SATURDAY, SEPTEMBER 5, 1931.

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An International Congress of Prehistory.

SCIENCE unquestionably is greatly indebted to France for the part she played in the efforts to re-establish relations between the scientific workers of different countries after the War. Anthropologists, in particular, should be grateful to their French colleagues for the initiative which led to the foundation of the Institut International d'Anthropologie (even though the Institut failed to attain internationality) and the organisation through that body of a congress of anthropology and prehistoric archæology at Liège, which was the first post-War common meeting-ground for some, though not all, of the anthropologists of different nationalities who had been kept apart for so many years by stress of circumstance. Yet curiously enough, France has failed to carry matters to their logical conclusion. Notwithstanding the admission of countries formerly enemy to participation in the later congresses which have followed that at Liège, the international status of these meetings has been called seriously into question, while in its organisation the Institut, which has made itself responsible for these assemblies and virtually has retained supreme control, is, for practical purposes, predominantly of one nationality.

The efforts of anthropologists outside France to ensure that these congresses in future should be truly, and not merely nominally, international in status and composition, has led to a counter-movement which was referred to in the leading article of NATURE of Mar. 1, 1930. This is manifest in the revival, ostensible rather than real, of the Congrès International d'Anthropologie et Archéologie Préhistoriques, which met last at Geneva in 1912. In theory it sat in joint session with the Institut at Lisbon in 1930. Long before that meeting, it was made evident that this measure would not satisfy everybody. It was, therefore, decided at the meeting to appoint a small committee consisting of nine members, to consider and report to an adjourned meeting in Paris in September 1931 on the future relations of the old Congrès and the Institut. This report will be presented on Sept. 20 next, the day on which the recently announced Congress in connexion with the Colonial Exhibition will open. In that report, a majority of the surviving members will recommend that the Congrès International d'Anthropologie et Archéologie Préhistoriques should be resuscitated, but entirely apart from the Institut and as a free and independent, migratory body, functioning "selon ses anciens statuts". The terms of the

report have been known for some time; but the Institut shows no sign that it will acquiesce.

In the meantime, the informal conference of representative archæologists of various nationalities, summoned on the personal invitation of Dr. Bosch-Gimpera, of Barcelona, has met at Bern. This conference, it will be remembered, follows up a movement initiated at the International Archæological Congress held at Barcelona in 1929. It met on May 28 last. The British archæologists present, Prof. J. L. Myres and Prof. V. Gordon Childe, were charged with messages from the Royal Anthropological Institute and its Joint Committee for Research and Teaching urging the re-establishment of the old Congrès and pressing for a wide general scope in future congresses.

The significance of the latter recommendation lies in the fact that there is a strong and growing body of opinion on the Continent in favour of broadening, and at the same time defining, the archæological side of the future congress, so as to take in the whole group of related studies bearing on the problems comprised in what is now known as prehistory, while limiting its scope in other branches of anthropology to their bearing upon prehistory. As there is no congress in existence which covers anthropological studies broadly, the Royal Anthropological Institute naturally desired that advantage be taken of the opportunity to bring together students in all branches of the subject.

A report of the proceedings at Bern on May 28, by Prof. J. L. Myres, appears in *Man* for July. Although the invitations were issued to archæologists individually, the meeting may be regarded as fairly representative from the point of view of nationality. Archæologists from fourteen European countries were present. The conference sat under the chairmanship of Dr. Bosch-Gimpera.

It is clear from Prof. Myres's report that, although alternative proposals were carefully considered, there was an overwhelming majority in favour of following a certain course. A strong preference was shown for a specifically prehistoric congress rather than any general combination of prehistory with anthropology or ethnology. It is clear also that there was a very strong desire for a quite fresh congress without any connexion with previous organisations. The suggestion of the Royal Anthropological Institute that the old Congrès should be revived as an independent body was put to the vote; but the resolution found three supporters only. Thereupon, on the motion of M. Lantier, of the Musée des Antiquités Nationales, St. Germain-en-Laye, it was unanimously resolved to establish a new Congrès International des Sciences Préhistoriques et Protohistoriques. This congress will include all the studies which contribute to prehistory—geology, palæontology of animals and plants, anthropology, ethnology, folk-lore, archæology, etc., in their application to prehistory and protohistory.

