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The New Museum Outlook.

THE museums of Great Britain are bestirring themselves, or, if that be putting it too strongly, at any rate many men of action and foresight are bestirring themselves concerning the museums. There is a museum feeling in the air. But in the midst of the reports and commissions, addresses and discussions which express this activity, the plain man may be excused if he fails to see that criticisms, suggestions, and counter-suggestions all point to a broad but tolerably well-defined road by which the museums of the British Isles must endeavour to make their way. The new road is the focus of many independent paths along which progressive museums have been feeling their way in recent years, often in face of difficulties, and scarcely realising that they were taking part in one of the great educational movements of the times. Though the reports have scarcely emphasised the magnitude of the change, it means a radical recasting of the museum idea and the adoption of a fresh museum outlook.

Here we propose to outline the fundamental change in outlook which progress demands, and to inquire whether recognition of the new objective may lead to suggestions for the development and control of existing museums.

In their historical origin, museums were simply conservatories, in the basic meaning of the word, houses for the storing and safe keeping of whatever was thought to be worth keeping, and their officers were and are 'keepers'. That is still looked upon as the primary and fundamental purpose of museums, and yet it is only in a few of the largest museums that the material is of a value so great or nature so irreplaceable that its conservation is of first and last importance. In the second stage of their development, museums condescended to show some of their possessions to favoured visitors, and finally to the public, but they placed the specimens just as they were accustomed to store them, in the arrangement most convenient for reference by experts. It is not so many years since a keeper in one of the national museums gave instructions that British birds (and that in a British museum) should be labelled with their Latin scientific names only. The attitude, and it was widespread, was that the public might learn if it could, but it was no purpose of the museum to teach.

That almost all the natural history collections in the museums which possess them are still arranged on the systematic lines of the expert taxonomist, is a relic of an early development, a convenient grouping for reference, easy for the museum officer

to arrange, and capable of infinite expansion. Educationally, however, it is a passive arrangement. It permits the visitor, if he is receptive, to gain certain impressions of form and of relationship, but it is not designed to thrust new ideas upon him, to compel him to consider and reconsider. In a general way, that is typical of the old museum attitude to education; hitherto the museum has been an inactive educator, allowing the visitor to sip where he would, or go away dry if the nectar was not to his taste, but never, by one wile or another, compelling him to drink of the stimulating cocktails it might concoct.

The new outlook which underlies the recent discussions regarding the museums of Great Britain, and towards which a few bright exceptions have been striving, is that museums must henceforward make it a primary duty to take an active and progressive part in the educational systems of the country. In a short preface to an American work dealing with the relationship between the American Museum of Natural History and the Educational authority of New York,[1] Prof. Henry Fairfield Osborn stated that "the growing museum influence, which during the past quarter of a century has been especially remarkable throughout the cities of the United States, is largely due to the recognition that the museum is not a conservative but a progressive educational force, that it has a teaching quality or value peculiar to itself, that the museum succeeds if it teaches, fails partially if it merely amuses or interests people, and fails entirely if it simply mystifies".

If only this could be set as an aim and end in the forefront of museum activities, the museums of Great Britain would take on a fresh lease of activity, and create for themselves a new and powerful place among the social institutions of the country, in no less degree than they have done in the United States of America.

In an address delivered a short time ago to the Royal Society of Arts and referred to in NATURE (Feb. 9, p. 227), Sir Henry Miers sketched in broad outline the ways in which museum collections might be brought into relationship with educational stages. He founded his proposals on the assumption that museums should cater for four classes of visitors. For the ordinary visitor the history and resources of the town or district should be displayed; school children and students of riper years require summary collections and introductory series; for the collector and serious inquirer systematic collections are needful; and the researcher must have at hand great stores of classified material for investigation and comparison.

Even this passive arrangement of museum exhibits falls short, however, of the needs of an active educational policy, such as the times demand, and such as has been attained by many of the museums in the United States. As typical of these, glance at the activities, almost violent activities our sedate institutions would regard them, of the museums of the Brooklyn Institute of Arts and Sciences. In the course of a single year ten special exhibitions of various art collections and eight exhibitions of prints were arranged, and exhibitions of motion pictures portraying the 'Chronicles of America' and zoological subjects, as well as lecture courses for the public, for teachers and for students, were held. In addition, the Institute has specialised in a 'Children's Museum', with loan exhibits of natural history specimens for schools, with schools visits helped by three teachers assigned by the Board of Education, summer field trips, lectures, and so on. The detail with which the educational side is organised is indicated by many little refinements, such as the small cases of mounted birds which a child may borrow and take home as he would a book, the files of five thousand pictures and of trustworthy magazine articles, so catalogued that any set may be selected and borrowed by child or teacher, and the loan series of eight thousand lantern slides.

Is it desirable that the museums of Great Britain should reach towards such a goal? And if it is, is such a goal attainable? The consensus of opinion amongst educationists, the efforts already being made by the more progressive museums in this country, and the views expressed in or underlying recent reports and discussions, all point to the desirability of some such development, if museums are to escape from the backwash of stagnation and move with the main stream of the nation's progress. It may be said that the proper purpose of the great national museums is rather to attend to scientific interests than to cater for the education of elementary school children, but the argument is sufficiently met by the actual development of the American institutions, which have satisfied the demand for intrusion into educational affairs without losing a whit of their scientific enthusiasm or reputation.

The question as to whether this desirable end is attainable is not so easily answered. Our opinion, however, is that it can be realised, but not under museum conditions as they generally exist in Great

[1] "Free Nature Education by the American Museum of Natural History in Co-operation with the Department of Education of the City of New York", by G. H. Sherwood; 1920.

Britain to-day. An analysis of the difficulties will suggest lines along which development might well take place.

There is the fundamental difficulty of staffing. The teaching of young and old is an art based upon scientific principles, definitely recognised and the subject of specialised courses in universities and training colleges. It cannot be expected that the curators of museums, whether they be chosen for their general knowledge or for their expert skill in particular branches of science, can be at the same time, barring a few exceptional cases, in close touch with educational developments and the needs of elementary, secondary, and advanced education. Even if they knew the demands, they cannot be expected to be familiar with the technique and progress of modern educational methods.

It is evident, therefore, that a scientific museum staff is not best fitted for the carrying out of an educational policy, quite apart from the fact that in the larger museums the scientific staff is already overburdened with its own particular problems. If the museum share in educational progress is to be more than a mere nibbling at the fringe of a great problem, new qualifications and new personnel must be drafted into the scheme. Moreover, this change must take place with as little disturbance of existing arrangements as possible ; for it is recognised that, for the purposes which they now serve, the greater museums are working competently and smoothly. There must be no uprooting of a well-established growth ; the educational shoot must be grafted upon the present sturdy museum plant.

These considerations suggest one or two broad lines of change which might well herald the adoption of an active educational policy. There must be a mutual approach between the museum body and the educational body. This *rapprochement* would develop in two directions, one affecting the framing of general museum policy and the other the actual development of the policies decided upon. In the first case, the governing body of the museum, whether it be an *ad hoc* committee of the county or municipality, the council of a naturalist society, or an advisory body of whatever origin, would be strengthened and broadened in outlook by the inclusion of one or more of the leading educationists of the district, selected for their capacity in dealing with new problems as well as for their knowledge of educational needs. It would be strange indeed if, on such a body, discussions between men of general culture, educational specialists, and representatives of the museums themselves did not evolve new suggestions worthy and capable of being carried out.

The carrying out of the schemes so formed leads to our second consideration. On one hand museum staffs must co-operate with educational authorities, and on the other, educational authorities must make more use of museums. On the lowest scale, this implies that exhibits of museum materials will be arranged in such a way that they can be used, simply and easily, to illustrate the Nature study lessons of the schools, and that school authorities will support the effort by making full use of the museum. But on a higher scale, and in the large museums, it would imply much more, as the activities of the Brooklyn Museum foreshadow. The large museum would play its part by appointing a staff specifically to deal with educational activities ; the educational authorities would detail certain of their teachers to conduct school parties in the museum, give museum lessons, and so on.

In whatever way it may be accomplished and whatever degree of development it may reach, the closer association between museums and formal education is an end eagerly to be desired ; it would inevitably lead to fresh lines of usefulness for museums already flourishing, and might spell a new life for many institutions now all but moribund. The passive, dead-and-alive museum is like a bank which, having collected the moneys of its customers, exhibits a few samples of currency in its windows and locks the remainder in its strongholds. It is not the receipt and storing of money or of specimens, but the use made of them, that means success for bank or museum. That is, in effect, our plea for the deliberate adoption, in museums large and small throughout Great Britain, of the new museum outlook.

Mathematical Physics.

Mathematical and Physical Papers. By Sir Joseph Larmor. In 2 volumes. Vol. 1. Pp. xii + 679. Vol. 2. Pp. xxxii + 831. (Cambridge : At the University Press, 1929.) £6, 6*s*. net.

THESE volumes contain the contributions made by the author to different scientific societies and periodicals during a period of nearly half a century, and the subjects treated of extend to almost every branch of physical science. The author observes in his preface that " every investigator bears the stamp of the domicile in which he has been brought up ". In the present case there are two domiciles ; to the first is probably traceable the influences of Hamilton and MacCullagh. The

second, beginning at Cambridge towards the end of the period which saw the rediscovery of Green's work, the publication of Thomson and Tait's "Natural Philosophy", and the publication of Maxwell's treatise on "Electricity and Magnetism", has also had its influence, both in the selection of the subjects of investigation and on the method of treatment.

One of the outstanding events of the period was the recognition of the importance of the Lagrangian method as the means of investigating not only the problems of mechanics but also the problems of physical science in general. The memoir by Green on the reflection and refraction of light is possibly the earliest in which the conditions for the successful application of the method to a physical problem are set out clearly, although not infrequently too much trust has been placed in his statement—"that but little effort is required on our part"—while the caution implied in the earlier part of the passage quoted from is overlooked.

By 1880 the value of the method in the investigation of the problems had been fully recognised, and had become the usual method of investigation for these problems. The method naturally plays an important part in the present collection. In the paper "On Least Action as the Fundamental Formulation in Dynamics and Physics" (*Proc. Lond. Math. Soc.*, 1884) the method is applied with success to a great variety of problems both in mechanics and physics, and the mathematical connexion between them is established. The same method is applied to the problem of "the flow of electricity in a system of linear conductors", leading to a very general solution of the problem. In the first 400 pages of the first volume there are papers on subjects in pure mathematics, optics, and electricity of varying length and importance, but all of interest. The British Association Report (1893) on "The Action of Magnetism on Light; with a Critical Correlation of the Various Theories of Light Propagation" gives an account of the different theories which had been proposed to account for the phenomena accompanying the propagation of light up to the time of its preparation, and compares them carefully, at the same time making various suggestions and removing some of their obscurities. This report is the forerunner of the series of three papers "On a Dynamical Theory of the Electric and Lumiferous Medium" published in the *Philosophical Transactions*.

The first of these papers appeared in 1893, and its central feature is the identification of the electric energy function with the energy function developed by MacCullagh in relation to optical phenomena. This energy function had been arrived at by adopting a procedure which was the converse of the procedure adopted by his predecessors.

The elastic solid theory of light propagation as developed by Green, Cauchy, and others had provided an adequate representation of the phenomena of the reflection and transmission of light in the case of isotropic media, but had failed to give results which were in agreement with Fresnel's results in the case of anisotropic media. Green and Cauchy had proposed to overcome this difficulty by the introduction of extraneous forces. MacCullagh set out to discover the energy function which would satisfy Fresnel's laws both for isotropic and anisotropic media. Later, Kelvin showed that the energy function built up by MacCullagh was that of a quasi-labile elastic medium or of a gyrostatically loaded medium, hypotheses which are not unrelated to the hypotheses of Green and Cauchy. In the author's paper of 1893, this energy function having been identified with the electric energy function is applied and tested for a great number of different phenomena. In particular, the result is obtained that the velocity of propagation of light is affected by a magnetic field. Experiments carried out by Sir Oliver Lodge showed that the effect, if any, is so small as to be incapable of detection. Two conclusions can be arrived at as the result of these experiments, either the luminiferous medium is fixed or stagnant, or the energy function which leads to this result is defective. The author has chosen the first of these alternatives, but it may be observed that the direct application of Faraday's laws to the problem of the effect of a constant magnetic field on the velocity of the propagation of light gives the same result as these experiments, namely, that there is no effect.

The problems of magneto-optic rotation and radiation are discussed on this theory, and with the introduction of a dissipation function, the circumstances of the reflection of light by metallic media are investigated.

In an appendix the theory of electrons is introduced and applied to some of the cases; in particular, the theory of natural magnets is treated from this point of view, and also optical dispersion. In the second paper (1895) the theory of electrons is developed to a greater extent, and is applied to the investigation of the phenomena which depend on the molecular or atomic properties of material media. In addition to the phenomena discussed in the first paper, the propagation of light in metals, conduction currents, the mechanical electro-dynamic

forces acting on a conductor, the problems of a conductor rotating in a symmetrical magnetic field and the conjugate problem of a rotating electrified conductor are considered, as also the pressure of radiation. The null result of the Michelson-Morley experiment is discussed on this theory, and explained in terms of what is now usually referred to as the Lorentz transformation.

In his memoir "La théorie électromagnétique de Maxwell et son application aux corps mouvants" (1892), and in a later memoir (1895), H. A. Lorentz developed a theory of electrical and optical phenomena similar to the theory presented in the present volumes. The energy function, which is fundamental in both cases, is the same, and although the treatment, more especially where statistical processes are involved, is somewhat different, the results obtained, when the phenomena discussed are identical, are naturally for the most part in agreement. The particular form of the transformation arrived at in the case of a material body moving with a uniform velocity, from which the later development known as the theory of relativity, has arisen, is an inevitable consequence of the form of the energy function which is the basis of the theory of a stagnant ether; but there are difficulties connected with this theory which, so far, do not appear to have been surmounted. For example, is the Lagrangian method applicable to the comparison of two systems, when the space co-ordinates of the one involve the time co-ordinate of the other, and the time co-ordinate of the first involves the space co-ordinates of the second? Furthermore, it has been proved that, if Faraday's laws are applied to the case of a material body moving with a uniform velocity, the axes of reference for Faraday's laws being the same as the axes of reference for the moving body, the relation between the moving body and a body at rest relatively to the same axes is that the moving body is contracted in the ratio $(1-u^2/c^2)^{\frac{1}{2}}$ in the direction of its motion, and no transformation involving the time co-ordinate is involved.

In the third paper of the series the theory of electrons is restated and its application to material media is more extensively developed. The investigations of the two previous papers are revised in some cases; the relation of the theory to the kinetic theory of gases and to radiation is investigated; a general theory of optical dispersion is set out, and the problem presented by absorption bands is discussed. Thermodynamics, osmotic pressure, the laws of chemical equilibrium, paramagnetism and diamagnetism are also discussed, and the mechanical relations of radiation are re-investigated.

Whatever the ultimate verdict on this theory of the ether, which is the basis of these papers (afterwards with additions and revisions embodied in the author's "Æther and Matter"), may be, it offered a possible and promising line of advance, it is in agreement with a greater number of physical phenomena than its predecessor the elastic solid theory of the ether, and the author's contributions to it are very notable. There are subsequent papers on other applications of the theory, the Zeeman effect, the optical influence of a magnetic field, etc., all additions of interest to the subject.

There are several papers on geophysics, an interesting paper on Huygens' principle, various reports and addresses, but probably the most important papers in the collection other than the electrical papers are the papers on thermodynamics and the theory of gases. The author has expressed a doubt as to whether the time is ripe for the formulation of a history of electrical theories; this, despite the many treatises on thermodynamics and the kinetic theory of gases, is true in some measure of the theories connected with these latter subjects. These volumes, however, contain valuable contributions in this direction, and in a connected form would go far to supply such a history.

A detailed examination of the different papers in the two volumes is impossible within the present limits, but it may be observed that they contain contributions of interest and value to most of the questions which have been prominent in physical science for the last half-century. By collecting them together so as to make them readily accessible to other scientific workers, the author has earned their gratitude, and the care with which they have been edited and printed reflects great credit on the author and on the Cambridge University Press.

One Hundred Years of the 'Zoo'.

Centenary History of the Zoological Society of London. By P. Chalmers Mitchell. Pp. xi + 307 + 33 plates + 9 plans. (London: Zoological Society of London, 1929.) 25*s*.

BY its 'Zoo' is the Zoological Society of London known to the people; its zoological gardens have given it a hold upon the nation which no purely scientific activity could have gained; and the progress of the Zoo is the touchstone by which its success will be tested, at any rate by the superficial. Yet from the outset of its career two distinct and almost antagonistic aims lay at the hearts of

the founders of the Zoological Society and were embodied in its charter: on one hand the popular appeal of the introduction of "new and curious subjects of the Animal Kingdom", and on the other the sternly scientific "advancement of Zoology and Animal Physiology". It is perhaps the greatest triumph of its hundred years of existence that the Society has cherished these two objects with equal favour, developing its gardens to their utmost limits and at the same time making vast contributions to the progress of knowledge. It has done more; it has blended a double function which might have split the Society to its roots into a harmonious whole, so that the Zoo has become the patron of science, contributing handsomely to its coffers, and science, the handmaiden of the Zoo, has eased the conditions of its inmates, and furthered their welfare in the details which make life in captivity worth living.

In his "Centenary History", Sir Peter Chalmers Mitchell traces with easy knowledge the multifarious lines of activity which have coalesced to make the Zoological Society and its Zoo what they have become. The Society owes its origin in 1826 to Sir Stamford Raffles, who lived just long enough to see it well on its way to success. Its earliest stages were recently discussed in an article in NATURE (May 4, p. 687), so that no further reference to its foundation need be made, except that it is desirable to point out that, following Scherren's "The Zoological Society of London" (1905), undue weight was there placed upon the part taken by the Zoological Club of the Linnean Society. Chalmers Mitchell has investigated this and many other controversial points with minutest care, and the pains which he has evidently bestowed upon the consultation of original sources of information ensure that his is the last word in these matters.

Since the Zoo is the hub of the system, let us glance at the major developments which have kept it in the centre of public favour. The chart which forms a frontispiece to the volume, and in itself is a mine of information, shows plainly that an unprogressive policy is reflected in stationary or dwindling audiences. The fresh appeal of the original gardens soon wrought itself out and was followed by a steady decline in numbers of fellows, in numbers of visitors, and in income, which must have caused deep concern to those in authority. Now a glance at the series of plans of the gardens at different stages of development, appended to the volume, shows that since the first concession of twenty acres in 1826, there has been a gradual extension of area to more than double the original size. But the chart reveals no connexion between increasing prosperity and mere accretion of acres. On the other hand, it clearly demonstrates that the secret of success from the public point of view is the staging of special features, which not only attract a temporary fresh influx of visitors, but tend to raise subsequent attendances to a new base level.

Accidental influences, such as the Great Exhibition of 1851 or the International Exhibition of 1862, are naturally enough reflected in the numbers of visitors to the Gardens, but the lesson of the chart is that special efforts at display meet a rich reward. Royal collections of animals, since that first exhibited by the Prince of Wales in 1876, have always been exceedingly popular, but the organised works which have brought overwhelming success are the Mappin Terraces in 1913, the Aquarium in 1924, the Reptile House in 1927, and the Bird House in 1928. Taking the appointment of the present secretary in 1903 as a convenient datum line, it is a remarkable testimony to his progressive policy that in the quarter of a century which has since elapsed, the number of fellows has more than doubled, annual income has trebled, and the number of annual visitors has increased almost fivefold.

Keeping step with these popular developments have been no less important changes which appeal perhaps more strongly to the scientific observer, notably the vital innovation from the stuffiness of closed and warmed cages to natural temperatures and open air, the introduction on a large scale of radiant heat for the animals, and, a great step in progress, the acquisition of Whipsnade Park and the planning there of scenic panoramas and paddocks on the most advanced lines.

Of the purely scientific activities of the Society we have left ourselves no space for comment. The *Proceedings* and *Transactions*, which are stocked with results based largely upon the collections themselves, are as indispensable to the scientific worker as is the "Zoological Record" and the one-time museum, notable for the large proportion of type and historic specimens which it contained, on its dispersal enriched the Natural History Museum at South Kensington, and to a lesser extent other institutions.

The century, not without its dissensions and difficulties, has been one on which the Zoological Society and the nation can look back with pride, and from which they can look forward with confidence in a strong guidance, enlightened by scientific knowledge and enriched by the naturalists' wide sympathy with living things. J. R.

Alpine Tectonics.

The Nappe Theory in the Alps (*Alpine Tectonics, 1905–1928*). By Prof. Dr. Franz Heritsch. Translated by Prof. P. G. H. Boswell. (Methuen's Geological Series.) Pp. xxx+228+8 plates. (London: Methuen and Co., Ltd., 1929.) 14*s*. net.

THE existence of great overthrusts in the Alps was recognised by Escher von der Linth in 1853, and by von Richthofen in 1859, and was proved from the mining at Idria by Lipold in 1874; but it was only after the work of Schardt in 1894 that these displacements were generally accepted and explained as nappes. Nappe is the French word for a sheet, but the term is used in Alpine geology, as in the title of this book, as an abbreviation for a *pli-nappe* or *nappe de recouvrement*, or over-folded sheet. Such nappes are explained as due to flat-lying folds from which, as they are pushed forward, the central limb is ground to powder and worn away. According to the advocates of the theory, the nappes in the Alps cause horizontal displacements that are well established for 60 miles, while the total movement may be much greater; for some of the mountains seen from the terrace at Berne are regarded as parts of Africa pushed into central Switzerland.

The difficulty of the subject to British students is increased by its scattered literature and special technical terminology. The book by Prof. Heritsch of Graz, therefore, should prove of great service, as a guide to the modern literature on the Alps, especially on the Eastern Alps, and as a statement of the evidence for and against the nappe theory. The work has been extended and revised by help of the author during the translation, which in several respects is an improvement on the original. It has additional illustrations, and the excellent glossary which has been prepared by the translator will, it may be hoped, standardise the English equivalents of many of the tectonic terms.

The attractiveness of the nappe theory depended upon its seductive simplicity. The alternative explanations are often complex. When, however, the theory is followed into details, the simplicity disappears owing to rapid changes in the hypothesis, extreme differences of opinion among its supporters, its evasiveness of crucial tests, and fantastic explanations introduced to explain special cases. The theory is often dependent upon uncertain identifications of the age of the rocks. For example, the Matterhorn consists of a pyramid of gneiss resting on schists which are regarded as altered Trias. If this age of the basal schists is incorrect, the upper part of the Matterhorn need not be explained as a far-travelled erratic. Similarly with the Hohe Tauern in the Eastern Alps; the nappe theory there depends on the identification of part of the schists as Trias, but if they are pre-Cambrian the application of the theory to the Tauern is invalid.

The difficulties of rock identification are met by the assumption that the differences between various parts of the same sheet are due to differences of facies. For example, the rocks identified as the southern root of the Silvretta nappe form the hills east of the northern end of Lake Como. These rocks are so different from those of the Silvretta as to suggest doubt as to their belonging to one sheet. This difficulty is circumvented by the assumption that the differences are due to the rocks having been deposited so far apart that they occur in different facies. This facies argument, as remarked by Prof. Boswell in the preface, is naturally regarded with suspicion by British geologists, who are used to the rapid lithological changes among our Jurassic deposits. The extreme movements claimed have not been supported by the discovery in the Alps of the characteristic North African facies of the Eocene or Cretaceous.

The nappe theory is faced by serious physiographic difficulties. According to some estimates, the nappe movements in the Miocene and Pliocene must have piled up rocks to a thickness of about 20 miles above the Alps. All this material must have been since removed by denudation, and there is no trace of the debris on an adequate scale in the surrounding areas. Another physiographic difficulty, to which attention was directed by Prof. Bailey Willis in 1912, is that there are in the Alps old land surfaces that date from the Lower Miocene and even earlier; and their existence, Prof. Heritsch remarks, is quite irreconcilable with the supposed later nappe movements. Such difficulties have been often ignored by the supporters of the nappes, who, in their enthusiasm, regard the evidence in favour of the theory as so convincing that they are confident that explanations of these difficulties will appear.

