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Classics and Science.

LORD MILNER, in his presidential address to the Classical Association on January 6, made a notable declaration of the unity of educational purpose of classical and scientific studies. He pointed out that to the mind which had received real enlightenment there could be no antagonism between these two great branches of human knowledge. "All modern science had its roots in the classics, and, on the other hand, no man imbued with the spirit of the great classical writers could be lacking in respect for science or fail to recognise its supreme importance to the progress of mankind." Lord Milner went on to say:—

"I wonder what Plato and Aristotle, could they reappear among men to-day, would say to an education that was purely linguistic, even if the literature with which it occupied itself was the best ever known. Looking with wondering eyes on the achievements of science which had transformed the world since their day and given to man command over physical forces such as they had never dreamed of, would they not be seized with an intense desire to probe these marvels to the bottom, to know all about their causes, the methods and the steps by which such great results had been attained? And what would they think of a man who, living in the midst of these achievements, took no interest in them except in so far as they affected his personal convenience and well-being, enabling him to satisfy his wants cheaply, to travel with rapidity and comfort, to communicate in a few minutes with the uttermost ends of the globe, to escape suffering, avert disease, and even postpone the advent of death, and who never felt impelled to go more deeply into the matter and to learn something of the inner nature of the mysterious forces the discovery of which was so rapidly transforming the life of men upon this earth? Any Greek philosopher revisiting the world to-day would condemn such a man as a misfit—a creature unsuited to its environment."

With this conception of the close relationship between classical learning and scientific discovery most scientific workers will be in cordial agreement. The common enemies of both are ignorance, sordid commercialism, and general public indifference to intellectual light, whether it comes from the past or the present. There was a time when this was not so clearly recognised as it is to-day, and when classical scholars placed followers of experimental science among the barbarians. Tradition, method, social distinctions and professional prospects were then all on the side of the classics of Greece and Rome, and the most capable pupils were directed to the study of them and discouraged from devoting attention to modern scientific studies. It was claimed that instruction in classical languages was particularly valuable in developing accuracy, training reasoning powers, improving the memory, and cultivating all the faculties necessary to make the best use of life in any field. Psychologists have, however, destroyed the educational concept upon which this claim is based, and it is no longer believed that the exercise of the mind on one kind of material improves the faculty to deal with other kinds. No subject can therefore be put forward as affording unique general training in mental faculties or powers.

We are glad that Lord Milner did not base his plea for classical studies upon the grounds of the mental discipline secured through concentration upon the letter, but dealt rather with the spirit manifested in the literature and culture of ancient Greece and Rome and its guidance for life to-day. Whatever may have been the true source of Greek thought and discussion, whether intuitive or acquired, our own intellectual culture is unquestionably of Greek origin. While Latin was first taught as a medium of expression, and for use in the needs of life, Greek was studied for the knowledge to be gained through it. We do not hesitate to pay tribute to the brilliant genius of Ionian philosophy, the careful work of Hippocrates and his school, and the richness of the Alexandrian epoch. In the teaching of the Ionian school it is possible to find, as Prof. Gomperz has pointed out, two of the corner-stones of modern chemistry—the existence of elements and the conception of a single fundamental or primordial matter as the source of material diversity. Advanced views relating to the shapes and motions of bodies in the solar system were held at a very early date in Greek

history (though they were afterwards superseded by childish ideas), and the first phase of the history of thought upon organic evolution began with early Greek philosophers in the seventh century before the opening of our era, while its effects on Christian theology and Arabic philosophy were felt for more than two thousand years. Acquaintance with these and other achievements of Greek genius should be part of the intellectual equipment of every educated man, and the science student can find even more to admire in that wonderful age than can the purely literary scholar.

While, however, we hold the philosophers of Greek antiquity in highest honour, it must be confessed that the whole of Greek natural knowledge has little bearing upon the principles, methods, and practice of modern science. Scarcely a scientific work of to-day contains a reference to contributions to the subject by Greek philosophers, and their guesses or observations may be said to be disregarded by scientific discoverers generally. While the mathematician esteems the achievement of Euclid and the investigations of Archimedes, and the physician finds much to admire in the works attributed to Hippocrates, the chemist and experimental biologist are disposed to regard Greek speculation on their respective subjects as fruitless. Indeed, from the point of view of practical chemistry, it would be more reasonable to study Arabic literature than Greek. The creative genius of the early Greeks is undoubted, but its results are negligible in comparison with the work of modern science.

The value of acquaintance with Greek learning is not in the material knowledge itself, but in the spirit which created it. The Greeks possessed to a high degree the spirit of scientific curiosity and the desire to find a natural explanation for the origin and existence of things which is the ground motive of progress in science. The aim of Greek thought was the unification of disconnected knowledge. This laid the foundation of synthetic science, but carried with it the tendency to reduce natural phenomena to a rigid geometrical or logical system. It is possible that the modern science student would be all the better if given a trend in the same direction, as experimental inquiry alone is apt to be narrow and must be specialised. Even neglecting this philosophical aspect of science, the early Greeks manifested supremely the characteristics of true apostles of science. Passionate regard for truth, disinterested research, imagination, acute reasoning, and creative intelligence were the essence of the Greek spirit, and they are elements of the unalterable germ-plasm which transmits the scientific temper throughout the ages. Because inspiration and constructive thought are necessary to the student of natural knowledge, the writings of Greek philosophers cannot be neglected by him without detriment to his intellectual equipment.

It is the human side of Greek thought and action that the science student should know, and the scientific facts themselves are ancillary to it as a means of training. Science as studied in most schools is a spiritless performance and has not that contact with human nature required to make it appeal to most pupils. Attention to the history of great scientific discoveries may perhaps tend to counteract the conception of science as a mere repository of facts and a vocational study. Greek philosophy can usefully take an important place in such a course, but consideration must be given to the most appropriate stage at which to introduce it. It is now generally agreed that there should be no specialisation of studies below the age of about sixteen years, so that up to this stage all students should have formed the same foundations of a general education, including both the literary and the scientific elements. If the preliminary training thus received in classics enabled an average pupil to read original Greek texts by sixteen years of age, the value of this attainment to the student who then proposes to devote himself mainly to science cannot be doubted. As, however, such proficiency is rare, it would appear that the case for the teaching of Greek or Latin holds chiefly for those who propose to continue the study to an advanced stage, and that for students who propose to specialise in other directions preliminary instruction which is necessarily truncated serves no very useful purpose.

A subject of study should be considered as an instrument of service—mentally, morally, and materially—as a working part of the machinery of life. If the preliminary training in classics cannot reach this stage of attainment for science students, then obviously it would be better to absorb the spirit of Greece through translations than to spend time at what must prove a vain study so far as reading original texts with intelligence is concerned. No student who proposes to devote himself to science could hope to render Aristotle into English in the style of the translation now being published by the Clarendon Press under the editorship of Mr. W. D. Ross, or of Sir Arthur Hort's translation of the "Enquiry into Plants" from the Greek of Theophrastus published in the Loeb Classical Library, to mention two instances only. Whatever may be urged as to the value of the study of the classics to science students must refer chiefly to the substance of the best works in these languages, and that can be gained from translations.

Acquaintance with the Greek spirit through such means is much needed in science teaching when the age is reached at which a student can appreciate the systematising aspects of science. Early interest in science comes through wonder and delight in the intrinsic beauty and charm of natural phenomena, and is followed by interest in the use of the forces of Nature by man. With adolescence comes the power of appreciating systems of theoretical completeness and unity, and it is then that attention may usefully be turned to the thoughts of Greek philosophers. Young pupils are very rarely impressed by unifying principles and philosophical speculations whether placed before them in Greek or their own language. Their work in science is thus almost necessarily limited to acquaintance with perceptual phenomena, and conceptual ideas make little appeal to them. Similarly in historical studies striking episodes and dramatic events are more easily intelligible to immature minds than the constitutional or other causes which produce them. Probably a grammatical generalisation is more readily understood than a principle derived from laboratory measurements, and on that account pupils who have been trained to apply scientific method to language may be better prepared to take up the study of science seriously than one in whose mind there is nothing but loose ends. Whether Greek and Latin are essentially the most suitable languages for promoting this sense of law and order, as well as facility in the art of expression, is a matter of opinion. There may on these grounds be a value in preliminary training in classics to students who propose to devote themselves mainly to scientific pursuits, but there is so much in Greek science and philosophy that cannot be understood without acquaintance with natural knowledge that an even stronger plea can be made for training in science for those who intend to give their chief attention to classical studies.

The Hormone Theory of Heredity.

Hormones and Heredity: A Discussion of the Evolution of Adaptations and the Evolution of Species. By Dr. J. T. Cunningham. Pp. xx + 246 + 3 plates. (London: Constable and Co., Ltd., 1921.) 24*s*.

IT would be no exaggeration to say that holes could be picked in any theory of heredity as yet put forward. The problem is one of great difficulty and complexity, and when we think of the enormous number of qualities or "factors" conveyed in the minute space of an ovum, or still more in a single sperm-cell, it seems at first sight impossible to believe that all these qualities are "represented," rather than that the presence of certain of them, which might be called "key-factors," imply the development of numerous others. But, however this may be, the thought suggests itself that perhaps the knowledge we possess of the nature of protoplasmic structure and function is not yet sufficiently advanced to warrant the statement of any theory professing to be adequate. We are, indeed, in some doubt even with respect to certain fundamental facts. As will have been clear to readers of the correspondence in these columns, in which Sir Archdall Reid and others have taken part, the actual meaning of many of the terms used is in dispute.

It may be of use to attempt to express in a few words the main question at issue without using language of uncertain connotation. Suppose, then, that an organism is exposed to a new set of external conditions. Some forces or influences acting upon it are changed, and the effects produced in the organism, which we call its "reactions," are not the same as before. These reactions are, of course, conditioned by the nature of the organism itself, and may or may not be of such a kind as to be of benefit to it in adjustment to the new state of affairs. If they are so, they are sometimes called "adaptations." But this term is apt to suggest to certain minds a species of directing agency, and is best avoided. In any case, the length of life of such an organism will be dependent on its response to the changed conditions. Those organisms with the longer life naturally leave more offspring, which will be more like their parents than like the offspring of parents which have responded less favourably to the change in environment. The first-mentioned offspring will, therefore, respond to this changed environment in the same way as did their parents, and probably some of them, owing to the random shuffling of the material of the germ-cells, more favourably.

It will be seen that we are not justified in speaking of such a case as one of "inheritance of acquired characters." If the response in question were continued in the offspring after the altered environment had returned to its original or some other state, an alteration in the "germ-plasm" might be supposed to have been produced. But some difficulty arises here in respect of cases in which it appears that a change may be persistent for a few generations and that then reversion to the original mode may occur. Are such cases to be regarded as changes brought about in the germ-plasm? We note how difficult investigation is made by the length of time needed for the tests. Many researches are in progress at the present time, and

we may look for much light from them. The conviction seems to be growing that at all events a slow and gradual change in the germ-plasm may be produced by altered conditions, although the main lines of heredity may be determined by ancestral nature.

Many obscure facts have to be taken into account, and it is no wonder that the author of the book before us finds it an easy task to show how unsatisfactory are the various theories of heredity and variation that have been suggested. He therefore puts forward a new one, which appears to have taken its present form on account of the renewed attention attracted to the effect of the chemical products of one organ on the activity of another—on account of the discovery of the mechanism of pancreatic secretion by Starling and the present reviewer in 1902. The hypothesis that every tissue of the body gives off its own specific chemical product, and that this product has its effect to a greater or less degree on all other tissues, was put forward by Brown-Séquard and d'Arsonval as early as 1869, but was thrown somewhat into discredit by the uncritical use of it by the former. Dr. Cunningham gives the credit of the first suggestion to Claude Bernard in 1855, but we regret to have been unable to find the statement referred to. It would be of much interest to have the exact reference.

The hormone theory of heredity may best be given in the words of its propounder: "We have within the gonads numerous gametocytes whose chromosomes contain factors corresponding to the different parts of the soma, and these factors or determinants may be stimulated by waste products circulating in the blood and derived from the parts of the soma corresponding to them" (that is, to the determinants). Thus the effect of chemical products on any particular organ or tissue in the soma is to be supposed to be exercised in the same way on the "determinant" in the germ-cell which afterwards gives rise to such organ in the progeny. For example, the exostosis on the frontal bone of stags, formed as a result of repeated butting, would give off products, not necessarily different in kind from those of bone in general, but in increased amount, and thus stimulate the corresponding factors in the germ-cells.

While it would perhaps be rash to deny the possibility of a process of this kind, the objection might naturally be made that when applied to the inheritance of bodily structures in general, or of changes in them, it argues so enormous a variety of "hormones" as to seem almost incredible. Not only so, but the chemical product of each organ and tissue must act on the germ-plasm in a way which leads to the formation of a tissue like that by which the hormone was formed. In view of the difference between the structure and activity of the germ-plasm and those of the various constituents of the soma, are we justified in supposing that a particular chemical compound will affect both in the same way or even in a similar way? Moreover, waste products would be expected rather to have a retarding than a stimulating influence on similar reactions. But it might be held that the hormones in question are not waste products in the ordinary sense, and that the precise name is immaterial.

The possibility cannot be denied that, however inaccessible to nervous action the germ-plasm may be, it must be affected by chemical agents in the blood. Indeed, Stockard's experiments, to mention a single instance only, show that this is so with alcohol. But in such cases the effect is of a more or less generalised nature on the progeny, and the existence of tissue products of the kind demanded by Dr. Cunningham's theory is not yet demonstrated. As Prof. Swale Vincent has pointed out, it is remarkable how few "internal secretions" have actually been shown to exist as chemical individuals. Although it may savour too much of mysticism, it is open to question whether the original form of Dr. Cunningham's theory, in which "influences" were spoken of, might not be the more cautious and wiser one as yet. The loss of differentiation in the growth of tissues *in vitro*, except in the proximity of another tissue, no doubt indicates some kind of influence by one tissue on another. But the fact that this influence disappears when the new cells wander away into the culture fluid is difficult to reconcile with a chemical product.

Notwithstanding this objection, the theory must be given the credit of introducing functional or physiological considerations into the problem, as does the somewhat similar one of Delage. Most theories seem to be content with the purely structural view of rows of determinants in chromosomes and the shifting about of these. The difficulty in those theories which limit the transmission of hereditary characters to the chromosomes is that these exist as distinct entities only at the time of karyokinesis, while even the nucleus itself is but a part of the cell in functional relation with the whole. Whether the chromosome view is necessarily involved in Mendelian interpretations is subject to doubt, however significant the experimental facts may seem. Bateson appears to be unconvinced, and states that the results of such experiments have not solved the problem of adaptation, while Brachet has obtained evidence that the ovum, when fertilised after removal of the nucleus, can transmit characters of the female parent.

Dr. Cunningham appears to be justified in his complaint that, although his theory was published in 1908, later writers have put forward similar

views without reference to his work. In the book before us he includes a detailed account of his experiments on the origin of somatic sex-characters, and uses these as the main support of his theory. One must admit that explanation on other lines is extraordinarily difficult. The discussion of the origin of the scrotum on pp. 147 and 148 is of much interest, although, no doubt, objection may be taken to the view of its origin as a kind of traumatic hernia.

Space forbids detailed reference to the many other facts of importance brought forward, such as the difference between specific and adaptive characters, the origin of new dominants, the presence of useless characters, continuous and discontinuous variations, and so on. Loeb's "tropism" theories are adversely criticised. The facts and views put forward cannot be neglected by investigators of the problems of heredity, and the book as a whole requires careful consideration. It is of particular value in bringing to notice a theory which was previously known to an inadequate degree, and, although modifications will doubtless need to be made, the various facts and theories contained in the book must not be forgotten in the formation of a complete theory of heredity. Dr. Cunningham's theory has the undoubted merit of suggesting new forms of experiment, and everyone will agree with the opinion expressed on p. 64: "Further light on the sex problem, as in many other problems in biology, can only be obtained by more knowledge of the physical and chemical processes which take place in the chromosomes and in the relation of these structures to the rest of the cell."

W. M. BAYLISS.

Medicinal Chemicals.

Organic Medicinal Chemicals (Synthetic and Natural). By M. Barrowcliff and F. H. Carr. (Industrial Chemistry.) Pp. xiii + 331. (London: Baillière, Tindall, and Cox, 1921.) 15*s*. net.

IN writing this book Messrs. Barrowcliff and Carr had in mind the production of a critical compendium of methods for the manufacture of organic medicinal chemicals, which would be useful to teachers and to those occupied in research work in the industry itself. The idea was to restrict attention to those published processes which seem capable of industrial application and are therefore of first importance when improvements are under consideration.

It may be said at once that for the ends in view the volume leaves little to be desired. The information given is well selected and reasonably complete, though it clearly does not exhaust the authors' knowledge of the subject: the descriptions are clear and easy to follow.

Considerations of space are no doubt responsible for the brevity exhibited in some cases; thus, under pilocarpine there is no reference to the alkaloids which accompany it in jaborandi, though any attempt to make pilocarpine is sure, sooner or later, to bring the operator into contact with *iso*-pilocarpine. The authors have every excuse for not embarking on a critical *résumé* of the tangled chemistry of digitalis by way of introduction to their description of the manufacture of the various products which appear in commerce as active principles of this drug; nevertheless, there can be no question that such a *résumé* would have been useful. It should be added, however, that the authors have only themselves to thank if their readers prove exacting in such matters, because in most cases they have provided excellent summaries of the kind indicated, which serve to emphasise the few cases in which they are lacking.

The subjects dealt with are grouped for the most part according to therapeutical applications—*e.g.* anæsthetics, narcotics, analgesics—though this arrangement is departed from when it is more convenient to group together a series of related substances such as the naturally occurring alkaloids and organo-metallic compounds. As already indicated, little that is essential has been omitted, but it might have been a good plan to refer quite briefly at the end of each section to any particularly promising drugs suggested by recent investigations. Thus, under local anæsthetics, mention might have been made of benzyl alcohol and certain of its homologues and derivatives, since these are already coming into use, at any rate in the United States, as a result of the work of Macht and his collaborators.

A drug which is not referred to, but is of special interest at the present time, is santonin, for the plant from which it is made grows in Soviet Russia, and there also is the only factory producing the drug. The plant is, however, now being grown experimentally in the United States, and a possible new source of supply has been found in India. Santonin is one of the best-known anthelmintics, a group of drugs which merits more attention than has been given to it by British chemists. The British Empire probably possesses among its coloured populations in the tropics more victims of hookworm, to mention only one of this group of parasites, than any other country, with the possible exception of China, and, like China, it is largely dependent on public-spirited citizens

in the United States for the distribution of suitable anthelmintics and the conduct of anti-hookworm campaigns within its borders. Processes for the preparation of these drugs are well-known, and the authors would be rendering a further service to their colleagues if they would add a section on anthelmintics when a new edition of their book is called for.

The volume is well produced, and contains a number of useful diagrams of plant and a good index. The proof-reading has been carefully done, and printers' errors are commendably few.

T. A. H.

Some New Text-books on Radio-telegraphy.

(1) *Wireless Telegraphy and Telephony: An Outline for Electrical Engineers and Others.* By L. B. Turner. Pp. xii + 195 + 24 plates. (Cambridge: At the University Press, 1921.) 20*s.* net.

(2) *Thermionic Tubes in Radio-Telegraphy and Telephony.* By John Scott-Taggart. Pp. xxiii + 424. (London: The Wireless Press, Ltd., n.d.) 25*s.*

(3) *Continuous Wave Wireless Telegraphy.* By Prof. W. H. Eccles. Part 1. Pp. vii + 407. (London: The Wireless Press, Ltd., n.d.) 25*s.* net.

(4) *Principles of Radio-Communication.* By Prof. J. H. Morecroft, assisted by A. Pinto and W. A. Curry. Pp. x + 935. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1921.) 45*s.* net.

