.—M. **Molliard**: The influence of sodium chloride on the development of *Sterigmatocystis nigra*. The addition of salt to the culture medium above a certain concentration reduces the velocity of the chemical reactions of the mould; it also indirectly causes sterility of the mycelium owing to the accumulation of nitric acid.—G. **Astre**: Contribution to the study of the distribution of the biological zones on the Mediterranean dunes of the Gulf of Lyons.—M. **Manquat**: The phototropism of *Leucoma phaeorrhoea*. The author's observations on the action of light on the young caterpillars of *L. phaeorrhoea* do not confirm the conclusions of Loeb.—E. **Couvreur** and X. **Chahovitch**: Microbial infections in the invertebrates. Criticisms of a recent paper by M. Paillot on the same subject.—F. **Vlès** and J. **Dragoiu**: The osmotic pressure of arrest of cell division. The cells studied were those of the eggs of the sea-urchin, and these were grown in sea-water containing sugar in solution. With osmotic pressures between 25 atmospheres (sea-water) and 30 atmospheres the effects were negligible. Between 30 and 50 atmospheres the percentage of eggs achieving division fell rapidly to zero. Ten per cent. of the eggs had their division stopped at 33 atmospheres and 90 per cent. at 39 atmospheres.—M. **Bridel**: The action of emulsin on galactose in solution in propyl alcohol of different concentrations.—E. **Kayser**: The influence of uranium salts on nitrogen fixation. A study of the effect on addition of uranium salts on the growth of *Azobacter agile* in glucose and mannite culture media.—R. **Anthony** and C. **Champy**: The reptilian form of the spermatozoid of *Manis javanica* and its signification.—R. **Hovasse**: The parthenogenetic activation of the eggs of *Rana temporaria* in hypotonic and hypertonic media.—C. **Lebailly**: Bovine aphthous fever is not transmissible to man; human aphthous stomatitis is not transmissible to cattle.—M. **Mirande**: Lathyrism, or the intoxication produced by vetch-seeds. The seeds of *Lathyrus sativus* and *L. cicera* have been proved to be poisonous to horses. The ground-up seeds, moistened with water, undergo a spontaneous fermentation and sulphuretted hydrogen is evolved. The poisonous action of the seeds is most probably due to the evolution of this gas in the stomach.

Books Received.

Priestley in America, 1794–1804. By Edgar F. Smith. Pp. v+173. (Philadelphia: P. Blakiston's Son and Co.) 1.50 dollars net.

How to Teach Agriculture: A Book of Methods in this Subject. By Prof. Ashley V. Storm and Dr. Kary C. Davis. Pp. vii+434. (London: J. B. Lippincott Co.) 12*s*. 6*d*. net.

Geography: Physical, Economic, Regional. By James F. Chamberlain. (School Text Series.) Pp. xviii+509. (London: J. B. Lippincott Co.) 15*s*. net.

Practical Geometry for Builders and Architects. By J. E. Paynter. (Directly-Useful Technical Series.) Pp. xii+409. (London: Chapman and Hall, Ltd.) 15*s*. net.

The Elements of Direct Current Electrical Engineering. By H. F. Trewman and G. E. Condliffe. Pp. vii+219. (London: Sir I. Pitman and Sons, Ltd.) 7*s*. 6*d*. net.

Bibliographie des Séries Trigonométriques: avec un Appendice sur le Calcul des Variations. By Maurice Lecat. Pp. viii+168. (Louvain: M. Lecat.)

Engineering Electricity. By Prof. Ralph G. Hudson. Pp. viii+190. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12*s*. 6*d*. net.

Logic. By W. E. Johnson. Part i. Pp. xl+255. (Cambridge: At the University Press.) 16*s*. net.

Abridged Callendar Steam Tables: Fahrenheit Units. By Prof. H. L. Callendar. Pp. 8. (London: E. Arnold.)

Abridged Callendar Steam Tables: Centigrade Units. By Prof. H. L. Callendar. Pp. viii. (London: E. Arnold.)

The Hilger Interferometer for Measuring the Aberration of Camera Lenses. Pp. 25. (London: Adam Hilger, Ltd.)

Rules of Golf, as approved by the Royal and Ancient Golf Club of St. Andrews, September 28, 1920. In force as from May 1, 1921. Pp. xiii+36. (London: Royal Insurance Co., Ltd.)

Impressions and Comments. By Havelock Ellis. Second Series, 1914–1920. Pp. 248. (London: Constable and Co., Ltd.) 12*s*.