The special merit of Prof. Heritsch's book is that it states the issues impartially, and by directing attention to the difficulties and uncertainties in the nappe theory, should guide the discussion to the critical points, and thus help in the solution of the problem. The book is not easy reading, owing to its conciseness and brief statement of views of bewildering variety. It should, however, prove indispensable to students of mountain structure as a guide to current Alpine literature and opinion.

Our Bookshelf.

An Introduction to the Study of Ore Deposits. By Dr. F. H. Hatch. Pp. 117. (London: George Allen and Unwin, Ltd., 1929.) 7*s.* 6*d.* net.

MOST books devoted to the study of ore-deposits suffer from an attempt to give too much detail. It is manifestly impossible to write an account of the mining fields of the world in small compass, and Dr. Hatch has not attempted this. He has set himself the ideal of producing a real introduction to the subject, elucidating everywhere the general principles by illustrations taken from actual instances, and it must be said that in this he has been extremely successful. Many of the examples are naturally chosen from his own experiences in different parts of the world, and the outcome is an admirable instance of the application of scientific ideas to a truly practical subject.

The first chapter is an interesting historical summary of theories of ore-genesis, largely based on the author's presidential address to the Institution of Mining and Metallurgy in 1912, but brought well up-to-date. The next nine chapters are concerned with the different processes of ore-formation and alteration, the last-named being of course a matter of the greatest practical import, in such matters as zones of oxidation and of secondary enrichment. Chap. ix deals with the origin of residual deposits of all kinds, including the laterite-bauxite group and manganese deposits, as well as residual ore-bearing gravels. It is pointed out that in the tropics so-called alluvial propositions are often in reality rock in place, so deeply decomposed as to be workable by hydraulic methods. The last chapter deals with the forms of ore-bodies, and there are no less than four indexes, of authors, localities, minerals, and a general index of subjects.

This book may be strongly recommended as being what it was intended to be—a real and valuable introduction to the study of mining geology. R. H. R.

Denkschriften der Schweizerischen Naturforschenden Gesellschaft (*Mémoires de la Société Helvétique des Sciences Naturelles*). Band 64, Abh. 2: *Nouveau catalogue des moules d'échinides fossiles du Musée d'Histoire naturelle de Neuchâtel.* Exécuté sous la direction de L. Agassiz et E. Desor par J. Lambert et A. Jeannet. Pp. ii + 83-233 + 2 planches. (Zürich: Gebrüder Fretz A.-G., 1928.)

ABOUT 1838, Louis Agassiz had assembled in Neuchâtel specimens of fossil sea-urchins borrowed from various public and private collections to aid him in his "Monographies d'échinodermes". Many of these specimens became the types of his new species; all were authenticated; and he conceived the happy idea of making plaster moulds from them and of distributing the casts to museums or students interested in the subject. After Agassiz left Neuchâtel, the good work was continued by E. Desor and later by H. Michelin, down to about 1858, when the number of species thus represented amounted to 960. A second edition of the casts was begun in 1854 by L. Coulon, who had succeeded to the direction of the Neuchâtel Museum. It is to be feared that after a time in many museums these valuable documents of research, having become dusty, lost the respect of a new generation of curators and were not kept in order. Even at Neuchâtel itself, the present director "found the casts piled up at random in two large boxes and sometimes spoiled".

Such being the state of things, all serious students of the Echinoidea should be most grateful to Messrs. J. Lambert and A. Jeannet for an extremely careful inquiry into the history of the series, the provenance and ultimate location of the originals, the distribution and fate of the casts, and above all for the annotated list of the species represented. In this list each entry gives the name under which the cast was issued, the subsequent nomenclature of the species, the horizon and locality of the original, with references to descriptions and figures of the specimen. In short, nothing seems missing from this *apparatus criticus*. F. A. B.

Three Lectures on Neurobiotaxis and other Subjects, delivered at the University of Copenhagen. By C. U. Ariëns Kappers. Pp. 76. (London: William Heinemann (Medical Books), Ltd., 1928.) 7*s.* 6*d.* net.

THE Lancashire Asylums Board was recently assured by its officers that persons equipped for neurological research would not now be forthcoming in England, even were money available to employ them. If this extravagant statement must be set aside as merely an item in official 'conversations', it is unfortunately true that Great Britain has now fallen far behind its continental neighbours and America in this direction. It is therefore to be hoped that these lectures will have a wide circulation among British readers, in whom neurological interest may thereby be reawakened.

The theory which Dr. Ariëns Kappers develops in the first of the lectures was first advanced by him more than twenty years ago, and has suffered misunderstanding in Great Britain owing to confusion with the chemotaxic explanation of nerve development proposed by Ramón y Cajal. Thus, even so acute a critic as Elliot Smith has put forward Kappers's own principle—one of relative growth at critical moments of development—while implicitly rejecting the theory as unnecessary (Cunningham's "Textbook of Anatomy").

The present lucid treatment lays stress on simultaneity of function as the essential principle underlying anatomical correlations in the nervous system, and extends the theory to cover a variety of freshly observed instances, particularly some of the baffling phenomena of the decussation of fibre-tracts. It is possible to appreciate the far-reaching and illuminating character of the principle of neurobiotaxis without, however, endowing it with causal significance as Dr. Ariëns Kappers does on p. 36. The last of the three lectures is a brilliant account of the development of the cerebral cortex in terms of neurobiotaxis.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Solutions and Heat Engines.

MAY I add a word to the discussion on osmotics? As regards the osmotic pressures of mixed gases I would point out that the reviewer's case (2) (NATURE, April 13, p. 569), where two atmospheres of nitrogen are inside the chamber and one atmosphere of hydrogen is on each side, is not in osmotic equilibrium if there be any interaction between the molecules of nitrogen and hydrogen: the equilibrium will obtain, so it seems to me, only when the partial pressure of the hydrogen equals its pressure outside, and we have, as yet, no means of calculating this effect.

With liquid solutions a little consideration will convince one that there are a multitude of formulæ, functions of the concentration, which will fit the facts for dilute solutions. Among these may I direct attention to one which seems promising?

If the observations of Berkeley, Hartley, and Burton (*Phil. Trans. R.S.*, vol. 218) on the osmotic pressures of cane sugar and α methyl glucoside are tabulated, as below, against the weight concentration multiplied by the density of the solution, squared, the figures agree to about 5 per cent.

CANE SUGAR.

	At 0° C.				At 30° C.			
c_2/c_1.	O.P.	Ratio of O.P.'s.	d^2.	Ratio of $d^2 \times c_2/c_1$.	O.P.	Ratio of O.P.'s.	d^2.	Ratio of $d^2 \times c_2/c_1$.
	Atm.				Atm.			
0·3400	..	..	..	..	26·82	1	1·216	1
0·5650	43·91	1	1·357	1	47·25	1·76	1·333	1·83
0·8120	67·43	1·54	1·468	1·56	72·59	2·71	1·439	2·82
1·1200	100·53	2·29	1·580	2·30	107·55	4·01	1·548	4·18
1·4100	134·86	3·07	1·667	3·08	143·33	5·34	1·632	5·56
1·8300	186·86	4·26	1·768	4·21	198·89	7·42	1·730	7·64
2·1750	230·70	5·25	1·835	5·20	249·16	9·29	1·796	9·47
2·4300	264·46	6·02	1·877	5·93	..	..	..	..
	α METHYL GLUCOSIDE.							
	Atm.				Atm.			
0·3500	48·29	1	1·199	1	49·42	1	1·179	1
0·4500	64·22	1·33	1·245	1·34	65·14	1·32	1·222	1·34
0·5500	80·50	1·67	1·287	1·68	81·73	1·65	1·262	1·68
0·6400	96·17	1·99	1·310	1·99	96·75	1·96	1·294	2·01
0·7500	115·74	2·40	1·361	2·44	115·34	2·33	1·331	2·42
0·9000	142·46	2·95	1·408	3·00	141·66	2·87	1·375	3·00
1·0500	170·18	3·52	1·451	3·60	168·34	3·41	1·415	3·60

NOTES.—c_2 and c_1 are the concentrations, *i.e.* number of grams per gram of solution; d is the density of the solution compressed to its osmotic pressure.

It is easy to see that the osmotic pressures must be a function of the density; for consider two cylinders containing different solutions and furnished at the bottom with semi-permeable membranes which just touch the surface of the solvent. If we neglect the stratification caused by the gravitational field, then, when there is equilibrium across the membrane, $P = hd$ where P is the osmotic pressure, d the density of the solution, and h its height, hence

$$\frac{P_1}{P_2} = \frac{h_1 d_1}{h_2 d_2}.$$

An explanation of the weight concentration part of the formula can be put forward. Assume that the solute takes no part in the bombardment of the membrane, that is, this bombardment is conditioned only by the solvent molecules. It will be necessary, therefore, to put a pressure on the solution to increase the speed of the solvent molecules such that the number striking the membrane per second on the solution side will be equal to the number on the pure solvent side. It is easy to see, if our solution is an ideal one (that is, there is no interaction between the two sets of molecules and therefore there is no change in volume when the *liquid* substances are mixed), that this pressure will be proportional to c_2, and, if we remember we are dealing with a *defect* in bombardment, it will roughly be inversely proportional to c_1. The c's are the number of grams of solute (c_2) and solvent (c_1) in one gram of solution—and c_2/c_1 = weight concentration/100.

Obviously this explanation is but a rough approximation to actual conditions, but, if the formula applies to substances other than the sugar type of molecule, we have a rule-of-thumb means of calculating both osmotic pressures—a matter of some importance as they are just as much physical constants as the density or refractive index.

A little thought will make it evident, if we remember that we are still considering an ideal solution, that we could have put $c_2/c_1 = v_2/v_1$ (where v_2 and v_1 are the volumes of the respective components in 1 c.c. of solution), and we should have had a more consistent formula. But with the v's[1] of the actual solutions the results are not so good—they only agree to 15 per cent; this is not to be wondered at, for we have not taken into consideration the molecular interaction nor the effect due to closeness of packing. I think, however, that these two considerations can be allowed for if we may assume that when one molecule strikes another the rebound is not instantaneous and a 'rest period' ensues; the effect of closeness of packing may turn out to be a function of the density, but I have not the means at hand for calculating this. I hope to return to the matter in another communication.

BERKELEY.

Determination of Crystal Potentials by Diffraction of High Voltage Electrons.

WHEN electrons are diffracted by a crystal cleavage face, Bragg's law, on taking account of the refractive index of the crystal for the electron waves, becomes $n\lambda = 2d \sin\theta \sqrt{1 + \frac{\mu^2 - 1}{\sin^2\theta}}$, or, putting $\mu = \sqrt{1 + \frac{\phi}{V}}$ and $\lambda = \frac{h}{mv} = \sqrt{\frac{150}{V}}$ A., where ϕ is the inner potential of the crystal and V is the energy of the electrons in volts, we obtain

$$\sqrt{V} \sin\theta = \frac{n\sqrt{150}}{2d} \sqrt{1 - \frac{4d^2\phi}{150n^2}}. \quad . \quad (1)$$

For a spacing 4 A. the first order will thus disappear entirely for ϕ as small as 2·4 volts, whatever the value of V. This wide variation from Bragg's simple law, then, will be quite as marked for high as for low voltages, and since swift electrons are less liable to be deviated by stray fields, etc., the high voltage method ought to be the more suitable for determining ϕ. The surprisingly large effect of refractive index at these high voltages depends on the very small angles of refraction which occur, and is only strongly marked when the reflecting plane is the free surface of the crystal. This effect has been pointed out by Prof. G. P. Thomson (*Phil. Mag.*, **6**, p. 939; 1928).

[1] These are derived from Porter's (*Proc. Roy. Soc.*, 1908, p. 460) definition of his s_2 and s_1.

Strong spots were obtained on a photographic plate by diffraction from the cleavage faces of calcite (1, 0, 0), galena (1, 0, 0), and antimony (1, 1, 1). For each spot the product $\sqrt{V}\sin\theta$ was constant within the limits of experimental error for the range 10 to 45 kv., but spacings calculated for $\phi = 0$ differed widely from X-ray determinations.

In the case of calcite there were two spots on the equator line. Photographs were taken of each, a willemite screen being used in setting the crystal at the correct angle. Substituting the values of $\sqrt{V}\sin\theta$ in equation (1) and taking the spots to be the nth and $(n+1)$th orders, we get two equations to determine n and ϕ. These give $n = 3$ and $\phi = 22$ volts, and for this value of ϕ the first and second orders disappear.

Galena gave one spot on the equator and two other spots vertically above and below it, that is, parallel to the axis of rotation, which was a cube edge. The latter spots were too near the equator line to be due to reflection from any of the geometrically possible planes of the crystal if refraction took place at the (1, 0, 0) plane. Good agreement was obtained, however, by supposing the crystal surface to be rough and refraction to take place at the plane producing reflection. This being the case, the spot on the equator line had to be taken as (6, 0, 0) and the spots above and below it as (6, 0, 2) with ϕ equal to 18·2 volts. The plates also showed faint vertical lines at positions corresponding to (8, 0, 0) and (10, 0, 0) for the above value of ϕ. The accompanying reproduction (Fig. 1) is a galena photograph showing the equatorial spot and the fainter spots vertically above and below it. The part of a circle on the extreme right is where the scattered electrons are cut off by the camera.

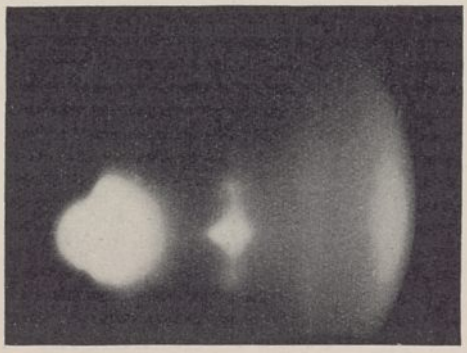

FIG. 1.

The pattern from antimony was similar to that of galena but less well marked, the spots above and below the equatorial spot being too faint to measure. For the spot on the equator line n was so chosen that the corresponding value of ϕ made the $(n-1)$th order disappear, whence $n = 4$, $\phi = 25$ volts.

In the calcite photographs, but not in those of antimony and galena, in addition to the spots there were a number of crossing lines, which were obviously similar to those obtained by Kikuchi (*Proc. Imp. Acad. Jap.*, **4**, p. 475; 1928).

No great accuracy is claimed for the above results, the experiments being of a preliminary nature, but the rapid variation of $\sqrt{V}\sin\theta$ with ϕ indicates that the method may be of importance for precise measurements of the inner potential of crystals.

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Luminous Discharge in Gases at Low Pressures.

IF the Lecher circuit previously employed for generating a luminous discharge in electrodeless tubes by electric oscillations of high frequency—20,000 kilocycles or more—(NATURE, **123**, p. 346; 1929), is exchanged for short coils, the luminosity can be much increased. By the same means it is possible to make the discharge pass through narrow quartz capillaries less than a millimetre in width, thus realising a source of light which has the linear shape suitable for spectrography, and moreover requires a very minute quantity of the gas to be examined.

With a plate current of, say, 50 milliamperes at an anode potential of 1000 volts, the light emitted from nitrogen or from the oxides of carbon under these conditions is so intense, that an exposure of thirty minutes or even less suffices for giving with a large quartz spectrograph a fully developed band spectrum in the ultra-violet. With the inert gases the luminosity is very intense, especially with neon, which gas can be excited to give light of an intensity almost insupportable to the eye both in narrow capillaries and also in wider tubes introduced within the coil through which the discharge is passing. Experiments which have still to be carried out will show whether krypton excited by this means in electrodeless tubes will be suitable as a source of the line at 5649 A., recently proposed for a new standard of wave-length.

Carbon monoxide and dioxide both show a rapid dissociation when subject to the oscillatory discharge. Probably for this reason my attempts to separate their spectra by the flow method have so far failed. Carbon monoxide excited when passing through a narrow capillary at a velocity of 5 metres per second gives a deposit of carbon, which in the course of a few minutes obscures the light and finally intercepts the discharge. Hydrocarbons from tap-grease, if once happening to be present within the tube while the discharge is passing, also give a carbon deposit, which no subsequent baking out of the tube in a high vacuum will remove, only burning out by protracted discharge with air or oxygen within the tube. If the discharge is made to pass through a tube contaminated in this manner at a low pressure, the oxygen produced from the disintegration of silica is largely converted into oxides of carbon which emit the white light erroneously ascribed to ozonised oxygen in my previous communication (loc. cit.).

In my spectrograms from the oxides of carbon excited in this manner, all the Deslandres bands belonging to the first negative carbon spectrum falling between 2300 A. and 2900 A., as measured by R. C. Johnson (*Proc. Roy. Soc.*, London, A, **108**, p. 343; 1925) have been identified, and an additional number of fainter bands of similar structure. The double bands near 2896 A. and 2883 A. show conspicuous variations in intensity on different spectrograms, which lends support to the view that their origin is different from that of the other bands of the series, which have also a different structure. Compare the work of Fox, Duffendack, and Baker (*Proc. Nat. Academy*, Washington, **13**, p. 302; 1925), who have found these two double bands to be due to carbon dioxide.

The red fluorescence from quartz or glass excited by the oscillation I now find to have been previously noticed by Wood and Loomis (NATURE, **120**, p. 510; 1927) and also by McCallum (*ibid.*, **121**, p. 353; 1928), whose communications had escaped my notice. The view of the first-named authors that this fluorescence is in some way due to excited molecules or ions of oxygen is no doubt correct, as can be beautifully demonstrated by deflecting with a strong horse-shoe

magnet the egg-shaped luminosity of greenish-yellow colour which is formed between the electrodes in a discharge-tube of wider diameter containing pure oxygen at low pressure. At the points where the deflected egg is brought near to the wall, two patches of brilliant red appear, separated by narrow, dark inter-spaces from the rim of gold-coloured fluorescence next to the electrodes. With other gases quartz fluoresces in the deep blue or violet, sometimes in the green, whereas the red fluorescence, corresponding to a band near 620 $\mu\mu$, is only observed with oxygen at low pressure.

HANS PETTERSSON.

Structure of the Band Spectra of the Hydrogen and Helium Molecules.

IN the spectrum of the hydrogen molecule many regularities have been found recently, especially by Richardson and his co-workers. In a note in the *Zs. f. Physik* I suggested an interpretation of those regularities based mainly on the theory of band complexes and the analogy with the helium band spectrum. The analogy was incomplete in so far as the bands found in the spectrum of the hydrogen molecules are analogous to helium bands which can be predicted from theoretical considerations, but which had not been actually found. I have found these missing helium bands now. Their structure is exactly analogous to that of the hydrogen bands given by Richardson and Davidson (*Proc. Roy. Soc.*, A, **123**, 54, 466, A, **124**, 50, 69), as will be best apparent from a description of their peculiarities. From the red to the violet we have the following branches :

Transition.	Description of the Bands.	Richardson's.	Finkelburg and Mecke.
$\sigma\Sigma \longrightarrow 2\pi\Sigma$	P- and R-branch of about equal intensity.	$^1K \longrightarrow 2^1S$	$^3D \longrightarrow 2^3S$
$\delta\Sigma \longrightarrow 2\pi\Sigma$	R-strong, P-weak.	$^1C \longrightarrow 2^1S$	$^3P_2 \longrightarrow 2^3S$
$\delta\Pi_b \longrightarrow 2\pi\Sigma$	Only strong Q.	$^1B \longrightarrow 2^1S$	$^3P_1 \longrightarrow 2^3S$
$\delta\Pi_a \longrightarrow 2\pi\Sigma$	P strong, R weak.	$^1A \longrightarrow 2^1S$	$^3P_0 \longrightarrow 2^3S$

In addition to these seven branches there is one more P-, Q-, and R-branch arising from $\delta\Delta_{a,b} \longrightarrow 2\pi\Sigma$ transitions. These branches are very faint, and their intensities make it probable that they are only present if the regular precession of the orbital electronic moment of momentum around the nuclear axis is considerably perturbed. It is not yet quite certain to which hydrogen bands these three branches correspond. If one takes these facts together with the arguments mentioned in the note in the *Zs. f. Phys.*, the evidence in favour of the proposed explanation of the hydrogen bands becomes very strong. The properties of the helium terms are well known (see the letter to NATURE of May 11 and a fuller discussion in print in *Zs. f. Phys.*), and therefore I think there is no reason to accept the conception of Finkelburg and Mecke (*Zs. f. Phys.*, **54**, p. 537) of the hydrogen bands which is given in the last column of the table.

All the bands the analysis of which seems most certain find their explanation in this way. The interpretation of some of the remaining terms does not seem to be easy. There are reasons, however, which make it not improbable that the assignment of initial vibrational and electronic quantum numbers ought to be changed for some bands. In such cases Richardson and Davidson's and Finkelburg and Mecke's analyses usually do not agree with each other.

A few words may be added about the newly discovered helium bands. There are three groups of them, all belonging to the triplet system, one in the red (4σ and $4\delta \longrightarrow 2\pi\Sigma$), one near 535 $m\mu$, and one near 495 $m\mu$ (5σ and 5δ resp. 6σ and $6\delta \longrightarrow 2\pi\Sigma$). The group near 535 was first found by Merton and Pilley. It and the 495 group have been partly analysed by Fujioka (*Zs. f. Phys.*, **52**, p. 657). All the bands are degraded toward the violet. The initial terms were known from other bands, the new final term $2\pi\Sigma$ lies 6118·4 cm.$^{-1}$ *above* the corresponding $2\pi\Pi$- ($2p$-) term, whereas in hydrogen the $2\pi\Sigma$-level (B-level) lies 8892 cm.$^{-1}$ *below* the $2\pi\Pi$- (C-) level. This is the most remarkable difference between the hydrogen and the helium terms, whereas in most other respects they are exactly analogous. That will be seen more clearly from the detailed paper. The new helium bands will be described in collaboration with Messrs. Takamine and Imanishi. Their discovery also made possible the hitherto doubtful analysis of bands in the region around 400 $m\mu$ and 378 $m\mu$. It appears that perturbations of the kind described in my letter to NATURE of Mar. 23 occur for the $\sigma\Sigma$- (s-) and $\delta\Sigma$- (z-) terms. The perturbation moves to lower j if we go to the higher terms. $4z$ (17), $5z$ (9), and $6z$ (5) are the perturbed z-terms.

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The Primary Process in the Formation of the Latent Photographic Image.

I HAVE read with much interest the communication from Dr. F. C. Toy and Mr. G. B. Harrison in NATURE of May 4, 1929, p. 679. The experiments described on the photo-conductance phenomenon in silver bromide afford valuable confirmation of the results obtained by Dr. W. Vanselow and myself on the photo-voltaic effect at silver bromide : silver electrodes, which were briefly described in the sixth Hurter and Driffield Memorial Lecture.[1] These results, we consider, not only demonstrated the primary separation of electrons by light in the photolysis of silver bromide, but also gave the first evidence that this separation of electrons is actually related to the liberation of bromine. The negative potential difference ascribed to electron liberation is produced within $\frac{1}{10}\frac{1}{0}$ second of the incidence of the light, attaining a maximum within $\frac{1}{10}$ to $\frac{1}{20}$ second.

We regard these, and other results now being published in the *Journal of Physical Chemistry*, as confirming the hypothesis of electron liberation from the bromide ion and transfer to the silver ion, which was proposed by Sheppard and Trivelli, and independently by Fajans, in 1921. Dr. Toy and Mr. Harrison interpret their recent results in terms of this same theory. Now it may be noted that the photo-conductance phenomenon by itself only shows the production of mobile electrons, but not that they are *valence* electrons from the bromide ions. The correspondence of the primary photo-conductance current with the photographic effect, as demonstrated for wave-length sensitivity and time-order sensitivity by Dr. Toy and his collaborators, is unquestionably very significant. Considered in relation with our measurements of the photo-voltaic effect, they strongly support the view that the inner photo-electric effects—photo-voltaic and photo-conductance—as also the photographic and photochemical effects, all derive from the same primary separation of the electron from the bromide ion.