(1) IT is a pleasure to come across a technical book, like that by Mr. Turner, which has the literary qualities of clearness, life, and continuity. In too many scientific text-books the manner is as cold as the matter is dead and already dissected; the parts are evident, but the whole is left to the constructive imagination of the reader. A book may be crammed with exact information, and yet be so unreadable as to have little value from the point of view of education. Even quite a slight historical framework adds human interest and may guide the student along the course of thought which resulted in discovery, and a text-book in which such a framework exists is therefore much more educative than one which merely states the physical facts, however accurately.

Unfortunately for the average student a sound knowledge of the mathematics of motion is required in the study of the production of high-frequency currents on account of the large number of variables involved, especially when the converter is a thermionic valve or an arc. Again, unfortunately, this branch of mathematics is known, in spite of Newton, by the entirely unilluminating and indeed repellent name of "the differential calculus." "Calculation by differences" does not suggest motion any more than "bits of iron" would suggest a locomotive, and it is doubtful if the would-be engineer realises that in avoiding this unpleasantly named subject as much as possible he is debarring himself from the most interesting and useful branch of mathematics. Could not mathematical teachers make the learning of the laws of motion more interesting than the study of geometry in the same ratio as a kinema is more attractive than a photograph?

In the books under review mathematics are freely used except in (2) Mr. Scott-Taggart's "Thermionic Tubes," which is quite an encyclopædia of types and circuits, but does not enter deeply into exact theory, although the graphical explanations are very useful. Mr. Turner has the happy knack of working his equations so naturally into the text that the deductions which he makes from them are almost self-evident, and although his book contains only 190 pages, there is but little that could be added with advantage to the outline which he has set himself to give. An interesting personal opinion is given on p. 11, where he says he can derive no satisfaction from the usual semi-Hertzian diagram of wave radiation over a conducting surface; but why should Dr. Howe's model, in which an inverted conducting cone with its apex at the transmitter is substituted for the upper atmosphere, be any simpler? It merely evades the question of where the lines go in space, and neglects the fact that aircraft experiments indicate that their directions are probably such as are shown in the Hertzian diagram. The expression of the opinion, however, shows the perfect honesty with which Mr. Turner treats his readers.

The other books are different in scope and style. (3) Dr. Eccles's is a first volume only and is devoted to the theory of electromagnetic induction and conduction on metallic circuits and vacuum tubes; both branches of the subject are treated clearly and in great detail, and a sound basis is laid for a thorough understanding of the technical applications which will presumably form the greater part of his second volume.

(4) Few, if any, books on radio-telegraphy have covered so many details of the subject as Prof. Morecroft's "Principles of Radio-Communication," and there is little connected with the functions of radio-gear which he does not touch upon.

A good deal of original matter is incorporated in the book, and, as the author says in his preface, much on which further experiment may be based. The descriptions of instruments and the theories of their actions are clear, but though the text is, on the whole, quite simply written, the mass of material is somewhat overwhelming, and one cannot help feeling that this is due, at least in part, to the space given to certain sections being out of proportion to their importance. It is a pity that the appearance of the book is marred by the very careless printing of the many half-tone blocks with which it is illustrated.

It is rather remarkable that actual radio-telegraphic transmission from station to station is dismissed in these text-books in a very few pages; in fact, their subject is rather radio-telegraphic instruments than radio-telegraphy. Atmospherics and their elimination, the laws of the transmission of power, the causes of distortion of wave fronts, and the relative telegraphic efficiencies of various methods, are the most important problems in radio-telegraphy to-day, and their solution is incomparably more urgent than that of any question of purely instrumental theory.

Our Bookshelf.

The New Physics. By Dr. A. C. Crehore. Pp. xii+111. (San Francisco: *Journal of Electricity*, 1920.) 2 dollars.

OBJECTION may be raised against the title of this book, on the grounds that it has been used before, and that it seems to imply an exaggerated sense of the importance of the views therein expressed. The physical dimensions of electric and magnetic quantities are first discussed, and the author, rightly we think, emphasises the importance of retaining the specific inductive capacity, k, and the permeability, μ, in the equations. He supposes that k may be considered as the reciprocal of a velocity, and Maxwell's relation then automatically determines μ as a quantity of the same kind. This gives a single system of units for all quantities in terms of length, mass, and time, electric and magnetic charges appearing as quantities of the same dimensions. Dr. Crehore's next step is far more questionable—he assumes that the dimensions of mass are those of a velocity. We cannot attach much importance to the first of the "two equally forceful reasons" he advances in support of this assumption. His new expression for Planck's constant may be the result merely of a numerical coincidence. His second reason is based on the gravitational equation which he has developed, but this equation has been criticised, and must be considered as still *sub judice*. As a literary production the book cannot be commended, and the habit of stating results "in advance of the narrative" tempts one to suggest that it should be read backwards.

Fermat's Last Theorem: Proofs by Elementary Algebra. By M. Cashmore. Third edition. Pp. 67. (London: G. Bell and Sons, Ltd., 1921.) 2*s.* 6*d.* net.

THE first attempt to prove Fermat's last theorem contained in this edition repeats a fallacy to which attention has already been directed in NATURE, Oct. 30, 1919. On pp. 18, 21, "quantities" t and u are defined, and it is assumed that these quantities are integers, which is not generally the case. In the second attempt there is a fallacy, pp. 34–35, relating to the divisibility of numbers. The pamphlet ends with a version of Barlow's attempt to prove the last theorem, taken from the 1811 edition of his "Theory of Numbers." Barlow's attempted proof contains a well-known fallacy, which need not be pointed out here.

In view of the considerable erroneous literature concerning Fermat's last theorem it may not be out of place to direct attention to two valuable additions to the correct literature which have appeared since the last edition of Mr. Cashmore's book was reviewed in NATURE. They are: (1) Mr. L. J. Mordell's "Three Lectures on Fermat's Last Theorem," and (2) a chapter in vol. 2 of Prof. L. E. Dickson's "History of the Theory of Numbers." W. E. H. B.

The Physical Properties of Colloidal Solutions. By Prof. E. F. Burton. Second edition. (Monographs on Physics.) Pp. viii+221. (London: Longmans, Green and Co., 1921.) 12*s.* 6*d.* net.

THE second edition of this work conforms in general to the plan of the first, *i.e.* it gives an account of the properties of suspensoid sols from the point of view of the physicist. The Brownian movement and the electrical phenomena accordingly claim the largest share, while the optical properties of small particles are also treated with unusual fulness. The rather difficult investigations dealing with these matters are summarised with great skill and lucidity. Apart from some omissions—among which the X-ray analysis of colloidal particles, Pauli's work on the effect of radiation, and Ostwald's on the protection of Congo-rubin sols must be mentioned—all important advances made since 1914 have been embodied in the present edition. This applies specially to the gradual breaking down of all "valency rules" in electrolyte coagulation. The book is excellently produced, and will be welcome to all serious students of the subject.

An Introduction to Organic Chemistry. By D. Ll. Hammick. Pp. viii+258. (London: G. Bell and Sons, Ltd., 1921.) 6*s.*

MR. HAMMICK'S book provides an introduction to organic chemistry suitable for junior students, and not differing in any notable way from numerous other books of similar standard. Experiments are described.

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.]*

Chemical Warfare.

SIR EDWARD THORPE, in his review of Victor Lefebure's book, "The Riddle of the Rhine," in NATURE of November 10, p. 331, quotes a passage which deals with my own work during the initial stages of the war, and that of the Kaiser Wilhelm-Institut für Physikalische Chemie, of which I am the principal. The intention is to make the world believe that the materials for gas warfare were prepared by the German military authorities and chemical industry for the intended war, and that experiments with this end were carried out in my institution, if not previous to the war, at least from August, 1914, onwards.

It is always dangerous to attempt to form a correct estimate of the intentions of others from the traces of events they have left behind them. But the greatest errors must necessarily arise if an outsider tries to deduce from his own impressions the intentions of men whose ways of thinking he does not know and cannot understand.

Perhaps there might have been some ground for suspicion if Germany could have foreseen the trench warfare, and if we could have imagined that the German troops could ever be held up for weeks and months before the enemy's wire entanglements. But previous to the war, and up to the Battle of the Marne, everyone in Germany imagined that the course of the war would be a succession of rapid marches and great pitched battles, and what use would gas have been to a field army in such a war of movements? I think I may safely say that during the course of the war I became acquainted with every man of any importance in the army, in industry, and in science, who had anything to do with chemistry as applied to military offensive and defensive operations, and that I am well informed regarding the development and the course of chemical warfare. Yet among all these men I have never met one who, previous to the war or during the first two months of its course, had conceived the idea of providing the field army with gas, or had made experiments or preparations for such a purpose. We had actually first to read in the French, Italian, and English Press—as, for instance, in the *Pall Mall Gazette* of September 17, 1914—of the terrible things that were in preparation for us before we began to make similar preparations in view of the commencement of the war of position.

As regards my own institution and its work during the first months of the war, that intelligent person who, according to the passage in Lefebure quoted by Sir Edward Thorpe, observed my activities in my institute from behind a wall, lacked the gift of interpreting correctly what he saw and heard. Visitors in grey Headquarters motors did indeed come to my institution in August, 1914, though not to see me upon the subject of chemical means of warfare, but because Headquarters were very anxious to know how motor spirit could be made proof against the cold of a Russian winter without the addition of toluol. The question of gas as means of warfare did not begin to engage our attention until the first three months of war had passed.

In war men think otherwise than they do in peace, and many a German during the stress of war may have adopted the English maxim, "My country, right or wrong," but that German science and industry before the war made preparations with deliberate intent for gas warfare against other nations is an assertion that, in the interest of the necessary interdependence of the nations in the realms of science and industry, must not be allowed to go uncontradicted in so serious and respected a journal as NATURE.

F. HABER.

Kaiser Wilhelm-Institut, Berlin-Dahlem,
December 17.

HERR GEHEIMRAT HABER takes exception to the quotation I made from Major Lefebure's "Riddle of the Rhine," in the course of my notice of that book, on the ground that it implies that the German military authorities were prepared to ignore their undertaking, under the Hague Convention, to abstain from the use of asphyxiating or deleterious gases in war, if not for some time before, at least at its outbreak in the summer of 1914. I have, of course, no precise knowledge of the intentions of the German military authorities, but it was not unreasonable to surmise that these authorities, who deliberately intended to violate the treaty with Belgium, would not hesitate—as, indeed, the sequel showed—to disregard their promise under the Hague Convention if and when it suited their purpose to do so.

As regards their intentions, Field-Marshal Lord French, in his dispatch after the first German gas attack, with which Prof. Haber was concerned, wrote: "The brain-power and thought which has evidently been at work before this unworthy method of making war reached the pitch of efficiency which has been demonstrated in its practice shows that the Germans must have harboured these designs for a long time."

"It is an arresting thought," says Major Lefebure, "that even as early as 1887 Prof. Baeyer, the renowned organic chemist of Munich, in his lectures to advanced students, included a reference to the military value of these compounds"—*i.e.* to substances intended to produce temporary blindness.

Prof. Haber, it will be observed, does not explicitly deny the accuracy of the statements made by the "neutral," as quoted by Major Lefebure. Indeed, the account is too definite and specific to be set aside by irrelevancies. It is probably true that "everyone in Germany imagined that the course of the war would be a succession of rapid marches and great pitched battles." Some people on this side of the Channel were of a different opinion. But even the vain imaginings of "everyone in Germany" were not necessarily inconsistent with the use of poison gas. It was used on the Eastern front by the Germans when there was little or no question of trench warfare or wire entanglements. Prof. Haber states that he never met a single person who previous to the war or during the first two months of its course had conceived the idea of providing the army with gas. "The question of gas as a means of warfare did not begin to engage our attention until the first three months of war had passed."

The first gas attack was launched in April, 1915, so that on Geheimrat Haber's own showing this method of conducting war was engaging attention at least six months before it was used. After all, the essential point is that it was used, and first used, by the Germans, and in flagrant contravention of a solemn promise given to the world; at what precise

period they decided to be false to their obligation is a matter of secondary moment.

The implication that the Allies were contemplating the use of poison gas as early as September, 1914, is so notoriously at variance with truth that it scarcely needs serious refutation. If Geheimrat Haber could only have been present when Lord Kitchener made his dignified protest in the House of Lords, or have been a personal witness of the wave of indignation and disgust which swept over the country at the Germans' breach of the rules of war, he would not have penned his statement. We were made aware of the rumours that were being spread through the German Press, but no credence was attached to them in this country. The German Empire, even to the last, had its "reptile Press" as in the days of the Iron Chancellor. The author of the Ems telegram was an adept in the art of circulating false rumours and misleading statements, and there were those who sought to better even his example during the fateful and, for the Germans, disastrous years of the war. Even now Germany does not know half the truth.

I agree with Prof. Haber that in war-time men are apt to think otherwise than they do in peace, and this is, doubtless, particularly true of his countrymen. Their ethical standard, apparently, varies with the two conditions—which seems a sufficient reason why they should abstain from war. Those who use poison gas are not "bonnie fechters."

The menace of the continued use of poison gas in warfare is a disgrace to civilised humanity. That menace really rests with Germany. If she would undertake for the future to be true to her obligation under the Hague Convention other nations would willingly follow her example.

They were reluctantly compelled to follow it in consequence of her action at the Battle of Ypres. They would far more promptly follow her lead if she announced her intention to discontinue the practice and gave the world a sufficient assurance of good faith.

Prof. Haber could render no greater service to civilisation and humanity than to use his great influence and pre-eminent position as a man of science in inducing his fellow-countrymen to remove what is a stigma upon their *Kultur*.

T. E. THORPE.

Some Problems in Evolution.

I AM quite as averse from "wasting time in endless and futile controversy" as Prof. Goodrich, but I cannot help thinking that so long as he and Sir Archdall Reid refuse to admit what seem to most biologists obviously true statements their arguments must be answered. Prof. Goodrich states in NATURE of December 22 last that there is no contradiction between his proposition that characters, whether new or ancient, may be inherited provided they are possessed by both parents, and my reply that a character may be inherited when it is apparent only in one parent or in neither. If we omit what is common to both of these propositions it follows that in Prof. Goodrich's opinion there is no difference between "both parents" on one hand and "one or neither parent" on the other.

Prof. Goodrich complains that I do not distinguish between the variation and the resulting character. In his presidential address he maintained that the word "variation" should mean the extent or degree of difference between individuals, not a new character or assemblage of characters, such as a colour or spot on a butterfly's wing, but a difference which can be measured or estimated. "We shall then find," he writes, "that a variation is either due to some change in the complex of germinal factors or to some change in the complex of effective environmental stimuli." Here Prof. Goodrich and I are in complete agreement. Where, then, is any difference of opinion or room for controversy? The difficulty reappears in the next paragraph of Prof. Goodrich's letter, in which he states that he agrees with Sir Archdall Reid that there are two kinds of variation but only one kind of character.

Although I have honestly tried to do so, I fail to see any meaning in this statement. After all, words and terms are seldom completely satisfactory expressions of what we mean; they obtain their meaning by actual or implied reference to facts of observation. I have lately been in the habit of using the term "character" more frequently than the term "variation," because the latter is often ambiguous, but I know of no such difference of meaning between the two terms as is assumed by Prof. Goodrich and Sir Archdall Reid. How can we define characters satisfactorily except by comparison—that is, as differences between one individual, or one type, and another? For example, the rose comb is a character of certain fowls as compared with the single comb. What do we gain by asserting that the difference between the rose comb and the single is a variation, but the peculiarity of the rose comb is a character? The only questions of importance are the origin and the heredity of the rose comb. We understand one another when we say that the rose comb is inherited. It is quite superfluous to insist, as Sir Archdall Reid does, that characters are not transmitted, but only predispositions. No one supposes at the present day that the fowl's egg or spermatozoon has a rose comb, but we know that there may be something, whether we call it determinant, factor, or gene, in egg or sperm which causes the rose comb to develop in the resulting organism. And yet Sir Archdall Reid argues as though it were a remarkable discovery that characters are not present as such in the fertilised ovum from which an organism develops—an idea that has been obsolete since the Middle Ages. Therefore, he asserts, there is only one kind of character, but there are two kinds of variation. The hoof of a new-born foal has developed without any external mechanical stimulus; when I practise rowing for some time I develop epidermic corns on the palms of my hands. According to Sir Archdall Reid, these are characters of the same kind, equally innate, acquired, and inherited. Yet he has himself insisted on the distinction between characters developed under the "stimulus of nutrition" and those developed under the "stimulus of use," the same distinction, with his own peculiar misuse of the word *stimulus*, which is generally recognised by biologists.

Avoiding altogether the use of the terms "variation" and "character," we may congratulate ourselves that there is agreement on the proposition that a difference of form or structure may be due either to a difference of germinal factors or to a difference in effective environmental stimuli. And then we can get on with the investigation of the problem of the relation to evolution of these structural differences.

But, as I have endeavoured to show elsewhere, among those characters which are more or less completely hereditary there are two kinds, in a vast number of cases definitely distinguishable: the adaptive characters on one hand and the non-adaptive on the other. The adaptive characters exhibit a definite relation to habits and external conditions, and, as a rule, they exhibit recapitulation in development. The

non-adaptive characters show no relation to differences of habit or environment, and, as a rule, develop directly without recapitulation. I have instanced the adaptive characters of Pleuronectidæ (flat-fishes) on one hand and their specific and generic characters on the other. The adaptive characters of flat-fishes exhibit one of the most remarkable cases of metamorphosis and recapitulation in the whole field of zoology, while the various peculiarities of the scales, as examples among specific and generic characters, show neither recapitulation nor any relation to habits and conditions of life. Thus, instead of agreeing that there is only one kind of character, I find it necessary to distinguish three kinds, one due to the effect of an external stimulus on the individual, and not apparently inherited, and two kinds which are hereditary. J. T. CUNNINGHAM.

Chiswick, December 31.

Optical Observation of the Thermal Agitation of the Atoms in Crystals.

ACCORDING to the theory of specific heats developed by Debye, Nernst, and others, the thermal energy of a solid is made up of the energy of elastic vibrations in its material, the frequencies of such vibrations ranging from very small values up to a maximum limit determined by the ultimate molecular or atomic structure. On this view it is clear that at ordinary temperatures the density of a solid, and therefore also its refractive index if it be of transparent material, would vary arbitrarily from point to point about its mean value. In other words, a transparent crystal cannot be regarded as optically homogeneous even with reference to the comparatively long waves which constitute ordinary light. It follows that a certain proportion of the energy of a beam of light traversing the medium would be deviated laterally and appear as scattered light, the intensity of such scattering being a measure of the thermal agitation within the crystal. That some such effect must occur has already been pointed out by Sir Joseph Larmor (*Phil. Mag.*, vol. 37, p. 163, 1919), but no theoretical discussion of its magnitude appears so far to have been put forward. It has occurred to the present writer that the effect to be expected may be found in the following way:—If the principles of statistical mechanics and the equipartition of energy were applicable in the case of solids, precisely the same considerations which determine the molecular scattering of light in fluid media would enter here as well, and the scattering coefficient would be given by the Einstein–Smoluchowski formula

$$\frac{\pi^2}{18}\cdot\frac{RT\beta}{N\lambda^4}\cdot(\mu^2-1)^2(\mu^2+2)^2,$$

where β is the compressibility of the solid, μ is its refractive index, λ is the wave-length of the light, and R, T, N are the constants of the kinetic theory. It is known, however, that the heat-content of solids at the ordinary temperature is much less than that indicated by the equipartition principle, the deficiency being most marked for substances, such as diamond, having a high "characteristic temperature." The scattering coefficient given by the preceding formula must therefore be diminished in the ratio which the actual heat-content at the temperature of observation bears to the heat-content indicated by the equipartition principle. This correction-factor may be found from the experimental data for the specific heats at low temperatures given by Nernst, Lindemann, and others.