The Age of Power: A First Book of Energy, its Sources, Transformations, and Uses. By J. Riley. Pp. viii+248. (London: Sidgwick and Jackson, Ltd.) 4*s*. net.

String Figures. By W. W. Rouse Ball. Second edition. Pp. 69. (Cambridge: At the University Press.) 2*s*. 6*d*. net.

The Chemists' Year Book, 1921. Edited by F. W. Atack. Vol. i. Pp. vi+422. Vol. ii. Pp. vii–viii+423–1142. (Manchester: Sherratt and Hughes.)

The Mneme. By Richard Semon. Pp. 304. (London: G. Allen and Unwin, Ltd.; New York: The Macmillan Co.) 18*s*. net.

A History of Psychology. By Prof. George S. Brett. (Library of Philosophy.) Vol. ii.: Mediæval and Early Modern Period. Pp. 394. Vol. iii.: Modern Psychology. Pp. 322. (London: G. Allen and Unwin, Ltd.; New York: The Macmillan Co.) 16*s*. net each vol.

Insanity and Mental Deficiency in Relation to Legal Responsibility: A Study in Psychological Jurisprudence. By Dr. William G. H. Cook. Pp. xxiv+192. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co.) 10*s*. 6*d*. net.

Idromeccanica Piana. By Prof. Umberto Cisotti. Parte prima. Pp. xii+152. (Milano: Libreria Editrice Politecnica.) 24 lire.

The First Assembly: A Study of the Proceedings of the First Assembly of the League of Nations. Edited by Oliver Brett. Pp. viii+277. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*. net.

Simple Lessons on the Weather: For School Use and General Reading. By E. Stenhouse. Pp. viii+135+xii plates. (London: Methuen and Co., Ltd.) 4*s*.

The Physical Society of London. Proceedings. Vol. xxxiii., part iii. (London: Fleetway Press, Ltd.) 6*s*. net.

Der Bau der Erde. By Prof. Leopold Kober. Pp. iv+324+2 Tafeln. (Berlin: Gebrüder Borntraeger.) 80 marks.

The Diseases and Pests of the Rubber Tree. By T. Petch. Pp. x+278+vi plates. (London: Macmillan and Co., Ltd.) 20*s*. net.

The Elements of Vegetable Histology. By Prof. C. W. Ballard. Pp. xiv+246. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 18*s*. net.

A First Course in Statistics. By D. Caradog Jones. Pp. ix+286. (London: G. Bell and Sons, Ltd.) 15*s*. net.

The New Stone Age in Northern Europe. By Prof. John M. Tyler. Pp. xviii+310. (London: G. Bell and Sons, Ltd.) 15*s*. net.

Elementary Algebra. By C. V. Durell and R. M. Wright. (Cambridge Mathematical Series.) Part ii. (with Answers). Pp. xxiii+253–551+xlvii–lxxxv. (London: G. Bell and Sons, Ltd.) 5*s*. 6*d*. net.

Gynecology. By Dr. Brooke M. Anspach. Pp. xxvi+752. (London: J. B. Lippincott Co.) 42*s*. net.

A Sketch-Map Geography: A Text-Book of World and Regional Geography for the Middle and Upper School. By E. G. R. Taylor. Pp. viii+147. (London: Methuen and Co., Ltd.) 5*s*.

Le Règlement d'Avaries du Grand Abordage. By René E. Bossière. Pp. 36. (Paris: Rousseau et Cie.)

Diary of Societies.

THURSDAY, MAY 26.

INSTITUTION OF GAS ENGINEERS (at Institution of Civil Engineers), at 10 a.m.

ROYAL HORTICULTURAL SOCIETY (at Chelsea), at 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—E. Law: The Architecture and Art of Hampton Court Palace. II. In Stuart and Later Times.

ROYAL SOCIETY, at 4.30.—Sir Alfred Ewing: The Atomic Process in Ferro-magnetic Induction.—C. D. Ellis: The Magnetic Spectrum of the β-rays excited by the γ-rays.—S. Datta: The Spectra of the Alkaline Earth Fluorides and their Relation to Each Other.—Dr. W. L. Balls: A Simple Apparatus for Approximate Harmonic Analysis and for Periodicity Measurements.—Dr. G. R. Goldsbrough: The Influence of Satellites upon the Form of Saturn's Ring.—Dr. H. Jeffreys: Certain Geological Effects of the Cooling of the Earth.—T. Kikuchi: The Moving Striations in a Neon Tube (title only).