In terming this the primary event, I take leave to differ somewhat from Dr. Toy and Mr. Harrison in regard to their statement on latent image formation.

[1] "The Formation of the Photographic Latent Image", *Phot. J.*, **67**, 397-414; 1928.

They say: "The complete building up of the latent image is now generally considered as divisible into two stages: (1) The absorption of light by silver bromide and the immediate resulting mechanism, and (2) complicated chemical reactions between the product of the light action and the other substances, such as gelatin, present in the emulsion." This description seems to me incomplete, because it applies equally to the formation of the visible image. It seems to me preferable to say that the primary event or elementary process is the separation of the electron from the bromide ion. We have then

$$\mathrm{Br}^- + h\nu \longrightarrow \mathrm{Br} + \theta$$

followed by other processes

$$\mathrm{Ag}^+ + \theta \longrightarrow \mathrm{Ag(atom)}$$
$$\mathrm{Br} + \mathrm{Br} \longrightarrow \mathrm{Br_2}$$
$$\mathrm{Br} + \mathrm{Acceptor} \longrightarrow (\mathrm{A})\mathrm{Br}$$
$$\mathrm{Br_2} + \mathrm{Acceptor} \longrightarrow (\mathrm{A}')\mathrm{Br_2} \text{ or } (\mathrm{A}')\mathrm{Br} + \mathrm{HBr}$$

The formation of a latent image involves both the segregation of bromine *and* the aggregation of the silver atoms produced. The mode of this 'aggregation' appears to me an essential aspect of the "complete building up of the latent image".

This formulation of the steps tacitly assumes that no work of predissociation or disgregation of the silver halide lattice is necessary at the interface with a conductor, as suggested in my letter in NATURE (**121**, 574; 1928) and discussed in detail in the *Journal of Physical Chemistry* (**33**, 250; 1929).

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The Classification of Soils for Purposes of Survey.

THE growth of interest in soil surveys of recent years and the impetus given to the natural study of soil by the work of the Russian pedologists have led to considerable discussion directed towards the formulation of a world system of classification. C. F. Marbut (*Proc. Intern. Congr. Soil Sci.*, iv. 1; 1928) has proposed a scheme which amplifies the earlier classification of Glinka, using profile as affected by climate as a basis. The problem of the worker in a small area will generally be the final subdivision of an area of soils mainly belonging to a single group in the world scheme.

The accompanying scheme indicates an attempt to classify Welsh soils, which belong to the feebly podsolised group, for the purpose of soil survey. The first division is into suites each characterised by the same or similar parent material and is, in a qualified sense, geological. The next division is into phases according to conditions of formation. This furnishes the series which, following American practice, are named after the localities in which they have been studied. The final types are given by considerations of texture.

For example, soils derived from non-calcareous sediments of Cambrian, Ordovician, and Silurian age, excepting hard crystalline grits, form one suite. Normal sedentary soils of this suite are called the Powys series and give such types as the Powys silt loam, Powys light loam, etc. The corresponding drift soils form the Penrhyn series; soil with impeded drainage, the Bethel series; podsolised soils, the Hiraethog series; and alluvial soils, the Conway series.

In addition there are a few series depending on purely local conditions of surface geology, and topographical soils, such as marine alluvium, dune, fen peat, mountain peat, and heath peat, for which it is proposed to use a descriptive rather than a local nomenclature.

G. W. ROBINSON.

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Bangor, June 5.

Parent Material.	Free Drainage.			Impeded Drainage.	Alluvium.
	Normal Phase.	Drift Phase.	Podsol Phase.		
Igneous rocks, Pyroclastic rocks, Cambrian and Ordovician grits	Bangor	Ebenezer	Ogwen	?	?
Mona Complex	Anglesey	Gaerwen	Holyhead	Gesail	Braint
Palæozoic sediments, except Cambrian Grits	Powys	Penrhyn	Hiraethog	Bethel	Conway
Old Red Sandstone	Monmouth	?	?	?	?
Carboniferous Limestone	Gower	Pentraeth	?	?	Talwrn
Non-calcareous Carboniferous sediments	Neath	Merton	Ruabon	?	?
Trias	Salop	Wrexham	?	?	?
Rhætic and Lower Lias	Glamorgan	?	?	?	?

The Origin of Adaptations.

IN NATURE of June 1 there is printed the report of a lecture by my old friend, Dr. E. J. Allen, on "The Origin of Adaptations". I do not desire to enter into a detailed criticism of the views put forward in that lecture, but in one paragraph Dr. Allen refers to my views. He correctly states that I believe that definite proof of the inheritance of acquired characters is available in the works of Kammerer, Durkhen, and Brecher, but that Graham Kerr and Goodrich have put forward strong arguments on the other side. So far as I understand the attitude of Graham Kerr and Goodrich, it amounts to this: that having convinced themselves on *a priori* grounds that the inheritance of acquired characters is impossible, they refuse to credit any evidence on the other side. Such an attitude is very illuminating as to the mental outlook of these two biologists, but it is not helpful in throwing any light on the question.

The question of the reliability of Kammerer's results has been placed in an entirely new light by the visit of Prof. Przibram, who was Kammerer's teacher, to London. Przibram saw Kammerer's experiments performed, and in particular saw the critical specimen of *Alytes* living: the sole question for him was who, during Kammerer's absence on war service, interfered with this and other specimens. He had no doubt whatever as to the *bona fide* of the experiments, for they were performed under his immediate supervision.

As to Durkhen's work on the colours of the pupæ

of white butterflies, Przibram agreed with me that the experiment and the results obtained were a repetition and confirmation of Kammerer's work on *Salamandra maculosa*. I think that I was the first in Great Britain to direct attention to the critical and important character of Durkhen's work; and I suggested to my friend Dr. Heslop Harrison, who had so much skill in breeding insects, that he should endeavour to repeat the experiment. This he successfully accomplished, and this feat makes the dogmatic criticism of Kammerer's work look rather foolish.

Since that time Metalnikoff, of the Pasteur Institute in Paris, has proved the inheritability of acquired immunity in the caterpillars of the beeswax moth; and this experiment is doubly interesting, because the effect on the offspring of the acquired character only became obvious after five generations, incidentally confirming Lamarck's view, who rightly emphasised the importance of the time-factor in use-inheritance.

Dr. Allen quotes with approval Hertwig's statement that the real question is not "Are modifications inherited?" but "How are new factors acquired?" In this statement there lurks an obvious fallacy, which one might expect from Hertwig, but not from Dr. Allen. There are no 'new factors' in animals. Every apparently new factor turns out on close analysis to be an enhancement or a diminution of a pre-existing one; and the supposed difficulty of explaining the value and function of incipient characters can only be characterised as a Darwinian nightmare.

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Cosmic Radiations and Evolution.

THERE seem to be no sure grounds for believing that the penetrating radiations are uniformly distributed throughout space. If they are not, and if considerable variations in the strength of those reaching the earth have occurred in the past—possibly referable to translatory movements of the solar system—then serious effects upon organic evolution may have taken place. Millikan estimates their present energy as equal to about one-tenth of that reaching the earth from the luminous radiation of the stars. At present, therefore, the penetrating rays are probably without positive effects upon organic life. It does not follow, however, that a recent decline in strength would be without serious effects.

The influence of gamma radiations upon organic structures has been studied from many points of view. It would seem to resolve itself finally into one of ionisation, the gamma radiations when absorbed being transmuted into beta rays. Medical researches directed to the elucidation of the changes consequent upon radiations applied to healthy and to morbid tissues appear to lead to the conclusion that a selective influence is involved, the morbid tissues being destroyed by the same radiations as fail to affect the neighbouring healthy tissues, but which seem, rather, to stimulate the latter to an attitude of increased stability.

This at once suggests an issue of rather sensational kind, and certainly at present purely speculative. I refer to the present world-wide increase of cancer in its various forms. This increase might be explained as due to the disappearance in recent times of a controlling factor which, in a word, acted in the same manner as γ-rays or X-rays upon animal tissues.

J. JOLY.

Trinity College, Dublin,
May 26.

DR. JOLY has pointed out the possibility that cosmic radiations, acting as a purely environmental factor, have produced changes in the resistance of human cells to the attacks of cancer.

In this connexion the work of Goodspeed and Olson (*National Acad. of Sciences*, vol. 14, No. 1, Jan. 1928) is of particular interest. These investigators have shown that a high percentage of variation in the progeny may be produced by the radiation of the sexual cells of the parents with X-rays. In one population of 200 plants from radiated parents there were more than 70 per cent of variant individuals. Visible alterations in the chromosomes accompanied these morphological variations. The results were obtained with rather intense radiation acting for a short time.

From these observations it appears possible that cosmic radiations (which are of the nature of X-rays) have been a factor in the production of variations by direct action on the germplasm.

HENRY H. DIXON.

School of Botany,
Trinity College, Dublin, June 10.

Electrified Omnibuses.

IT may be worth while to record in NATURE an observation made by me of electrification of an omnibus. Recently I was going to board an omnibus in Victoria Street and in order to do so grabbed the brass rail just as the omnibus was about to stop. In doing so I received an unmistakable electric discharge. On coming back after a short time I went to the same spot—opposite to the Army and Navy Stores—and put my knuckle against the rails of those omnibuses which I could touch before anyone else did so. In all cases in which they came along at a brisk pace and pulled up quickly I received a sharp prick from the spark. In one case a second application was rewarded by a second spark. It was at a time when the sun was shining down the street and all was as hot and dry as could well be. No doubt it was the scuffling of the rubber tires on the polished asphalt that gave rise to the electrification. In intensity the shock, if such a term can be used, was two or three times as strong as that obtained after stroking a cat by the fire on a frosty night, when a visible spark may be obtained from the cat's nose.

In all my experience of omnibuses this is the first time I have noticed this electrified condition, and I have never heard of it from anyone else.

C. V. BOYS.

66 Victoria Street, S.W.1, June 11.

Spectrum of Trebly Ionised Bromine.

I REPORTED classification of the spectrum of doubly ionised bromine in a previous note to NATURE of Feb. 16, p. 244. Following that work, I have been able to classify the lines of trebly ionised bromine. The chief lines of the group $N_2(O_1 \leftarrow\!\!- O_2)$ have been thus located: $^3P_2\ ^3D_3$ line at $\nu = 36675{\cdot}2$; the $^3P_2\ ^3P_2$ at $\nu = 40130{\cdot}8$, and $^3P_2\ ^3S_1$ line at $\nu = 42247$. The singlet system and inter-combinations have also been obtained, namely, $^1P_1\ ^1P_1$ at $\nu = 42177$. The differences are $^3P_0 - {}^3P_1 = 506$, $^3P_2 - {}^1P_1 = 933$, and $^3P_0 - {}^1P_1 = 2532$.

SURESH CHANDRA DEB.

Physical Laboratory,
Allahabad, May 9.

The Origin of Variations.

By Sir OLIVER LODGE, F.R.S.

ARTICLES in NATURE have the advantage that they are addressed not merely to experts in the same line of work as their writer—these have to be placated rather than informed—nor are they specially addressed to the school-educated general public, who are more likely to recognise the etymological character of the terms used than to appreciate their physical or biological significance. Articles in these pages are, I suppose, primarily intended to reach workers in other branches of science, thereby putting them into touch with modes of thought differing from but akin to their own. Our relations with each other are somewhat like those of politicians in alien countries: the problems are different, the methods dissimilar, but the general aims are alike.

International exchange of views is sometimes valuable; international conversation at Geneva has become possible: and long may it be before NATURE is subdivided into delimited areas labelled A and B. Seldom, however, does a member of one group feel entitled to intervene or say a word concerning the business of any other group. If he does, he runs the risk of being regarded as a trespasser and treated with contumely. That of itself would matter little. What usually deters him is the doubt whether anything he has to say is likely to be of the smallest use: he might be merely airing his own ignorance. Well aware of that likelihood, he may nevertheless occasionally venture to intervene, with all due diffidence and dependence on the charity and better understanding of those whose knowledge is so thorough that they can afford to pardon crudenesses of expression, and be willing to give favourable interpretation to presentations from another point of view.

These remarks are introductory to some comments on this year's Joseph Hooker Lecture before the Linnean Society, by Dr. E. J. Allen, on "The Origin of Adaptations", as partially reported in NATURE for June 1, page 841; and without further apology I would thank him for this concise summary of opinions on so interesting a subject—first explicitly treated, so far as I know, by Bateson many years ago.

Take then the question of heredity, on which so much turns. Certain truisms may safely be laid down. The only material transmitted to descendants is the germ-plasm (using that term comprehensively as including germ and sperm). No portion of the soma is transmitted, and therefore changes in the soma can only be inherited if they are such as to modify the germ-plasm. We know, however, that that substance is modifiable by slight changes in the environment, and hence it would appear quite possible for body changes to have their due effect. Such change may be imperceptible; except when tested by the actuality of inheritance, they might otherwise escape observation: hence only experience can tell us what is heritable. The body is the organ which gains experience of surrounding conditions and adapts itself to them; whether it can transmit any part of such adaptation to the germ-plasm can only be effectively tested by observation of the descendants. If no such transmission occurs it is difficult to see how racial experience can contribute to progress. I gather that observation shows that evolution proceeds in such a way that descendants are on the whole better adapted to their surroundings than their ancestors; and further, that improvements do not proceed as if executed in accordance with some preconceived set plan, but that they are flexible and able gradually to follow unexpected changes in the environment which could not have been foreseen. Inheritance of modifications may be slow, but changes or adaptations of an individual may be quick, as when a flat fish rapidly and surprisingly adapts its coloration to suit the background on which it is placed. In other words, adaptability of a somatic kind exists in the individual as a fact of observation, so that there is no question about the possibility of individuals adapting themselves to circumstances. The question is how more serious adaptation, to permanently changed surroundings, can be conveyed to descendants.

The first *vera causa* suggested is natural selection and survival value. Permanent modification may result from the improved chances of life for those individuals who happen to be born with some approach to the favourable variation or mutation; subject to the added proviso that such innate peculiarity is transmissible by inheritance. This doctrine, though apparently true so far as it goes, obviously does not explain how the variation arises: it only acts as a lock to secure its continuance in the race when it has arrived. The problem of the origin of the variation is deeper than that. The survival of the fittest or the elimination of the unfit, alone, is little more than a shipwreck experience.

I will now make a quotation or two from the article referred to; and as it is so accessible, and this is not a controversial epistle, I will not hesitate to introduce into my quotations words in square brackets that are not in the original. In the second column of page 843, I read:

> "That evolution proceeds according to laws of the same character as other [known] laws of Nature, is the common basis of all modern evolutionary theory, and was held perhaps more strongly by Darwin, Huxley, and Weismann than it is by some writers of to-day."

The word "known" which I have thus introduced is surely important, for if it be omitted I do not see how anyone could doubt the statement. Every event must happen in accordance with laws of Nature in the widest sense. But as to whether at any given period those laws are all known, or rather whether the laws known to a particular generation are sufficient as a basis from which to explain every recognised phenomenon, may very well be doubted. That, I presume, is the only point on which modern

writers can differ from what may be called the Huxley point of view—or, to make it impersonal, say, from the view that the fundamental knowledge of Nature already acquired by humanity is sufficient to account for all observed phenomena. Those phenomena have been added to since the middle of last century, and everyone who knows anything of Darwin and his great protagonist must realise how eagerly the newer experimental results would have been assimilated and utilised by them.

GUIDANCE AND CONTROL.

The question which still remains open, as worded by Dr. Allen, is "*how* the soma influences the factors in the germ cell". Well, that is one way of putting it, from the material point of view: and an interchange or circulation of hormones has been suggested as a material method. For paternal inheritance this particular method may possibly lack cogency, but doubtless some machinery will be found; one can scarcely expect to see changes produced in matter without *some* appropriate mechanism! But that alone does not solve the problem. There is about the process a suggestion of purpose, as if, like all other mechanism, it were constructed for a definite object, and designed so as to work in a particular way. A random circulation of hormones, or of anything else, could scarcely be trusted to effect the precise changes which, having originated in the soma and possessing survival value, ought to be transmitted to the germ-plasm so that they may be inherited. Hormones may, for all I know, constitute the material means of conveyance; but how do they exercise that function? And what initiates or controls their activity? So much is left unexplained even when the machinery is discovered.

Material mechanism is just what can be followed by those whose business it is to study the physical basis of life, but mechanism is never self-explanatory. The most automatic mechanism ever constructed must have mind behind it, not indeed in its contemporary working, but in its design and purpose; and if the result of mechanical working simulates the effect of purpose, it may be wise to keep our minds open to the possibility that after all there may have been some purpose, or so to speak intention, in the change that is being observed and in the adaptation of the means. The mechanism whereby a flat fish (to go back to that merely popular illustration) changes its pattern when greater concealment can be thus secured, has I believe been made out: certain pigment cells swell, while others contract. That the animal knows what it is doing is quite unlikely: the mechanism presumably works automatically. But surely biologists scarcely feel that they have got to the bottom of the problem when they merely point out the mechanism!

Some biologists apparently realise that a statement in terms of automatic working is not ultimately satisfying, and are said to have introduced "the idea of some psychic or psychoid influence, controlling and regulating the processes of metabolism and organic growth"; which idea is deprecated by Dr. Allen, in common I suppose with many others, as too like "the animisms of primitive man", too suggestive of conscious purpose, "such as we know only in ourselves, or by analogy assume in higher animals".

Purposive action and planning, however, do after all exist in the universe, and therefore may have to be taken into account in ways of which we at present have no suspicion. It is true that the higher animals who thus act for the future have "an elaborately differentiated nervous system"; but that is only part of the mechanism for the forming and carrying out of a purpose. A machine does not really explain the rationale of its own action: no machine is able to do that. The most elaborate machine is a mere executive.

Suppose we revert to an earlier position and ask, How do we know that germ-plasm may be influenced and modified or adapted to new and unexpected conditions? Doubtless we know it in several ways, but among others by the direct experiments mentioned by Dr. Allen in the second column of page 842, where we are told "that the germ-plasm itself can be acted on by physical and chemical forces in the environment in such a way that mutations are produced". For

> "Harrison has shown quite clearly that the germ-plasm can be changed by chemical substances contained in the food of an animal, or in more general terms that the germ-plasm can be altered by the environment".

Here, then, is a change which has been produced through proper physical and chemical means and has resulted in a mutation. But surely Dr. Heslop Harrison may be not impolitely called "a psychic or psychoid influence, controlling and regulating the processes of metabolism and organic growth"; and H. J. Muller, by finding the correct dosage of X-rays for mutation production, seems to be another of those influences. An imaginary observer able to watch the processes, but from whom the operator was concealed, might feel impelled to infer him. But indeed we need not appeal only to recent advances. The long-established procedure of breeders, and even of gardeners, long ago showed that mental operations—put into effect by a nerve-muscle system—were able to guide and direct the ordinary forces of Nature so as to produce variations almost at will. The beneficent progress of discoveries in agriculture, from which ultimately we hope so much, is an outcome of this purposive activity of a "psychic or psychoid influence". Such an influence is therefore another *vera causa*, which may be more widely operative than at present we imagine.

CONCEALED INFLUENCES.

It will be said, however, it is quite unfair to bring in the operations of a highly organised product of evolution, and use that as an analogy for what occurs in connexion with low organisms without any trace of psychic or even nervous development. How is it possible for anyone who wishes to adhere closely to the laws of Nature to think of any other

influences than those displayed by the organisms themselves? How can we detect concealed influences? If we attend only to matter, and to those laws which have been already ascertained, I admit it may be impossible. But a physicist is not limited to the contemplation of matter. He regards the behaviour of matter chiefly as a sign or indication of what is going on in space. Faraday showed that the phenomenon of electric charge would never be properly understood by attending to matter alone: he traced the electric field to a property of space. Charged conductors are only the boundaries or terminals of an electric field existing *in vacuo*. Similarly Poynting showed that an electric current is not propelled by anything occurring in a metallic conductor, but by an influence reaching the conductor through space. The energy of the sun reaches the earth in that sort of way. Atoms act on each other across intervening space; and it is to space that modern physics turn for explanation of cohesion, elasticity, and of what used to be called 'gravitational attraction'.

In fact, it may be said that modern physics attends very much to space and its properties, and utilises matter mainly as an index, demonstration, or manifestation of those properties. The very electrons of which matter is composed are spatial peculiarities, and seem to have more affinity with waves than our scientific ancestors suspected. An electric current, considered materially, is a procession of electrons; but the driving power is not an end-thrust like that of water through a pipe: the propulsion is a lateral propulsion exerted by electromotive forces which reach the conductor through the surrounding medium, along paths which can be mapped out.

Undoubtedly we are dependent on matter for every observation; we cannot study even ether or radiation without it; occurrences in space are concealed from us, they have to be inferred. For example, a magnetic field is an etheric or space phenomenon, and yet, admittedly, it is by aid of the properties of matter that we explore and investigate such a field. But matter after all is secondary; it displays and locates the phenomenon: it helps us to deal with it and make experiments upon it; yet an actual magnetic field is turning out more like a circulation in space than anything else. Before the discovery of electric currents, the only magnets known were natural magnets and those which had been propagated from them by regulated movements. One magnet could produce any number of others, without being itself weakened, and there was no magnetism without antecedent magnetism. The parable is obvious.

The progress of science in that department, however, led on to the production of artificial magnets, electromagnets, whereby fresh magnetism could be generated by setting electricity in motion. Yet, even so, 'generated' is scarcely the correct term. The act of magnetisation seems to be only the utilisation and opening out of circuital relations which already exist, so that instead of being shut up into infinitesimal configurations they are displayed openly and made manifest. Pre-existing but imperceptible magnetism could be incarnate in matter and exhibited. All matter has close relations with the space surrounding it. Radiation is a constant means of communication, not only obviously, but also secretly, in ways only recently discovered. An atom under certain conditions can emit energy into space, and can receive energy from space; and all material activity is the result of this interchange of energy. In space, the energy is what we call potential: in matter, it is what we call kinetic. The one form is continually passing into the other, and back again.

It must be admitted that analogies prove nothing, but they are sometimes suggestive. My suggestion is that life is something which primarily exists in space, though we only know of it when it is associated with and displayed by matter. I venture to say that we shall never understand life so long as we attend to its material manifestation alone. We must always use matter as our index and means of exploration, because it is matter alone that appeals to our senses; but the reality may lie beyond or behind matter, and may only interact with it for a time. We should never have understood the laws of an electromagnetic field, and the nature of radiation, by theorising as if matter were supreme. Even now we scarcely understand the nature of gravitation, though we can apply its laws with considerable success to the motions of material bodies. Similarly, the nature of life is unknown, though a vast amount has been learnt about living bodies.

I would ask biologists to consider whether they could not, as a working hypothesis, begin to contemplate life as something existing in space as in a sort of infinite reservoir, out of which it could under appropriate stimulus enter into association with molecules of sufficient complexity to enable it to catch hold and become as it were incarnate. They might go on to suspect or infer concealed mechanism, not of a perceptible material kind, but still possibly of a physical nature, activated by something at present unknown. I suggest that concealed powers have put the organism together, in a specific form, out of such materials as came to hand. When the machine goes out of order the controlling powers cease to be able to display themselves: the instrument of manifestation is spoilt. But we need not jump to the conclusion that when they related themselves to matter they came into existence, and that when they leave matter they cease to be.

Few of the controlling powers can have attained an individual or personal existence, but we know that matter, in its more complex and higher protoplasmic forms, has been the means of individualising those concealed activities; and consequently, as developed personalities, we ourselves are able to testify and help the explorers. If they made use of all the information available they would have a wider scope for contemplating the apparently purposive movements of live things, and might realise that in studying as they do the material basis of life, they are studying the influence of some

controlling entity—perhaps etheric, perhaps psychic, probably both—by aid of the material mechanism which it utilises.