Calculations made in the way indicated above show that transparent quartz should scatter light 9½ times as strongly as dust-free air at normal temperature and pressure. A scattering of approximately this magnitude in clear quartz was detected photographically by R. J. Strutt (now Lord Rayleigh) (Proc. Roy. Soc., vol. 95, p. 495, 1919), but was ascribed by him to inclusions which he assumed were present in the crystal. It is clear from what has been said above that the effect observed by him was actually due to the thermal agitation of the atoms in the crystal. The present writer has succeeded in demonstrating the scattering of light in clear quartz by direct visual observation. For this purpose a block of the crystal with smooth polished faces is immersed in a tank of clean distilled water to minimise surface-reflections and a converging lens is used to bring a beam of sunlight to a focus within the crystal. The blue track of the beam within the crystal may then be readily observed, and its intensity can be judged by comparison with the scattering of the beam in saturated ether vapour. The writer has had the pleasure of exhibiting the phenomenon to Sir W. J. Pope and other distinguished callers at his laboratory.

Transparent rock-salt which has a low characteristic temperature and shows a marked "Debye-effect" in experiments on X-ray reflection exhibits a very strong scattering of ordinary light. The increase of the scattering with rise of temperature may readily be observed with it. C. V. RAMAN.

210 Bowbazaar Street, Calcutta, November 19.

A Fossil Buttercup.

WHEN we examine a catalogue of fossil plants, such as that for North America recently published by Knowlton, we are struck by the enormous number of recorded species, and readily receive the impression that the flora of former ages is quite well known. It is only when we make a more critical investigation that we perceive the great gap in our present knowledge. We do, perhaps, know a fair proportion of the trees and deciduous-leafed shrubs of a number of geological periods, but when we look for the herbaceous flora the limitations of our knowledge at once appear. Thus the Ranunculaceæ, an extensive family in the present North American flora, do not furnish a single definitely recorded fossil in the same area. Dawson in 1875 vaguely referred to a Thalictrum, without specific name, supposedly from the Eocene, but it is not to be taken seriously. Schenk thought the fossil genus Dewalquea presented a certain analogy with Helleborus, but it is now referred to quite another family. It is, of course, impossible to suppose that the Ranunculaceæ were absent from North America during Tertiary times; they simply must have escaped preservation or observation. To those who would see in the geological record a proof that herbaceous plants did not exist in the past, or were extremely rare, we can only reply that the record as it stands proves too much. To accept it at its face-value postulates the impossible. The general proposition that the herbaceous flora is, *on the whole*, more recent than the woody may be valid, and has much to recommend it.

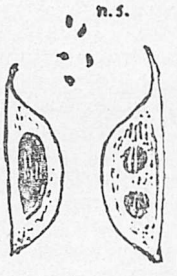


FIG. 1.—Achenes of *Ranunculus florissantensis*.

With regard to the Tertiary Ranunculaceæ of North America, we can fortunately rescue them from utter oblivion. Several years ago I found some slabs of Miocene shale at Florissant, Colorado, plentifully besprinkled with small dark fossil seeds. The exact locality is the railroad cut just east of the town.

These seeds were not studied at the time, but they are now seen to agree excellently with those of Ranunculus. They are, properly speaking, achenes, about 1·7 mm. long and 1 mm. broad, with a fairly long moderately curved beak. The general form approaches that of *R. pennsylvanicus*, but the achene is less robust. The fossil may be known as *R. florissantensis* n. sp. Ranunculus has a single seed in the achene. It has been definitely determined for *R. acris* at least that there is only one ovule. Our fossils, however, very distinctly show two, after the manner of Hydrastis. They were evidently small and dry at maturity, as in Ranunculus, and the most mature ones contain only one seed, dark and clearly outlined. It would be worth while to investigate the immature achenes of numerous species of Ranunculus to determine whether any start with two ovules, one aborting, as I have determined to be the case in Malvastrum. Heer has described a very similar Ranunculus seed (achene) from the Miocene of Oeningen in Baden.

T. D. A. COCKERELL.
University of Colorado, Boulder, Colorado,
December 8.

The Absorption of Fluorescing Sodium Vapour.

ACCORDING to Bohr's theory concerning the origin of spectral lines, electrons in the atoms of sodium vapour under the influence of exciting D radiation are displaced from their normal 1·5 S orbit to the $2p$ orbits. During the return of the electrons to their normal orbit the so-called "resonance" radiation, first observed by Wood (*Phil. Mag.*, November, 1905, and "Researches in Physical Optics," part 2, p. 166), is re-emitted as fluorescent light. It has been suggested, therefore, by more than one observer (Foote and Meggers, *Phys. Rev.*, vol. 15, part 4, p. 323, and *Phil. Mag.*, vol. 40, p. 80, 1920) that fluorescing sodium vapour should absorb lines of the first and second subordinate series $2p_{1/2} - ms$ and $2p_{1/2} - md$. To test this point I have

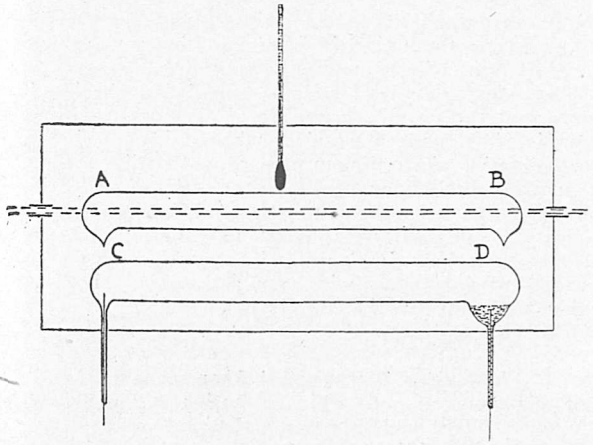


FIG. 1.

made use of the experimental arrangement outlined below. While a negative result was obtained, it seems worth while to record the trial, along with one or two suggestions for a more rigid test which I am not able to make at present.

A narrow beam of light from a Nernst lamp traversed the tube AB, some 25 cm. long, into which some sodium had been distilled in high vacuum (Fig. 1). By means of a lens the light was focussed on the slit of a Hilger constant-deviation spectroscope. Directly below the sodium tube was a sodium–potassium alloy "lamp" CD, a slight modification of the type recently described by Neuman (Proc. Phys. Soc. London, vol. 33, part 2, February 15, 1921). Both tubes were enclosed in an electric oven, by means of which they could easily be heated to 300° C. or higher. For two reasons it seemed to the writer that this lamp should be most suitable. In the first place, resonance can best be excited by very narrow spectral sources, and it had been shown that the light from the lamp consisted almost entirely of D lines of narrow width. Again, it could be operated at temperatures at which resonance is obtained in sodium vapour, so that it was possible to place the two tubes side by side in the same oven.

At temperatures ranging from 200° C. to 300° C., therefore, observations were made to see if there was any difference in the absorption spectrum when the exciting lamp was "on" and "off." The D absorption lines were easily visible, but not the slightest difference could be detected in the two cases. It is possible, however, that with an improved arrangement the absorption looked for might occur. The lines of the subordinate series most likely to be absorbed are the first members, which, however, are in the infra-red region and could not be observed visually. A much better test, therefore, would consist in photographing with dicyanine-stained plates in the hope of observing absorption of the doublet λ 8195 and λ 8184. Again, the intensity of the exciting light may not have been great enough to put a sufficiently large number of atoms in the desired state. This difficulty would be lessened by the use of two or three lamps, or possibly by adapting for use with sodium some such arrangement as was used by Füchtbauer (*Phys. Zeit.*, vol. 21, November 1 and 15, 1920) for observing resonance in mercury vapour. Finally, a longer absorption tube obviously would be more desirable. With improvements such as are suggested a much more rigid test could be made.

JOHN K. ROBERTSON.
Queen's University, Kingston, Canada,
December 17.

The Message of Science.

MR. W. ROBERTSON'S letter in NATURE of January 5 is very timely. May I invite him and those his letter has interested or impressed to put into practice, in Middlesbrough or any other town, the "most practical suggestion of immediate value" he describes, with one important addition. Some of us have recently been striving to get his suggestion, thus widened and clinched, made operative in other British centres of population on behalf of the British Science Guild, the objective of which comprehends the exact duty Mr. Robertson acclaims and the methods of which in a new campaign have been dictated by a lively sense of provincial and metropolitan needs in the harnessing of science to important public tasks.

Our methods begin just where those of so many other people leave off. We ask local scientific societies and organisations and all who desire to make their special scientific equipment of use to their times to establish touch at once with the important local organisations and groups in which business men, administrators, and the occupational classes gather, and with them to consider "the progressive connecting of science with individual and corporate conduct," not in general, nor on another continent, but in their own towns (where facts can be known and methods tested), and in any of the problems on which much public time and public money have inevitably to be spent. That suffices for a beginning.

Many are feeling to-day that science should become, and can become, the "chief formative factor of modern

life." It will not become anything of the sort of its own volition, as scientific workers are not usually interested in broad problems outside their own particular fields, and those who have to be forced into the work are best out of it.

Functioning best begins with a real task, however difficult, before the particular community, preferably the first task which involves large sums of money, large expenditure of time and of energy, and considerable risk to human life. These tasks exist in bewildering profusion. The knowledge, without which they cannot even be stated correctly, exists also, and the prize of efficient performance cannot be won apart from its application. With human contact and the common sense of an adaptable race, tasks and knowledge can approximate each to each, and the first step in the unity of purpose which science can best bring to national life may be taken to-day in any city of the country.

J. J. ROBINSON
(Secretary of the Parliamentary Committee of the British Science Guild).
6 John Street, Adelphi, London, W.C.2,
January 9.

Terrestrial Magnetic Disturbances and Sun-spots.

MAY I add a few remarks on Mr. Evershed's interesting letter on this topic (NATURE, December 29, p. 566), and supplementary also to my former letter (NATURE, October 27, p. 272). The protracted magnetic storm of May 12–21, 1921, after a lull on May 18, resumed an active phase on May 19–21. In my former letter I traced a sequence of magnetic disturbances, in connection with that of May 21, which extended to October 5. I may now add that the sequence has persisted until December 24, that is for 217 days, embracing eight synodical rotations of the sun, with a mean period of 27·13 days. The corresponding mean sidereal period would be 25·25 days, or 14·26° per day. This is Carrington's rotation period for latitudes 10° to 15°, and agrees closely with the sidereal period found by Mr. Evershed for the main series of disturbances from March 22 to September 29, 1921.

With regard to the series of disturbances from January 1 to November 21, 1920, which was also recorded at this observatory, Mr. Evershed deduces the equivalent solar period as 25·22 days, which is Carrington's value for spots about latitude ±10°. He remarks: "The slight difference of period compared with that obtained from the 1921 series does not make the evidence for these sequences less convincing." To my mind, in this particular case at least, it makes the evidence more convincing, because the mean latitude of the sun-spot group observed from December, 1920, to May, 1921, was about −6°, and, in fact, in the January appearance extended from 0° to −12° in latitude. In the case of the 1921 group, May 9–17, the mean heliographic latitude was +0·8°, but it extended north of the equator at least 5° in latitude, sufficiently in accord with a synodical rotation period of 27·13 days.

A. L. CORTIE.
Stonyhurst College Observatory, January 2.

Reform of the Calendar: Mean Value of the Year.

I SEE there is to be a meeting at Rome in 1922 to consider questions concerning the calendar. I should like to direct attention to the fact, apparently little known—I, at least, have never seen it in any book—that if we make the year equal to 365 218/900 days we get a very good approximation, and one which can be applied by omitting leap-years at certain complete centuries, something like what is being done under the present Gregorian rule. If we say that "a century-year shall be a leap-year only if it gives a remainder of 2 or 7 when divided by 9," we have a rule which is much more approximate than the Gregorian rule, and one which has been followed *de facto* since 1582 (year of the Gregorian reform). The new rule would not differ in its application from the Gregorian rule before the year 2400. The Gregorian year, 365 97/400 days, differs from the true tropical year by 26 seconds; if the above modified rule were introduced the difference would be reduced to 2 seconds.

The "Encyclopædia Britannica" in the article "Calendar" mentions the value 365 31/128, which, no doubt, is very approximate (difference from true year 1 second), but depends on the awkward cycle of 128 years; and, besides, its application would mean a new break in the way of introducing, or rather suppressing, leap-years.

ARTHUR ROSE-INNES.
Yokohama, November 27.

Units in Aeronautics.

PLEASE allow me to protest against Mr. A. R. Low's attack in NATURE of January 5, p. 12, on the "slug," which was not introduced by Prof. Bairstow, but probably by Prof. Fleeming Jenkin about thirty years ago. The slug does not lead to any evasion of Newton's laws any more than the poundal which was introduced by Prof. James Thomson. All such terms are useful so long as they are precisely defined and correctly understood; in recent years a distinguished German mathematician has been striving to introduce Prof. Thomson's "radian" in place of "Einheitskreisbogenlänge."

The contempt common amongst chemists and physicists towards so-called "engineers' units" is without justification. The chemist or physicist derives his unit of force from a definition of mass and acceleration, whereas the engineer derives his unit of mass from a definition of force and acceleration. The engineer's reason is that his problems come to him in terms of forces, and he wants his solution in the same units. Engineers on the Continent use the kilogram as the unit of force, and derive a metric slug in terms of the metre and second.

The ideologist is fond of so-called "absolute" units, but the physical meaning of Newton's or other laws is often made more clear when units are chosen conveniently. An ordinary man cannot realise a force of a dyne, though an insect might collapse under it; and while an astronomer measures distances in light-years, the peasant uses hours of walking and the spectroscopist μ. It is unlikely that the British or foreign working-man will ever ask for his beer in cubic centimetres: the unit is inconveniently small.

Chiswick, January 9. H. S. ROWELL.

A Curious Physiological Phenomenon.

THE phenomenon to which attention is directed by Mr. F. C. Dannatt in NATURE of December 22, p. 529, is an exceedingly interesting one, and may be the explanation of what occurs in "table turning" and "hat turning." Many have, no doubt, seen the hat, upon which many fingers are resting, move in a very peculiar manner, and it is difficult to believe that those who are engaged in the exhibition are not telling the truth when they declare that they are not aware that they are the cause of the movements. An essential element of the game is that the weight of the arms should be carried by the muscles, and it is interesting to learn that such strained conditions lead to involuntary muscular movements.

R. M. DEELEY.
Tintagil, Kew Gardens Road, Kew, Surrey,
December 24.

Oceanography of the Gibraltar Region.

By DR. JOHS. SCHMIDT.

THE first month spent at sea by the *Dana* Expedition was occupied with investigations in the boundary area between the Atlantic and the Mediterranean—*i.e.* in the Bay of Cadiz, the Straits of Gibraltar, and the Western Mediterranean as far as Algiers. We had worked there before, in 1908–10, with the *Thor*. We were, therefore, not unacquainted with local conditions, and it was very interesting to compare the new investigations with the old. The expedition was particularly fortunate in being able, during this month, to enjoy the co-operation of Dr. J. N. Nielsen, who, from his participation in the *Thor* expeditions, is perhaps more familiar with the hydrography of these waters than anyone else. The remaining scientific staff of the expedition consisted of Messrs. P. Jespersen and A. V. Tåning, both ichthyologists and trained in the work of general marine biology; K. Stephensen, as expert in crustaceans; while the physical and chemical investigations were carried out by Messrs. J. Olsen and N. C. Andersen, the last-named being physician to the expedition.

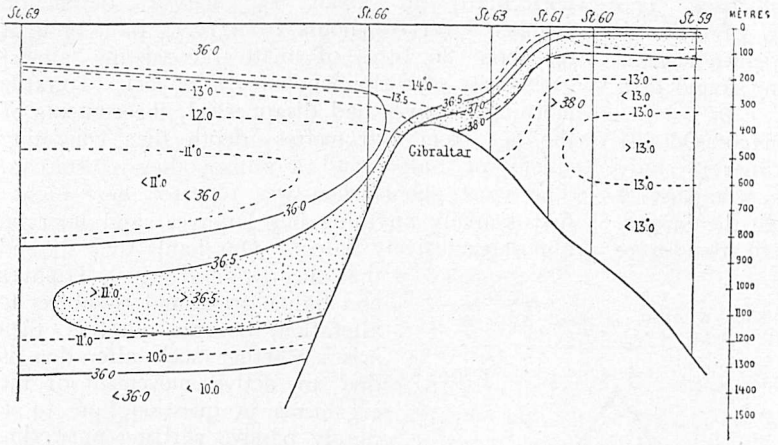


FIG. 1.—Showing isohalines (figures in italics) and isotherms. Hydrographical section through the Straits of Gibraltar from the investigations of the *Thor*, February, 1909. (Schmidt, Nielsen, and Jacobsen, 1910.)

Previous investigations—British, Danish, and Norwegian—have given us the main features (but no more) in the transfusion of water which takes place between the Mediterranean and the Atlantic. The most striking difference between Mediterranean and Atlantic water is in the salinity. Owing to the great evaporation, the water in the Mediterranean is of higher salinity than the Atlantic water—viz. more than 38 per mille (that is, 38 grams of salt in 1000 grams of sea-water) as against about 36–36·5. The less saline Atlantic water flows through the Straits of Gibraltar into the Mediterranean as a surface current. Deeper down, the Straits of Gibraltar are filled with salter water, which, coming from the Mediterranean, moves westward over the comparatively shallow threshold, in places only 400 metres down, formed here by the sea floor, which falls away steeply both to the east and west. On reaching the western edge of this ledge, the Mediterranean water pours down, like a veritable submarine waterfall, towards the depths of the Atlantic Ocean (Fig. 1). It does not, however, reach the bottom; being warmer, and therefore lighter, than the bottom water of the Atlantic, it spreads out as an intermediate layer in the Atlantic, which is recognisable in that it is of higher salinity than the water-layers above and below. J. N. Nielsen and F. Nansen have previously demonstrated the existence of this intermediate layer of Mediterranean water—or, more correctly, mixed water—right up to the west of the British Isles. At the stations of the *Dana* Expedition between Madeira and the Cape Verde Islands (Stations 1142, 1152, 1156, 1157, 1159) we found it at depths of about 1000–1500 metres, with a salinity naturally decreasing towards the south, but varying from about 35·7 per mille at Madeira, to about 35·03 near the Cape Verde Islands.

Up to now we have referred only to the outflow of Mediterranean water into the Atlantic. Fig. 2 gives a picture of the inflow of Atlantic water into the Mediterranean, based on the investigations of the *Dana* Expedition in the waters between Oran, Algeria, and the south coast of Spain. The figure represents a vertical section of the upper 400 metres of sea through our three stations 1119, 1120, and

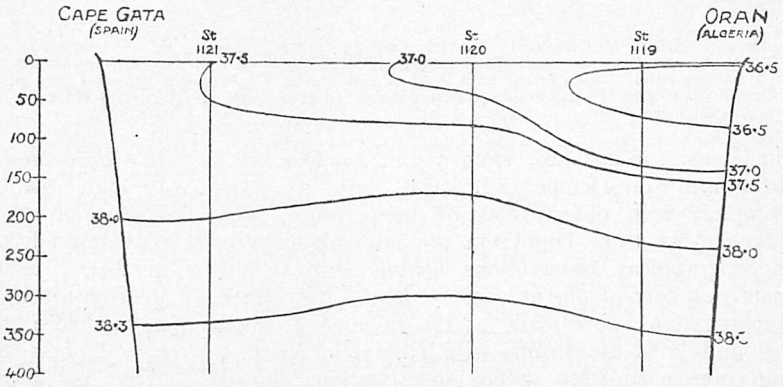


FIG. 2.—Hydrographical section through the westernmost portion of the Mediterranean as shown by the *Dana's* stations 1119, 1120, and 1121, about October 1, 1921. The isohalines for 36·5, 37·0, 37·5, 38·0, and 38·3 per mille salinity are shown. The depths are given in metres. The section shows that the inflowing Atlantic water (salinity less than 36·5 per mille) follows the coast of Africa.