INSTITUTE OF PATHOLOGY AND RESEARCH (at St. Mary's Hospital, Paddington), at 4.30.—Dr. J. A. Murray: Aims and Progress of the Experimental Study of Cancer.

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place), at 6.—A. Johnsen and K. Rahbek: A Physical Phenomenon and its Application to Telegraphy, Telephony, etc.

CONCRETE INSTITUTE (Annual General Meeting), at 7.30.—L. S. White: Land Subsidence and its Effects on Concrete and other Structures.

ROYAL SOCIETY OF MEDICINE (Urology Section) (Annual General Meeting), at 8.30.—V. Z. Cope: Genito-urinary Symptoms in Acute Appendicitis.

FRIDAY, MAY 27.

ROYAL SOCIETY OF ARTS (Indian and Colonial Sections), at 4.30.—Sir Charles H. Bedford: Industrial (including Power) Alcohol.

PHYSICAL SOCIETY OF LONDON (at University College), at 5.—The General Electric Co. (communicated by C. C. Paterson): A Method for the Micro-analysis of Gases by the Use of the Pirani Pressure Gauge.—H. Pealing: The Reflection of the K-ray Spectrum of Palladium from Fluorspar.—Sir W. H. Bragg: The Intensity of X-ray Reflection by Diamond.—Exhibits of Crystal Models, and of Photographs by the Duc de Broglie of β-ray Spectra produced by X-rays.

ROYAL BOTANIC SOCIETY OF LONDON, at 5.15.—E. Law: Shakespeare's Garden, as it was, is now, and is to be.

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section)

(Annual General Meeting), at 5.30.—Dr. H. Thursfield: The Diagnosis of a Case of Renal Calculus in a Child.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—J. G. Graves: The World's Money System.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—S. A. Stigant: Notes on Electrical Transformer Breakdowns.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section) (Annual General Meeting), at 8.30.—Dr. R. J. Reece: Some Observations on the Occurrence of Cow-pox and Human Cases in Connection Therewith.—Dr. F. R. Blaxall: Some Notes on the Preparation of Vaccine Lymph at the Government Lymph Laboratory.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—A. Mallock: Elasticity.

SATURDAY, MAY 28.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. Legge: Gnosticism and the Science of Religions. II.

MONDAY, MAY 30.

SURVEYORS' INSTITUTION (Annual Meeting), at 5.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall) (Anniversary Meeting), at 5.30.

ROYAL SOCIETY OF ARTS, at 8.—Sir Kenneth Weldon Goadby: Immunity and Industrial Disease.

NATIONAL UNION OF SCIENTIFIC WORKERS (in Botanical Theatre, University College), at 8.—Chairman: Viscount Haldane.—Prof. L. Bairstow: The Administration of Scientific Work (followed by a Discussion).

TUESDAY, MAY 31.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir James Frazer: Roman Life: Time of Pliny the Younger.

FARADAY SOCIETY (at Chemical Society), 4.30-6.30 and 8-10.30.—Discussion on Physico-chemical Problems Relating to the Soil.—Dr. E. J. Russell: A General Survey of the Subject.—B. A. Keen: The System Soil—Soil Moisture.—Prof. D. R. Hoagland: The Soil Solution in Relation to the Plant.—Dr. C. A. Shull: Activity and Imbibition in Relation to Soil Moisture.—H. J. Page: The Part Played by Organic Matter in the Soil System.—Prof. Sven Oden: The Application of Physico-chemical Methods to the Study of Humus.—Dr. E. J. Salisbury: The Vertical Distribution of Soil Acidity in Natural Soils and its Relation to the Organic Constituents.—E. A. Fisher: The Phenomena of Absorption in Soils: a Critical Discussion of the Hypotheses Put Forward.—E. M. Crowther: Soil Acidity in its Physico-chemical Aspects.—C. G. T. Morison: Pan Formation.—Prof. Sven Oden: The Clays as Disperse Systems.—N. M. Comber: The Mechanism of Flocculation in Soils.—Dr. J. W. Mellor: Plasticity of Clay.—G. W. Robinson: The Physical Properties of the Soil in Relation to Survey Work.

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place), 5.—Annual General Meeting. 5.45.—Special General Meeting. At 6.30.—Ordinary Meeting. Dr. F. B. Jewett: Research Work in the United States.

ROYAL SOCIETY OF MEDICINE, at 5.—General Meeting of Fellows.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Dr. C. T. Holland: The Snow and Ice Scenery of Switzerland.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.