CONDITIONS FOR VITALITY.

There are certain narrow conditions which have to be satisfied before live things can appear—a certain narrow range of temperature, the presence of chains of carbon atoms and perhaps of oxygen and liquid water—all of which are commonly called the conditions necessary for life to exist. I would rather call these the conditions necessary for vitalising or animating matter—the conditions for vitality; in other words, the conditions enabling life to enter into association with matter. I admit that it is the peculiar behaviour of organised cells that we commonly designate by the term 'alive', but we must not be too much hampered by our use of terms. Animated matter displays life, and the display or manifestation of life we might call vitality. When vitality ceases we are apt to imagine that life has gone out of existence. But we do not think that electricity has gone out of existence when a body is discharged, though it is no longer electrified; nor need we think of magnetism as going out of existence: it can become concealed and go out of our ken. Nor do we think of electricity as ever coming into existence—at least not under observation; it can be localised so as to display itself by material effects. Animated matter behaves in a curious way, and so does electrified or magnetised matter. A compass-needle points north and south, as if mysteriously cognisant of those regions; but everyone knows that it is only acted on by the peculiarities of the space near it.

Similarly, if we try to understand apparently purposive action in animated matter, we may fail unless we realise more clearly that something is controlling and being itself displayed by that matter. An electrician uses a compass-needle or a filament to display or manifest an electric current; but he would not understand much about the current if he limited himself to a discussion of its material manifestation. Nor do I think that we shall understand much about heredity, and the other strange occurrences dealt with by the biologist, so long as we attend only to the material vehicle or instrument of life. Life enters into a nascent organism gradually, as its cellular constitution is enabled to receive it; and when, in the long course of evolution, an organism has attained sufficient complexity, the higher stages or aspects of life, called mind and consciousness, enter or are manifested too. But a study of the mechanism alone will never detect more than an indication of our thoughts, plans, hopes, and aspirations; nor can we thus explain consciousness and our power of understanding what is going on in the material explored.

One more quotation from Dr. Allen in conclusion, with which, I need scarcely say, I heartily agree, especially if extended by the words in square brackets:

> "In whatever direction we look problems bristle, problems open to successful attack; and the old qualities, insight, patience, and determination, will get them solved. But we must not limit the outlook, and all aspects of biological research must proceed hand in hand. Botany, zoology, palæontology, the work of the systematist and of the field naturalist, the study of structure and the study of function, the work of the embryologist and of the experimental physiologist, of the geneticist and of the statistician [aye even of the physicist and the psychologist], all are necessary, and none can succeed without the others."

The Joint Meeting of the French and British Associations at Havre.

IN 1914, while the British Association was meeting in Australia, the delegates of the Corresponding Societies were invited as guests at the conference of L'Association Française pour l'Avancement des Sciences, then being held at Havre. Those who were present will remember the hospitable way in which they were entertained at the Hotel Frascati, at the meetings and excursions, though as day by day passed there seemed to be something mysterious going on; the hotel gradually emptied, there were signs and whisperings, the members were impressed by the enormous accumulation of foodstuffs in the warehouses, and before the meeting was closed the declaration of war explained a good deal. The members had to find their way back to England as best they could, and those who had the experience will never forget it.

The French Association, towards the end of July this year, again meets at Havre, and as the principal members of the British Association will then be at South Africa, our French colleagues have again extended the courtesy of inviting the other members of the British Association to attend its conference at Havre without any extra fee beyond the ordinary subscription to the British Association, which would be paid in any case.

In addition, the French Association has invited the delegates of the Corresponding Societies to hold their conference during the Havre meeting, and in connexion with this a sub-committee was appointed consisting of the president of the Conference of Delegates, Dr. F. A. Bather; the secretary, Dr. C. Tierney; and the acting secretary for the Havre meeting, Mr. T. Sheppard. Sir Henry G. Lyons was also appointed the official representative of the British Association and chairman of the organising committee referred to.

At the Glasgow meeting of the British Association, Dr. A. Loir, whose courtesy was so much appreciated in 1914, was present and gave an official invitation to the General Committee of the British Association and was prepared to do the same for the Conference of Delegates, but apparently that body was too fully occupied to spare the necessary time. Mr. T. Sheppard has recently visited Havre and met the chairman of the Local Committee (the English Consul, Mr. H. C. Swan), Dr. Loir, and others interested in the local arrange-

ments. The Hôtel des Sociétés Savantes, next to the Lycée de Garçons, where the meetings of the French Association will be held, has been generously placed at the disposal of the British Association for any special meetings, etc. These rooms provide a general meeting room for the delegates, a committee room, and an exhibition room. During the conference, Dr. Bather will give an address on museum matters to a section of the French Association, and Dr. Pullein will speak on radiology at the request of the Association. The Conference of Delegates will be held at 5 P.M. on July 26, when the question of the Channel Tunnel from both engineering and geological points of view will be discussed. The British committee is arranging an exhibition of air photographs, regional survey maps, etc.

The French Association commences its programme on Thursday, July 25, at 11 A.M., when the opening session will be held at the Grand Theatre. In the afternoon is the organisation of the sections, and in the evening a reception by the Corporation at the Town Hall. On Friday, July 26, there will be papers and discussions; visit to exhibitions organised at the Lycée de Garçons, natural sciences by the Geological Society of Normandy and the Linnean Society of the Seine Maritime, and exhibits by the civil engineering, dentistry, meteorological sections, etc.; visit to the Port and a liner; and a conference at the Grand Theatre. On Saturday, July 27, there will be a visit to the English exhibitions and museum; visit to the museum at Old Honfleur, and a public conference in the Franklin Hall. Sunday, July 28, will be occupied by a general excursion to Fécamp; and the unveiling of a monument to Dr. Léon Dufour. On Monday, July 29, further discussions, visits to various buildings, and in the afternoon an excursion to the Art Gallery and New Archæological Museum at Graville Abbey. In the evening there will be a soiree at the Municipal Casino or on a liner. Tuesday will be occupied by papers and discussions and the closing session. On Wednesday, July 31, and Thursday and Friday, Aug. 1 and 2, there will be final excursions to Grouville, Lisieux, Caen, Bayeux, Mont St. Michel; and Rouen and district.

Inquiries in reference to the meeting should be addressed to Mr. T. Sheppard, at the Museum, Hull, or to Dr. A. Loir, Comité Local, Hôtel de Ville, Le Havre, France.

News and Views.

ON June 26 the centenary occurred of the death of James Lewis Smithson, who by his will, dated Oct. 23, 1826, left his fortune "to the United States of America to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men." Born in France in 1765, Smithson was the illegitimate son of Hugh Smithson (1715–86), who married the heiress of the Percy property, took the name of Percy, and in 1766 was made Duke of Northumberland, and of Mrs. Elizabeth Macie, widow of James Macie, of Bath. He was known during the first half of his life as James Lewis Macie, and under that name he entered Pembroke College, Oxford, graduated as M.A. in 1786, and was the following year admitted a fellow of the Royal Society. His attainments in chemistry and mineralogy were vouched for by Kirwan, Blagden, and Cavendish, and Smithson's life was mainly devoted to scientific studies. He travelled and lived much abroad, counted among his friends and correspondents, Davy, Thomson, Cavendish, Biot, and Arago; contributed some 27 papers to the *Philosophical Transactions*, Thomson's *Annals of Philosophy*, etc., and collected a great mass of notes on various subjects. His death took place at Genoa, and his grave, until the end of 1903, was to be seen in the little English Cemetery on the heights of San Benigno overlooking the Gulf of Genoa. Early in 1904 his remains were exhumed and, under the supervision of Alexander Graham Bell, conveyed to Washington, where they now lie in a mortuary chapel in the great institution founded through his action.

SMITHSON'S fortune came to him through his mother, who could claim descent from Henry VII. and was connected with the Hungerford family of Studley. In his will he directed that his property should first go to a nephew, Henry Hungerford, and it was in the case of his nephew's death that it was to go to the United States. It was not until 1837 that any of the money was received in America, and a further nine years elapsed before Congress decided to accept the trust and found the Institution. The Board of Regents designated by the Government met on Sept. 7, 1846, and one of their first acts was to appoint Prof. Joseph Henry, of Princeton, as secretary. It is not too much to say that it was largely owing to Henry's foresight, energy, and broad-mindedness that the Smithsonian Institution soon gained an international reputation. Henry has been succeeded by Spencer Fullerton Baird (1878–87), Samuel Pierpont Langley (1887–1906), Charles Doolittle Walcott (1907–1927), and the present secretary, Dr. Charles Greeley Abbot. "Smithson's wishes", wrote Langley thirty years ago, "have been carried out by those immediately administering them with a constant scrupulous thought of the intent of the founder, while in doing this the best results have flowed from a rigid construction of his own words, so briefly expressed, and from a division of the activities of the Institution into two great distinct but parallel paths, the 'increase' and 'diffusion' of knowledge". The motives which led Smithson to leave his money to the United States will probably remain unknown, but we are in no doubt as to the admirable manner in which his wishes have been carried out or of the fruitfulness of his bequest.

IN his presidential address to the Pharmaceutical Conference in Dublin on June 25, Mr. R. R. Bennett dealt with some aspects of materia medica in which a rational use of drugs has replaced a crude em-

piricism, owing to recent advances in chemistry and physiology and in the science and practice of medicine. Such increased knowledge has led to improvement in the public health, and to the discovery of new remedies, the beneficent effects of which are world-wide in their application. In the tropics especially, knowledge of the natural history of parasitic diseases and the discovery of drugs exerting a curative effect have led to a measure of control which makes available for human habitation large tracks of otherwise unhealthy country. In this work the part played by synthetic drugs is of great importance, but in spite of the discovery and use of powerful new remedies our knowledge of the relationship between chemical structure and physiological action is fragmentary. It can only be increased by the systematic preparation of new compounds and the examination of their pharmacological properties. In this connexion the establishment of a chemical research laboratory at Teddington under the general scheme of research directed by the Department of Scientific and Industrial Research must be regarded as an experiment of great interest. In collaboration with the Medical Research Council, an endeavour is to be made to obtain experimental evidence of the relationship between constitution and activity.

NEW remedies or methods of treatment are often of respectable antiquity. Mr. Bennett mentioned that ephedrine, which has found a place in the treatment of asthma, is similar both chemically and pharmacologically to adrenaline : it was isolated, but not used, fifty years ago : the Chinese, however, have employed the crude drug for more than two thousand years. Again, animal preparations were used as medicinal agents, only to fall into disfavour : now they are coming into vogue again, and some exert a specific effect in certain diseases ; for example, liver and its extract in the treatment of pernicious anæmia, or thyroid gland and its active principle, thyroxin, in the treatment of cretinism. The tendency is to replace the crude drug with the active principle extracted from it ; then the latter is prepared synthetically, often more cheaply than the natural product, and except for the fact that the synthetic compound requires resolution into the optically active isomers, it is identical with that prepared in Nature's laboratories. But modern remedies include more than is implied under the term drug : organotherapy is assuming as important a place as chemotherapy, vitamins can be prepared in concentrated form, and, finally, bacterial products play an indispensable part in the treatment of many diseases. Vaccination for smallpox, antitoxins for diphtheria or tetanus, and still more recently inoculation for canine distemper and yellow fever indicate the wide range covered by the modern use of the term remedy. Finally, it must not be forgotten that physical methods also play their part, of which the use of radium in cancer may be considered a most notable example.

THOUGH the loss of life was fortunately small, the earthquake that occurred in New Zealand on June 17 appears to have been the strongest felt in that country since 1855. The epicentre lay in the north-west of the South Island, the greatest damage having been done at Westport, Greymouth, and Murchison. At these places scarcely a building escaped serious injury. At Nelson a tower fell, so that the area of damage must have been more than 150 miles long in the south-south-west direction and about 50 or 60 miles in width. In the epicentral area, landslips were unusually frequent and large, and, indeed, most of the fifteen deaths reported seem to have been due to landslips rather than to the fall of buildings. Our record of New Zealand earthquakes is a brief one, but, in the century that has elapsed since 1826, no other prominent movement appears to have occurred in the centre recently in action. The three great earthquakes of Oct. 16, 17, and 19, 1848, visited a district fifty miles or more to the east, in the chain of mountains that runs south-south-west from Cloudy Bay, along which a remarkable fissure 60 miles long was then formed. The still greater earthquake of Jan. 23, 1855, occurred in the south-east end of the North Island, its epicentral area being in or near the continuation of that of the earthquake of 1848. With this earthquake, an area of 4600 square miles was raised from one to nine feet, the greatest elevation being along the line of the Wairarapa Valley.

AMONG the recent additions to the British Museum (Natural History) are the late Dr. J. de Bedriaga's herpetological collections and a selection of books and pamphlets from his library, presented to the Department of Zoology by Dr. G. A. Boulenger. This collection (1306 specimens) is especially rich in representatives of the numerous races of the wall lizard from the islands of the western Mediterranean. The books and pamphlets, 159 in number, are almost all works or editions new to the zoological library of the Museum. Dr. Hugh Scott and Mr. J. Omer Cooper have presented to the Department of Entomology some 40,000 insects collected in Abyssinia during their expedition to that country in 1926–27. The entomology of the high plateaux of Central Abyssinia, where these collections were made, has been relatively very little investigated, but is of great interest owing to the peculiar mingling of tropical African, northern, and Oriental forms. Certain small groups already worked out show a high percentage of species new to science.

THE collection of Lepidoptera made by the late Mr. A. E. Wileman during his thirty years' consular service in Japan, Formosa, and the Philippine Islands, which consists mainly of moths and comprises some 25,000 specimens, including nearly 760 types, has been presented to the British Museum (Natural History) by Mrs. Wileman in memory of her husband. Dr. J. M. Aldrich, of the United States National Museum, Washington, has presented a series of dried larvæ of a Saturniid moth, *Coloradia pandora*, Blake, from the Mono Lake district, California. The caterpillars of this moth feed on the needles of a species of pine (*Pinus jeffreyi*) at an altitude of some 7000 feet, and are collected, dried, and used as food by the local Indians. The life-cycle of the insect occupied

two years, and, as an indication of the numbers in which the caterpillars sometimes occur, an Indian chief is said to have prepared a ton and a half of these larvæ during a single summer. The Department of Mineralogy has received from Mr. F. N. Ashcroft a further selection of about a thousand mineral specimens, representing more than a hundred Swiss localities. With Mr. Ashcroft's previous donations of Swiss minerals and those bequeathed by the Rev. J. M. Gordon in 1922, the Museum now possesses the finest collection extant for illustrating the conditions of mineral growths in the special type of Alpine veins.

SIR RICHARD GREGORY'S presidential address to the Royal Meteorological Society last January, entitled "Amateurs as Pioneers", which has just been published (*Quar. Jour. Roy. Met. Soc.*, vol. 55, No. 230), deserves to survive as a chapter in the history of British science. Nowhere in the world has the amateur flourished as he has in Great Britain; and he flourishes still. It has often been pointed out that, though it is easy to beat the Englishman in the field of high specialism and technique, if the view be extended so as to take in the larger number of amateurs and fairly good performers in any branch of study or of sport, Great Britain may face the world. In this matter it is the same with tennis as with Greek, with chess as with meteorology. Sir Richard is concerned mainly with contributions to the last-named subject. His contributors range from the Rev. William Merle, or Morley, who went from Oxford to be rector of Driby in Lincolnshire in 1331 and kept a systematic record of the weather for seven years, down to the amateurs of the present day, who have set up two-way radio communication between England and the Antipodes on a wave-length of 80 metres.

METEOROLOGY has been a favourite field for the amateur. In 1846, James Glaisher, following a long line of amateur observers, was able to correct a false conclusion published by the Registrar-General as to the relative temperature of London and York. As a result he was requested to collect suitable observations for inclusion in the "Quarterly Returns of Marriages, Births, and Deaths". He thereupon formed a band of 50 to 60 voluntary observers who became the nucleus of the Royal Meteorological Society and the pioneers of the Meteorological Office. The exploration of the air has been the special triumph of the amateur. The same Glaisher became famous as a balloonist, and some stirring pictures are published in this pamphlet of his experiences, ascending and insensible, at the height of seven miles. The Royal Society itself, indeed, and practically all the pioneers of the seventeenth century, were amateurs, at a time when the universities were close in the grip of religious controversy and Aristotelian dialectics. It was men out of touch with this who first came together in Oxford, and afterwards consolidated their efforts in the Royal Society in London. They were mostly men of means, and it would be well for us if as large a proportion of that class were amateurs of science to-day.

SINCE 1846 the only material changes in the scope of the United States National Museum have been the addition of a department of American history, and in 1920 the separation of the National Gallery of Art as a unit. Now, as the Report for 1928 shows, there is imperative need for further accommodation for purposes both of exhibition and storage of study collections. Especially, it would appear, has natural science suffered, since exhibits of animals have been curtailed to make way for historical subjects, and space designed for anthropology has been pre-empted for objects of art. In view of this contraction of natural science in favour of other studies, we turn with interest to the records of visitors, which give an indication of the comparative interest taken by the people in the different groups of exhibits. In the first complete year in which natural history is treated as a separate group, the number of visitors to this section was 151,112, while 'arts and industries' claimed 207,010. But now (1927–28) the numbers are respectively 618,773 and 517,238; and this scarcely gives the true contrast, for a glance shows that natural history must have claimed on an average during the last eighteen years about 200,000 additional visitors a year. Thus the public gives little excuse for extending art at the expense of natural history. A large part of the Report deals with the activities of each of the departments, in acquisition, research, exchange, and so on. The extent of the collections which have now been amassed may be judged by the fact that the department of geology possesses more than two million specimens, and biology well over eight million. It is sad to read that of the 333,329 birds in the collection, 8126 have been classed as alcoholics '—and this in a dry land.

ON Jan. 5, 1927, the Governor-General of Canada in Council gave authority "to designate the Museum branch of the Department of Mines the 'National Museum of Canada.'" Thus the Museum publicly assumes a national relationship towards which its activities have been broadening since it began as a part of the Geological Survey of Canada in 1841. During that developmental period, many changes have taken place. Gradually the purely geological activities have had added to them anthropology, biology, and palæontology, each now claiming a division of its own. At the same time, various transferences of site have moved the Museum, first from its original home in Montreal to Ottawa in 1880, and there, finally in 1910, to the handsome Victoria Memorial Museum, where the collections and staff have since been housed, except during a partial and temporary dispossession, from 1916 until 1920, when, their own Parliament House having been destroyed by fire, members and senators transferred their activities to the Museum building. An account of the history of the Museum and of the developments due to each of its successive directors, from Sir William E. Logan to the present day, has been written by the acting director, Mr. W. H. Collins, for the Annual Report for 1926, just published, the first of a series of reports proposed to be devoted wholly to the interests of the National Museum of Canada.

THE Council for Scientific and Industrial Research for the Commonwealth of Australia has issued its second annual report (Canberra: H. J. Green, 1929. 1*s.* 8*d.*). The Council, being a new department, is still mainly occupied in building an efficient research institution to co-operate with existing institutions in solving many pressing national problems. Although some investigations have been initiated, the Council has principally taken over investigations that were in progress. Four divisions, each under a chief, have already been formed. They are animal nutrition, economic entomology, economic botany, and forest products. A fifth division to deal with animal health is in course of formation. So far the Council undertakes to carry out extensive investigations only in those fields where it has been found possible to find a suitable chief of the division. The report dwells on the lack of efficient research workers in Australia in the fields where work is most required, that is to say, in pastoral and agricultural problems. A plea is made for the more extensive training of research workers in the biological sciences. The difficulty is partly overcome at present by extensive co-operation with the Australian universities and the State departments of agriculture. The report contains notes on many valuable lines of research now under way.

THE Australasian Antarctic Expedition (1911–1914) Scientific Reports, Series B, vol. 2. (Terrestrial Magnetism and Related Observations), Part II., issued in March 1929, is devoted to a discussion of "Magnetic Disturbance and its Relations to Aurora", by the late Dr. C. Chree (Sydney: Alfred James Kent. 15*s.*). Of the 132 pages in this part of vol. 2, 53 are occupied by tables and 79 by text; it is to be regretted that no summary of the conclusions resulting from this long discussion is included. Of the four chapters, one only is devoted to the connexion between auroræ and magnetic disturbance; when auroræ are specially intense, so also, in general, is magnetic disturbance, but on more ordinary occasions there appears to be no close relationship between the two phenomena, in the Antarctic. The other chapters deal with daily and hourly character figures for disturbance; the international daily character figures are found to be on the whole indicative of Antarctic as well as of non-polar conditions.

THE Department of Embryology in the Carnegie Institution of Washington has from the outset, under the late Prof. Mall and now under Prof. G. L. Streeter, pursued a policy of close association with other departments engaged in related work in its own institute and in the Johns Hopkins University and Medical School, as well as with the general medical profession. The policy has been a fruitful one for the study of human development, for many of the researches summarised in *Year Book* No. 27 could only have been carried out upon material obtained from such outside contacts. The programme of study is of the widest character. More than forty investigations have been completed or were in progress during the year reviewed, to June 30, 1928. They included researches on the differentiation of primitive tissues from the mammalian egg, the origin of the human heart, the locomotion of white blood cells, organogenesis, and the functions of the corpus luteum and other ovarian structures. A monkey colony recently established has yielded interesting results bearing upon the duration and symptoms of pregnancy and the act of parturition, while many studies have been devoted to the nervous system, particularly to the correlation between function and structure, and to the phenomena of growth in the higher primates and man.

VOLUME 19 of "Contributions from the Jefferson and Cruft Laboratories of Harvard University" contains reprints of 72 papers by the staff and research fellows which have appeared mainly in American scientific journals during the years 1926–27. Ten of these papers are by Prof. P. W. Bridgman, who has continued his work on the properties of substances under high pressures. Prof. E. H. Hall contributes five, mainly on the emission of electrons from the surfaces of bodies, and Prof. Lyman four on ultra-violet spectra. Prof. Duane and Dr. R. J. Havighurst, a research fellow, are responsible for ten on crystal analysis by X-rays, and Prof. R. S. Mulliken and two research fellows for eight on the relations between band spectra and electronic structure of the emitting molecule. Dr. J. C. Slater contributes five and Dr. E. E. Witmer, a research fellow, four on the structure of atoms and the bearings of wave mechanics on the subject. Prof. G. W. Pierce describes his magnetic oscillators, giving frequencies from a few hundred to 300,000 per second. A rod of magnetisable material passes through the centres of two coils, one connected to the filament and plate, the other to the filament and grid of a valve with a condenser in the circuit. The oscillating currents produce changes of length of the rod, and the apparatus is much more convenient than the piezo-electric generator. The volume maintains the high standard its predecessors have led us to expect from Harvard.

WE have received a copy of the prospectus announcing the sixth great exhibition of chemical apparatus and machinery to be held at Frankfurt-on-Main on June 10–22, 1930. The brightly decorated cover shows the remarkable growth in size of successive exhibitions since the first of its kind was held at Hannover in 1920, and it is confidently expected that the Frankfurt exhibition will excel in importance even that held two years ago at Essen. Many foreign countries will be represented among the exhibitors, and members of the *Dechema* (*Deutsche Gesellschaft für chemisches Apparatewesen*, Seelze, bei Hannover) will receive special privileges. Frankfurt is described as the greatest centre of chemical industry in the world. In addition to this, the manufacture of chemical machinery and apparatus has grown to very considerable importance in the neighbourhood. The exhibition will be held in four large halls, which are housed in three main buildings, plans of which are given. The main avenues in the exhibition bear the names of famous chemists—Liebig, Bunsen, Wöhler, Emil Fischer, Nernst, Ostwald, Baeyer, Willstätter,

Goldschmidt, Raschig, and others. The first hall will contain scientific apparatus and instruments for laboratory use, technical measuring instruments, and also the postal department, press-rooms, and writing-rooms. In the second hall will be found porcelain and stoneware and products of the ceramic industry. Machinery and appliances used in the industry of oils and fats are to be assembled in Hall 3, a section of which will be devoted to the chemistry of daily life, whilst in the fourth hall large technical apparatus and machinery used in chemical industry, together with complete exhibitions of plant and processes and also raw and other materials, will be found.