1121, showing the depths and the course of the isohalines. It will be seen that unmixed Atlantic water, of a salinity less than 36·5 per mille, flows in along the north coast of Africa. Midway (Station 1120) we find a slight, and farther north, off the coast of Spain (Station 1121), a somewhat more pronounced, admixture of Mediterranean water. From this it must be concluded that the velocity of the east-going current is at its highest close in to the African shore, and lowest off the coast of Spain, which is also in accordance with fact. The section further shows that the inflow of Atlantic water is a comparatively superficial phenomenon, almost pure Mediterranean water being found at a relatively slight depth.

For nearly a week at the beginning of October the *Dana* remained at Gibraltar in order to study the inflow of Atlantic water and the accompanying migration of pelagic organisms through the Straits. On several occasions continuous investigations were made, as, for instance, from 9 p.m. on October 8 to 6 a.m. on October 10, when series of water samples, with observations of temperature, were taken every three hours; in the intervals between hydrographical observations fishing with pelagic nets was carried out at various depths. All these investigations were made at the same spot, about the middle of the Straits, with Tarifa, in Spain, to the west-north-west. The investigations showed that both physical and biological conditions varied greatly in the course of the twenty-four hours. Temperature and salinity, for instance, did not remain constant at a given depth throughout that time. Fig. 3 shows how water of 14° C. and 37·4 per mille salinity—characteristic values for temperature and salinity of mixed Atlantic and Mediterranean water—changes its level within the twenty-four hours. It will at once be noticed that the changes are periodical, and a closer investigation of the times indicated places it beyond doubt that we have here to deal with a tidal phenomenon, albeit the magnitude of the alteration in level would appear to be also dependent upon other factors, such as the direction and force of the wind.

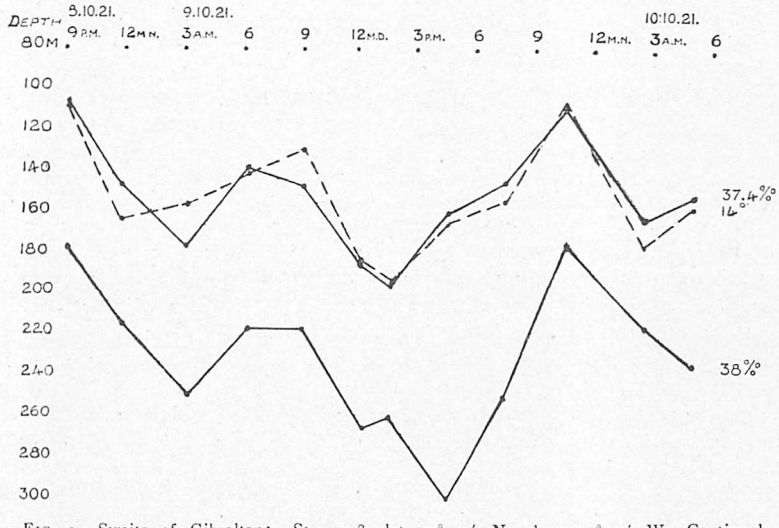


FIG. 3.—Straits of Gibraltar: St. 1138, lat. 35° 59′ N., long. 5° 30′ W. Continual observations at the same spot from 9 p.m. October 8 to 6 a.m. October 10, showing periodical shifting of the level at which salinities of 37·4 and 38·0 per mille and a temperature of 14° C. are found during the period of observation. The depths are given in metres.

A comparison of the contents of the pelagic nets throughout the night at our station off Tarifa proved highly interesting, but raised questions which I soon perceived were to be solved only by a far longer stay at this point than the *Dana* could afford. I will take one example. A net drawn horizontally at about 150 metres' depth on October 8 for two hours from 10.15 p.m. brought up about 80 litres of matter, consisting almost exclusively of a siphonophore (Diphyes). Towards morning Diphyes had disappeared, the contents of the net from 150 metres' depth then consisting chiefly of Salpæ and a schizopodous crustacean. The same phenomenon was repeated next night: first scarcely anything but Diphyes, and later on almost exclusively Salpæ. Our hauls thus showed that the depth at which Diphyes and Salpæ are found is subject to alteration, but the question then arises whether such alteration is due to active movement of the organisms in question, or to a purely passive shifting answering to the change in level of the water layers effected by the action of the tides.

A comparison of the pelagic fauna on both sides of the Straits of Gibraltar was likewise of much interest. As the main result it may be stated that several species were common to both areas, while others were found only west of Gibraltar. Among the latter may be quoted, of fishes: *Argyropelecus Olfersi*, *Vinciguerria Sanzoi*, *Myctophum laternatum*, and *M. Valdivia*, with various murænoid larvæ (*Leptocephalus Synaphobranchi pinnati*, *L. latissimus*, *L. lanceolatoides*, etc.). In contrast to these I may mention the larvæ of the common freshwater eel (*Leptocephalus brevirostris*), which pass through the Straits of Gibraltar in enormous numbers. This phenomenon was one of particular interest to the expedition, and I hope to be able to say more about this to readers of NATURE later on. Here again we are faced with new problems. Why, for instance, should certain pelagic species stop just outside the Straits of Gibraltar, and others, which out here may be taken in the same haul with the former, not be found in the Mediterranean? Are they killed immediately on entering the Mediterranean by the natural conditions prevailing there, or are they able in some way, despite their pelagic habit, to maintain their position—possibly by means of vertical migrations? Various features would seem to suggest that it is not sufficient to regard the problem solely from the point of view of direction of current as found by

the use of a current meter, but that other factors also come into play. Otherwise it would be difficult, for instance, to understand how certain pelagic species of fish (*Myctophum glaciale* and *M. Dofleini*, *Stomias boa*, etc.) can at all seasons occur in far greater quantities—have a maximum of density—in the Alboran Sea (the westernmost part of the Mediterranean, between Spain and Morocco) than either west or east of there, despite the fact that the surface layers are in constant movement towards the east. This is actually the case, as was first shown by A. V. Tåning and Vilh. Ege on the basis of material from the *Thor* expeditions. The *Dana* Expedition has proved the same thing. Comparatively few specimens occur west of Gibraltar and east of Oran, but in the Alboran Sea itself great quantities of all three species were found, so that the contents of a single net might show, for instance, more than 1500 specimens, especially *Myctophum glaciale*.

In conclusion I cannot refrain from emphasising the extreme importance an intensive study of the Straits of Gibraltar and adjacent waters would have for general—physical and biological—oceanography. When, at the commencement of October, I was obliged to leave this area in order to take up the other tasks allotted to the *Dana* Expedition, it was with the conviction that the expedition would in all probability have been able to do more for the cause of oceanography in general by keeping station at Gibraltar during the ten months we have for work, than by cruising about the ocean. Being so convinced, I venture to hope that British naturalists may soon take up this important task, which Great Britain, with Gibraltar as a base, has unique opportunities for dealing with. A research vessel stationed at Gibraltar would take but half an hour to arrive on the scene of operations, the meeting-place of two deep seas. The saving in time and coal, and the unparalleled opportunities of utilising all favourable weather conditions for oceanographical work, are self-evident.

(On board the *Dana*, at San Vicente, Cape Verde Islands, November 1, 1921.)

Photographic Studies of Heights of Aurora.

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

THE two publications referred to below,[1] by Prof. Carl Störmer, of Christiania, merit the attention of all interested in the physics of the atmosphere. As is generally known, Prof. Störmer discovered a satisfactory method of measuring the height and position of aurora by means of photographs taken simultaneously at the two ends of a long base. The photographs include two or more stars, the exact positions of which in space are ascertainable, the precise time of taking the photographs being known. The difference between the positions of the aurora relative to the stars in the two photographs enables the necessary calculations to be made.

The first memoir gives a very full account of photographs taken in the spring of 1913 at two Norwegian stations, Bossekop (B.) and Store Korsnes (K.), 27·5 km. apart, near latitude 70° N. Some of the results have been already discussed in a series of papers enumerated on p. 7, which have appeared in different publications, especially *Terrestrial Magnetism and Electricity*, the *Astrophysical Journal*, and the Paris *Comptes rendus*. But the present memoir, besides summarising these, contains much new matter. In chaps. 1 and 2, pp. 8–37, there is a description of the apparatus and equipment and of the methods of observation. This is intended to be supplementary to descriptions already given, but describes various improvements and simplifications. Chap. 3, pp. 38–156, is a complete journal in chronological order of all the 336 pairs of photographs discussed. Besides the date and hour and time of exposure, values are given of the parallax of each selected auroral point (*i.e.* the angle subtended at the point by the 27·5-km. base), its astronomical co-ordinates (altitude and azimuth), and several calculated data, including the height of the point above the ground, and the distance from Bossekop of the point itself and of the corresponding point on the earth's surface vertically under it. The vertical heights vary from 87 to 323 km., the horizontal distances from Bossekop from 5 to 780 km. Some of the more notable auroras are discussed in considerable detail. The 336 pairs of photographs appear in plates 1 to 28, each plate containing twelve B. (Bossekop) and the corresponding twelve K. (Korsnes) photographs. To each pair of photographs there answers a diagram showing the stars used in the calculations, the positions of the auroral points, usually distinguished by numerals, and dashed lines to represent the parallaxes.

We reproduce two pairs of B. and K. photographs. One (Fig. 1) represents an auroral curtain in which twenty-one points were measured. The nearest point (towards the apparent tops of the photographs) was at a horizontal distance of 99 km. from Bossekop, the most remote point (near the lower left-hand corner) at a distance of 265 km. The heights measured varied from 90 to 130 km. Fig. 2 represents a band having the right-hand edge exceedingly sharp and luminous. The twelve points measured are shown in the key diagram (Fig. 3). Their heights varied only from 102 to 108 km. The horizontal distances from Bossekop of points 1 and 12 were respectively 61 and 178 km., and their parallaxes were 13·1° and 7·7°. The stars used were α, β, and θ Aurigæ. C_1 and C_2 represent the positions relative to the stars of the centres of the plates for Bossekop and Korsnes. The other details as to the stars refer

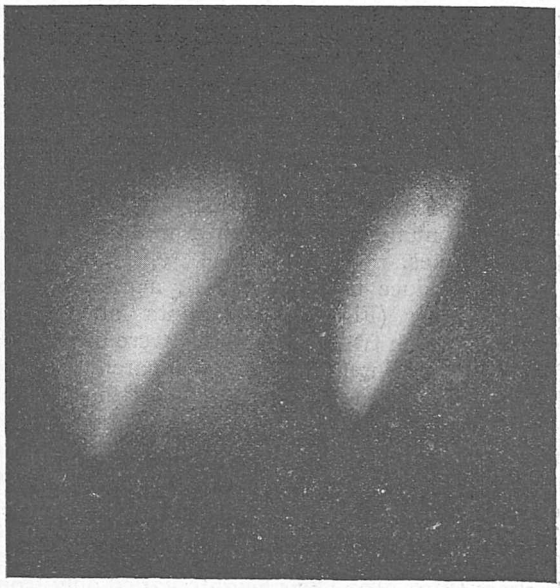
[1] Carl Störmer: "Rapport sur une expédition d'aurores boréales à Bossekop et Store Korsnes pendant le printemps de l'année 1913." *Geofysiske Publikationer*, vol. 1, No. 5. Pp. 269+104 plates. (Kristiania, 1921.)

"Exemples de rayons auroraux dépassant des altitudes de 500 kilomètres au-dessus de la terre." *Geofysiske Publikationer*, vol. 2, No. 2. Pp. 5+2 plates. (Kristiania, 1921.)

to the Bossekop photograph. The arrow-heads radiating from each star show the directions of the star's declination (δ) and altitude (h) circles and of the auroral parallax (p). The numerals 39, 43, 46 represent degrees of altitude. The azimuths of the stars, 180°–89·5°, etc., are also shown. The dotted lines represent the parallaxes in magnitude and direction.

K. B.

FIG. 1.—Auroral curtain photographed at Korsnes and Bossekop.



B. K.

FIG. 2.—Auroral band photographed at Bossekop and Korsnes.

The 336 key diagrams occupy plates 33 to 87. Finally, there are charts numbered 1 to 32, included in plates 90 to 104, which show the geographical positions of the points on the earth vertically under all the auroral points dealt with. The observational data are thus presented in an extremely systematic fashion. Chap. 4, pp. 157–212, includes a mathematical investigation of the variation in the inclination of the trajectory of an electrified corpuscle to the direction of magnetic force, the magnetic field having a potential. In the applications the earth's field is supposed to be given with sufficient accuracy by the first-order Gaussian terms. The corpuscle is supposed to have emanated from the sun, and its course is considered after it has come to within 500 km. of the earth's surface. The inclination of the trajectory to the magnetic lines of force tends to increase as the corpuscle approaches the earth. If the angle attains to 90° the corpuscle retreats. The energy may be absorbed while the corpuscle is approaching or while it is retreating, or some may remain after the retreat has carried the corpuscle outside the atmosphere. What happens is

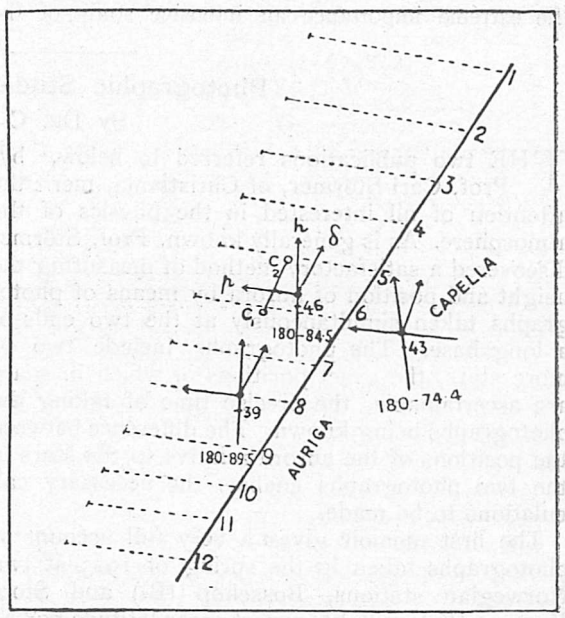


FIG. 3.—Measurements of points on Fig. 2.

shown to be largely dependent on the constitution of the atmosphere. The author assumes that throughout the troposphere, the upper limit of which is put at 10·5 km., air is constituted exactly as at the earth's surface. But higher up in the stratosphere the several constituents, nitrogen, oxygen, argon, neon, helium, krypton, xenon, and hydrogen, behave independently. The author essentially follows Mr. Jeans, rejecting Wegener's hypothetical gas geocoronium. According to his calculations, p. 173, helium is the most important gas between heights of 110 and 200 km., hydrogen preponderating at greater, and nitrogen at lower, levels. These are practically the only gases that count when we consider how far down an auroral ray can come in the atmosphere. Separate calculations are made of the absorption of cathode and β-rays on one hand, and of α-rays on the

other. A number of special cases are worked out for both positive and negative rays, and the luminosity at different heights is considered.

Chap. 5, pp. 213–222, comparing theory with observation, gives a brief analysis of the observed heights and contains some historical matter. The α-ray theory of aurora is credited to Prof. Vegard, who has now, however, abandoned it. The author's own conclusions seem, on the whole, in general accord with those now held by Vegard. He considers that the luminosity phenomena of aurora cannot be explained on the α-ray hypothesis except for what he calls "plaques pulsatoires." The most likely sources of all other auroras, he thinks, are cathode rays.

On pp. 221–22 is an interesting statement of what Prof. Störmer takes to be the auroral problems now calling for attention. The observational problems include height measurements in the Arctic and Antarctic, and the investigation of the auroral spectrum at different levels. The first theoretical problem remaining is to take account of the mutual electro-magnetic actions of the corpuscular currents, as well as of the action of the magnetic fields of the earth and sun. "On pourra alors . . . étudier jusqu'à quel point les objections de Shuster (Schuster) relatives à des faisceaux cathodiques dans l'espace sont bien fondées ou non." A second theoretical problem is to apply the knowledge we may gain of the auroral corpuscles to the study of solar physics.

The second paper by Prof. Störmer relates to auroral measurements made during a great magnetic storm on March 22–23, 1920. Use was made on that occasion of seven stations giving bases varying in length from 26 to 250 km. Of the heights measured, six exceeded 500 km., one being 607 km. The plates attached to the paper are enlarged negatives of the photographs obtained. The photograph reproduced here (Fig. 4)

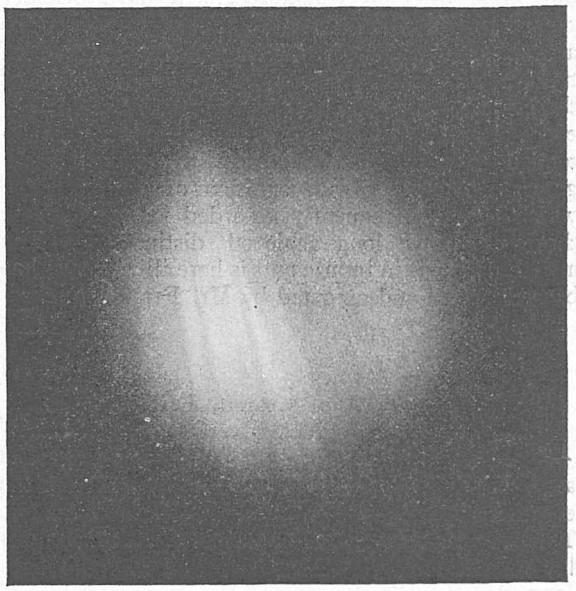


FIG. 4.—Aurora during the magnetic storm of March 22-23, 1920.

is a positive, which we owe to the kindness of Prof. Störmer. The demonstration of the existence of a sensible atmosphere at heights exceeding 500 km. is a notable event.

The Meldola Medal.

RAPHAEL MELDOLA was a man of remarkable versatility, eminent to an unusual degree in several sciences—chemistry, biology, entymology, astronomy—and of unbounded energy. How broad his sympathies and interests were, and how distinguished his services, should be sufficiently apparent from the fact that he was elected to the presidential chairs of the Essex Field Club, the Entomological Society, the Chemical Society, the Society of Dyers and Colorists, the Society of Chemical Industry, and the Institute of Chemistry. Apart from the distinctions connected with his scientific pursuits, Meldola was held in high honour among his own people as president of the Maccabæans, a society in London consisting mainly of Jewish professional men devoted to the promotion of the interests of the Jewish race.

That society has instituted a medal in order to perpetuate his memory, and has arranged with the council of the Institute of Chemistry that the

The Meldola Medal.

Meldola medal be presented annually for the most meritorious chemical work of the year, ending on the last day of December preceding the award. The award is not to be restricted to any particular branch, but the administrators, who are the council of the institute and a member of the Maccabæans appointed by their committee, will have primary regard to work done in analytical chemistry. The award, however, is restricted to British subjects of not more than thirty years of age at the time of the completion of the work—a condition seldom, if ever, attaching to awards of this kind. It is intended to afford encouragement to young investigators and to imply recognition of high merit—which is more frequently accorded in later life to those who have long achieved distinction. The medal, which is in bronze and is here illustrated, has been designed and executed by Mr. Frank Bowcher.

The council of the Institute of Chemistry hopes that the first award may be made at the annual general meeting of the institute on March 1 next. Chemists are invited at any time prior to Friday, January 20, to direct attention to published work of distinctive character, preferably in analytical chemistry, carried out during 1921. Such communications should be headed "Meldola Medal," and should be addressed to the registrar of the institute, 30 Russell Square, W.C.1.

Meldola died on November 16, 1915, and many will remember that in 1917, by subscription among his friends, two portraits of him, by Mr. S. J. Solomon, R.A., were presented to the Royal Society and the Institute of Chemistry. The medal affords an additional fitting tribute to one of the most notable men of science of our time.

Obituary.

Dr T. A Chapman, F.R.S.