ILLUMINATING ENGINEERING SOCIETY (Annual Meeting) (at Royal Society of Arts), at 8.15.—J. S. Dow: The Use of Artificial Light as an Aid to Various Games and Sports.

WEDNESDAY, JUNE 1.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 5.30.—C. A. Pannett: The Treatment of the Imperfectly Descended Testicle.—Dr. A. Goodman Levy: Cardiac Massage.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—F. F. Beach, T. E. Needs, and E. Russell: The Composition of Egg Powder.—N. Evers: The Colorimetric Method of Determining Hydrogen-ion Concentration: Some Uses in the Analytical Laboratory.—F. R. Dodd: The Estimation of Woody Fibre in Cattle Foods.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

THURSDAY, JUNE 2.

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Summer Meeting), 2.30 to 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Alexander C. Mackenzie: Beethoven.

INSTITUTE OF PATHOLOGY AND RESEARCH (at St. Mary's Hospital), at 4.30.—Prof. G. Dreyer: A New Departure in the Serum Diagnosis of Syphilis.

ROYAL SOCIETY, at 4.30.—Dr. T. M. Lowry and Dr. C. P. Austin: Optical Rotatory Dispersion (The Bakerian Lecture).

LINNEAN SOCIETY, at 5.—Prof. Garstang and Others: Discussion on Biogenetic Law (Recapitulation).

CHEMICAL SOCIETY, at 8.—H. King: Derivatives of Sulphur in Commercial Salvarsan. Part I.—S. Glasstone: Physical Chemistry of the Oxides of Lead. Part I. The Solubility of Lead Monoxide.—M. O. Forster and W. B. Saville: Studies in the Camphane Series. Part XXXIX. *p*-Aminophenylaminocamphor (Camphoryl-*p*-phenylenediamine).—K. Stratton and J. R. Partington: Latent Heats of Fusion. Part I. Benzophenone, Phenol, and Sulphur.—G. T. Morgan and H. D. K. Drew: Researches on Residual Affinity and Co-ordination. Part V. Gallium Acetylacetone and its Analogues.—J. C. Thomlinson: Analysis of Cresol Disinfectants.—G. T. Morgan and D. Webster: Diazo-derivatives of 4-aminophenyl-4′-methylbenz-2′:7′-thiazole (Dehydrothio-*p*-toluidine).—A. K. Macbeth and D. D. Pratt: The Labile Nature of the Halogen Atoms in Substituted Nitromethanes.—K. G. Naik: The Formation and Properties of Dithioketones ($R_2C:S:S$) and Dithioethers ($RS:S$). Part II.—K. G. Naik: The Formation and Properties of Dithioketones ($R_2C:S:S$) and Dithioethers ($R_2S:S$). Part III. Interaction of Sulphur Monochloride with Organic Compounds containing the grouping

—CO—CH_2—CO—CH_2—CO—.

K. G. Naik: The Formation and Properties of Dithioketones ($R_2C:S:S$) and Dithioethers ($R_2S:S$). Part IV. Interaction of Sulphur Monochloride with Organic Compounds containing —CO—CH_2—CO— grouping, forming the Part of a Closed Ring.—K. G. Naik: The Formation and Properties of Dithioketones ($R_2C:S:S$) and Dithioethers ($R_2S:S$). Part V. Nitration of Dithioketones and Dithioethers.—K. G. Naik: Interaction of Sulphur Monochloride with Organic Acid Amides.—S. J. Lewis and F. M. Wood: A New Adjustable Thermostat for all Temperatures between 0° and 100°.—H. Burton and J. Kenner: The Influence of Nitro-groups on the Reactivity of Substituents in the Benzene Nucleus. Part III. The Partial Reduction of the Dinitrotoluenes by Stannous Chloride and Hydrochloric Acid.—J. Kenner and E. Witham: The Influence of Nitro-groups on the Reactivity of Substituents in the Benzene Nucleus. Part IV. The Condensation of Ethyl 3- and 5-nitro-*o*-Chlorobenzoates with Hydrazines.

FRIDAY, JUNE 3.

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Summer Meeting), 10 to 1.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science), at 2.30.—F. L. Engledow: Methods of Increasing Yield in Crop Plants.—C. B. Saunders: Some Problems of Seed Testing.—W. Brown: The Physiology of Infection.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—M. Adams: Eyes in Portraiture.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. L. Huxley: Chronicles of the Cornhill.

SATURDAY, JUNE 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. R. S. Rait: Scotland and France.

CONTENTS.