THE forty-first Congress and Health Exhibition of the Royal Sanitary Institute will be held at Margate, at the invitation of the Town Council, on June 21–28, 1930.

IN NATURE of May 25, p. 795, Messrs. C. von Bonde and J. Marchand described a case of 'Siamese twins' in the spiny dogfish. We find that similar twin dogfish were caught by a trawler in the English Channel and landed at Newlyn on Aug. 25, 1928, and a reproduction of a photograph of the specimen was published in the *Fishing Gazette* of Dec. 22, 1928.

REFERRING to the note on p. 922 of NATURE of June 15, on a course of electrostatic methods in biology in Basel, Mr. R. Keller points out that it is scarcely correct to state that he and his colleagues "are introducing physical methods into biochemistry". This has already been done by other workers. The Prague school is specialising on certain electrostatic *microscopical* methods.

IN order to facilitate the work involved in preparing the annual publication of "Organic Syntheses", the editorial board has been fortunate in securing the co-operation of Dr. C. F. H. Allen, of Tufts College, Mass., who is acting as secretary to the board. All correspondence regarding "Organic Syntheses" may be addressed to Dr. Allen, who will receive contributions to be considered for publication in future volumes.

THE Old Students' Association of Faraday House Electrical Engineering College has this year elected Dr. Alexander Russell as its president to commemorate the fortieth anniversary of his appointment on the staff of the College. It was in 1882 that the Hammond Electrical Engineering College for training electrical engineers was founded, and it was in 1889 this was merged in the present Faraday House College. Since then, some 2050 students have entered Faraday House, and of these more than 900 are members of the Old Students' Association. A portrait in oils of Dr. Russell, by Miss A. M. Burton, has been presented to the Governors by the artist's brother, Mr. R. G. Burton, who was at Faraday House during 1912–1915, and is now with the well-known firm of Messrs. A. Reyrolle and Co. A reproduction of the portrait forms the frontispiece of the summer issue of the *Faraday House Journal*.

THE drawbacks to most of the radio-receiving sets at present on the market are the difficulties connected with keeping them thoroughly clean and in good condition, the periodic charging of the low-pressure accumulators, and the replacing of the high-tension batteries. Those who use the electric light often wonder why electricians do not use the domestic electric supply and thus get rid of both accumulators and high-tension batteries. Good progress, however, has been made in this direction. When the domestic supply is alternating current, it is not difficult to buy quite satisfactory 'eliminators' which require neither batteries nor accumulators. With direct current supply the practical problem of abolishing the high-tension batteries has been achieved and excellent progress is being made in the direction of abolishing the accumulators. Messrs. Claude Lyons, Limited, of 76 Old Hall Street, Liverpool, issue a catalogue called "Getting the most out of Radio". The ordinary scientific reader who wants to know the latest developments in methods of receiving broadcasting will find this catalogue very instructive. Much of the apparatus described has been made by the General Radio Company of America. The products of several English manufacturers are also described. Excellent hints are given of the best methods of keeping sets in condition. As it is very difficult to get piezo-electric crystals large enough to give fundamental frequencies below 25 kilocycles, we are glad to see that magneto-striction oscillators can be purchased suitable for low frequencies. The same firm also publishes a booklet describing a 'clarostat', an instrument which does for high resistance what a variable condenser does for capacitance. It provides a method of continuously varying the value of a high resistance. The material used is a highly pulverised graphite intermixed with pulverised mica. The resistance is altered by applying pressure. This material should also prove very useful in the laboratory.

CATALOGUE No. 169 of Messrs. Dulau & Co., Ltd., 32 Old Bond Street, W.1, just issued, gives particulars of 1200 second-hand works dealing with botany and horticulture. The prices asked appear to be reasonable.

WE have received from M. Paul Lechevalier, 12 Rue de Tournon, Paris, a copy of that firm's catalogue No. 114 of second-hand works relating to zoology, nearly 1800 in number, published for the most part outside the British Isles.

WE have received from Messrs. J. H. Steward, Ltd., 406 Strand, London, a copy of their new catalogue of surveying, drawing, and nautical instruments. The catalogue illustrates a wide choice of theodolites, levels, plane tables, compasses, aneroids, drawing instruments, etc. Full specifications of the instruments are given.

A SPECIAL Clearance List of instruments has just been issued by the City Sale and Exchange, Ltd., 81 Aldersgate Street, London, E.C.1. It is classified, and various sections deal with field glasses, telescopes, surveying apparatus, etc., with a miscellaneous group including microscope accessories, mathematical instruments, and a 3-inch Watson's Student telescope. Deferred payments can be arranged.

THE latest addition to the valuable series of catalogues of Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, is No. 426, which deals with upwards of 1600 works classified under the headings of botany, agriculture, early medicine and surgery, forestry, fruit-culture, gardens and gardening, herbals, modern medicine, and tobacco. Many of the volumes offered for sale are rare.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A principal of the Birmingham Central Technical College—The Chief Education Officer, Education Office, Margaret Street, Birmingham (July 1). A temporary lecturer in physics at the Birmingham Central Technical College—The Principal, Central Technical College, Birmingham (July 1). An assistant in geography at the London School of Economics and Political Science—The Secretary, London School of Economics, Houghton Street, W.C.2 (July 1). A demonstrator in botany—The Secretary, King's College, Strand, W.C.2 (July 2). An assistant lecturer (woman) in the Department of Education—The Secretary, King's College, Strand, W.C.2 (July 2). A junior forestry inspector under the Department of Agriculture—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (July 3). A resident lecturer (man) in geography and mathematics—The Principal, Normal College, Bangor (July 3). A chief instructor in the Engineering (Production) Department of the Wolverhampton and Staffordshire Technical College—Clerk to the Governors, Education Office, North Street, Wolverhampton (July 4). A research student in experimental physics—The Registrar, Trinity College, Dublin (July 5). A professor of geology at the University of Glasgow—The Secretary of the University Court, University, Glasgow. An assistant lecturer in biology, who will lecture in botany; and a part-time demonstrator in biology—The Warden and Secretary, London (Royal Free Hospital) School of Medicine for Women, 8 Hunter Street, W.C.1. A civilian education officer, Grade III., at the Royal Air Force Electrical and Wireless School—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1. A full-time lecturer in modern languages (French and German) at the Royal Technical College, Salford—Secretary for Education, Education Office, Chapel Street, Salford. A principal of the Kenrick Technical College—Director of Education, Education Offices, Highfields, West Bromwich. A lecturer in biology and mathematics at the Bishop Otter College—The Principal, Bishop Otter College, Chichester. An assistant with experience of biological and physical apparatus, for sales department—Messrs. Griffin and Tatlock, Ltd., Kemble Street, W.C.2.

Our Astronomical Column.

THE DISINTEGRATION OF COMETS.—Mr. N. T. Bobrovnikoff contributes an important study on this subject to *Lick Observatory Bulletin*, No. 408. He has prepared statistics on all the comets for which good determinations of magnitude are available; they are 94 in number. There is shown to be a strong correlation between brightness and period, those of short period being less luminous. It is assumed as a working hypothesis that all comets came into existence at the same time, and that those of shorter period, having approached the sun more frequently, have suffered greater disintegration. It is found that the comets of extremely small perihelion distance do not conform to the regression line given by the other comets, which is tolerably straight. It is concluded that some special action, such as partial evaporation of the nuclei, comes into play at these small distances. It also appears from the statistics that the proportion of light due to the nucleus alone is greater for the comets of short period, indicating that these have lost a larger proportion of their gaseous envelopes.

The indicated rate of loss leads to the conclusion that comets cannot be original members of the solar system, the age of which is estimated at thousands of millions of years. Mr. Bobrovnikoff estimates their age at about a million years, and concludes that they were all introduced into the solar system at the same time. He endorses a conjecture which F. Nölke put forward in 1909 that comets were introduced into the solar system at a time when the sun was passing through a nebulous region in space. There are great difficulties in seeing how they could fail to describe hyperbolic orbits in this case. Friction with the surrounding nebula could not be invoked, for all adjacent regions of the nebula would have the same acceleration towards the sun. Nor could resisting medium in the solar system be invoked, as a million years is so small a fraction of the age of the solar system that the density of such a medium would not be appreciably greater then than now. The number of close approaches to planets would be far too small to explain the great host of comets.

However, every attempt to explain the origin of comets is accompanied by grave difficulties. The present paper undoubtedly establishes some important points, and advances our knowledge on the subject even if we hesitate to accept all its conclusions.

STELLAR PARALLAXES WITH THE YALE TELESCOPE AT JOHANNESBURG.—Dr. H. L. Alden, who with Mr. O'Connell is conducting the photographic determination of stellar parallaxes at Johannesburg, publishes his first list of fifty stars in *Astro. Jour.*, No. 921. It is satisfactory to note that the parallax found for Alpha Centauri, which is 0·755″ for the mean of the components, is in almost perfect accord with Gill and Elkin's value obtained with the Cape heliometer. That for Proxima Centauri is 0·783″; as this exceeds the value for Alpha in nearly the same ratio as the proper motion does, it confirms the conclusion that Proxima belongs to the Alpha Centauri system.

After this system, our next nearest neighbour is the Barnard star, for which Alden gives the parallax 0·555″. The next largest parallax on the present list is that of Epsilon Indi 0·286″; the parallax of this star was previously regarded as rather uncertain, so the new determination is welcome. There are on the list two other stars the distance of which is less than five parsecs; these are 70 Ophiuchi, parallax 0·209″, and Omicron 2 Eridani, 0·200″.

All the parallaxes are relative, and need to be increased by about 0·005″ to reduce to absolute values. The negative value −0·005″ was found for Alpha Orionis; this confirms the fact of its great distance and huge size. The number of plates used for each star varies from 15 to 23; the average probable error of a parallax is 0·0068″.

Research Items.

MAGIC IN BENGAL.—The *Indian Antiquary* for April and May contains a study on magic in Bengal by Dr. Biren Bonnerjea. Magic was largely practised by the ancient Hindus and survives to a considerable extent among the modern inhabitants of Bengal. Iron is one of the principal weapons against evil spirits. They will not touch anyone who has anything of iron or steel on them, and a married woman is safe from them because of her bangle of iron, which is usually covered with gold. A pair of betel cutters is kept under the pillow of a sleeping child, and when a woman dies in child-birth a nail or piece of iron is hidden in the folds of her dress so that her spirit may not return and take away her child. A traveller may contract dangerous infection from strangers; hence anyone returning from, say Europe, must be purified by the ceremony known as Prâyaścitta, consisting in the polling of the hair and eating, or at least touching with the lips, of cowdung. Ambassadors of native princes, on returning from England, have been considered so polluted as to require to be re-born. In Chittagong at a difficult child-birth the doors must be thrown open, corks taken from bottles, and dogs and other animals set free. Amulets made of the teeth and claws of tigers and crocodiles are worn because these are the most dangerous of the animals of Bengal. To ensure the health and well-being of a child during the coming year, water is poured over it on its birthday through a sieve which contains ten different kinds of flowers and leaves and bits of gold or silver. Many of the simple acts of life have peculiar rituals of their own. For example, a woman who cleans out her ears after nightfall runs the risk of bodily injury, but she may do it with impunity if she asks the permission of anyone present. If she is alone, she asks permission of the wall. A precaution against the dangers attendant on the common acts of life is to snap the thumb and middle finger of the right hand.

EDENTATES OF ARGENTINA.—The University of Buenos Aires has published a monograph on "Los 'Edentata' Argentinos," submitted by José Yepes for the degree of "Doctor en Ciencias Naturales" (*Revista Univ. Buenos Aires*, Ser. 2, Section 5). The work, which contains short descriptions and summaries of the distribution within the Argentine and beyond it, and full synonymies, is well illustrated and forms a handy guide for the identification of the various forms. Several of the species of the South American edentates have developed well-marked geographical races, so that the number of forms of this odd group now distinguished in the neotropical region numbers sixty-eight. Many of these are widespread, so that Argentina contains in all nineteen forms, of which only six are peculiar to it. The most outstanding of these, since they represent distinctive genera, are *Chlamyphorus truncatus* and *Zaëdyus pichiy*, but *Chætophractus*, all the four forms of which occur in the Argentine, is also a genus of restricted distribution, confined to that republic and Bolivia.

EMBRYONIC MORTALITY IN FOWLS.—Even under the best conditions, the poultry farmer suffers a considerable loss from mortality among embryos during incubation. Mr. F. B. Hutt and Dr. A. W. Greenwood have made an investigation into the causes of such mortality and have examined more than 12,000 eggs which failed to hatch during incubation (*Proc. Roy. Soc. Edin.*, vol. 49, Pt. 2, 1929). They find that one of the major causes of failure to hatch is the malposition of the embryo in the shell. Four main malpositions are described. One of these, in which the head is buried between the legs, definitely prevents the embryo from chipping the shell and so hatching. The other three, by preventing access to the air chamber of the shell, hinder pulmonary respiration and so suffocate the embryo. A further cause of embryonic mortality is the abnormality known as chondrodystrophy. The occurrence of this abnormality is independent of the breed of fowl, sex of embryo, and age of dam. Its incidence is highest in January and February and declines steadily to almost complete absence in June. The incidence is inversely proportional to the amount of sunshine, and it is suggested that lack of direct sunshine is a factor in the etiology of the abnormality. There is a suggestion that the causal agency is an hereditary physiological abnormality in the dam. A further percentage of the embryos in the eggs which failed to hatch were actual monstrosities. The various types are described and their frequency noted. There is a decline in the incidence of monstrosities from February to June. Ninety-three per cent of the monstrosities were characterised by various degrees of abnormality either in the brain, cranium, or eyes, or in the combinations of these organs. It is suggested that monstrosities are caused by the arrest of the development of the embryo at a critical stage, probably by the chilling of those eggs laid in the early stages of gastrulation.

PHYSIOLOGY OF THE EMBRYONIC DEVELOPMENT OF EARTHWORMS.—While there is a considerable literature on the morphological side of development of Oligochæta, the physiological processes of the development have never been studied, and a recent paper by P. G. Svetlov (*Travaux du laboratoire zoologique et de la Station zoologique de Sébastopol*; Académie des Sciences, Leningrad; Série 2, No. 13; 1928) contains much of interest in this respect, while the morphology of embryonic development is also treated very fully. Of particular interest are the observations made by the author on the osmotic pressure of the fluid in the cocoons of the two species studied. It was found that in *Bimastus constrictus* Rosa the osmotic pressure is very low, while in *Eisenia fœtida* Sav. it is almost as high as in the blood of adult worms. Osmotic pressure in the cocoons of both species is closely connected with that of the environment, that is, that of the soil water; this necessitates the presence in *B. constrictus* of a special apparatus for regulating the osmosis (osmo-regulating blastomeres); in the case of *Eisenia fœtida* this apparatus undergoes a reduction because this species has a high osmotic pressure little influenced by the external conditions. On the whole, however, the embryos of both species are not particularly well adapted to the osmotic conditions of their environment. The importance for ecological studies of the osmotic relations between cocoons of earthworms and the environment is strongly emphasised by these observations.

GERMINATION AND VIABILITY OF FERN SPORES.—Whilst studies of seed viability and the effect of external conditions on seed germination abound, similar studies upon the unicellular spores of ferns are much less numerous, although such studies may throw considerable light upon the physiological problems connected with the maintenance of viability and conditions for germination, etc. The very extensive studies by F. Okada, described in the *Science Reports* of the Tôhoku Imperial University, Vol. 4, No. 1, series 4, of the germination of the spores of five species of ferns and the retention of viability

under different conditions are, therefore, particularly welcome. Okada finds that the spores of *Equisetum*, which rapidly lose viability under almost any conditions of storage (10-24 days under laboratory conditions), contain nearly 50 per cent water on fresh weight, whilst the much more durable spores of *Woodwardia* (174-191 days under laboratory conditions) contain only about 6 per cent water. The spores of several species of ferns failed entirely to germinate in complete darkness; the spores of *Equisetum arvense* and *Osmunda japonica* would grow under these conditions. The catalase content of the spores was examined and in every case it diminished with increasing age.

YEAST FROM A THEBAN TOMB.—The principal feature of the current "Jahrbuch" of the Gesellschaft für die Geschichte und Bibliographie des Brauwesens, E.V. (Institut für Gärungsgewerbe, Berlin) is an article by Prof. J. Gruss on the contents of a beer jar from the tomb of Wah, a Pharaoh of the eleventh dynasty. Mr. H. E. Winlock, the leader of the expedition from the Metropolitan Museum of Art, New York, which opened the tomb in 1920, considers that although the jar was found on its side, it was probably upset when the stopper blew off, and the contents are therefore almost certainly 4000 years old. The microscopic examination is illustrated by twelve plates, and revealed diatoms probably from the Nile water, aluminium silicate crystals from the pottery, cloth fibres, starch grains, and fragments of emmer. Bacilli, pediococci, diplococci, and citromycelia were also found, and in addition an autogenic yeast similar to Digora, which Prof. Gruss has named *Saccharomyces Winlocki*. It is distinguished by elliptical or round cells 5 μ in diameter and has a close-grained plasma and nuclear vacuole. The yeast was also found with *Schizomyces ducens n. spec.* and aleurone cells in pieces of beer-loaf from the same tomb, and it is noteworthy that these pieces are contemporaneous with bread in the Berlin museum found in the tomb of Mentuhotep in the same cemetery. The chemical analysis of the loaf indicates the addition of honey for sweetening purposes and of a fruit of the *Citrus Aurantium* type to produce bitterness. The same publication also contains several interesting articles on the medieval monastic breweries of Germany, and a note by F. Schuster on the 'ferula', a carved wooden sceptre which was formerly the symbol of the skilled brewer in Germany. Apparently the name is derived from the plant *Ferula L.*, a variety of fennel, the stalk of which figured in Bacchus worship (Narthex), and therefore had a special significance for the brewer.

VOLUME TABLES FOR INDIAN TIMBER.—It is only during the present century that the preparation of growth and volume statistics has been commenced in the forests of the British Empire; and its inauguration was due to the Indian Forest Service. Statistics of the kind are now available for some of the more important timber species of India and Burma, such as deodar, sal, and teak. In a recent number of the *Indian Forest Records* (vol. 13, Pt. 3, Sylviculture Series; 1928) commercial volume tables for sal (*Shorea robusta*) in the wet mixed forests of the Bengal Duars are published. Several volume tables for this species are already in existence, but they relate chiefly to the growth of this tree in the drier climate of the United Provinces. The latter tables, it is considered, can be safely applied to the drier types of Bengal sal forest, as also to similar forest in Assam. They are inapplicable, however, to the moist type and it is for this latter that the new tables are designed. The preparation of such tables involves considerable field work in connexion with the measurement of the crops on selected areas of forest, work in which the compiler, Mr. Parma Nand Suri, statistical assistant to the sylviculturist of the Research Institute, was ably assisted by the local forest staff. The same officer has also prepared (*Indian Forest Records*, vol. 13, Pt. 4; 1928) a set of tables, the first of their kind, for the sundri (*Heritiera Fomes*) in the Sundarbans, the Gangetic delta south of Calcutta. These tables have been drawn up for the two types of sundri forest, the salt-water type and the fresh-water type. They should prove of great assistance in estimating the outturn of coupes and volume of growing stock. In connexion with the Sundarbans sundri volume tables, Mr. H. G. Champion, sylviculturist at the Research Institute, writes in a preface: "Since the work was begun there has been published *Burma Forest Bulletin* No. 15 (December 1926), a quarter girth volume outturn table for this species, for the Delta division of Burma. . . . There is a very fair agreement in the small overlapping portion, suggesting that if larger trees are grown in the Sundarbans the Burma figures may prove useful." Both pamphlets are illustrated and furnish evidence of the great strides made in the scientific aspects of forest work in India.

PROGRESS OF SURVEYING IN INDIA.—The Report for 1925–26 of the geodetic branch of the Survey of India, which is dated July 1928, has a record of much work. Geodetic triangulation was resumed with work in Lower Burma, after an interval of eight years. Previous work in that area dated from 1875. High precision levelling occupied several detachments. Tidal observations with automatic gauges were continued at eight ports. There are now more than fifty stations in Indian waters, including the Persian Gulf and Red Sea, at which automatic tidal observations have been taken for a number of years. Among other interesting matters on which the report touches is the value of bench-marks on trees. In Canada such bench-marks have been used. Their constancy has not been tested with any permanent mark of the land established in precise levelling, but the topographical survey does not disfavour their use. At Dehra Dun experiments have been made on tree bench-marks and eleven of them have been connected at intervals, during twelve years, with the standard bench-mark in the Geodetic Office grounds. The conclusions of those tests are that for secondary precision, as in irrigation work, a tree bench-mark is sufficiently good, but is not constant enough for lines of high precision. In all cases the mark should be placed on the heart wood and not on the bark of the tree.

OIL AND GAS IN WESTERN CANADA.—The economics of the Canadian oil industry have changed much since the two well-known volumes on petroleum and natural gas in the Dominion, by F. G. Clapp, were published in 1914–15. Then it was the eastern provinces which were mainly responsible for production, especially Ontario. With the gradual decline of these eastern fields, however, attention is naturally being concentrated on the more westerly developments, and the performance of "Royalite No. 4" well in the Turner Valley Oilfield, Alberta, 1924, which raised this province to the leading position of production in the Dominion, a position since maintained, has naturally had a strong influence in reviving interest in this region. Alberta has always swayed popular feeling, equally scientific interest, by its famous gas-fields, but search for large oil-pools has not often proved encouraging, save the instance cited. It is characteristic that new possibilities of oilfield development in the western hemisphere should be the occasion of renewed literary activity, so that the bulletin now appearing under the above title from the pen of

G. S. Hume (Department of Mines, Canada) has for some time been anticipated by oil technologists. It is also characteristic that such bulletins should include what we may term 'chapters of instruction for the uninitiated', a kind of condensed text-book outlining the general features of oil-origin, occurrence, accumulation, structures, and so on, much as occurs in the previous volumes cited. A modern note in this 'text' is struck by a chapter on geophysical methods for locating oil, but it is doubtful whether this 'outline' would do more than confirm an inexperienced operator in the opinion that the subject was far beyond his (the operator's) comprehension; technically, such a chapter is too brief and sketchy to be of any value. The descriptions of the oil and gas fields of the western provinces are more to the point, though unnecessarily burdened with detailed well-logs. The maps and sections given are, however, most valuable, and the description of the Turner Valley field particularly good.

QUANTISED TRANSITIONS.—In the correlation of the terms of line spectra with the stationary states of atoms, considerable use is made of a number of quantum rules that express the possibility and the probability of various types of transitions. A generalisation of the theory upon which these are based has been made by J. A. Gaunt in a paper in the May issue of the *Proceedings of the Royal Society*, on the relativistic theory of an atom with many electrons. He finds that the 'selection rules' are valid if there are no external fields, the rule '$\Delta\Sigma k$ is odd' is equally rigorous, even in a uniform magnetic field, and that the 'summation rule' for the intensities in a multiplet is true to a first approximation. The greater part of Mr. Gaunt's paper is of a general nature, but one practical point to which he refers specifically is of some significance in astrophysics. Certain lines of nebular spectra have been attributed to forbidden transitions between stationary states of the doubly charged ion of atomic oxygen; if they have been correctly identified, it would seem that their emission must occur in an electric field or in a non-uniform magnetic field, since they have $\Delta\Sigma k$ equal to zero.