DR. THOMAS ALGERNON CHAPMAN died at Reigate on December 17 last after a long period of failing health, in the eightieth year of his age. His father, Dr. Thomas Chapman, of Glasgow, was in his day an entomologist of high repute, and the life-long devotion of the son to the study of insects commenced at an early age. After graduating in medicine (with honours) and surgery at Glasgow and Edinburgh, Dr. Chapman was for a time resident physician and surgeon to the Glasgow Royal Infirmary, and in 1866 he received an appointment to the Joint Counties Asylum at Abergavenny. He afterwards became Medical Superintendent to the County and City Asylum of Hereford, and during his tenure of this office, from which he retired in 1895, he contributed several important papers to the *Journal of Mental Science*.

A keen and successful collector, and a delightful companion in the field, Dr. Chapman was, in addition, one of the most philosophical of naturalists and the most accurate and painstaking of observers. His long series of entomological memoirs—the Royal Society's Catalogue and the "Zoological Record" enumerate more than 250 separate papers published by him from 1868 onwards in the current magazines and the Transactions of the Entomological Society of London—regarded as a whole, takes rank among the most important contributions to the science of entomology by a single individual in recent years. Some of his early papers deal with the life-histories of certain wood-feeding Coleoptera of great economic importance and interest, but the great bulk of Dr. Chapman's work relates to the Lepidoptera, chiefly from the bionomic and taxonomic aspect. Of late years he devoted considerable attention to the biology of sawflies, and the last paper from his pen on this subject appears in the *Entomologists' Monthly Magazine* for January.

Among the most important of Dr. Chapman's memoirs are those on the value of pupal characters in the classification of the Lepidoptera; on the life-history of the Micropterygidæ, and the true relations of these singular insects, for which he recently proposed a new order, the Zeugloptera; and the life-histories, in some cases previously unknown, of many species of British and European Lycænidæ or "blue" butterflies, and the association of their larvæ with ants and other insects, the material for these researches being acquired in many visits to the Alps and other parts of the Continent in his later years. The solution of the mystery of the larval and pupal life of *Nomiades arion*, for so many years an entomological enigma, is in large measure due to his acumen and patient observation.

Dr. Chapman became a fellow of the Entomological Society of London in 1891, served repeatedly on the council, and was vice-president of the society on no fewer than four occasions; but, to the great regret of his colleagues, he could never be induced to assume the office of president, which was long open to his acceptance. He joined the Zoological Society in 1898, and in 1918 he was elected a fellow of the Royal Society. His genial and engaging personality will be greatly missed by his wide circle of friends and fellow-workers, and very few men were more highly and deservedly esteemed in life or are more deeply regretted in death. J. J. W.

It is announced in *Science* that Prof. Henry Turner Eddy, professor emeritus of mathematics and mechanics in the University of Minnesota and dean emeritus of the graduate school, died on December 18 last at the age of seventy-seven years. Prof. Eddy was professor of mathematics, astronomy, and civil engineering in the University of Cincinnati for sixteen years, and went to the University of Minnesota in 1894 as professor of engineering and mechanics. Later he became professor of mathematics and mechanics. He served both as secretary and vice-president of the American Association for the Advancement of Science, and was also a member of several other learned societies in America.

Notes.

ALL friends of humanity will welcome with a profound sense of relief the intimation that the representatives of Great Britain, France, Italy, Japan, and the United States, assembled at the Washington Conference, have agreed to the American proposal to prohibit the use of poison gas in warfare. As Mr. A. J. Balfour pointed out, in announcing the adherence of Great Britain, Mr. Root's resolution was, in effect, a re-affirmation of international law as it existed prior to 1915, when it was deliberately violated by Germany. He was conscious, as was M. Sarraut, the representative of France, that the exercise of authority in banning the use of an abhorrent method of warfare was, under present conditions, scarcely practicable, and that whilst the agreement would serve to bind the Five Powers, it would not relieve nations from the necessity of preparing themselves against the use of gas by an unscrupulous enemy. We could not afford to ignore the lesson of April, 1915. The position thus reached by the Washington Conference is as satisfactory as could be expected. It is, in fact, all that was practicable, and it will be welcomed by all the Powers comprising the League of Nations. The issue now rests with Germany. But the moral effect of the action of the Conference will not be lost upon the world.

SIR DAVID PRAIN will shortly retire on account of age from the post of Director of the Royal Botanic Gardens, Kew, which he has held since 1905, and the First Lord of the Treasury has appointed as his successor Dr. A. W. Hill, who has been Assistant Director of the gardens for the last fourteen years, and was previously fellow and dean of King's College, Cambridge, and University lecturer in botany. Sir David Prain was born in 1857, and entered the Indian Medical Service in 1884, when he was almost at once seconded for service in the Botanic Garden at Sibpur, Calcutta, as curator of the herbarium, in 1898 succeeding the late Sir George King as superintendent. During this period his activities included the duties of professor of botany in the Calcutta Medical College, Director of the Botanical Survey of India, a trustee of the India Museum, and fellow of the Calcutta University. Upon the retirement of Sir William Thiselton-Dyer in 1905 from the directorship of the Royal Botanic Gardens at Kew, Sir David Prain was appointed his successor, and he has worthily maintained the high traditions of his post, the highest and most important of its kind in the British Empire. He has also been president of the Linnean Society of London (1916–19) and treasurer of the Royal Society since 1919, besides serving on numerous boards and committees of biological associations, where his well-balanced judgment and large experience have made him welcome. On entering on his duties at Kew he found them so exacting that his favourite botanic studies have been curtailed; with his coming release from official labours he will, no doubt, be able to devote himself to original work once more. Dr. Arthur Hill, who succeeds to the office of Director, has travelled in South America and tropical Africa; he has also been largely responsible for the laying-out of British cemeteries in France and Italy.

AN expedition, consisting of Prof. J. W. Gregory, of Glasgow University, and his son, Mr. Christopher J. Gregory, which has for its primary object the investigation of some features in the mountain structure of north-western Yunnan and western Szechuan, expects to leave for Burma at the end of March. The area is one of special geological and biological interest. It includes some mountains of which the height varies, according to the available information, from 20,000 to 25,000 ft.; and as these mountains occur in line with the Himalaya and the mountains south of Assam, it has been suggested that they represent a prolongation of the Himalaya and are continuous through China with the main mountain lines of north-eastern Asia. This view is opposed to the interpretation by von Richthofen that the mountains of this part of China belong to a pre-Himalayan system which they cross almost at right angles, and that the continuation of the Himalayan folds bends back through western Burma and is continued by the mountains on the southern edge of the Eastern Archipelago. It is hoped to obtain evidence for the solution of this problem, and also in reference to the remarkable parallelism of the three great rivers which discharge from south-eastern Tibet. The area is of biological interest in connection with the geographical distribution of the fauna and flora of south-eastern Asia. Some zoological and botanical collections will be made which it is hoped will be worked out in the British Museum of Natural History and in the India Museum, Calcutta. The expedition will travel *via* Rangoon, and hopes to start from Bhamo, near the north-western frontier of Burma, at the beginning of May.

THE council of the Geological Society has this year made the following awards:—Wollaston medal, Dr. A. Harker; Murchison medal, Dr. J. W. Evans; Lyell medal, Dr. C. Davison; Wollaston fund, Dr. L. J. Wills; Murchison fund, Mr. H. Bolton; and Lyell fund, Mr. A. Macconochie and Mr. D. Tait.

BEGINNING on January 26, we have arranged to issue a monthly supplement giving the titles of new books on science and technology published at home and abroad. Publishers have been invited to send us the titles of such additions to their catalogues, and it is hoped to make the lists an index to the chief scientific works issued. Any assistance which may be offered in order to make our lists complete will be welcomed.

AN Exchange telegram published in the *Daily Mail* on Monday announced that after a visit to Mount Kosciusko, the highest in Australia, Sir T. Edgeworth David and Profs. Skeats and Richards have confirmed the discovery in 1893 that the summit of that mountain was formerly covered by glaciers. The

new observations show that the glaciation was contemporary with the extinct giant wombat and other giant marsupials, which there is much evidence to show lived in south-eastern Australia when moister climatic conditions prevailed. The date of this glaciation is estimated by Sir Edgeworth David and his colleagues, according to the report, as 100,000 years ago.

AT a meeting of the provisional council of the New Zealand Astronomical Society, held at the Hector Observatory, Wellington, on November 15 last, the following officers were elected:—*President:* Dr. C. E. Adams. *Vice-Presidents:* Hon. Sir Francis Bell, Prof. E. Marsden, Mr. T. Allison, and Dr. C. Munro Hector. *Secretary:* Prof. D. M. Y. Sommerville. *Treasurer:* Mr. C. G. G. Berry. *Editor:* Mr. A. C. Gifford. *Council:* Mr. J. C. Begg, Hon. Mr. Justice Chapman, Prof. C. Coleridge Farr, Mr. E. G. Hogg, Capt. G. S. Hooper, and Mr. J. T. Ward.

UNDER a provision of the Sundry Civil Act of March 4, 1921, Government Departments of the U.S.A. were required to suspend publication of all periodicals except those approved by Congress by December 1, 1921. A resolution empowering the Congressional Joint Committee on Printing to authorise the continuance or discontinuance of these periodicals, among them the *Journal of Agricultural Research,* passed the Senate, but did not come to a vote in the House before the adjournment of the last session of Congress. The *Journal of Agricultural Research* has, therefore, been suspended until its continuance is authorised by Congress.

ON Tuesday next, January 17, at 3 o'clock, Dr. F. H. A. Marshall begins a course of two lectures at the Royal Institution on "Physiology as Applied to Agriculture"; on Thursday, January 19, Mr. Seton Gordon gives the first of two lectures on "Mountain Birds of Scotland" and "Sea-birds and Seals"; and on Saturday, January 21, Dr. Charles Macpherson, organist of St. Paul's Cathedral, commences a course of two lectures, with musical illustration, on "The Evolution of Organ Music." The Friday evening discourse on January 20 will be delivered by Sir James Dewar on "Soap Films and Molecular Forces," and on January 27 by Viscount Burnham on "Journalism."

THE *Echo de Paris* is to be congratulated on the success of the subscription it raised to enable the octogenarian physicist Edouard Branly to continue his experimental work. Like many scientific men, Branly never sought commercial profits out of his discoveries, but the French public was unaware of the straits to which he had been reduced. It is now announced that the Branly Fund exceeds 200,000 francs (about 4000*l.*). Branly was the first to point out in 1890 that the electric resistance of a mass of metallic powder changed enormously when an electric spark took place in its neighbourhood. The resistance generally diminishes, but in a few cases—for instance, with peroxide of lead—it increases when the spark ensues. This was the principle of the earliest form of coherer which in the early days gave such an impetus to radio-telegraphy.

THE first meeting of the Society of Telegraph Engineers was held on February 28, 1872, and the council of the Institution of Electrical Engineers (originally the Society of Telegraph Engineers) is arranging to commemorate the fiftieth anniversary of the meeting. On February 21 at 4 p.m., and on February 22 at 8.30 p.m., Prof. J. A. Fleming will deliver a popular lecture (to which admission is by ticket) on "Michael Faraday and the Foundations of Electrical Engineering." The annual dinner of the institution will be held on February 21, at 7 p.m., at the Hotel Cecil, and in the afternoon and evening of February 23 several members of the institution and others closely connected with the early development of electrical engineering will give short discourses on their reminiscences and experiences during the early history of the electricity supply industry. The speakers will deal both with matters of scientific and technical interest, and also with the effect of legislative action on the progress of the industry.

INFLUENZA seems to be asserting itself with sufficient intensity to call for caution, especially on the part of the individual attacked, although at present the epidemic has not become sufficiently violent to cause alarm. The Registrar-General's weekly returns show that for the ninety-six great towns of England and Wales, including London, the deaths from influenza in the last six weeks have increased from 80 to 418, and in London alone the deaths from this cause have increased from 26 to 151. Fifty-nine per cent. of the deaths in London have occurred at ages above forty-five, whilst between twenty and forty-five years of age the deaths are 27 per cent., and below twenty years of age only 14 per cent. The age-incidence of death in the present epidemic differs from that in the severe epidemic of 1918–19, which for the most part attacked the able-bodied; the present attack has reverted to the incidence shown by the earlier epidemics after 1890. In the six weeks the deaths from pneumonia have nearly doubled, whilst deaths from bronchitis have remained fairly steady. With the abnormally mild weather in December the disease increased, which was a common feature with earlier epidemics, and it is to be hoped that the drop in temperature experienced in the early days of 1922 will lessen the severity of the attack.

TEMPERATURE in the past year was almost as abnormal as the rainfall, and November was the only month at Greenwich with the mean temperature below the average, whether compared with the normal for sixty-five years, 1841–1905, or with the normal for thirty-five years, 1881–1915, used by the Meteorological Office. The temperatures are given in Fahrenheit, and are chiefly from civil-day observations at Greenwich. The warmest month was July, with a mean of 68·5°, which is 4·8° above the average for sixty-five years, but both in January and October the excess of temperature was rather more than 7°. In November the

deficiency was 3·4°, but in December the excess was 4·7°. The mean temperature for the year was 52·8°, which is 2·7° in excess of the yearly normal; this is the highest mean annual temperature on record since 1841, the next highest being 52·0° in 1868 and 1911. In July the mean of the maximum, or highest day temperatures, was 81·6°; there have been only two years since 1841 with a higher mean maximum in July, 81·8° in 1859 and 82·0° in 1868. In January the mean maximum was 50·0°, and January, 1916, with a mean maximum 50·4°, is the only January with so high a mean maximum since 1841. The mean minimum in January is the highest on record. The mean for October, 57·6°, has never previously been equalled at Greenwich, and the high temperatures at the commencement of the month were most abnormal. For the British Isles generally the mean temperature for each month from January to April and in July, September, and October was above the normal in all districts, and in England and Wales there was an excess every month from January to October, except for August, in North-West England, where it was in agreement with the average. The mean excess of temperature for all districts in the British Isles, except the North of Scotland and the English Channel, for the ten months, January to October, was 2·6°; in January the excess was 5·2°, in July 4·3°, and in October 6·9°.

THE United States National Museum (Proc., vol. 59) has published a descriptive catalogue of its collection of Buddhist art, compiled by Mr. I. M. Casanowicz. The collection is large, but it does not seem to possess many objects valuable for their antiquity or artistic beauty, the best being a Japanese bronze statue of Buddha, dated 1648. There is also a good collection of rosaries, examples of magical appliances, and objects used in worship. Mr. Casanowicz has given an interesting introduction on Buddhism and its developments. The pamphlet deserves the attention of all those who are interested in the subject.

THE Journal of the Royal Anthropological Institute, part 1, for 1921, prints the presidential address delivered by Sir Everard im Thurn, which gives an interesting historical sketch of the relations between Europeans and the natives of the South Sea Islands after they were discovered. The state of savagery in which the natives were found does not imply fierceness: they were wild and uncontrolled in so far as they had not been subjected to what we call "civilisation," but they had developed for themselves a certain degree—in many cases a very high degree—of culture. The writer sums up his conclusions thus: "The Islanders were, when Europeans first went among them, not a savage, *i.e.* a fierce race, but were highly cultured, if self-cultured, people, but entirely uncivilised; they were at first puzzled what to make of the civilised, or quasi-civilised, people who went among them, and they only became repellent when they were habitually injured by their visitors."

THE educational work of the Commercial Museum of Philadelphia, as decribed by its curator, Mr. C. R. Toothaker, in Bulletin No. 13 (1920) of the United States Bureau of Education, is partly for business men and partly for the rising generation. Aid is given to the former by the foreign trade bureau of the museum, which publishes two journals, one of them in separate Spanish and English editions. Schools are provided for by official guidance to a study of the exhibits, daily lectures to visiting classes on subjects chosen by the school-teachers, lectures to teachers and others, loan lectures with lantern-slides sent to schools outside Philadelphia, and school collections given, not lent, to the schools of Pennsylvania. Full details of these last are given in this well-illustrated pamphlet.

THE recently published annual report of the Yorkshire Philosophical Society for 1920 reminds us that with 1922 the society reaches its centenary. It sprang from the suggestion that a museum should be founded to receive the bones just discovered in the Kirkdale Cave. Famous men have been connected with the society. It was the parent of the British Association in 1831 and of the Museums Association in 1888, while in local archæology it has done, and is doing, admirable work. Under the present keeper of the museum, Dr. Collinge, the zoological collections are being put in good order, and Mr. J. Hetherton has lately placed a wood of considerable area at the disposal of the society for use as a bird sanctuary. The geological collections contain many valuable fossils, and the report concludes with "Notes on the Later Tertiary Invertebrata" of these islands by the veteran Mr. Alfred Bell; most of the species are in the society's museum.

THE last annual report of the National Museum of Wales records some advance in completing the western section of the new building. The reserve galleries and basement are now occupied, and the keepers of art, botany, and zoology, with their staffs, are installed in their new quarters, while the department of geology has temporary accommodation. These departments are, however, hindered by lack of museum furniture, for which the available funds are insufficient. The museum worthily acts up to its title of "National," co-operating with all relevant bodies in the Principality, with mine-owners, quarry-owners, and industrial firms, and in particular with the faunistic survey of the County of Glamorgan and the local education authorities. A number of accessions of local interest, as well as many others, are recorded by all the departments. It is not in man to command financial support, but Dr. Hoyle and his able staff undoubtedly deserve it.

THE geological model of the Bristol district which has recently been placed in the Bristol Museum and Art Gallery depicts the relief and the geological outcrops of the district on a horizontal scale of 3 in. to 1 mile and a vertical scale of 1 in. to 500 ft. An explanatory guide to this relief map has been prepared by Prof. S. H. Reynolds. The pamphlet includes a description of the present land surface and a sketch of the geological history designed to explain the

origin of the chief physical features. A short account of the distribution of the geological formations is also given, and this is followed by a section which describes the roads and railways of the district in their relation to the surface relief. The pamphlet should prove indispensable to those students and teachers of geography and geology who have access to the model.

FROM the "Report on the Zoological Service for the Year 1920" we learn that the Giza Zoological Gardens have been restored to their pre-war condition of cleanliness. The number of visitors during that year was greater than in any previous year. A special feature of these gardens is the thousands of birds in a state of complete liberty which frequent the grounds, and we are glad to note that the numbers of cattle egrets, little egrets, and hoopoes which have nested there are increasing. The new building of the Giza Zoological Museum was opened in 1920. Lack of space and insufficiency of staff, however, will prevent the development of a general natural history museum. The insect collections have already been transferred to the Ministry of Agriculture and the marine invertebrates to the Sultana Hydrobiological Institute. The Zoological Service of Egypt is doing a useful work in the preservation of the natural fauna of the country both by protecting game and nesting birds and by controlling beasts of prey. Special success has attended its efforts to protect birds from the birdlimers, to preserve the breeding colonies of the cattle egrets, and to keep down the number of jackals.

AN interesting addition to the flowering plants of the British flora is announced in the November issue of the *Naturalist*. Mr. R. W. Butcher found *Tillaea aquatica* at Adel, near Leeds, in September, where it was the dominant plant growing in abundance on the drying-up mud on the margin of a pool. Dr. G. C. Druce has examined the plant, and agrees that it is probably a true native species or one brought there by purely natural means. The typical plant is known from Germany, and a sub-species also occurs in France and Italy.

THE December issue of the Journal of the Franklin Institute contains a paper by Mr. Enoch Karrer, of the Nela Research Laboratories, Cleveland, Ohio, on the shape assumed by a deformable body immersed in a moving fluid. The author's attention was directed to the subject by the behaviour of a drop of mercury just above a constriction in a vertical glass tube up which a current of gas was flowing. As the speed of the gas was increased the drop was raised above the constriction and assumed a slightly egg-shaped form with its larger end downwards. With increase of speed it elongated, keeping its larger end downwards, and finally a small drop detached itself from its upper end. From these observations the author concludes that a deformable body in a moving fluid assumes a stream-line shape. He supports his conclusion by figures of snow drifts and snow bosses from Cornish's "Waves of Sand and Snow," of egg-shaped boulders with their long axes in the direction of the wind and their big ends up-wind, and by the shapes of moths, birds, and fishes. By analogy with "geotropism"—the adjustment of organisms under gravity—the author proposes to name this new principle "rheotropism."

THE Meteorological Office of the Air Ministry has recently issued as No. 18 of the Geophysical Memoirs a memoir by Mr. W. H. Dines on observations on radiation from the sky and an attempt to determine the atmospheric constant of radiation. The measurements were made at Benson during 1920. The sky was divided into six zones of 15° width, and the radiation was taken at the altitudes corresponding to the mean altitude of the zones. The final form of instrument used was a thermopile of copper-eureka junctions designed by L. F. Richardson. The observations were made at, or a little after, sunset, and are classified under "clear sky," "overcast sky," and "very clouded sky." By suitable methods the amount of radiation received from each zone on a horizontal surface at ground-level is calculated, and the final results show that the average daily supply of heat from the atmosphere throughout the year falling on one square centimetre in the South of England on clear days is 506 gram calories. For fully clouded skies the value is about 700, with a general mean for all days of about 600. For a mean temperature of 50° F. the outward radiation from the earth is 711 gram calories, so that the net or effective radiation for a clear sky is rather more than 200 gram calories. This is 25 per cent. less than the values usually given, which, however, have been mostly obtained at much greater altitudes than Benson (186 ft. above sea-level).

THE commercial transmission of power conveyed electrically by overhead wires has made the study of lightning arresters of great importance. In places where thunderstorms are violent, such as in certain parts of South Africa or where the lines have to traverse mountainous regions, the use of efficient lightning arresters is a necessity. In this connection the papers published in the *General Electric Review* for November and December last by J. L. R. Hayden and N. A. Lougee are of value. The object of lightning arresters is to afford protection against sudden rushes of electricity at high potential in the lines due to atmospheric disturbances. To get similar electric surges in the laboratory they build up a battery of glass-plate condensers which by means of the kenotron (a two-electrode thermionic valve for rectifying currents of high voltage) can be charged by an alternating-current transformer to 30,000 volts; 200 of these condensers are used, which can be connected in parallel or in two groups of 100 in parallel or in four groups of 50 in parallel. When they are all in parallel the capacity is 1·6 microfarads, and at 30 kilovolts the energy stored is 720 joules. With the arrangements they used they got a maximum discharge of 9500 amperes at 120,000 volts, the discharge frequency being 126,000. Three types of lightning arrester were examined: (1) the horn type with resistance in series, (2) the electrolytic type, and (3) the multigap type. Their results prove that the

resistance in the horn type was very detrimental, that the electrolytic type was very efficient, but that its expense limited its use, and that the multigap type was an efficient and cheap type of lightning arrester.

MESSRS. LONGMANS AND CO. have in the press "Modern Practice in Heat Engines," by T. Petrie, which is intended to form a companion to the late W. Inchley's "Theory of Heat Engines." It deals with the subject of power from heat engines as a whole, and attempts to show how far theory may be applied to the design of modern types. The book is divided into three sections, steam boilers, steam prime movers, and internal-combustion engines, each section containing a descriptive chapter on the latest types with sectional illustrations which, in many cases, approximate to working drawings. Another book announced by the same publishers is a translation, by Dr. J. S. Thomas, of Prof. A. Smits's "The Theory of Allotropy."

MR. F. EDWARDS, 83 High Street, Marylebone, W.1, has just issued a Hand-list (No. 422) of Biographies, Autobiographies, Diaries, Journals, Correspondence, etc., of Famous Men and Women. Many men of science are represented in the catalogue.

MR. E. MARSDEN, one of the authors of "Geography for Junior Classes," of which a short notice appeared in NATURE of December 22 last, writes to point out that the phrase "lines and belts of equal heat," which the reviewer remarked "is bad anywhere," occurs also in Geikie's "Elementary Lessons in Physical Geography" and in the revised edition of Huxley's "Physiography." The use of the phrase in other books does not, however, alter the reviewer's objection to it.

IN an article entitled "Fisheries Biology" in NATURE of December 29, p. 585, it is stated that "the spur-dog and nurse-hound are viviparous." Mr. E. Ford writes to inform us that the term "nurse-hound" is applied at Plymouth to *Scyliorhinus stellaris*, which is not viviparous. We understand from the writer of our article that confusion has arisen from the fact that the name "nurse-hound" is also used by fishermen in his district to refer to *Mustelus vulgaris*, which is viviparous.

Our Astronomical Column.

THE SHOWER OF JANUARY METEORS.—A rather abundant display of these objects was observed on the night following January 3. Mr. W. F. Denning writes as follows:—At Bristol the early part of the evening was clear, and between 5.40 and 6.50 p.m. meteors appeared at the rate of thirty per hour. Clouds, wind, and sleet then interrupted watching until about 9 p.m., when the atmosphere again cleared, and the remainder of the night was splendidly favourable for observation. The shower, however, declined in numbers strikingly, for in the two or three hours preceding midnight the hourly rate of apparition was only twelve, and there was a further falling off as the night progressed. The radiant point was at 232°+53°. Large meteors were frequent, and a number of them have been recorded at several stations. Miss A. Grace Cook witnessed the event from Stowmarket and saw a considerable number of meteors on the two nights January 2 and 3. She registered a fair proportion of large ones, and found the maximum intensity occurred in the early part of January 3. The radiant was at 231°+53°.

SPECTRAL EVIDENCE OF A PERSISTENT AURORA.—Bulletin No. 76 (vol. 3, No. 1) of the Lowell Observatory, contains an interesting account by Mr. V. M. Slipher of his successful attempts to show that the aurora is always present in the night sky. Working on the fact that the spectrum of the aurora consists of certain emissions, of which one in the yellow-green is so intense relatively as to contain a considerable portion of the total auroral light, he finds it possible to record this line with an exposure of only a few hours, even if there be moonlight. The instrument he employs is a spectrograph with a 66 degree flint glass prism, and a Dallmeyer lens of f/1·9 ratio, the photographic plates being of the Cramer isochromatic brand. This spectrograph was usually simply pointed to the sky, but in some cases a small objective was placed in front of it. All the exposures he made showed the characteristic auroral line, thus proving the existence of auroral illumination, persistent or permanent at least over the period covered by his series of plates, which commenced in the year 1915. The two plates which accompany his paper show the auroral line clearly on both moonlight and moonless nights.

MOVEMENTS IN SPIRAL NEBULÆ.—Dr. Jeans exhibited at the November meeting of the Royal Astronomical Society some slides sent by Dr. Van Maanen, showing movements in the spirals M 101 and M 33. He demonstrated that the only tenable motions that would conserve the equiangular spiral forms were compounded of pure rotation and motion along the arms. The latter type greatly predominates in these nebulæ, and the indicated times of revolution round the nucleus are 85,000 years and 160,000 years respectively. Since only two whorls of nebulosity can be traced, implying a duration of a third of a million years, it was conjectured that the outer whorls may have become invisible, just as the puffs of steam from a locomotive soon dissipate. By the combination of observed shifts with line-of-sight velocities, a distance of 2000 parsecs was deduced for M 33. This would be fatal to the island-universe hypothesis, since it would place the object well within the confines of the galaxy. There have been fairly regular oscillations of opinion on the hypothesis, the prevailing view at the Royal Astronomical Society's meeting being hostile to it.

A BRIGHT FIREBALL.—Mr. G. E. Sutcliffe writes from Shahpur, Ahmedabad, India, that on November 22 last, at about 6 a.m., when gazing towards the Southern Cross, he saw a large fireball emerging from the horizon. The object appeared to be approaching him and to move more slowly than ordinary shooting stars. It became intensely brilliant. Its motion was directed nearly from south to north, and it passed a little to the east of his zenith. During the early part of its track the fireball was globular in shape, and it had a distinct tail like a comet.

A Notable Exhibition of Physical Apparatus.

THE Physical Society of London and the Optical Society held their twelfth exhibition of electrical, optical, and other apparatus at the Imperial College of Science on January 4 and 5. As in past years, the exhibition rooms were crowded with apparatus and visitors; the latter were so numerous that the exhibition became a continuous one instead of closing between 6 and 7 p.m. each day. The display of scientific apparatus was probably the finest ever seen in this country, and the quality and finish of the instruments left little to be desired. There were many instruments of novel design, but attention can be directed to a few only.

A quite novel exhibit was an optical sonometer by the firm of Hilger, Ltd. This is designed to record the pressure variations caused by sound-waves, and should prove invaluable to workers in acoustics. The most novel feature is the diaphragm, which is a film having a thickness of a fraction of a wave-length of light, and is silvered or gilded on one side by a cathode process. The sound-wave under examination is received by a horn, and causes the diaphragm, and ultimately a beam of light, to vibrate. An intense point image is produced, and a photographic record can be obtained on a rotating film. The vowel sounds and all kinds of acoustic disturbances may thus be analysed. In another arrangement, which is excellently adapted for demonstration purposes, a rotating band with white lines on a dark ground is illuminated by a line image from the diaphragm. By adjustment of the speed of rotation stationary wave effects are obtained.

The episcope, shown by Newton and Co., is a marked improvement on forms previously seen, and should come into more general use for the projection on screens of opaque objects. The present instrument is of beautiful design, and with its two 2000-candle-power lamps very bright pictures of opaque objects may be projected on a screen 5 metres or more away. In large teaching institutions this instrument could be put to many uses.

The Marconi Co. exhibited its new automatic alarm which responds to the wireless call of a ship in distress. In the present form of instrument the distress call must consist of three dashes, each of four seconds' duration, the dashes being separated by one-second intervals. By means of an amplifying circuit, plungers working in dash-pots are caused to respond to the four-second impulses, and after a series of three such impulses a warning signal occurs. If the impulses last for more or less than four seconds, subject to a tolerance of about half a second, the circuit necessary to operate the alarm is not completed. The demonstrations given were accompanied by artificial atmospherics and continuous wireless reception, and were remarkably successful.

Creed and Co. again showed their system of high-speed automatic printing of wireless messages, but at an increased speed of reception. Signals from Chelmsford were regularly received, the Morse code perforations in a paper strip being transposed into Roman characters by an automatic printer. The speed ranges from 50 to 200 words per minute. While the writer was present a message was received from the Marconi Co. conveying its wishes for the success of the exhibition. The receiving aerial appeared to be a very insignificant affair, and many visitors marvelled at the present efficiency of triode-valve amplifiers.

A novel weather foreteller, the design of which is due to Mr. Kitchen, was shown by Negretti and Zambra. The instrument is based on meteorological data extending over many years. The forecast for twelve hours appears in a small window in the instrument after the barometer and wind-scales have been set to correspond to the conditions existing at the time. It would be of interest to have a record over six months of "predictions" and "happenings."

Tucker's hot-wire resonator microphone was shown by H. W. Sullivan. The microphone consists of a heated wire in the neck of a resonator and is insensitive to all but the particular sound frequency which it is desired to receive. The hot wire is cooled by the oscillating air-currents at the resonant frequency, and the change in the resistance of the wire is caused to operate an amplifier.

The Cambridge and Paul Instrument Co. exhibited a novel temperature regulator, in which the current from a thermo-couple in a furnace passes through a millivoltmeter, at the end of the pointer of which is a light thermo-couple in series with a moving coil relay. When the furnace is at the temperature which it is desired to maintain, the light thermo-couple is brought, by the movement of the pointer, into close juxtaposition to a small heated body. A current is thus generated which operates the relay and indirectly controls the current in the furnace. The instrument exhibited controlled a small electric furnace at about 700° C. within about 5° C.

The Edison Swan Co. showed a 10,000-candle-power pointolite lamp of ingenious construction; many visitors remarked on the skill required to seal leads into glass for the passage of a current of 40 amperes. The firm of Ilford, Ltd., showed a new and improved colourless filter which completely cuts off ultra-violet rays. It is claimed to be much superior to the usual æsculin filter, and is known as "Q" (acetamino-quinoline). The Davison microtelescope, while not new, attracted considerable attention, and users of the microscope admired a new 25-watt mercury vapour lamp made by Chas. Baker. Shotter's integrator for water-flow meters was shown by H. Tinsley; it represents a new application of the Wheatstone bridge. Among precise measuring instruments the Campbell fundamental standard of mutual inductance (shown by R. W. Paul) must be mentioned, and also the "Talymin," by Taylor, Taylor and Hobson, which determines within small limits of error the outside diameters of small manufactured parts.

An experimental lecture on "The Johnsen-Rahbek Electrostatic Telephone and its Predecessors" was given on both days by Mr. A. A. Campbell Swinton. Another lecture on "Radium: Its Application in Peace and War" was delivered by Mr. F. Harrison Glew, and a third lecture on "The Employment of Coarse Wire Gratings in Astronomy" was given by Sir Frank W. Dyson. These lectures were attended by large audiences, and were highly appreciated.

Science in Secondary Schools

THE twenty-second annual general meeting of the Science Masters' Association, which was held last week at the Imperial College of Science, was presided over by the Master of Balliol. His address on the subject of the relationship of history and science will long be remembered by those who were fortunate enough to hear it for the genial humour and literary grace with which he defined the position and importance of these complementary branches of learning.

The association has been growing steadily in size and influence, and in recent years more than one important development in scientific education has taken its origin in the deliberations of its assemblies. Unless we are mistaken, we may expect to see, as a result of this meeting, a serious endeavour to introduce the fundamental principles of physical chemistry in the early stages of science teaching. Brig.-Gen. H. Hartley made this suggestion both in the interests of intellectual economy and of clear thinking. It was time, he said, that they tried to simplify for their pupils the memorising of the ever-growing mass of known chemical facts by showing them at the outset how these are co-ordinated; thus would pure memory work be reduced, being replaced by reasoning which was well within the powers of the students. Prof. J. C. Philip, who, in common with other speakers, strongly supported this view, emphasised the importance of introducing the physico-chemical ideas into the ordinary chemistry courses in preference to teaching physical chemistry as a separate subject at the start. It was further explained that neither expensive apparatus nor extraordinary mathematical ability on the part of the pupils is necessary in the early stages of such instruction. It is rare to find in a big gathering such unanimity of opinion that a change of this sort in traditional teaching is both desirable and possible. In all probability more will be heard of it.

During the course of the meetings, which extended over two days, there were several other discussions, of which the following general impressions were obtained:—First, as regards the teaching of dynamics; this is still, with rare exceptions, in a chaotic condition in our schools. The subject is often left in the hands of mathematical masters, and divorced from the teaching of science. In any case, the presentation of mechanics is usually far too formal, with the result that it makes little appeal to beginners.

Geography seems to be in a better way. Some attempt was made at the meeting to define, perhaps to limit, the activities of the specialist teacher of geography. But it was fairly generally agreed that he had made good, and that science has much to gain and nothing to lose by the growing importance which is being attached to the modern geographer's methods.

Major E. R. Thomas, in opening a discussion on post-certificate science for the non-specialist, spoke of the importance of emphasising the cultural value of the subject. For this class of student especially it is desirable to bring into prominence the historical, biographical, and philosophical aspects of the subject. This kind of teaching is now being widely adopted, and is already being reflected in the work of those who are specialising in science. For many years the association has done its utmost to save the youth of the country from the materialistic tendencies which may follow from the study of natural science if it is narrowly conceived and inadequately expounded.

The discussions will be fully reported in the next issue of the *School Science Review*, which Mr. G. H. J. Adlam will continue to edit. During the coming year Sir Ernest Rutherford will be the president of the association, of which Major V. S. Bryant (St. Piran's School, Maidenhead) and Major C. E. Sladden (Eton College) are the secretaries.

The annual meeting of the Association of Science Teachers was held at University College, London, on January 3 last. At a business meeting in the morning the following resolution was unanimously passed:—"That this meeting of the Association of Science Teachers deeply regrets the action of the University of Cambridge, in that, alone among British universities, it continues to exclude women from membership. The association believes that such exclusion must be prejudicial to the higher education of women in general, and especially in natural science, for the study of which Cambridge can offer exceptional advantages."

A very useful discussion on practical examinations in science, initiated by a resolution concerning general elementary science as a subject in the General School Examination of the University of London, was made more valuable by the presence of Mr. Lea, representing the University. The general sense of the meeting was in favour of the retention, or even extension, of practical tests in science as a part of the First Examination.

In the afternoon Dr. Winifred Brenchley, of the Rothamsted Experimental Station, lectured on "The Effects of Competition on Plant-life." She pointed out that competition is prevalent both above and below ground. In the soil the deficiency of any constituent of plant-food may become a limiting factor in the growth of the plant, and the elements which act most frequently in this way are nitrogen and phosphorus, and to a less extent potassium. Tests on this point are made by pot-cultures, in which the composition of the soil can be controlled. By such tests it can be shown that with scanty nourishment one plant will increase as much in dry weight as a number of plants crowded into the same amount of soil.

Above ground the limiting factor is light, leaf mosaics and other leaf arrangements being an adaptation to this condition. The effect of light is not always obvious, as crowded plants are taller than "spaced" ones, but a comparison of dry weights shows that the "spaced" plant increases 50 per cent. more than the crowded one.

Plants are adapted to live in communities on a limited amount of soil by varying root depth, *e.g.* during the drought of last summer bird's foot trefoil flourished exceedingly because it had deep roots. Cultivated plants cannot exist at all in competition with weeds. Investigations undertaken at Rothamsted have shown the extraordinary vitality of weed-seeds, and work is now proceeding on a survey of weeds of various districts. In this matter Dr. Brenchley seeks to enlist the help of schools in various parts of the country, and will be glad to send details as to the data required to anyone who can help in this way.

Problems of Animal Breeding.

AN interesting series of articles on research in animal breeding appeared in the April–July issues of the *Journal of the Ministry of Agriculture*. In the first two papers the author, Prof. R. C. Punnett, traces the results of crossing red with black and polled with horned cattle, and in this way illustrates the Mendelian principles underlying all breeding methods. Mendelism not only enables the breeder to understand why red calves sometimes appear even in the most highly pedigreed Aberdeen, Angus, or Holstein cattle, but it also supplies the knowledge which can be used to prevent their ever appearing again. The factors with which breeders are concerned are rarely as simple as in the black-red case of cattle, where the possibilities form a simple alternative pair, and in both cases one of the characters is completely dominant to the other, black being dominant to red and polled to horned. A more

complex example is given by crossing black polled with red horned cattle, which in the first generation yields all black polled animals, but in the second generation a very mixed progeny arises. If the factors for the black-red and the polled-horned pairs are transmitted in the same manner, but *independently of one another*, then the second generation will consist of four classes: black-polled, black-horned, red-polled, and red-horned in the ratio of 9 : 3 : 3 : 1. This ratio has not been verified on a comprehensive scale for the cattle cross, but it has been worked out in all details in several cases for smaller animals. That horned-blacks and polled-reds appear in the second filial generation means that there has been a "break up" of the parental types, and the new classes arise through re-combination of the two pairs of factors in which the original parents differed.

Many of the characters of animals owe their manifestation to the presence of one or other definite factor transmitted according to a definite scheme. If these factors are not divisible under normal conditions they must be transmitted through the germ-cells as definite entities producing their full effect in each successive generation. Therefore, if these factors are relatively permanent, and follow a fixed scheme of distribution in heredity, it is obvious that the characters of living things can be brought under accurate control by the breeder. This factorial theory of heredity has been tested and proved to hold good in a large number of cases, and the problem now engaging the attention of research workers at Cambridge is to find whether it can be applied to those cases where at first sight there appears no suggestion of clear-cut alternative pairs of characters.

The last two papers of the series under notice deal with some of the experiments carried out on these lines. One of the most extensive analyses was designed to investigate the inheritance of weight in poultry. Two standard breeds were chosen; for the larger bird the Gold-pencilled Hamburgh, and for the smaller one the Silver Sebright Bantam, the latter being, roughly, three-fifths of the weight of the former. The first-cross birds were intermediate in size, but in the second generation there was a very wide variation. The majority of birds were between the weights of the original parental birds, but a few were larger than the Hamburgh, while a few were smaller than the Sebright. Nilsson-Ehle, working on wheat and oats, was the first to give an explanation of such cases, and the closeness with which the theory fitted his results left little doubt of its being a true interpretation. Essentially, his theory is that a similar effect may be brought about by more than one factor, though such factors are independently transmitted. Accordingly, if there are several similar factors, A, B, C, D, etc., which influence the weight of poultry, then a bird possessing none of these factors will be the smallest type. When it contains A, it will be rather larger; when it contains A and B, it will be larger again, and so on until the largest bird is reached which contains the full collection of the weight factors.