REFLECTION CAUSTICS.—A note in the *Transactions of the Optical Society* (vol. 30, p. 134) from the Optics Department of the National Physical Laboratory contains an interesting set of photographs of reflection caustics, which were obtained by the double reflection of light within a photographic lens. The reproductions, in spite of the fact that they do not show all the finer details of the original, include a number of beautiful patterns, mostly built up of various elliptical and cusped curves, and are of considerable interest as illustrations of an aberration which is not often encountered now in optical instruments. The usual absence of this effect, it is suggested by the authors—Messrs. T. Smith, J. S. Anderson, and L. C. Cordle—is possibly due to the fact that the main interest is now centred in systems so well corrected that faults of this type are masked by diffraction, and the caustics only reappear when the lens is used under conditions different from those for which it was designed. The same issue of the *Transactions* contains a pair of coloured reproductions of the appearance presented by a test-bar when examined in plane polarised light and in circularly polarised light in the Coker strain testing apparatus, which are also of considerable educational value.

MAGNETOSTRICTION.—The phenomena of magnetostriction are anomalous in that, in spite of the way in which they are observed, they are far too large to be explained by purely magnetic forces. The corresponding difficulty which arises in connexion with Weiss's molecular fields in iron and similar bodies has recently been removed by Heisenberg's theory of ferromagnetism, which is based upon the 'exchange' properties of electrons, and it has now been shown by R. H. Fowler and P. Kapitza that the same theory can be extended, with very little elaboration, to include all the essential facts of magnetostriction and the phenomena of the Curie point. One striking feature of their paper on this subject in the issue of the *Proceedings of the Royal Society* for May 2 is the scarcity of accurate experimental data by which the theory—in itself still far from complete—can be tested. So far as magnetostriction is concerned, experiment does appear to be well ahead of theory, but the measurements of the allied change in the size of specimens when they lose their intrinsic magnetisation at the Curie temperature are particularly unsatisfactory. The experimental values for the changes in the specific heat at the Curie point are also perhaps uncertain, although they do suffice to show that nickel has probably one magnetisable electron per atom, whilst iron and magnetite have two or three effective electrons, the latter both being cases for which the quantum analysis has still to be constructed. Heisenberg's theory will require to be considerably extended before it can account for all the complex features of ferromagnetism, but it has certainly already removed the subject from its previous somewhat isolated position, and has at the same time emphasised the need for further experiment and indicated the lines upon which it should be attempted.

SOME PHYSIOLOGICO-OPTICAL EXPERIMENTS.—Prof. Bohuslav Brauner has recently communicated to the Bohemian Academy of Sciences a paper describing some remarkable physiologico-optical experiments which he first made fifty-five years ago under the inspiration of Helmholtz. He afterwards discussed them with the late Prof. Deyl, a prominent Central European ophthalmist, who was impressed by their novel character, and as they have never been published, Prof. Brauner was persuaded to lay them before the Bohemian Academy. The first to be described relates to 'artificial blindness', which can be induced by 'throwing' the image of a well-illuminated body upon the 'blind spot' of the retina. Thus, when the image of the moon is projected upon the 'blind spot', total blindness results in a few seconds. Other remarkable experiments concern the visibility of the observer's eye and stereoscopic results without the use of a stereoscope (results acquired after some practice in making the axes of the eyes parallel or crossed as circumstance and effect demand). In this connexion one of the experiments described is an amplification of an observation by Pouvilliers (see NATURE, April 14, 1923, p. 511). It appears that when two identical contour maps placed side by side with their centres 62 mm. apart were observed with the axes of the eyes nearly parallel, a double, superposed picture, much larger than the originals, is observed in the middle, apparently below the level of the paper. The mountains stand out higher according to their contours, so that a relief map is obtained. When viewed with crossed axes the combined picture is apparently much smaller than the originals, both of which are here pushed farther apart and appear relatively larger. In this instance the summits of the mountains appear as funnel-shaped depressions. It would seem that some of the effects obtained by Prof. Brauner can be explained by the fact that the accommodation of the eyes changes automatically with the change of the angle of the ocular axes.

South Africa Meeting of the British Association.

PROGRAMMES OF SECTIONS.

MATHEMATICS AND PHYSICS.

AT the forthcoming South Africa meeting, Section A (Mathematics and Physics) will be under the presidency of the Right Hon. Lord Rayleigh. Representatives from Great Britain of all branches of the Section will support him and will communicate papers in the two centres of the meeting, Cape Town and Johannesburg. Prof. Hevesy, who is a foreign guest, will open a joint discussion with the Section of Chemistry on quantitative chemical analysis by X-rays and its applications, and a second joint meeting, in this case with the Section of Geography, will be held for a series of papers on geodesy and surveying. Recent work on atomic nuclei will be described by Sir Ernest Rutherford and Dr. Aston, and spectroscopic papers presented by Prof. McLennan, Prof. A. Fowler, Mr. R. H. Fowler, and Mr. A. C. Menzies. Some aspects of the work of the National Physical Laboratory, to be dealt with by Dr. Ezer Griffiths, should bring to the notice of South Africans the important part played by the Laboratory in the scientific and industrial life of Great Britain. In Cape Town itself, some interesting communications are expected from Prof. Ogg and his colleagues in the University of Cape Town.

Cosmical physics, already strongly represented in South Africa itself, will receive the aid of Prof. de Sitter as a foreign guest, the Astronomer Royal, Prof. Eddington and Prof. Chapman. Lastly, the claims of mathematics will be met by papers from Sir Gilbert Walker, Mr. F. P. White, and Dr. Wrinch.

CHEMISTRY.

THE address of Prof. G. Barger, as president of Section B (Chemistry), will be delivered at Cape Town, and is entitled "Applications of Organic Chemistry to Biology". Organic and biochemical subjects occupy the major portion of the Cape Town programme. Prof. K. Freudenberg, of Heidelberg, will give a lecture on "The Vegetable Tannins", a subject of special interest in South Africa, and it is hoped to hear an account of "Essential Oils from South African Plants" by Prof. St. J. van der Riet, of Stellenbosch. Although the nature of vitamins from the chemical point of view was discussed so recently as the Leeds (1927) meeting, the rapid development of our knowledge of the vitamins since that time makes the joint discussion with Section I (Physiology) particularly opportune. On the one day at Cape Town devoted to general and inorganic chemistry, Dr. N. V. Sidgwick will give a lecture on "Chemical Linkage" and Prof. J. Smeath Thomas, of Cape Town, will give an account of "Recently discovered Nitrate Deposits in S.W. Africa". From Cape Town it is hoped that the Section will have the privilege of visiting the factory of The Cape Explosives Co. at Somerset West.

The sectional programme at Johannesburg is to be devoted almost entirely to inorganic and physical chemistry. Mr. H. A. White, of the Geduld Proprietary Gold Mines, Ltd., is to give an account of "The Chemistry of Gold Extraction", and two special features of the Johannesburg programme are a joint discussion with Section A (Physics) on "Qualitative Analysis by X-rays" to be opened by Prof. G. Hevesy, of Freiburg, and a lecture by Prof. E. C. Franklin, of Stamford University, California, on "The Ammonia System of Compounds". Mr. A. C. Egerton is to give an account of "The Influence of Antiknocks on the Combustion of Hydrocarbons", and other important contributions to the programme are being made by Prof. H. Bassett and Dr. F. H. Constable.

GEOLOGY.

THE organisation of Section C (Geology) has been necessarily affected by the meeting of the International Geological Congress at Pretoria, and a programme has been adopted which, while enabling the section to carry on its work with the Association, yet allows its members to take some part in the proceedings of the Congress. Two sessions will be held at Cape Town and two at Johannesburg. Members of the Congress who wish to be present and take part in the proceedings at Johannesburg will be able to take advantage of the invitation which has been extended to them.

Sir Albert E. Kitson, of the Geological Survey of the Gold Coast, president of Section C, will deliver his address at Johannesburg on "The Utility of Geological Surveys to Colonies and Protectorates of the British Empire".

The special position that Africa takes in all questions involving continental drift makes the joint discussion with Sections D (Zoology) and K (Botany) specially appropriate. Phases of the problem may be touched in the papers by Prof. W. T. Gordon on "Some Limestone Erratics from the Beardsmore Glacier", and Mr. W. N. Edwards on "Triassic-Rhætic Floras of the Southern Hemisphere". Dr. F. Dixey will describe the geology of the Lower Shire-Zambezi Basin, and Mr. F. P. Mennell will put forward "Some Suggestions as to the Origin of the Diamond Pipes". Of wider interest is the paper of Prof. P. G. H. Boswell on "The Precipitating Action of Colloids on Fine-grained Sediments": this opens a new field of investigation.

As is usual with Section C, the excursions are a feature of the programme. As these have been arranged by Dr. A. L. Hall, of the Union Geological Survey, and secretary of the International Geological Congress, their interest and importance is assured. Two half-day and one whole-day excursion will be made in the neighbourhood of Cape Town. The journey from Cape Town to Johannesburg will be spread over four days, with stops at Laingsburg and Kimberley. Between the two sessions at Johannesburg members will be able to join the Congress for the Witwatersrand excursion (three days).

GEOGRAPHY.

THE president of Section E (Geography) for the South Africa meeting is Brigadier E. M. Jack, Director-General of the Ordnance Survey, who will deal with "National Surveys" in his presidential address. Following this a series of papers will be read by Capt. McCaw, Dr. Van der Sterr, and others, dealing in further detail with cartographical and survey problems relating to Africa in general, and to South Africa in particular. In connexion with these, it may be recalled that at the Glasgow meeting the Section emphasised the importance of completing, as soon as possible, the survey of the arc of the thirtieth meridian, and urged also the need for the publication of a uniform series of maps of Africa on a scale of 1 : 2,000,000, as the only satisfactory base for various distributional studies in Africa. The significance of the latter will be further developed, along with other points, in a report to be presented by Mr. A. G. Ogilvie of a special committee which has been investigating problems connected with the geography of tropical Africa.

Various aspects of South African geography—both physical and human—will be analysed, both at Cape Town and Johannesburg, by local authorities, including Prof. J. H. Wellington and Prof. E. Walker. At Cape Town, Mr. Van Reenen, chairman of the

Irrigation Commission, will review various problems connected with the utilisation of available water supplies in South Africa, while Prof. Serton will examine critically the extent to which the term 'desert' may be justifiably applied to various regions of low rainfall (for example, the Western Karroo, with an average annual rainfall of less than 5 inches in parts).

A meeting in a region of winter rains such as south-western Cape Colony provides a fitting opportunity for a critical survey of "the Mediterranean Climatic Type, its World Distribution and the Human Response", which Dr. Marion Newbigin proposes to undertake. The various important problems connected with the South African sector of Antarctica will also be presented in a paper prepared by Mr. F. Debenham, and it is hoped that General Smuts will take part in the discussion on the matters raised.

The position of geography in South African education is not all that can be desired, and attention will be directed to this important aspect in a joint discussion that has been arranged with Section L at Johannesburg, a whole morning being devoted to the question.

Outside of Africa various interesting papers are being presented dealing with parts of both the southern and northern hemispheres. The significance of China's expansion in the Far East is to be considered by Prof. P. M. Roxby, while among the papers on Europe will be one by Prof. H. J. Fleure analysing the significance of various city types in the interpretation of the different cultural regions of the Continent.

Dr. Vaughan Cornish's interest in the æsthetics of scenery is now well known in Great Britain, and a paper by him on "The Rural Scenery of England and Wales" will be welcomed in South Africa.

Economic Science and Statistics.

THE programme for Section F (Economic Science and Statistics) of the British Association has now been arranged for the forthcoming meeting in South Africa, and, as was to be expected, special attention is to be devoted to those economic problems which are of importance in the Union. Labour questions, for example, are to be discussed in the light of South African conditions, and for this purpose a joint discussion has been arranged with the Anthropological Section on "Economic Competition between Advanced and Backward Peoples", while Prof. A. Leslie is to speak on "Coloured Labour and Trade Unionism in Cape Town". Another economic topic of considerable importance to South Africa is the marketing of agricultural produce and the joint meeting which has been arranged with the agriculturalists on "The Problem of Stabilising Agricultural Prices, with special reference to Control Boards, Equalisation Funds, and other methods of Price Regulation", should lead to an interesting discussion. It is anticipated that Mr. R. B. Forrester, Dr. Tinley, and Mr. R. J. Thompson will participate in this discussion. At Johannesburg, Dr. J. E. Holloway is to speak on "Population Problems of South Africa", while Mr. W. H. Clegg will describe "South African Banking".

Engineering.

ENGINEERS attending the South Africa meeting of the British Association will have papers and discussions at both Cape Town and Johannesburg. The president of Section G (Engineering), Prof. F. C. Lea, will deliver his address at Johannesburg.

The principal subjects chosen for papers are of great importance to South Africa. At Cape Town Dr. Ezer Griffiths, of the National Physical Laboratory, and Mr. E. A. Griffiths, of Cape Town, will give papers on recent research work carried out in England and South Africa in refrigeration. The successful export of fruit from the Union depends largely on this work.

The importance of transport, which is as great in South Africa as in any other country, will be dealt with from many different angles by English and South African authorities. Sir Henry Maybury will describe the developments which have taken place in Great Britain during the past few years, referring to the effect of recent legislation on road administration. Papers dealing with transport costs, alcohol fuels, railways, and roads as feeders to the railways will also be given. Sir Henry Fowler's paper will describe chiefly the work of the Directing Committee, of which he is a member, appointed by the British Government to study aspects of mechanical transport likely to further the economic development of the oversea Empire, and it is hoped that the discussions on these papers will be of great help to this committee.

At Johannesburg cheap power will be dealt with. Sir Charles Parsons will give a description of the more recent developments in steam turbine practice, chiefly in regard to the increased output per unit.

Prof. E. W. Marchant's paper on the limits of the economical transmission of electrical energy will have an added interest, for at the last South Africa meeting of the Association the late Prof. Ayrton made an important contribution on the transmission of power from the Victoria Falls. Mr. C. H. Merz will describe the development of the national scheme of electricity supply in Great Britain, and discuss the anticipated economies and the probable effects of the cheapening of electric power on the distribution of population and industries.

The acute problem in mining in South Africa is the cooling and ventilation of the deep mines, and the joint discussion of the Engineering and Physiological Sections on deep mine ventilation, to take place at Johannesburg, should prove very valuable.

Anthropology.

SOUTH African anthropologists have prepared a full and interesting programme for Section H (Anthropology), in which archæology figures largely. There is ample evidence, however, that other branches of the science are not neglected in the Dominion, and it has been necessary to make arrangements for a subsection at Johannesburg to provide for a number of papers on physical anthropology by Prof. Dart and other members of the Anthropological School which centres in the University of the Witwatersrand. At Cape Town especial interest will attach to a series of papers on the Fish Hoek Caves, which will be followed by a visit to the caves themselves. The meeting at Cape Town will, however, be curtailed to allow the members of the Section to proceed in advance of the main body to Kimberley, where the collection of skulls and archæological exhibits in the Museum will be visited, Mr. Cronin's remarkable collection of photographs of South African natives will be viewed, and archæological excursions in the neighbourhood will be made.

The programme at Johannesburg will be particularly interesting. Prof. Dart will exhibit the Taungs skull, and arrangements have been made for a visit to the site of discovery. Mr. Leakey will describe his discoveries in the prehistory of East Africa, and Mr. Wayland will deal with the present position of Stone Age research in Uganda. Mr. C. von Riet Lowe will deal with the archæology of Sheppard Island, with an addendum on the associated fauna, and Prof. Dart will describe mammoths and other fossil elephants of the Transvaal, some of them not previously known.

The question of Bushman rock engravings will be discussed by Miss Wilman, a subject on which much illuminating discussion may be expected, in view of

the visit of L'Abbé Breuil to South Africa as a guest of the Association and the demonstration of the Late Palæolithic art of Spain which he will give at Cape Town. Members of the party proceeding from England—Prof. Fleure, Prof. Ruggles Gates, Miss Murray, and others—will contribute to the proceedings.

The items in the sectional programme, however, which are expected to arouse the keenest interest are the papers centring around Zimbabwe. Dr. Leo Frobenius will give an account of the explorations of prehistoric Rhodesia made to date by the expedition of which he is leader. He will be followed by Miss Caton-Thompson, who will describe the results of the work, undertaken at the request of the Association, which she has carried out at Great Zimbabwe and on which she has been engaged since the beginning of the year on behalf of the Association.

PHYSIOLOGY.

SECTION I (Physiology) this year includes in its programme one or two unusual items. Probably the most striking is a joint discussion with the other biological sections on "The Nature of Life", which General J. S. Smuts has promised to open. Among the other speakers on this topic are Profs. D'Arcy Thompson, J. S. Haldane, Wildon Carr, and E. C. C. Baly. That an agreement will be reached is more than can be expected, but it is certain that much of interest will be said.

The Capetown part of the programme also includes joint meetings with Section D on experimental biology, one morning being mainly occupied by papers on this subject, and an afternoon being devoted to demonstrations on kindred topics in Prof. Lancelot Hogben's new laboratory. Many of the contributions, both here and at Johannesburg, are from South African workers, and the matters discussed range over a wide field.

At Johannesburg the most important feature probably is a joint discussion with Section G (Engineering) on "Problems connected with Deep-mine Ventilation". The economic importance of this matter is very considerable, and it is hoped that members of the Transvaal Mining and Metallurgical Society will also be able to participate.

Of almost equal interest to physiologists and to economists is "The Problem of Dust Inhalation", on which also a discussion has been arranged. The sectional programme is now, however, restricted to questions connected with the mining industry. Papers are being contributed by local workers on the measurement and effects of ultra-violet light, and a varied programme includes a paper by Dr. Monckton Copeman on "Diet and Cancer", and a description of "The Feeding Habits of Vampyrella", with kinematograph accompaniment, by Prof. F. E. Lloyd, of McGill University.

PSYCHOLOGY.

SECTION J (Psychology) meets this year under the presidency of Mr. F. C. Bartlett, the Director of the Cambridge Psychological Laboratory, who in his address will discuss "Experimental Method in Psychology". The programme is full and varied; in it nearly every department of psychology is represented. A joint discussion has been arranged with Section L on "Psychological Tests in Relation to Education and Vocational Guidance", in which papers will be read by Prof. Reyburn, Dr. C. S. Myers, and Dr. Shepherd Dawson.

South African psychologists will present seven or eight papers, three of which, by Prof. Wilcocks, Prof. Eybers, and Dr. Fick, will report the results of investigations into the intelligence of South African children, both white and black. The philosophical aspects of psychology are represented by Prof. G. Dawes Hicks in a paper on "The Notion of Fusion in Psychology", by Prof. H. Wildon Carr, who will speak on "Imagination and Reasoning", and by Prof. Forsyth of Bloemfontein, who will read a paper on the "Significance of Holism", a philosophical theory propounded by General Smuts.

The Industrial Fatigue Research Board is represented by Mr. Eric Farmer, who will give an account of some of his own work on 'accident proneness'.

BOTANY.

SECTION K (Botany) has a very full programme both at Cape Town and at Johannesburg. The large number of papers to be communicated by South African workers indicates clearly the very active interest which is being taken there in botany at the present time. All branches of botany are well represented in the programme. Prof. Seward's presidential address on "Botanical Records of the Rocks" will be given at Johannesburg. As might be expected, much time will be devoted to papers on the South African flora, and there will be a discussion on its origin and evolution, in which Dr. Marloth, Prof. Bews, Prof. Compton, Dr. Pole Evans, Prof. Adamson, Prof. Moss, and others will take part. Dr. Pole Evans will also give an account of the present position of the botanical survey of South Africa. Prof. F. E. Lloyd will exhibit a film illustrating the mechanism of the trap of *Utricularia*, and Dr. A. S. Hitchcock, of the Smithsonian Institution, will speak on the subject of grasses in relation to man. Miss Saunders will discuss her recent work on carpel morphology.

Popular lectures will be given by Dr. Margery Knight on "Seaweeds, a Study of Adaptation and Opportunity", and by Prof. Priestley on "From Lake to Veld: a Study of the Water Relations of the Higher Plant". The forestry group also has an interesting programme, in which contributions from persons interested in forestry problems in South Africa are prominent. Numerous excursions to places of botanical interest have been arranged.

EDUCATION.

THE programme of Section L (Educational Science) is promising and varied. Two objects have been kept in mind in its preparation: (*a*) the desirability of showing the recent development in educational administration, practice, and teaching in England; and (*b*) the presentation and discussion of South African problems.

Dr. Kimmins has chosen for his presidential address the subject "Modern Movements in Education". One session at Cape Town is to be devoted to general educational problems in South Africa, when five separate papers will be given by leading experts.

At Johannesburg a full session will be devoted to "Education and the Native Races", four papers being expected. At a joint session with Section J at Cape Town, leading psychologists from both countries will discuss psychological tests in relation to education and vocational guidance. Other sessions at Cape Town will be given to discussions on the relation of examinations to the secondary schools and on the teaching of science, including biology and botany, in schools. At Johannesburg, at a joint session with Section E, papers will be given on the teaching of geography by members from both countries.

Committees of the Section will also present reports on science in the school certificate, formal training and training for life overseas.

AGRICULTURE.

PERHAPS the most significant development which has taken place in agricultural science is the realisation of the very close relationship between soil and animal nutrition problems as they exist in Great Britain and the various Dominions of the Empire.

The fact that much of the work in progress in the British Isles has a direct bearing on Dominion problems has resulted in a desire for closer touch and collaboration between research workers in various parts of the Empire. This trend was emphasised and focused at the Imperial Agricultural Conference in London in 1927 and practical recognition has been given by the creation in the British Isles of Agricultural Bureaux in Soil Science, Animal Nutrition, Plant Breeding, Animal Genetics, and Veterinary Science. It is fitting, therefore, that by far the greater part of the programme for Section M (Agriculture), which is meeting at Cape Town and Pretoria, should be occupied by the discussion of broad agricultural problems. Two whole sessions are being devoted to soil problems, the first at Cape Town to a discussion on soil fertility and its control, and the second at Pretoria to methods of soil investigations in field and laboratory.

A morning session will be occupied by a discussion on Empire wool growing problems with particular reference to South Africa and to the manufacturing requirements of Great Britain. Grassland and the production of stock is another problem of world-wide range, the fundamental aspects of which are similar in all parts of the Empire. Major Walter Elliot will open a discussion on the mineral aspects of pasture nutrition in relation to the live stock industry, and representatives of the Rowett Research Institute, Aberdeen, and the South African Veterinary Research Station will contribute.

The possibility of stabilising agricultural prices and the methods of achieving the object in view continue to exercise the minds of farmers and economists the world over, and considerable experience has been acquired in South Africa, Canada, and New Zealand. Section M has arranged for a joint discussion with Section F (Economics) on this subject, with particular reference to the operation of control boards, equalisation funds and other methods of price regulation. Agriculture and the Empire will form the subject of Sir Robert Greig's presidential address to Section M, and the address, together with a discussion on Empire agricultural problems, will occupy the whole of the second morning session at Pretoria.

Some Function Problems attaching to Convergence.[1]

THE arrangement of the conducting paths of the nervous system, branching and redistributing their impulses as they do, exhibits places where numerous convergent paths run into one. When at such places two or more of the converging arcs are concurrently active, the trains of impulses arriving by them can interact. Such convergent places are co-ordination points. An example of much importance, and relatively accessible to experiment, is that in the spinal cord, where the motor nerve-cells innervating a muscle receive as a group the various afferent paths which reflexly operate the muscle. If two or more of the convergent afferent nerves are excited concurrently, the reflex interaction, as revealed by the muscle, exhibits three main sets of cases.

In one set of cases the muscular response under concurrent stimulation of two or more afferents shows a deficit in amount as compared with the sum of the responses obtainable from the several afferents taken separately. This occurs especially when the excitation of the reflexes is strong; it is most marked when they are of maximal strength. The contraction effect of one afferent may default altogether. The result might seem to indicate inhibition, but analysis shows that it is not referable to any form of inhibition.

The explanation lies in the limitations of the mechanical response of the muscle fibres of the motor-units activated: the contraction effect pertaining to one afferent being 'occluded' for the time being by that pertaining to another. 'Occlusion' is a result of the overlap of different afferent arcs upon the same motor-units: this overlap is 'central', for example, in the spinal cord. The amount of 'occlusion' as observed by the myograph gives a measure of the amount of that 'central' overlap. In such estimates, however, the assumption is made that the component motor-units of the muscle all of them possess individually the average value of contraction-tension which obtains for them. This in the knee-flexor (cat) semitendinosus has a value which is only one-third of that obtaining for gastrocnemius. It is, however, certain that the individual motor-units differ considerably in contraction-value within one and the same muscle. Examined by occlusion, the overlap of the constituent branches of a single large afferent nerve upon its motor-units can be well above tenfold. This gives a functional picture in harmony with the histological picture furnished long since by Cajal.

In another set of cases, on the contrary, the contraction response of the muscle, under concurrent stimulation of two or more reflex arcs which are excitatory for it, shows a surplus of contraction as compared with the sum of the responses to the component afferents taken separately. This result is most evident with weak reflexes. As with the other set of cases this result also, although opposite to the previous class, brings evidence of the overlap of the convergent arcs upon the central ends of motor-units held by them in common. Moreover, evidence is thus furnished that central states of excitement, individually too weak to provoke the motor-units into discharging activity, can by summation become effective for that activation.

The reflex excitation provoking contraction of the muscle is shown to be accompanied regularly in the spinal centre by concomitant subliminal excitation in other spinal motor cells over and above those excited to actual discharge. The time relation of central subliminal excited states obtaining in certain typical reflexes has been determined (J. C. Eccles). By the summation of subliminal excited states this fringe of subliminal effect is a functional means of liaison enabling co-operation between different adjuvant parts of the nervous system. Although the neuron upon which convergent arcs interact is subject to their combined influence, and is to that extent an instrument passive in their hands, it is an instrument clearly with ways of its own. Thus, to receipt of a single stimulus it may react by a response consisting of a whole tetanic series of impulses.

Another and third set of cases arising from interaction at the convergence point is where the upshot is inhibition. The clash is between 'central' excitation and a central process which arrests or precludes it, but about which all that is known is that it antagonises excitation. Evidence was adduced of the

[1] Summary of the David Ferrier Lecture delivered before the Royal Society on Thursday, June 20, by Sir Charles Sherrington, O.M., F.R.S.

quantitative interplay of the opposed influences upon the individual neuron. Conditions favouring inhibition were discussed.

Though trains of impulses are the sole reactions which enter and leave the central nervous system, it is clear that nervous impulses are not the sole reactions functioning within that system. States of excitement which can sum together, and states of inhibition which can sum together, and states which represent the algebraical summation of these two, are among the central reactions. The specific cell units, the neurons, far from behaving merely as passive recipients and transmitters of impulses, modify as well as transmit what they receive.

Joint Russian-German Expedition to the Pamir.

A JOINT expedition to the Pamir was organised last year by the Russian Academy of Sciences and the Notgemeinschaft der Deutschen Wissenschaft, consisting of eleven German members and about thirty Russians representing various branches of science, under the leadership of N. P. Gorbunov. The expedition started in June from Osh (in Turkestan) and went through Gultcha into the Alai valley, then across the Transalai ridge to the alpine lake Kara-kul; from there various sections of the expedition radiated in different directions, and the field work went on until November. Scientific results of the expedition will take some time to work out fully, but a preliminary account, as published in the *Information Bulletin* of the Russian Academy (No. 3-4, for 1929), already gives some idea as to their value.

The geographical section of the expedition collected exhaustive information on the areas traversed. Of particular interest was a study of Fedtchenko's glacier, which has been found to extend for more than 75 km., that is, it ranks amongst the largest glaciers in the world. The topographical section accomplished the enormous task of surveying the wide expanse of Pamir; most of the work had to be done at the altitudes exceeding 4000 metres, which made it exceedingly difficult. Nine astronomical and twelve triangulation points were determined, and altitudes of twenty-two mountains estimated. The meteorological and geophysical section made regular meteorological, aerological, actinometric and hydrological observations; 47 geomagnetic points and 150 gypsometric points were determined. The geological section studied the history of the glaciation of the Pamir and prepared a general geological map of the area; the mineralogical collections are very rich and contain proofs of a number of useful minerals.

The zoologists of the expedition collected more than 13,000 animals, mainly insects; it was interesting to find some southern forms at very great altitudes; thus at 3700 m., scorpions, Mutillid wasps, *Ammophila*, *Bombus melamorus*, etc., were found. Experiments in hybridisation of *Ovis polii* with the domestic sheep were made and the progeny will be studied in detail. Apart from the specimens collected, a considerable number of living local animals was sent from the Pamir to the Moscow Zoological Garden. The linguistic section collected materials for a dictionary of the Tadzhik language, made phonograph records of native speech, and studied native customs and folklore. The radio section of the expedition had three transmitting stations at its disposal; apart from keeping in touch with central Russian stations, it made a series of experiments relating to the transmission under the peculiar local conditions. A kinematographic section made about 9000 metres of films of all places and phases of the expedition. The Alpine section made about thirty ascents to the highest peaks of the Pamir, the greatest height reached being 7120 m. (Lenin's peak).

Scientific results of the expedition will be published in parts, as the working out of materials proceeds; it is suggested that the whole series, which will be published partly in Russian, partly in German, will be completed in 1930, apart from detailed monographs on different problems which will be published separately.

University and Educational Intelligence.

CAMBRIDGE.—The Harkness Scholarship in geology has been awarded to L. Bairstow, King's College. The Anthony Wilkin Studentship in archeology and anthropology has been awarded to J. B. Charlesworth, of Christ's College.

The following reappointments have been made: F. W. Dootson, University lecturer in chemistry; P. M. S. Blackett, University demonstrator in physics; R. G. W. Norrish, University demonstrator in chemistry; E. M. Taylor, University lecturer in agricultural chemistry; E. H. B. Boulton, University lecturer in forestry; H. E. Woodman, University demonstrator in agricultural chemistry; C. E. Tilley, University lecturer in petrology; W. A. Fell, University demonstrator in anatomy; F. W. Dootson, University demonstrator in chemistry.

Dr. W. M. Smart, of Trinity College, chief assistant at the Observatory, has been reappointed to the John Couch Adams astronomership.

Frank Smart Prizes have been awarded to H. R. Barnell, of Downing College, in botany, and to R. J. Pumphrey, of Trinity Hall, in zoology.

The syndicate to consider the organisation and finance of the Botanic Garden has reported to the University. The most important of its recommendations are the following:

(1) The Botanic Garden should become an integral part of the Department of Botany, and the responsible head of the Garden should be the professor of botany.

(2) The duties of the Director of the Garden should be general responsibility for the management of the Garden and particular care for its development as an aid to the study of botany.

(3) The stipend attaching to the office of Director should be variable according to the nature of the other offices held simultaneously by the Director.

(4) A new University lectureship should be created for the teaching of systematic botany.

(5) Consideration should be given to the fact that a part of the land adjoining the Garden could be sold under suitable restrictive conditions without detriment to the present or future needs of the Garden.

(6) The town of Cambridge should be invited to contribute to the cost of the Garden, so long as it is made accessible to the general public.

GLASGOW.—Prof. J. W. Gregory, having attained the age of sixty-five years during the past session, has resigned the chair of geology in the University which he has held since 1904. Prof. Gregory is not subject to the age-limit regulation, but he has decided to retire to make way for a younger man and to devote his time to the completion of work in which he has been engaged.

Among others, the honorary degree of LL.D. was conferred on June 19 on: Prof. H. S. Carslaw, professor of pure and applied mathematics, University of Sydney; Madame Marie Curie, of Paris; The Earl of Elgin, chairman of the Carnegie United Kingdom Trust; C. O. Hawthorne, chairman of the Repre-

sentative Body of the British Medical Association; and Lord Lugard, ex-Governor of Nigeria.

LIVERPOOL.—The Council of the University, at its meeting on June 18, elected Dr. D. B. Blacklock, professor of tropical diseases of Africa, to the Walter Myers chair of parasitology. Prof. Blacklock is a graduate of the University of Edinburgh. From 1911 until 1914 he was in turn assistant director and director of the Runcorn Research Laboratory. In 1914 he became a member of the commission appointed to investigate the problems of sleeping sickness in West Africa, and was elected to a lectureship in parasitology in the University of Liverpool. During the War period he was in charge of a pathological laboratory and conducted investigations on malaria on behalf of the War Office. Prof. Blacklock has been secretary and a vice-president of the Tropical Section of the British Medical Association and has played an active part in the promotion of tropical medical research.

At the same meeting the Council appointed Mr. E. C. Titchmarch to the chair of pure mathematics in the University, and Dr. J. H. Orton to the Derby chair of zoology. Mr. Titchmarch, a scholar of Balliol, was appointed in 1923 to a lectureship in mathematics at University College, London, and to a fellowship of Magdalen College, Oxford. Since 1925 he has been reader in mathematical analysis in the University of London. Dr. Orton is a graduate of the Royal College of Science, London. In 1914 he was appointed assistant naturalist at the Marine Biological Laboratory, Plymouth, and after War service returned to the laboratory, in which he was promoted in 1924 to the post of chief naturalist. He has conducted extensive research on problems of marine biology, paying particular attention to the life history of the oyster.

MANCHESTER.—A limited number of research scholarships in technology, each of the value of not more than £100, are to be awarded in July by the Manchester Municipal College of Technology. Application forms, returnable by, at latest, July 6, can be obtained from the Registrar of the College.

KING'S COLLEGE, London, celebrated during the past week the hundredth anniversary of its foundation. The celebrations, inaugurated on Tuesday by their Royal Highnesses the Duke and Duchess of York, included the dedication of the chapel and opening of the library and new wing of the Vincent Square hostel by the Archbishop of Canterbury, who is the official Visitor. Beginning in 1829 with work of university standard in arts, science, and medicine, and a 'junior department' which became the present King's College School at Wimbledon, the growth of the College has been marked by the establishment of an engineering department in 1838, a hospital (now on Denmark Hill) in 1839, a theological department for the training of clergy in 1847, evening classes in 1856, a department for women (in Kensington) in 1885, and a teacher-training department in 1890. The post-War years have seen a remarkable further enlargement of its activities and increase in the number of its students, with the result that additional accommodation is urgently required, especially in the departments of chemistry and anatomy. The building scheme designed to meet this need at a cost of £125,000 will, if carried out, improve the architectural amenity of the Thames frontage in the neighbourhood of Waterloo Bridge. For this, and for the endowment of professorial chairs and scholarships the College is asking the public to subscribe to its centenary appeal fund.

Calendar of Patent Records.

June 29, 1722.—A patent was granted on June 29, 1722, to Martin Triewald, the Swedish engineer, for his invention of a "certain engine or machine for drawing water out of mines and collyeries by the power of the atmosphere". Triewald, who was in England when the first Newcomen engines were being set up and himself helped in the erection of one, built the first engine in Sweden, that for the Dannemora mines, and is the author of the earliest monograph on the steam engine, which was published at Stockholm in 1734. Triewald claims to have made improvements on the engine, but what these were and what was the construction for which his patent was granted he does not say.

July 1, 1769.—The stamped brass trade dates from the patent of John Pickering, whose specification was enrolled on July 1, 1769. The invention consisted of a "new method of performing that kind of work commonly called chasing in gold, silver, brass, tin, or other metal, by a machine consisting of an oblong frame with two rods, in which a moving forcer is worked upon a striking block with a die fixed thereon formed for each respective purpose, whereby the work is executed in a much more expeditious manner and far superior to anything of the kind (not being actual chasing) ever yet performed by any other means".

July 1, 1877.—There was no common patent law for Germany before 1877, but for many years patents had been granted by the constituent States under their respective laws and regulations. The first patent law of the German Empire, superseding the various State laws, came into force on July 1, 1877, and the first patent under it dates from the following day.

July 3, 1769.—The practical application of the principle of roller drawing in cotton-spinning is due to Sir Richard Arkwright, whose patent for the invention was sealed on July 3, 1769. Arkwright was partnered and greatly helped in the establishment of the industry which was started at Cromford Mill, Derbyshire, by Jedediah Strutt, the inventor of the rib stitch hosiery frame.

July 3, 1861.—The manufacture of mechanical wood-pulp for papermaking was the invention of F. G. Keller in 1845, but its commercial introduction and development are mainly due to Heinrich Voelter, papermaker, of Heidenheim, who was granted a Prussian patent for five years for his improved process on July 3, 1861.

July 4, 1767.—On July 4, 1767, there was granted a patent to John Winn, a shipwright of Shadwell, for a method of saving life "in case of a ship being in distress on a lee shore where a boat cannot live". Ropes were sent ashore by means of a buoy, and the passengers and crew were then transported in a basket slung on one of the ropes and hauled to the shore.

July 6, 1897.—The patent of Walther Nernst, of the University of Göttingen, for the electric lamp which is known by his name, was granted in Germany on July 6, 1897. At the time of its introduction, practically no improvement had been made in the earlier carbon filament lamp, other than in the details of the manufacturing processes, and Nernst utilised for his lighting element one of the refractory rare-earths, which allowed a current to pass after a preliminary heating, and withstood a greatly increased temperature. He succeeded in reducing the consumption from the 4 watts per candle power of the carbon filament to 1·5 watts. The lamp has now been very largely displaced by the metal filament lamp.

Societies and Academies.

LONDON.

Royal Society, June 13.—**W. S. Stiles**: The scattering theory of the effect of glare on the brightness difference threshold. The theory that the observed increase in the threshold due to the presence of a glare source in the field is caused by light scattered in the eye media, is formulated mathematically. Deductions from it are not in accord with observation. The general conclusion is that the scattering effect can play only a subsidiary part in increasing the threshold.—**Grace Briscoe** and **Winifred Leyshon**: Reciprocal contraction of antagonistic muscles in peripheral preparations, using flashing neon lamp circuit for excitation of nerve. Controlled and co-ordinated rhythmic movements of a limb, closely resembling natural movements, are produced by suitable artificial stimulation of cut efferent nerves. If during this controlled rhythmic movement the mechanism producing phasic variation is stopped at any point, the limb remains held in posture. The method of stimulation is thus adequate for both movement and posture. An analysis of the forces controlling movement shows that the control of relaxation is as important for smooth co-ordination as the control of contraction.—**T. Moran**: Critical temperature of freezing living muscle. Up to 40 per cent of the water in amphibian muscle can be removed by freezing or drying, and its original state completely recovered by restoring water. On removal of 78 per cent, the muscle immediately dies. The critical water removal of 78 per cent corresponds to the freezing of the muscle to equilibrium at about $-2°$ C. Muscles frozen to equilibrium below $-2°$ C. undergo marked changes on thawing.—**E. C. Smith**: The formation of lactic acid in muscles in the frozen state. Freezing (that is, drying) upsets the balance, making production exceed removal. This upset is due to, or accompanied by, injury to the mechanism. Below $-1{\cdot}6°$ C. the mechanism of removal is destroyed, that of production persisting. Is the mechanism of removal the 'living' part?—**F. M. L. Sheffield**: Chromosome linkage in *Oenothera*, with special reference to some F_1 hybrids. Most results can be brought into line with Cleland's hypothesis—absence of pairing due to lack of harmony between homologues. Chromosome linkage may be inherited as a genetic character.—**A. C. Downing** and **A. V. Hill**: A new thermopile for the measurement of nerve heat-production.—**A. V. Hill**: The heat-production and recovery of crustacean nerve. The heat-production of crab's nerve in response to maximal excitation is at least $2{\cdot}5 \times 10^{-3}$ calorie per gram of moist nerve per second of stimulus. This is 33 times as great as in frog's nerve. The crab's nerve is highly fatiguable. The initial process, completed during stimulation, yields only about $2\frac{1}{4}$ per cent of the total heat: the recovery process, lasting for 25 minutes at 16° C., supplies the rest. In respect of fatiguability and of oxygen requirement a crab's nerve probably presents a closer analogy to certain characteristics of the central nervous system than does a frog's sciatic.

PARIS.

Academy of Sciences, May 22.—The president announced the death of M. Depéret, non-resident member, and of M. Cornet, foreign *correspondant* for the Section of Mineralogy.—**Léon Guillet**, **Jean Galibourg**, and **Michel Samsoen**: Extension tests at high temperatures. Data are given for the elastic limits at 450° C. for various alloy steels, including nickel, nickel-chromium, and nickel-chromium-molybdenum steels. No general conclusions can be drawn from the results, but the previous heat treatment certainly has a considerable influence on the elastic characteristics at 450° C.—**Eduard Čech**: Some remarks relative to the differential projective geometry of surfaces.—**C. Pawlowski**: Remarks on the disintegration of aluminium. Discussion of the results obtained by the author and by Rutherford and Chadwick on the H-rays of aluminium.—**Y. Rocard**: The fall of a heavy gas in a light gas. The stability of ozone in the upper atmosphere. From considerations based on the kinetic theory of gases, it is concluded that the velocity of ozone in nitrogen would be 22 metres per day, and of ozone in hydrogen, 17 metres per day. In either case the atmospheric ozone is practically stable.—**L. Genevois**: The variations of the respiratory intensity and of the intensity of fermentation in the tissues of the pea.—**Bounhiol**: Respiration in media containing an excessive percentage of oxygen. The fact has been established by previous workers that animals breathing an atmosphere containing an excess of oxygen rapidly die. Under these conditions there is a rapid increase in the proportion of urea in the blood, and the accumulation of oxidation products in the blood prevents the fixation of fresh oxygen.—**L. Lutz**: The soluble ferments secreted by the hymenomycete fungi. The alkaloids and the anti-oxygen function.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 2).—**P. P. Lazarev**: Modern treatment of malignant tumours from the point of view of the ionic theory of excitation. The success of treatment of malignant tumours by calcium salts is explained by the suggestion that calcium ions inhibit the development of tumour cells, while those of potassium and sodium favour it. **V. Vernadskij**: The concentration of radium by living organisms. Radium from water solutions is absorbed by aquatic organisms, both vegetable and animal, and is concentrated there; from solutions in soil it is absorbed by terrestrial plants and from drinking water by terrestrial animals. In some cases the concentration of radium in an organism was found to exceed that in water 56·5 times.—**V. Vernadskij**: Rare earths elements in massive rocks. Minerals rich in rare earths are found mainly in pegmatite seams, but their occurrence in the rocks proper is not clear, probably because of insufficiently exact methods of examination.—**V. Vernadskij**: The geochemical constants of some cultivated plants. Geochemical energy of the best selected varieties is less than the energy of the varieties usually cultivated.—**A. Vinogradov**: Chemical composition of plankton from the Ekaterininsky pond at Dietskoe Selo, near Leningrad.—**D. Grave**: Magnetic anomalies. A reply to the critical note by Kravetz (*Comptes rendus*, p. 470; 1928).—**N. Olenev**: Systematics and geographical distribution of Ixodidæ (3). The genus *Rhipicephalus* is represented in Russia by three species, *R. sanguineus* Latr., *R. bursa* Can. et Fanz., and *R. schulzei*, sp. n. The genus *Boophilus* is represented only by *B. calcaratus* Birula. The geographical distribution and hosts of each species are given.—**G. Verestchagin** and **I. Sidorytchev**: Winter chemical regime of the rivers Selenga and Uda. The oxygen content of the water decreases sharply from the end of November and reaches its minimum early in February; parallel to that process, the carbon dioxide content increases. This must be of great importance to fish life.

(*Comptes rendus*, No. 3).—**V. A. Silberminz**: The deposits of cerite, bastnæsite, and a new mineral, lessingite, in the Kyshtym district, Urals. The deposits are described, and descriptions and chemical

analyses of the three minerals are given.—A. Mordvilko: The anolocyclic plant-lice of *Pistacia* and the distribution of pistachios during the Tertiary period. The genus *Pistacia* was very widely distributed in the Tertiary, extending northwards as far as Greenland, where the plant-lice *Triphidaphis phaseoli*, representing a migrant form from pistachios, survive until the present time. While *Pistacia* disappeared in such high latitudes under the influence of cold climate, it is impossible to account in the same way for the disappearance of *Pistacia* in some Mediterranean countries where in places only root-forms of pistachio aphids are to be found at present.—A. Frank-Kamenetskii: The fat of *Phoca sibirica* Gmel. Physical and chemical properties of the fat are described fully.—D. D. Ivanenko: A geometrical generalisation which may be useful in the quantum mechanics.

(*Comptes rendus*, No. 4.)—P. Lazarev: The causes of plasticity of substances. The greater plasticity of loam as compared with sand is due to the ability of particles of loam to bind water on their surfaces. Capillarity must also play some part in the plasticity.—L. A. Kulik: The Mamra meteorite. A description of a meteorite which fell at Mamra in Kazakstan (Kirghiz Steppes) at night on May 5, 1927. The meteorite belongs to the stony meteorites and, probably, to sulphurous chondrites.—V. I. Romanovskii: The law of probability of frequencies subject to linear conditions and Pearson's criterium χ^2.—A. A. Birula: The pelvic bone of *Rhytina stelleri* Oser. Amongst the semi-fossil remains of *Rhytina stelleri* found at the Komandor islands, pelvic bones are rare; a detailed description of one such bone is given and illustrated.—A. A. Birula: A preliminary communication on the mammals of the kitchen midden of a Stone Age habitation on the Verkholensk mountain near Irkutsk. Remains of twelve species of mammals have been identified.—N. Smirnov: Diagnoses of some geographical varieties of *Phoca hispida* Schreb. Two new subspecies and one new form are described.—E. G. Shramkov: The stability of the permanent magnetism of some rocks.—B. V. Numerov: The relation between the local anomalies of gravity and the derivatives of the potential.

PRAGUE.

Czech (Bohemian) Academy of Arts and Sciences (second class, Natural Sciences and Medicine), Mar. 8.—J. Petrbok: Stratigraphy of the Pleistocene and Holocene in the plain of Arsuf in Palestine.—Fr. Čechura: Geomagnetic examination of the contact of Algonkian and granite near Příbram.—J. Sekanina: The symmetry of tourmaline.—J. Hýbl: The dependence of saturated vapour-pressure on temperature. The author tested various formulæ with the vapour pressure data of liquid carbon dioxide, sulphur dioxide, ammonia, water, and hydrocarbons; the best record is given by a shortened formula of Kamerlingh Onnes: $\log p = a - \frac{b}{T} - cT + dT^2$.—Jar. Hahn: *Monocystis Mrázeki*.—J. Křepelka and F. Toul: The dissolution of silver in water. Silver passes as Ag^+ into water containing atmospheric gases, being oxidised. The amount, determined by nephelometry, potentiometry, and conductance, varies between 0·01 mgm. and 0·037 mgm. Ag^+ per litre.—K. Petr: The composition of *n*-ary quadratic forms.—E. Votoček and F. Rác: The identity of E. Fischer's quinovose with *d*-glucomethylose (isorhodeose). Reduction of quinodose with sodium amalgam and identification of the methylpentite obtained with isorhodeite leads the authors to the same conclusion as Freudenberg and Raschig on the isolation of crystalline quinovose.

ROME.