This theory was found to cover all the observed facts, and although it is not suggested that weight is dependent solely upon such factors, yet it seems probable that even such complicated characters can be interpreted in terms of definite factors. On the other hand, very different results were obtained in experiments on rabbits, where the large Flemish was crossed with the small Polish rabbit. In this case the F_2 generation contained no animals at all approaching the size of the original Flemish, and no explanation of this can at present be offered. Further experiments on rabbits were concerned with the inheritance of coat patterns, and the analysis of the continuous series from self-colour to almost white provided an interpretation in terms of the factorial theory.

Another interesting series of analyses dealt with the peculiar form of inheritance known as sex-linked heredity. This can be illustrated by the Hamburgh-Sebright cross used for the weight experiments. The Hamburgh was a gold-pencilled and the Sebright a silver, and the experimental work showed that silver and gold form an alternative pair, silver being a simple dominant to gold, but in the hen the transmission of the factor for silver is sex-linked. The silver hen is never pure for the silver factor; half of her eggs are "silver" and half are "gold"; moreover, she transmits the silver factors to her male-producing eggs and the gold to her female-producing eggs. A large number of birds have been bred from the mating of silver hen and gold cockerel, but there has not been one exception to the rule that the cockerels all come silver and the pullets all gold. This sex-linked type of inheritance is found in several other characters in poultry, and it may prove of economic importance, for by making use of suitable crosses the breeder of poultry for egg-production can be sure of rearing nothing but pullets through the earlier, and more costly, stages.

Further experiments dealt with the inheritance by cocks of henny feathering, while others were concerned with the characters of egg-colour and broodiness in poultry. These had to be curtailed considerably owing to war conditions, although some interesting results were obtained.

Although all these analyses may prove to be of economic value, yet it must be remembered that the "main object of the work at Cambridge is the elucidation of the principles that underlie the phenomena of heredity," and when these have been revealed the application can be left to those who will derive profit from it.

A Petrological Microscope.

WE have received for examination from Messrs. R. and J. Beck an example of their "Standard London Petrological Microscope," which they have recently designed for the use of students. It embodies some of the recommendations of a committee of the British Science Guild, which carefully considered the subject (Journal of the British Science Guild, November, 1916, pp. 28–30). The microscope, which is strongly built and stands firmly, has the following distinctive features:

The analyser is a form of the Abbe prism, devised by Mr. E. M. Nelson. It is placed immediately below the upper lens of the ocular, and slides laterally in and out of position. This arrangement, while it does not appreciably contract the field, has the advantage that it allows a quartz wedge to be inserted between the nicols in the focus of the ocular, with the result that the colour bands are sharply defined, as is also the dark band indicating the position of compensation. It is stated that in certain circumstances a faint second image of the cross wires can be seen, but it is scarcely noticeable, and causes

no inconvenience. The analyser can be rotated about the axis of the microscope, and is provided with clicks in the positions of crossed and parallel nicols. There is an arrangement by which it can be rotated alternately through small equal angles in opposite directions, from the position of crossed nicols, thus affording an accurate means of determining whether the exact position of extinction of a mineral has been arrived at.

The "directions-image," showing interference figures, is obtained, not by the insertion of a "Bertrand" lens in the tube, but by placing a "Becke" lens over the ocular. This is decidedly preferable as it enables the optical effects of a small crystal or twin lamella to be isolated by first placing a diaphragm, with a hole of suitable dimensions, in the focus of the ocular, so as to hide everything except the object to be studied, and then putting the Becke lens into position. The diaphragm is so constructed that it allows of the insertion of a gypsum plate or quartz wedge immediately above it.

These arrangements render it unnecessary to cut into the tube of the microscope to allow of the introduction of the analyser and the Bertrand lens. This means less labour in construction, and therefore less cost.

It may be added that the upper lens of the ocular is adjustable, so as to admit of its being exactly focussed on the quartz wedge, the cross wires, or the perforation in the diaphragm, and there is also an adjustment of the Becke lens for the purpose of focussing the interference figures.

The polariser is conveniently placed in a swing-out below the stage. It has a slot immediately below it for the insertion of a diaphragm with a small circular or linear aperture for comparing the refractive indices of adjoining minerals by the Becke method, and other purposes.

When it is required to insert the condenser it is slid up into a cylindrical fitting in the stage. This is not very convenient, but we are informed that the firm is arranging to substitute a swing-out attachment, which it is believed will prove in every way satisfactory.

An interesting feature is the Sloan objective changer, which takes only two or three seconds to operate. Each objective is attached to a collar by means of two screws. When these are once correctly adjusted, the objective will always be found to be correctly centred immediately on insertion.

Among the accessories is a quartz wedge cemented to a gypsum plate, and graduated in intervals of fifty micromillimetres of relative retardation. This should render unnecessary the quarter-wave mica and Klein's plate, which are, however, still retained in the list of accessories.

It may be suggested that the fine adjustment should be provided with a milled head graduated to five microns on its circumference, even if it were only approximately accurate.

Archæology in Mexico.

AT a meeting of the Royal Anthropological Institute on November 22 Mrs. Zelia Nuttall gave an account of recent archæological investigations in Mexico. As an introduction to her report Mrs. Nuttall referred briefly to the fact that after a period of quiescence of some centuries the great volcano Popocatapetl had again become active in 1920, and that its activity still continued.

During the last decade evidence that great volcanic disturbances had taken place at long intervals has been forthcoming. Two distinct types of figurines have been found in conditions which indicate that the topography of the valley has been changed and its inhabitants destroyed by great catastrophes antedating the arrival of the Nahuas or Aztecs.

Of these figurines the first, provisionally distinguished as the sub-gravel type, was brought to Mrs. Nuttall's notice in 1909, when specimens were offered for sale by Indians, and she herself discovered an example *in situ* under a gravel bed at Atzacapotzalco. They were delicately fashioned of fine clay, with slender bodies, long faces, smooth-hanging hair, some wearing chaplets. All presented a worn and polished surface. In the Valley of Mexico the gravel beds extend under the lava flow at the base of the extinct volcano Ajusco.

Under the lava bed, to which Dr. Tempest Anderson assigns an age of at least 20,000 years, Mrs. Nuttall in 1908, and afterwards Señor Gamio, head of the Department of Archæology of Mexico, have discovered a second type of figurine, to which the name "sub-lava type" has been given. This type is characterised by turbans and caps, evidently of fine stuffs or fur, and decorated with circular ornaments of stone or shell. They indicate that the southern part of the valley was inhabited by a race totally distinct from that of the "sub-gravel type" and the Aztec. The distribution of the clay figurines is now under investigation. They have been traced as far as Guatemala.

Mrs. Nuttall also described the results of recent excavations at Teotihuacan, during which a small pyramid was opened up and reconstructed by Señor Gamio. A tunnel pierced at the height of 35 ft. to the centre of the pyramid revealed that it had been formed of mud filled with innumerable fragments of pottery vessels which had prevented the mud from cracking when it baked in the sun. A remarkable discovery was that of the remains of the ancient pyramid temple with a wonderful sculptured frieze which had been partly destroyed and then concealed by another terraced pyramid temple built in front. The sculptured serpents' heads and the masks of the water-god Tlaloc are of a form hitherto unknown. Associated with them are sculptured shells, principally the conch shell and the pecten or pearl shell. Not only is it remarkable that sea-shells should be represented in sculpture in the heart of the continent, but the association of the water-god with the ocean is entirely new.

In the discussion which followed Mrs. Nuttall's paper, Mr. Maudslay expressed the hope that it might be possible before long, by the elaboration of a system of stratification, to date Mexican antiquities. As Mexico appeared to have been untouched by outside influence, the study of its antiquities afforded evidence of the highest value for the study of the development of the human mind acting by itself. Mr. T. A. Joyce emphasised the importance of the evidence relating to the figurines, and pointed out that the British Museum had acquired a figurine of similar technique from Ecuador. Prof. Elliot Smith expressed the opinion that, contrary to what had been stated by Mr. Maudslay, Mexican antiquities showed clear evidence of influence from outside, and in particular from Asia. Mrs. Nuttall's work showed that this culture must have crossed the Pacific.

The Treasury Grant to Universities.

WE have already referred on several occasions to the proposed reduction, from 1,500,000*l.* to 1,200,000*l.*, in the Treasury grant-in-aid of university education for the coming financial year 1922–23. A memorandum, in which the dangers of reducing the grants and the rightful claims of the universities are ably stated, signed by the Vice-Chancellors of the Universities of Birmingham, Durham, Leeds, Liverpool, Manchester, and Sheffield, has been forwarded to the Prime Minister. The document has also received the approbation of the Vice-Chancellors of the Universities of Oxford, Cambridge London, Bristol, Glasgow, Aberdeen, and Wales. As we have repeatedly pointed out, the universities are the chief centres of research; they advance science and, to regard the matter from the purely commercial side, they have unquestionably added millions to the national wealth by the way in which they have enriched industry and commerce. In return for their great services, and in order to continue to be able to give such service, they are asking the Government to assist in maintaining their relatively modest financial resources. Encouraged by the hope that funds raised locally would be met by a corresponding increase in Treasury grants, great efforts have been made and every form of self-help employed; severe economy has been practised in structural expenditure and in the maintenance and equipment of laboratories; students' fees have been increased so that one-third of the total income of the universities of the North is derived from this source; private benefactors have given 1,175,000*l.* in response to urgent appeals; and local authorities have increased their grants to these universities from 74,268*l.* in 1913–14 to 135,868*l.*

In spite of this effort and the proportion of the Treasury grant allocated to the universities of the North of England, heavy losses were sustained in the working of the last academic year. It is therefore considered that with a curtailment of the existing grant the efficiency of the universities will be seriously impaired. In other countries, with which Britain must come into competition, efforts are being made to increase the resources of the universities. It is only necessary in this connection to recall the case of McGill University of Montreal, which has recently received sums amounting to seven million dollars in gifts from private benefactors and subsidies from public funds. The universities are admittedly of prime national importance, and when their resources, exploited to the uttermost, are insufficient for the maintenance of efficiency and vigour, it becomes a national duty to provide the necessary additional funds.

The Royal Academy Winter Exhibition.

THE exhibition which opened this week of works by recently deceased members of the Royal Academy affords an opportunity of comparing the pictures which have been exhibited at different dates during the past fifty years with those of the present time as shown year by year at the summer exhibitions. Even a rapid tour round the galleries shows that, so far as landscapes and Nature studies are concerned, the past can well bear comparison with the present, the number of unsatisfactory representations of Nature in the present exhibition being remarkably few. This does not prove that such pictures were not exhibited fifty years ago; it may indicate only that the Selection Committee in making choice has avoided pictures of that type. It may, on the other hand, indicate that "recently deceased members" were less addicted to post-impressionism and similar phases of art than those still living.

Thirty-six artists are represented in the exhibition. Of those who excelled in landscapes Sir Ernest Waterlow must be mentioned. He is represented by eighteen works of almost uniform excellence. Alfred Parsons's landscapes are equally pleasing, particularly No. 233, "River Scene," first exhibited in 1878. His garden pictures are not quite so successful, the flowers not presenting in all cases an entirely natural appearance. Napier Hemy, whose sea paintings are so well known, is represented by several of these works, and also by views of the Thames in London, of which No. 80, "The Riverside, Chelsea" (1873), derives an added historical interest as showing a wooden bridge over the Thames in the foreground, the familiar square tower of Chelsea old parish church being seen behind. Much more ancient history is shown in "The Catapult" (No. 208), a stout wooden apparatus manipulated by Roman soldiers in the siege of a walled city. The construction looks strangely modern.

Peter Graham's works show much more variety than was to be found in his recent paintings. One of the earliest shown, "A Spate in the Highlands" (No. 105), exhibited in 1866, is typical of his modern work with hill-mist in a Scotch glen, but without cattle. Then in 1873 came a Highland farm scene, and in 1896 and 1898 two really excellent pictures of sea and rocks (Nos. 191 and 216). It is a great pity that a subject in which the artist showed such skill should have been entirely discarded later in favour of the mountain scenes, successful as these were. It would not be fitting to close this note without favourable mention of Briton Riviere's numerous scenes from animal life, some of which are very striking.

J. S. D.

Botany of the Argentine Republic.

THE Anales (vol. 29, 1917) of the Museo Nacional de Historia Natural de Buenos Aires, recently received, a bulky volume of 700 pages, is devoted to the botany of the Argentine Republic. The earlier portion of the book contains the first part of a catalogue of the flowering plants, with the preparation of which Messrs. Hauman and Vanderveken have been occupied since the foundation of the botanical section of the museum in 1914. The catalogue consists of a list of all the species recorded for the area, under their families, which are arranged according to Engler's system. The entries in each family have been revised by the latest monograph dealing with the family in question. Under each species references are given to the publications on the authority of which the species is included. A systematic enumeration of the results of botanical explorations in this large area of temperate and sub-tropical South America has been much needed, and it is to be hoped that the authors will carry it to completion. A communication by Mr. Hauman on the orchids of the Argentine gives some indication of the work which remains to be done.

Two main groups are represented, a sub-Antarctic (Patagonian-Andine) and a sub-tropical, the latter being the more important. The present work has increased by 50 per cent. the number of genera and species belonging to the sub-tropical group. Mr. Hauman also supplies a number of floristic notes, which conclude the series of memoirs he has already published on the Monocotyledons of the Argentine, in which he has added some seventy species to the flora, about one-third of which are new. The volume concludes with a revision by Mr. Carlos Spegazzini of the Argentine Laboulbeniales, that remarkable group of minute fungi which live parasitically on insects. The enumeration includes 213 species, each of which is carefully figured; a large proportion are described for the first time. The volume is a very important contribution to our knowledge of the botany of temperate South America.

University and Educational Intelligence.

DR. A. SMITH WOODWARD will give a lecture on fossil man, with special reference to the Rhodesian skull, on Tuesday, January 24, at 5.30 p.m. at University College, London. Tickets for the lecture, at 5*s*. and 2*s*. 6*d*., can be obtained from the Secretary of the college. The proceeds will be devoted to the St. Christopher's Working Boys' Club in Fitzroy Square, which is largely worked by students and members of the staff of University College. The chair will be taken at the lecture by the Right Hon. the Earl of Plymouth, who is president of the club.

THE second term at University College, London, begins on Tuesday next, January 17. The following are some of the public lectures to be given during the term:—"Industrial Unrest," by Mr. B. Seebohm Rowntree; "The Bridges of London," by Mr. A. T. Walmisley; "The Preservation of Ancient Buildings," by Mr. A. R. Powys; "The Evolution of Man" (four lectures), by Prof. G. Elliot Smith; "The University of London: Its History, Present Resources, and Future Possibilities," by the provost, Sir Gregory Foster; and two lectures by Sir George Aston on "Some Principles of Amphibious Warfare" and "War History and its Application." A copy of the full programme may be obtained by sending a stamped addressed envelope to the Secretary, University College, London, W.C.1.

THE annual general meeting of the Incorporated Association of Head Masters was opened on January 4 at the Guildhall, and the new president, Mr. C. M. Stuart, delivered his inaugural address. Mr. Stuart stated that the two most revolutionary changes in education—the introduction of the schemes for 25 per cent. of free scholars and advanced courses—were instituted without consultation with secondary school representatives. In consequence, the original schemes had already required several modifications. The whole scholarship system needed reform based upon the study of the capacities of boys. In making awards it was of no use to go below the first 10 per cent., for this meant rewarding mediocrity, and it was by no means certain that the best from among the mediocrity were selected. The following resolution was carried unanimously by the meeting:—"That this meeting, while recognising the need for economy in every department, is of opinion that the recently awakened public interest in education demands that no hindrance of any kind shall be placed in the way of educational progress."

Calendar of Industrial Pioneers.

January 13, 1890. Daniel Adamson died.—A pioneer in the use of Bessemer steel for boilers, in the application of hydraulic power for riveting, and in the use of high-pressure steam, Adamson in 1861 built one of the earliest triple expansion engines. He became the head of the Penistone Ironworks, served as president of the Iron and Steel Institute, and was one of the chief promoters of the Manchester Ship Canal.

January 14, 1908. John Macfarlane Gray died.—When manager of a works at Liverpool Gray in 1866 constructed for the s.s. *Great Eastern* the first successful steam steering engine, thus enabling one man to do what had previously required as many as one hundred. He was well known for his writings on thermo-dynamics and his advocacy of the application of scientific principles to engine construction.

January 14, 1830. Johan Georg Repsold died.—The founder of the famous firm of instrument makers, Repsold was born in 1771, and was long connected with the Hamburg Fire Brigade. He introduced improvements in meridian circles and supplied many instruments to the large observatories.

January 15, 1900. Thomas Egleston died.—After graduating at Yale, Egleston studied for some years at the Ecole des Mines in Paris, and in 1863 initiated the plan for the School of Mines of Columbia University, New York, where he held the chair of mineralogy and metallurgy for thirty-three years.

January 17, 1909. Francis Elgar died.—Trained in Portsmouth Dockyard, Elgar became one of the first fellows of the Royal School of Naval Architecture and Marine Engineering at South Kensington. He was assistant to Reed, Adviser to the Japanese Government, John Elder professor of naval architecture at Glasgow, Director of Dockyards, and head of the Fairfield Shipbuilding Company.

January 17, 1833. Friedrich König died.—At the age of thirty-two, in 1806 König removed from Leipzig to London, and in 1811 with Andreas Friedrich Bauer (1783–1860) patented the printing machine in which the paper was pressed against the type by a revolving cylinder. On November 28, 1814, the *Times* was first printed on one of König's machines driven by a steam engine, "a memorable day in the annals of typography."

January 18, 1861. John Heathcoat died.—A journeyman frame-smith, Heathcoat at Loughborough in 1808–9 brought out his lace-making machines. The first square yard of plain net sold for 5*l*.; the price in 1890 was 5*d*., while the annual value of the trade had grown to 4,000,000*l*. Heathcoat's factory at Loughborough was destroyed by the Luddites in 1816 and he removed to Tiverton.

January 18, 1865. James Beaumont Neilson died.—While in charge of the Glasgow Gasworks, where he introduced clay retorts and the use of sulphate of iron as a purifier, Neilson experimented on the air-supply for blast-furnaces, and in 1828 patented the "hot blast," which enormously increased the production of iron and made available the black band ironstone discovered by David Mushet. It has been said Neilson did for iron manufacture what Arkwright did for the cotton industry.

January 18, 1873. Pierre Charles François, Baron Dupin, died.—A student of the Ecole Polytechnique, Dupin first gained distinction by his papers on naval architecture and engineering. He made a profound study of the industries of Great Britain and was one of the first in France to raise statistics to the rank of a science. E. C. S.

Societies and Academies.

LONDON.