Royal National Academy of the Lincei, Mar. 17.—P. Vinassa de Regny: The law of simple parametral relations and the distances of the components of the solar system. It has been recently shown that Haüy's law concerning simple and rational parametral relations holds not only for crystal lattices, but also for the distances of the electrons from the atomic nucleus. A similar relationship is now shown to exist in the cases of the sun's planets and of the satellites of Mars, Jupiter, Saturn, and Uranus.—E. Soler: The second gravimetric campaign on the Carso. Measurements made in 1926 at S. Canziano give for the gravitational constant the observed values, 980·568 cm. outside and 980·604 inside the cave, these becoming 980·698 and 980·696 respectively when corrected for the reduction in free air, and 980·661 and 980·684 when Bouguer's and topographical corrections are applied. The discrepancy between these values is considerably greater than the mean errors and is to be discussed later. The normal gravity value, derived from Helmert's formula (1901), is 980·676 cm.—U. Pierantoni: The symbiotic organ of *Silvanus surinamensis* (L.).—G. Bemporad: Photographic position of planet (1036).—T. Boggio: Hypersurfaces of spaces of constant curvature.—V. Glivenko: Certain general forms of the law of large numbers.—A. Kolmogoroff: The law of large numbers.—Maria Pastori: Total and partial commutation relative to derived tensors.—G. Scorza-Dragoni: The continuous dependence of the integrals of the equation $y' = f(x, y)$ on the initial values.—Pia Nalli: The principal value of an integral.—S. Finikoff: The congruences of Demoulin.—M. Manarini: The motion of two variable masses which attract one another according to Newton's law. Vranceanu's equations (1928) have indicated the difficulty of this problem, but the introduction of a simple and plausible hypothesis regarding the variation of the masses furnishes a means of simplifying the investigation and of obtaining results comparable with those of Armellini (1915) and of Pizzetti (1915).—A. Clementi: investigations on arginase (7). Ureotelic character of the nitrogen metabolism of Chelonia. The urine of *Testudo Græca* and *Emys Europœa*, like that of *Bufo*, contains uric acid in very small proportions only, which are usually too minute to be determined. In the summer season the content of urea in the urine of these two organisms corresponds approximately with that in the urine of *Bufo* at the same period, namely, about 0·5 part per 1000. Oral administration of ammonia to *Testudo* and *Emys* causes a very marked increase in the urea content *prodie* and per 1000 of the urine, this being contrary to what is observed with uricotelic animals (birds). Hence, the nitrogen metabolism of the Chelonia is not, as with other reptiles and with birds, uricotelic, but ureotelic.—V. Rivera: Experimental cicatrisation of the stem of *Ricinus communis*, determined by *Pseudomonas fluorescens* (Flügge) Migula. Cuts made aseptically in the stem of *Ricinus*, and afterwards inoculated with a pure culture of *Pseudomonas fluorescens*, gradually seal up as a result of pronounced cellular proliferation at the sides of the cut, whereas control cuts, uninoculated, undergo no such sealing. It may, therefore, be assumed that this organism, which is of universal occurrence, is the cause of the cicatrisation often observed after a root or a stem has been wounded.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 2, Feb. 15).—Arthur M. Banta and L. A. Brown: Control of sex in Cladocera. (3) Localisation of the critical period for control of sex. Females of *Moina macrocopa*

produce parthenogenetic eggs or, under adverse conditions, sexual eggs. Crowding of the females leads to production of eggs giving males; the critical time for crowding is about four hours (at 20° C.) before oviposition, which is more than three hours before spindle formation in the nuclei.—**Chas. W. Metz** and **Silka S. Ullian**: Genetic identification of the sex chromosomes in *Sciara* (Diptera). The males alone of these dipterans have two peculiar 'sex-limited' chromosomes, but these chromosomes are transmitted by all sperms. Sex chromosomes distinct from these have been detected by tracing the inheritance of a sex-linked character, swollen wing veins.—**Gregory Pincus**: A spontaneous mutation in the house mouse.—**G. A. Miller**: Possible α-automorphisms of non-Abelian groups.—**W. L. Ayres**: (1) On continuous curves having certain properties.—(2) On simple closed curves and open curves.—**I. A. Barnett**: On a relation between conformal and projective groups in function space.—**Francis D. Murnaghan**: On elements of content in metrical geometry.—**G. C. Evans** and **E. R. C. Miles**: Potentials of general masses in single and double layers. The relative boundary value problems.—**H. S. Vandiver**: Summary of results and proofs on Fermat's last theorem (4).—**Francis B. Sumner**: The analysis of a concrete case of intergradation between two subspecies. A mouse, *Peromyscus polionotus*, common in Florida and Alabama, has two races distinct in several characters, one existing on the coastal region and the other inland. The races are interfertile, but trapping them at a line of stations running inland shows an abrupt transition from one to the other. The coastal form seems to have arisen from the inland or a similar ancestral race, in adaptation to life on a background of pale sand.—**Edwin B. Wilson** and **Margaret M. Hilferty**: Note on C. S. Pierce's experimental discussion of the law of errors. The mean and standard deviation for many observations of an identical experiment repeated on 24 days vary much more than is predicted by the law of errors.—**Edwin H. Hall**: Photoelectric emission and thermionic emission once more. A theoretical criticism of experiments suggesting that photoelectric and thermionic work functions are equal.—**Gilbert N. Lewis** and **Joseph E. Mayer**: The quantum laws and the uncertainty principle of Heisenberg. In earlier papers, the second and third laws of thermodynamics were deduced from a single statistical principle implying that the properties of a system can be described by assuming a finite number Ω of possible states. Assuming that Ω is a minimum *sufficient* to account for the whole *behaviour* of a system, the fundamental laws of the quantum theory are developed.—**E. L. Nichols** and **H. L. Howes**: The transformation spectrum of the ruby. An incandescent ruby gives a continuous spectrum on which is superimposed a system of narrow emission bands. The latter appear in the temperature range corresponding to changes in the absorption of light by the ruby and occur in sets, including also the absorption and fluorescence bands of the ruby, with a constant frequency interval.—**Leonard B. Loeb** and **Karl Dyk**: The effects of a homologous series of amines on the mobilities of ions in hydrogen gas. With *N*-propylamine, there is a large initial drop in mobility of both positive and negative ions. With methylamine the negative ion mobility is decreased but the positive ion mobility is unaffected. Although the results are consistent with the formation of addition products with only one or two molecules, this explanation is not accepted.—**Marius R. Campbell**: Late geologic deformation of the Appalachian Piedmont as determined by river gravels. The rocks of this region are old, but minor flexures of more recent date have been discovered by tracing high level gravels in the area. Sections and a map are given.

Official Publications Received.

BRITISH.

Proceedings of the Royal Society of Edinburgh, Session 1928–1929. Vol. 49, Part 2, No. 15: The Stability of Suspensions, III. The Velocities of Sedimentation and of Cataphoresis of Suspensions in a Viscous Fluid. By William Ogilvy Kermack, Anderson Gray M'Kendrick and Eric Ponder. Pp. 170-197. 2*s*. 6*d*. Vol. 49, Part 3, No. 16: The Lyotrope Series and the Antagonistic Action of Ions. By Dr. W. W. Taylor. Pp. 198-209. 1*s*. Vol. 49, Part 3, No. 17: On the Asymptotic Expansion of the Characteristic Numbers of the Mathieu Equation. By Sydney Goldstein. Pp. 210-223. 1*s*. Vol. 49, Part 3, No. 18: Quanta in Biology By Hans Przibram. Pp. 224-231. 9*d*. Vol. 49, Part 3, No. 19: Colour Sensitivity. By G. N. Hunter. Pp. 232-244. 1*s*. Vol. 49, Part 3, No. 20: Bands in Hydrogen related to the Fulcher System. By Dr. Ian Sandeman. Pp. 245-255. 1*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Harper Adams Agricultural College, Newport, Salop. Advisory Report No. 4: Report of the Advisory Department, 1928–1929. Pp. ii+24. (Newport, Salop.)

Transactions of the Yorkshire Numismatic Society. Vol. 3, Part 2. Edited by T. Sheppard. Pp. 57-86. (Hull.) 5*s*.

The Ross Institute and Hospital for Tropical Diseases (Incorporated), Putney Heath, London, S.W.15. Annual Report and Accounts for 1928. Pp. 59. (London.)

The Proceedings of the Physical Society. Vol. 41, Part 4, No. 229, June 15. Pp. iv+231-430. (London.) 7*s*. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 67, No. 390, June. Pp. 685-812+xxxviii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 1: Studies on the Inheritance of (a) Petal Spot, (b) Pollen Colour, and (c) Corolla Colour in the Cotton Plant. By S. C. Harland. Pp. 53+3 plates. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*.

The Himalayan Journal: Records of the Himalayan Club. Edited by Kenneth Mason. Vol. 1, No. 1. Pp. 150. (Calcutta: Thacker, Spink and Co.) 5 rupees; 8*s*.

Joint Board of Research for Mental Diseases: City and University of Birmingham. Annual Report of the Laboratory for the Year ending March 14th, 1929. Pp. 17. (Birmingham.)

Canada. Department of Mines: Mines Branch. Industrial Fuel and Power Statistics for Ontario, Calendar Year 1928. By E. S. Malloch and C. E. Baltzer. (No. 698.) Pp. iv+23+12 plates. (Ottawa: F. A. Acland.)

Department of Agriculture, Ceylon. Bulletin No. 84: Fodder Grass Trials on the Experiment Station, Peradeniya. By T. H. Holland. Pp. 12+6 plates. 40 cents. Bulletin No. 85: The Termite-proof Construction of Buildings in Ceylon. By F. P. Jepson. Pp. iv+36+26 plates. 40 cents. (Peradeniya.)

The Economic Proceedings of the Royal Dublin Society. Vol. 11, No. 25: The Production of Essential Oils from Irish-grown Plants. Part 5: Note on Oil of Dill. By J. Reilly, P. J. Drumm and C. Boyle. Pp. 415-418. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Survey of India. General Report, from 1st October 1927 to 30th September 1928. Pp. v+86+4 plates. (Calcutta.) 1 rupee; 1*s*. 9*d*.

Records of the Geological Survey of India. Vol. 61, Part 4, March. Pp. 327-367+xxx+vii+plates 26-29. 2.12 rupees; 5*s*. Vol. 62, Part 1, April. Pp. 185. 2.12 rupees; 5*s*. (Calcutta: Government of India Central Publication Branch.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1179 (Ae. 343): The Airflow around a Circular Cylinder in the Region where the Boundary Layer separates from the Surface. By A. Fage. (T. 2644.) Pp. 18. 9*d*. net No. 1194 (Ae. 356): An Investigation of Fluid Flow in Two Dimensions. By Dr. A. Thom. (T. 2680.) Pp. 18+10 plates. 1*s*. net. No. 1206 (Ae. 367): Wind Tunnel Experiments with Infinite Cascades of Aerofoils. By Dr. R. G. Harris and R. A. Fairthorne. (T. 2685.) Pp. 18+11 plates. 1*s*. net. No. 1210 (Ae. 370): On the Effect of Air Compression on Drag and Pressure Distribution in Cylinders of Infinite Aspect Ratio. By T. E. Stanton. (T. 2689.) Pp. 5+2 plates. 6*d*. net. No. 1218 (Ae. 377): The Hydrodynamic Factors on a Cylinder moving in Two Dimensions. By Prof. H. Lamb. (T. 2744.) Pp. 5. 4*d*. net. (London: H.M. Stationery Office.)

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1928. Pp. 200+9 plates. (Bristol.)

The Cawthron Institute, Nelson, N.Z. Cawthron Lecture: The Work for Agriculture of Two Great Englishmen. By Sir John Russell. Pp. 12+6 plates. (Cawthron, N.Z.)

Department of Scientific and Industrial Research, Dominion of New Zealand. Observations of Upper Air-Currents at Apia, Western Samoa. (Second Series.) By Andrew Thomson. Pp. 79. (Wellington, N.Z.: W. A. G. Skinner.)

The University of Leeds: Department of Coal Gas and Fuel Industries (with Metallurgy). Report of the Livesey Professor for the Sessions 1926–27 and 1927–28. Pp. 15. (Leeds.)

Proceedings of the Society for Psychical Research. Part 111, Vol. 38, June. Pp. 411-516. (London: Francis Edwards, Ltd.) 4*s*.

Empire Cotton Growing Corporation. Report of the Eighth General Meeting. Pp. 16. (London.)

The Newcomen Society for the Study of the History of Engineering and Technology. Transactions, Vol. 7, 1926–1927. Pp. xi+159+21 plates. (London.) 20*s*.

FOREIGN.

Svenska Linné-Sällskapets Arsskrift. Årgång 12, 1929. Pp. v+194. (Uppsala: Almquist and Wiksells Boktryckeri A.-B.)

Proceedings of the Imperial Academy. Vol. 5, No. 4, April. Pp. vii+161-181. (Tokyo.)

Přírodovědecké práce J. E. Purkyně v zrcadle kritiky jiných badatelů. Ce qui a été écrit sur les travaux scientifiques de Jan Evangelista Purkyně (Purkinje) par les biologistes. Napsal O. V. Hykeš. Pp. 51. (Praha: Knihtiskárna Jednoty československých matematiků a fysiků.)

Spisy vydávaní Přírodovědeckou Fakultou Masarykovy University. Čis. 103: Příspěvek ke studiu komplexních solí dimethylglyoximu (Contribution à l'étude de combinaisons complexes de la dimethylglyoxine). Napsali J. V. Dubsky a Fr. Brychta. Pp. 28. Čis. 104: Sur une classe de surfaces. Par Jos. Kaucký. Pp. 21. Čis. 105: Iter Turcico-Persicum. Pars 4: Plantarum collectarum enumeratio. (Plumbagineae—Cyperaceae.) Scripsit Dr. Fr. Nábělek. Pp. 48+4 tab. Čis. 106: Sur une classe de surfaces minima plongées dans un espace à cinq dimensions à courbure constante. Par Otakar Borůvka. Pp. 28. Čis. 107: Sur les surfaces du troisième degré qui ont, aux points d'une courbe plane, un contact d'ordre deux avec une surface générale. Par Ladislav Seifert. Pp. 17. Čis. 108: Nový typ thermostatu (A new Type of Thermostat). Napsal Václav Cupr. Pp. 8. (Brno: A. Píša.)

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 17, Nos. 11 and 12: Report of the President of the Academy for the Year 1928, by C. E. Grunsky; Report of the Director of the Museum for the Year 1928, by Barton Warren Evermann. Pp. 297-360. (San Francisco.)

Bergens Museums Årbok, 1929. Hefte 1. Naturvidenskapelig rekke. Nr. 1: Draktskiftet hos lirypen (*Lagopus lagopus* Lin.) i Norge, av Sigurd Johnsen; Nr. 2: Rovdyr- og rovfuglstatistikken i Norge, av Sigurd Johnsen. Pp. 84+140+17 plancher. (Bergen: A.-S. John Griegs Boktrykkeri.)

Proceedings of the United States National Museum. Vol. 75, Art. 15: A new Crab from the Eocene of Florida. By Mary J. Rathbun. (No. 2786.) Pp. 4+3 plates. (Washington, D.C.: Government Printing Office.)

Gorgas Memorial Laboratory. Hearings before the Committee on Foreign Affairs, House of Representatives, Seventieth Congress, First Session on H.R. 8128: To authorize a Permanent Annual Appropriation for the Maintenance and Operation of the Gorgas Memorial Laboratory, January 20, 1928. Statements of Hon. Maurice H. Thatcher, Dr. Franklin Martin, Edgar Wallace, Dr. Bowman C. Crowell, Dr. George W. Crile, Henry S. Wellcome, Surg.-Gen. Merritte W. Ireland, Surg.-Gen. Hugh S. Cumming, Dr. Arthur T. McCormack, Dr. Herman N. Bundesen. Pp. iv+90. (Washington, D.C.: Government Printing Office.)

Memoirs of the College of Science, Kyoto Imperial University. Series B, Vol. 4, No. 3, Articles 7-17. Pp. 165-369+plates 26-30. (Kyoto and Tokyo: Maruzen Co., Ltd.)

Carnegie Institution of Washington. Year Book No. 27, July 1, 1927, to June 30, 1928, with Administrative Reports through December 14, 1928. Pp. xix+438+2 plates. (Washington, D.C.: Carnegie Institution.)

Studies in Comparative Seismology: Earthquake Conditions in Chile. By Bailey Willis. With Contributions by J. B. Macelwane, Perry Byerly, Johannes Felsch and H. S. Washington. (Publication No. 382.) Pp. xi+178+75 plates. (Washington, D.C.: Carnegie Institution.) 5.50 dollars.

Miocene Mollusks from Bowden, Jamaica. Part 2: Gastropods and Discussion of Results. By Wendell P. Woodring. (Contributions to the Geology and Palaeontology of the West Indies.) (Publication No. 385.) Pp. vii+564 (40 plates). (Washington, D.C.: Carnegie Institution.) 7 dollars.

The Genus *Haplopappus*: a Phylogenetic Study in the Compositae. By Harvey M. Hall. (Publication No. 389.) Pp. viii+391 (16 plates). (Washington, D.C.: Carnegie Institution.) 5 dollars.

The Hydrostatic-Pneumatic System of certain Trees: Movements of Liquids and Gases. By D. T. MacDougal, J. B. Overton and Gilbert M. Smith. (Publication No. 397.) Pp. 99. (Washington, D.C.: Carnegie Institution.) 1.25 dollars.

Contributions to Palaeontology from Carnegie Institution of Washington: Papers concerning the Palaeontology of the Cretaceous and Later Tertiary of Oregon, of the Pliocene of Northwestern Nevada, and of the Late Miocene and Pleistocene of California. By Charles W. Gilmore, John H. Maxson, John C. Merriam and Chester Stock. (Publication No. 393.) Pp. v+58+13 plates. (Washington, D.C.: Carnegie Institution.) 1.50 dollars.

Papers from the Tortugas Laboratory of Carnegie Institution of Washington. Vol. 26: An Investigation on Organization in a Sea-Urchin Egg, by David H. Tennent, C. V. Taylor and D. M. Whitaker; Activation of the Eggs of *Echinometra mathaei* by Sperms of the Crinoids *Comatula pectinata* and *Comatula purpurea*, by David H. Tennent; Early Development and Larval Forms of three Echinoids of the Torres Strait Region, by David H. Tennent; On the Postlarval Development of the Coral *Maeandra areolata* (L.), by H. Boschma; On the Morphology, Coloration and Behavior of seventy Teleostean Fishes of Tortugas, Florida, by E. W. Gudger; Observations on certain Littoral and Terrestrial Animals at Tortugas, Florida, with Special Reference to Migrations from Marine to Terrestrial Habitats, by A. S. Pearse; Two new Mites from the Gills of Land Crabs, by A. S. Pearse; Further Studies on Marine Bacteria with Special Reference to the Drew Hypothesis on $CaCO_3$ Precipitation in the Sea, by C. B. Lipman; The Chemical Composition of Sea-Water, by C. B. Lipman. Pp. iii+257+4 plates. (Washington, D.C.: Carnegie Institution.) 2.50 dollars.

Japanese Journal of Astronomy and Geophysics: Transactions and Abstracts. Vol. 6, No. 3. Pp. iii+143-178+39-64. (Tokyo: National Research Council of Japan.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 189: A Study on the Helium Band Spectrum, 2. By Sunao Imanishi. Pp. 237-252+plates 23-25. (Tokyo: Iwanami Shoten.) 35 sen.

CATALOGUES.

The Far East: its History, Literature and Arts; Books and Views relating to Japan, China, Korea, Formosa, Siam, the Philippine Islands and the Far East Indian Archipelago. (Catalogue 516.) Pp. 48. (London: Francis Edwards, Ltd.)

Early American Voyages and other Travels. (Catalogue No. 26.) Pp. 48. (Newcastle-upon-Tyne: William H. Robinson.)

Diary of Societies.

FRIDAY, JUNE 28.

PHYSICAL SOCIETY (at Imperial College of Science), at 4.45.—Dr. Teresa J. Dillon: The Relation between Hydrogen Pressure and Filament Resistance in a Tube containing Glowing Tungsten.—Dr. Frances Lowater: The Band Systems of Titanium Oxide.—F. E. Smith: The Absolute Measurement of Sound Intensity.—A Demonstration of an Apparatus for the Measurement of Electrical Resistance at High Temperatures will be given by Dr. J. L. Haughton.

MONDAY, JULY 1.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Gunning-Victoria and Makdougall-Brisbane Prizes to be presented.—Prof. R. A. Sampson and Prof. A. E. Conrady: Description of Three Huygens Lenses in the Possession of the Royal Society of London.—W. J. M'Callien: The Metamorphic Rocks of Kintyre.—Dr. T. M. Finlay: Old Red Sandstone of Shetland (North-Western Area).

ROYAL INSTITUTION, at 5.—General Meeting.

TUESDAY, JULY 2.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (jointly with Institution of Engineers and Shipbuilders in Scotland) (at Newcastle-upon-Tyne), at 10 A.M.—Sir Westcott S. Abell: The Story of Safety at Sea.—J. Ireland: The Applications of Monel Metal in Engineering and Shipbuilding.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham), at 11 A.M.

ROYAL SOCIETY OF MEDICINE, at 4.30.—Annual General Meeting.

BRITISH WATERWORKS ASSOCIATION (at Portsmouth) (continued on July 3, 4, and 5).

WEDNESDAY, JULY 3.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (jointly with Institution of Engineers and Shipbuilders in Scotland) (at Newcastle-upon-Tyne), at 10 A.M.—J. L. Adam: Some Notes on Damage to Ships.—R. P. Sloan: Developments in the Uses of Electricity.

FRIDAY, JULY 5.

INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association), at 8.30 A.M.—Visit to Liverpool to see the Work in connexion with the Mersey Tunnel.

OVERHEAD LINES ASSOCIATION, at 12.15 P.M.—Visit to the Mid-Cheshire Electricity Supply Company.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College, Gower Street), at 7.30.—Christopher T. A. Gaster: Chalk Zones in the Neighbourhood of Shoreham, Brighton, and Newhaven, Sussex.—H. G. Smith: Some Features of Lamprophyres, near Sedbergh, Yorkshire.

SATURDAY, JULY 6.

PHYSIOLOGICAL SOCIETY (at Oxford).

TUESDAY, JULY 9.

SOCIETY OF CHEMICAL INDUSTRY (at Manchester), at 10.15 A.M.—Annual General Meeting.—Dr. A. D. Little: Science and Labour.

WEDNESDAY, JULY 10.

SOCIETY OF CHEMICAL INDUSTRY (at Manchester), at 10 A.M.—Annual Meeting.—Prof. T. H. Pear: The Human Factor in Industry.—Dr. A. D. Little: Process Development.

INSTITUTION OF MINING ENGINEERS (at University College, Nottingham), at 11 A.M.—General Meeting.—Dr. W. Hancock, A. G. R. Whitehouse, and Dr. J. S. Haldane: The Salts lost by Sweating owing to High Air-temperatures (Sixteenth Report to the Committee on The Control of Atmospheric Conditions in Hot and Deep Mines).—Dr. J. S. Haldane: Work of the Committee of the Institution of Mining Engineers on The Control of Atmospheric Conditions in Hot and Deep Mines.—The following papers will be submitted for further discussion:—W. S. Cooke and I. C. F. Statham: The Flow of Air at Bends and in Straight Airways (Sixth Report of the Midland Institute Committee on the Ventilation of Mines).—Dr. T. David Jones: Spontaneous Combustion in North Staffordshire. Part II. A Record of Analyses of Air-samples taken during the Combating of a Fire.—Dr. T. E. Wall: Electro-magnetic Testing of Wire Ropes.—2.15.—The General Meeting will be resumed.—3.30.—The General Meeting will be closed.

CONFERENCE.

JULY 1 TO 5.

MUSEUMS ASSOCIATION (at Worthing).

Monday, July 1.

Tuesday, July 2, at 10 A.M. (in Connaught Hall).—Sir Henry A. Miers: Co-operation—the Association's Task (Presidential Address).—Reading and Discussion of Papers.

At 3 (in Connaught Hall).—Reading and Discussion of Papers.

Wednesday, July 3, at 10 A.M. (in Connaught Hall).—Reading and Discussion of Papers bearing on the Co-operation of Museums in this Country and throughout the Empire, and on the Work of the Association in this Connexion.

At 2.15 (in Connaught Hall).—Reading and Discussion of Papers.

Thursday, July 4, at 10 A.M.—Reading and Discussion of Papers.

At 11.30 A.M.—Annual Business Meeting.

Friday, July 5.—Excursions.