Geological Society, December 21, 1921.—Mr. R. D. Oldham, president, in the chair.—H. B. **Milner**: The nature and origin of the Pliocene deposits of the County of Cornwall and their bearing on the Pliocene geography of the south-west of England. Tertiary deposits of Cornwall at St. Agnes, St. Erth, Lelant Downs, Polcrebo, and St. Keverne have been provisionally assigned to the Pliocene period; except those of St. Erth, all are unfossiliferous. The average composition of the St. Agnes, St. Erth, and St. Keverne deposits is substantially the same. On this basis correlation of the deposits is effected by (*a*) the frequency of occurrence of individual species, (*b*) their persistence or distribution, and (*c*) the constancy of crystallographical, physical, and optical properties of grains of the same mineral, wherever met. The source of the material is essentially local. The gradual "swamping" of sediment-bearing rivers by the advancing Pliocene sea from the south-west is correlated with certain physical features apparent, especially the "400-ft. plateau."—L. **Owen**: The phosphate deposit of Ocean Island. Ocean Island, in the Western Pacific Ocean, consists of a mass of terraced and dolomitised coral-limestone which rises to a height of 300 ft. above low water, spring tide. Its surface is almost completely covered by a capping of calcium phosphate of exceptional purity which can be divided into three varieties: (*a*) Amorphous calcium phosphate, formed of the insoluble residue of the original guano; (*b*) detrital coral-limestone, converted into calcium phosphate by solutions leached from the guano; and (*c*) phosphatised coral *in situ*. The percentage of tricalcium phosphate at any point varies in a remarkably regular manner, according to the position of the point on the island, suggesting that (*a*) the original guano was deposited on the coral base during a slow negative movement of the strand-line, and (*b*) subsequent to the formation of phosphate the island was tilted at about a third of a degree south-south-eastwards.

EDINBURGH.

Royal Society, December 5, 1921.—Prof. J. W. Gregory, vice-president, in the chair.—Prof. **Jehu**: Observations on the geology of Iona. The Archæan complex of the western and greater part of Iona consists mainly of orthogneisses of dominant acid and hornblendic types, although pyroxene-hornblende gneiss and garnetiferous pyroxene granulites also occur. Paragneisses of various kinds are found at isolated localities as lenticular masses in the orthogneisses. On the south coast the forsterite-tremolite marble (Iona marble) is associated with hornfelsed green rocks, some of which are altered sediments and some altered igneous rocks. The paragneisses are younger than, and unconformable to, the orthogneisses, and represent remnants of pre-Torridonian rocks which became infolded with the orthogneisses. A massive white pegmatite forms a prominent feature in the landscape from the marble quarry on the south coast to near the centre of the island. A belt of Torridonian beds lying unconformably on the Archæan forms the eastern margin of the island, and consists of a lower group of epidotic conglomerates and grits and an upper group of finer grits, slates, shales, and banded flags. The Torridonian series of Iona may be correlated with the lower parts of the Diabaig group of that series in Skye and other districts. In post-Torridonian time the Archæan and Torridonian rocks have been subjected to isoclinal folding, the Archæan series being dragged more or less into approximate parallelism with the Torridonian. Along the line of junction there has been considerable crushing, but no actual thrust. The Torridonian rocks show dynamic metamorphism, and the later intrusion of the Ross of Mull granite has resulted in a later thermal metamorphism. This granite forms three small islets close to the south-east shore, and probably underlies the southern half of Iona. A series of genetically connected minor intrusions occur, and, with the granite, belong probably to the Caledonian phase of igneous activity.—H. M. **Cadell**: The geology of the Blackness district. Recent borings for oil-shale and coal in the Blackness district south of the Firth of Forth have not disclosed much mineral wealth, but have provided a complete vertical section of the Oil-Shale series in that region, indicating a notable attenuation of the whole shale section towards the north and west. To the west of Blackness no workable oil-shale was found above the Burdiehouse Limestone, although the positions of the seams were recognisable. The borings were continued westward up to the Bo'ness coal-seams of the Carboniferous Limestone series through ground that had never been previously explored. Six distinct beds of limestone had been found varying much in thickness from place to place. The No. 5 limestone measuring from the top downwards appeared from its fauna to be the equivalent of the Blackhall Limestone of the West of Scotland. The old volcano of Binns Hill to the south of Blackness belonged to the volcanic horizon situated near the top of the oil-shale section between the Two Feet Coal and the overlying Raeburn Shale seam. There had been much boring and mining for shale under the east end of the hill, and the evidence showed that within a few hundred yards of the thick ash on the hill there was no ash under the Raeburn Shale where it was to be expected. Binns Hill had been a very small volcano, one of a group that emitted showers of ash after the formation of the Houston and Two Feet Coal seams over a district extending southward about seven miles. Under the whole district and below the Burdiehouse Limestone there was a large intrusive basalt sill, and Binns Hill and other small local ash-necks seem to have acted as geological safety-valves by which imprisoned gases escaped and blew up part of the fluid eruptive rock in the form of fine dust and ashes.

PARIS.

Academy of Sciences, December 27, 1921.—M. Georges Lemoine in the chair.—The president announced the death of Prof. Schwarz, correspondant for the section of geometry.—E. **Borel**: Quasi-analytical functions with real variables.—W. **Kilian**: A problem of the tectonic of the sub-Alpine chains of Dauphiné.—C. E. **Guillaume**: Recent fundamental determinations and verifications of the standard metres. Slight elongations in the lengths of the working standard metres of the International Bureau have been proved. The cause of the change is not clear, but is possibly due to the effects of cleaning. Recent determinations of the coefficients of expansion of the bars have proved a small error in the opposite direction, and at the present time these errors compensate each other at about 15° C.—M. **Gevrey**: The determination of the integrals of partial differential equations, order $2p$, and m variables, admitting a multiple family of characteristics of order p.—G. **Bertrand**: Fredholm's equation and static masses of the first kind.—M. **d'Azambuja**: A mode of graphical representation of the filaments of the upper layer of the solar chromosphere.—J. **Villey**: The adiabatic liquefaction of fluids.

In a recent communication M. Bruhat has deduced from thermodynamical reasoning that the heat of vaporisation of a liquid at the absolute zero tends to a limiting value, not zero, and also that an adiabatic expansion sufficiently extended should always result in liquefaction. These conclusions have been objected to by M. Ariès. The author now shows that on the basis of the kinetic theory M. Bruhat's results are probable.—L. **de Broglie**: The theory of the absorption of the X-rays by matter and the principle of correspondence.—A. **Dauvillier**: Contribution to the study of the structure of the elements of intermediate atomic weight.—E. **Carvallo**: The problem of relativity in dielectrics.—R. **Boulouch**: The problem of achromatism.—H. **Pélabon**: The constitution of selenium. Different specimens of grey selenium are regarded as mixtures in variable proportions of two modifications, α and β, the α modification having a high resistance, the β a low resistance. The change in the specific resistance with temperature shows that the α changes into the β modification with absorption of heat. It is the α-selenium which is sensitive to light.—C. **Staehling**: The radio-activity of the uranium oxides. The changes in the radio-activity of the green oxides of uranium are attributed to the slow absorption of moisture; the black, strongly ignited oxide has a constant radio-activity, and is not hydrated on standing.—P. **Woog**: Relations between molecular properties and the capacity of fixing iodine of certain hydrocarbons.—M. **Samec** and V. **Ssajevič**: The composition of agar.—A. **Schoep**: Kasolite, a new radio-active mineral. The mineral was found at Kasolo, Belgian Congo, and occurs along with curite and chalcolite. It contains lead and uranium, and analysis gives the composition as

$$3PbO{\cdot}3UO_3{\cdot}3SiO_2{\cdot}4H_2O.$$

—H. **Hubert**: New researches on the storm squalls in western Africa.—A. **Petit**: The cytology of two bacteria.—L. **Daniel**: New researches on grafts of Helianthus. An account of further experiments of grafting sunflowers on Jerusalem artichokes, with special reference to the weights of the tubers.—L. **Emberger**: Contribution to the cytological study of the sporangium in ferns.—M. **Boel**: The automatic adaptation of the angle of attack of flight in living insects. Study on the mechanism of natural flight.—M. **Nicloux** and G. **Welter**: The gravimetric quantitative micro-analysis of urea. Application to the estimation of urea in 1 c.c. of blood. The urea is precipitated as xanthylurea, and weighed on a Kuhlmann balance to 0·001 milligram.—E. **Aubel**: The attack of glucose and levulose by the pyocyanic bacillus. Glucose gave formic and acetic acids, with some ethyl alcohol. Levulose gave the same products, together with lactic acid.—E. **Chatton** and A. **Lwoff**: A new family of Acinetians, Sphenophryidæ, adapted to the branchia of the acephalous molluscs.—P. **Courmont**, A. **Rochaix**, and F. **Laupin**: The rhythm of the disappearance of ammonia in the course of the purification of sewage by activated sludge.—A. **Lumière**: The mechanism of the accidents caused by the injection of the serum of epileptics.—L. **Blum**: The antiphlogistic action of calcium salts.

Official Publications Received.

Office scientifique et technique des Pêches Maritimes. Notes et Mémoires No. 10: Le Controle Sanitaire de l'Ostréiculture. Par Dr. G. Borne, F. Diénert, et G. Hinard. No. 11: Le Conseil International pour l'Exploration de la Mer. Compte rendu Sommaire de la Session tenue à Copenhague, Juillet, 1921. (Paris: Ed. Blondel la Rougery.)

University of Illinois: Engineering Experiment Station. Bulletin No. 124: An Investigation of the Fatigue of Metals. By Prof. H. F. Moore and J. B. Kommers. Pp. 185. (Urbana: University of Illinois.) 95 cents.

Report on the Administration of the Meteorological Department of the Government of India in 1920-21. Pp. 14+1 chart. (Simla.) 4 annas.

Department of Fisheries, Bengal and Bihar and Orissa. Bulletin No. 17: Statistics of Fish Imported into Calcutta for the Year ending 31st March, 1921. Pp. ii+13. (Calcutta: Bengal Secretariat Book Depôt.) 8 annas.

Department of Agriculture, Madras. Bulletin No. 80: The Entomologist's Crop Pest Calendar for the Madras Presidency. By T. V. Ramakrishna Ayyar. Pp. 4+4 plates. (Madras: Director of Agriculture.) 2 annas.

The Marine Biological Station at Port Erin (Isle of Man). Being the Thirty-fifth Annual Report of the former Liverpool Marine Biology Committee, now the Oceanography Department of the University of Liverpool. (Read before the Liverpool Biological Society, November 11, 1921). Drawn up by Prof. J. Johnstone. Pp. 36. (Liverpool: University Press.)

Notes from the Royal Botanic Garden, Edinburgh. Vol. 6. Additional Plate Number. Addition to Numbers 29-30 (January, 1917). Plates 1-37. 2*s.* net. Vol. 13. No. 62. Pp. 67-100+plates 170-179. 1*s.* 6*d.* net. (Edinburgh: H.M. Stationery Office.)

Transactions of the Royal Society of Edinburgh. Vol. 53, part 1 (No. 3): Geological Observations in the South Shetlands, the Palmer Archipelago, and Graham Island, Antarctica. By D. Ferguson. Pp. 29-56+plates 1-4. 6*s.* 6*d.* Vol. 53, part 1 (No. 4): A Contribution to the Petrography of the South Shetland Islands, the Palmer Archipelago, and the Danco Land Coast, Graham Land, Antarctica. By G. W. Tyrrell. Pp. 57-80.—Vol. 53, part 1 (No. 5): On the Innes Wilson Collection of Rocks and Minerals from the South Shetland Islands and Trinity Island. By Dr. H. H. Thomas. Pp. 81-90. 1*s.* 6*d.* (Edinburgh: R. Grant & Son; London: Williams & Norgate.)

Diary of Societies.

THURSDAY, JANUARY 12.

ROYAL AERONAUTICAL SOCIETY (Juvenile Lecture) (at Royal Society of Arts), at 3.—Major D. C. H. Hume: Boats that Fly.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—J. E. Campbell: Einstein's Theory of Gravitation as an Hypothesis in Differential Geometry (II).—Miss G. D. Sadd: Rational Plane Curves.—Fritz Lettenmeyer: Neuer Beweis des allgemeinen Kroneckerschen Approximationssatzes.—T. Carleman: A Theorem Concerning Fourier's Series.—T. Stuart: Parametric Solutions of Certain Diophantine Equations.—W. P. Milne: Apolarity and the Weddle Surface.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Exhibition of Cinematograph Films.—P. Torchio, with explanatory notes by Dr. C. C. Garrard: Investigations and Tests on High-tension Switchgear.—F. Gill: Telephone Inventors of To-day.—F. Gill: The Audion.—F Gill: Electricity in the Home.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at Food Reform Club, 2 Furnival Street, E.C.), at 7.30.—A. H. Keable: Super Centrifugal Force and its Application to the Clarification of Varnish and Dehydration of Oil.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Dr. C. J. Peddle: The Manufacture of Optical Glass.—Dr. J. W. French: The Barr and Stroud 100 ft. Self-contained Base Rangefinder.—T. Smith: The Optical Three Apertures Problem.

INSTITUTE OF METALS (London Section) (at Sir John Cass Technical Institute), at 8—Col. N. Belaiew: The Inner Structure of the Crystalline Grain.

HARVEIAN SOCIETY (Annual General Meeting) (at 11 Chandos Street, W.1), at 8.15.—Dr. G. de Bec Turtle: Some Points on Spasm in the Alimentary Tract (Presidential Address).

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Sir Frederick Mott and Dr. Uno: Changes in the Brain in Cases of Surgical Shock.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, JANUARY 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.—J. S. Paraskévopoulos: Jupiter in 1915 and 1916: Rotation Period in Different Latitudes, from Observations at the National Observatory, Athens.—Prof. G. Forbes: Solar Motion from 1922 Radial Velocities.—Major W. J. S. Lockyer: The Use of a Graduated Wedge in Stellar Classification and Parallax Work.

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

JUNIOR INSTITUTION OF ENGINEERS, at 8.—E. C. West: Artificial Ice.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—M. L. Hepburn: Experience Gained from 150 Trephine Operations for Glaucoma.—H. Neame: Epibulbar Leucoma with Intraocular Involvement.

MONDAY, JANUARY 16

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge, Kensington Gore), at 5.—O. J. S. Crawford: The Archæology of the Ordnance Survey Maps.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Hunterian Lecture.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—E. H. Richards and G. C. Sawyer: Further Experiments with Activated Sludge.

ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street), at 8.—H. J. Paton: Plato's Theory of εἰκασία.

TUESDAY, JANUARY 17.

ROYAL HORTICULTURAL SOCIETY, at 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. F. H. A. Marshall: Physiology as Applied to Agriculture (1).

EUGENICS EDUCATION SOCIETY (at Royal Society), at 5.—Sir Frederick Mott: The Neuroses and Psychoses in Relation to Conscription and Eugenics.

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

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—H. W. Macrosty: Some Current Financial Problems.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. V. Lawley: Automatic Methods of Kinematograph Film Processing.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Dr. H. S. Stannus: Arts and Crafts from Nyassaland.

ROYAL SOCIETY OF MEDICINE (Pathology Section), at 8.30.—Sir G. Lenthal Cheatle: Multicentric Origin in a Case of Rodent Ulcer of the Trunk.—J. B. Buxton: Grass-disease and Botulismus.—Dr. A. B. Rosher and Dr. H. A. Fielden: Agglutinins for Bacilli of the Salmonella Group in Sera obtained from the General Population.—Dr. W. W. C. Topley: The Effect of Dispersal during the Early Stages of a Mouse-epidemic.

WEDNESDAY, JANUARY 18.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Hunterian Lecture.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—Dr. F. P. Wilson: The Plague in Shakespeare's London.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. A. C. Seward and R. E. Holtum: Jurassic Plants from Ceylon.—F. S. Wallis: The Carboniferous Limestone (Avonian) of Broadfield Down (Somerset).

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Annual General Meeting.—R. H. Hooker: The Weather and the Crops in Eastern England, 1885-1921.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.—Annual Meeting.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—W. Stoneman: Faces, Famous, Fair, and Funny.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Prof. J. Eyre: Microscopy and Oyster Culture (Presidential Address).

ROYAL SOCIETY OF ARTS, at 8.—J. S. Huxley: Recent Advances in the Determination of Sex in Animals.

SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Essex Street), at 8.30.—Earl Russell and others: Discussion: Divorce and Birth Control.

THURSDAY, JANUARY 19.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—S. Gordon: Mountain Birds of Scotland.

ROYAL SOCIETY, at 4.30.—*Probable Papers.*—Prof. L. Hill, H. M. Vernon, and D. H. Ash: The Kata-Thermometer as a Measure of Ventilation.—Lt.-Col. C. B. Heald and Major W. S. Tucker: Recoil Curves as Shown by the Hot Wire Microphone.—E. W. A. Walker: Studies in Bacterial Variability: The Occurrence and Development of Dys-agglutinable, Eu-agglutinable, and Hyper-agglutinable Forms of Certain Bacteria.—Marjory Stephenson and Margaret Whetham: Studies in the Fat Metabolism of the Timothy Grass Bacillus.—J. A. Gardner and F. W. Fox: The Origin and Destiny of Cholesterol in the Animal Organism. Part 12: The Excretion of Sterols in Man.—Dr. S. J. Lewis: The Ultra-violet Absorption Spectra and the Optical Rotation of the Proteins of the Blood Sera.

LINNEAN SOCIETY OF LONDON, at 5.—Dr. E. Marion Delf: Studies in *Macrocystis pyrifera*, the Giant Alga of the Southern Temperate Zone.—J. L. C. Musters: The Flora of Jan Mayen Island.

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

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—J. F. Allan: A Typical Example of Magmatic Injection.—W. E. Whitehead: Steep Sights in Underground Surveys.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Brig.-Gen. R. K. Bagnall-Wild: Aeroplane Installation.

INSTITUTION OF ELECTRICAL ENGINEERS (Joint Meeting with Institution of Heating and Ventilating Engineers), at 6.—Discussion: The Utilisation of Waste Heat from Electrical Generating Stations, with the following Introductory Papers: C. I. Haden: Utilisation of Exhaust Steam from Electric Generating Stations, and Coal Economy.—F. H. Whysall: The Utilisation of Waste Heat from Electrical Generating Stations.

CHEMICAL SOCIETY, at 8.—Prof. A. Smithells: Models of the Lewis-Langmuir Atom, with Explanations.

FRIDAY, JANUARY 20.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Hunterian Lecture.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 5.—A. Tweedie: Short Account of the Research Work being conducted in Utrecht on the Saccular, Utricular, and Allied Reflexes (continued).

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H. S. Denny and N. V. S. Knibbs: Some Observations on a Producer-gas Power Plant.

ROYAL SOCIETY OF MEDICINE (Electro-therapeutics Section), at 8.30.—Dr. Zimmern, Dr. Agnes Savill, Dr. Sloan-Chesser, Dr. C. A. Robinson, Dr. W. J. Turrell, and others: Discussion: Electrotherapy in Gynæcology.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir James Dewar: Soap Films and Molecular Forces.

SATURDAY, JANUARY 21.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. C. Macpherson: The Evolution of Organ Music (1).

PUBLIC LECTURES.

(A number in brackets indicates the number of a lecture in a series.)

THURSDAY, JANUARY 12.

ST. JOHN'S HOSPITAL FOR DISEASES OF THE SKIN, at 6.—Dr. W. K. Sibley: Electrical Treatments—Diathermy, etc. (Chesterfield Lecture).

THURSDAY, JANUARY 19.

KING'S COLLEGE, at 5.30.—Dr. O. Faber: Reinforced Concrete (1).

ST. JOHN'S HOSPITAL FOR DISEASES OF THE SKIN, at 6.—Dr. W. Griffith: Diseases of the Skin Appendages (Chesterfield Lecture).

FRIDAY, JANUARY 20.

METEOROLOGICAL OFFICE, SOUTH KENSINGTON, at 3.—Sir Napier Shaw: The Structure of the Atmosphere and the Meteorology of the Globe (1).

KING'S COLLEGE, at 5.—Prof. R. Robinson: Orientation and Conjugation in Organic Chemistry from the Standpoint of the Theories of Partial Valency and of Latent Polarity of Atoms (1).

KING'S COLLEGE, at 5.30.—Rev. Dr. F. A. P. Aveling: Matter, Mind, and Man.

SATURDAY, JANUARY 21.

UNIVERSITY COLLEGE, at 10.30 a.m.—A. Chaston Chapman: Yeast: What it is, and what it does (Lecture for Teachers).

LONDON DAY TRAINING COLLEGE, at 11 a.m.—Prof. J. Adams: The School Class (1).

CONTENTS.