Statutes for the new congress were drafted and adopted on the spot. On general lines they resemble those of the old Congrès. It will meet once in every four years, and each meeting, before adjourning, will fix the date and place of the next meeting and elect a president and general secretaries for that occasion. In certain respects the new organisation differs from the old. The following provision, which will give a certain permanence and stability lacking in the older organisation, is especially worthy of note:—The congress will be managed by a permanent council consisting of one or two members for each country, chosen in the first instance by the Bern meeting. These may be assisted by one or two secretaries. Vacancies hereafter will be filled by the congress on the nomination of the council. In any country which invites the congress, these members, with their secretary or secretaries, will act as the nucleus of the organising local committee, this local executive being confirmed and completed by the congress when it meets. Obviously this organisation opens up unlimited possibilities in the way of securing agreement and continuity in an international policy in archæology. Sir Charles Peers and Prof. Myres have been appointed members of the council for Great Britain, with Prof. Gordon Childe and Mr. C. F. Hawkes, of the British Museum, as secretaries. Finally, to ensure continuity with the old Congrès, surviving members of its permanent council have been invited to act as an honorary committee with other distinguished persons and, eventually, all retired members of the permanent council.

The British representatives had been authorised by the Society of Antiquaries of London and the Royal Anthropological Institute, in the event of it being decided to resuscitate the Congrès International d'Anthropologie et Archéologie Préhistoriques, to proffer an invitation for the congress to meet in London in 1932. In view of the event, this invitation could not be tendered. It has since been decided that the invitation should hold good, and the Royal Anthropological Institute and the Society of Antiquaries of London, with the support of the Joint Committee for Anthropological Research and Teaching, the Royal Archæological Institute and other learned societies, have invited

the new congress to meet in London at the end of July 1932.

This cannot be regarded as the most happy ending of a protracted and tiresome series of negotiations extending over some years. The best that can be said for it is that the result, however deplorable, is inevitable. The French Institut has shown itself unwilling, or as it declares, unable under French law, to enlarge its management so as to become truly international. Nor has it shown itself ready to offer as a solution a dignified withdrawal from an impossible situation by a voluntary surrender of control of the congress and co-operation with others in reviving the old Congrès as an entirely independent organisation. The situation now created cannot endure; but, as a result, prehistorians must, for a time at any rate, submit to the imposition of two congresses, with the resulting dissipation of energy and division of interests. On the other hand, as general anthropology and ethnology are left without a congress of their own to cover the rest of these subjects on inclusive lines, the suggestion of another independent organisation has been favourably received—a further burden on an already overburdened world.

Agriculture and Physics.

The Physical Properties of the Soil. By Dr. Bernard A. Keen. (The Rothamsted Monographs on Agricultural Science.) Pp. vii + 380 + 2 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 21*s*. net.

STOKES'S paper on the theories of the internal friction of fluids in motion was published in 1845, and in it he discussed the motion of a sphere falling through a viscous liquid and arrived at a well-known equation. That result has become the basis of important experimental results in widely differing branches of physics: for example, in Wilson's cloud expansion apparatus for the determination of the electronic charge or in Millikan's researches in the same subject, or again as a viscometer, while towards the end of the last century it was applied to estimate the size of the particles in a sample of soil. How this is done is explained in detail in the earlier pages of the book under review, and the account is both interesting and instructive.

The physics of the soil is a comparatively new subject, complex to an alarming extent, and yet, as the book shows, of great importance. Results of marked value have already been reached by workers in the field, who, had they done nothing else, and this is far from being the case, have deserved our gratitude by directing attention to the complex nature of the subject and the field it opens for fruitful investigation. As a simple example of this complexity, take the effect of water on the heat conductivity of soil.

The conductivity of dry soil is about one-third to one-half that of water; hence the addition of water should increase its value. This was found to be the case, but as the soil is moistened its conductivity rises much beyond that of water. As the amount of water is increased, the conductivity falls again to about that of water.

The soil is composed of grains of material which in a solid form have a conductivity much in excess of that of water. When water is added to the dry grains of sand, it fills the narrow interstices and by its surface tension draws the grains closer together, increasing the area of contact of grain to grain, and where they are not in contact, replacing air by water. Thus in the damp mass there is a substance more nearly representing the solid form of the material, with a conductivity above that of water. As the water content is increased, the grains move apart; the water becomes the medium through which the heat passes. The apparent paradox is solved by an elementary application of physical principles. And so it is with a number of other more complicated problems. The book gives an admirable account of the application of physics to many of very real importance to the agriculturist and indicates one direction in which science can aid agriculture; a few examples may be given.

Soil differs from one part of the country to another and on the nature of its constituents depends its fertility; the grains of which it is composed vary in size, and a first step in the examination of any soil is its mechanical analysis, the determination of the sizes of the particles of which it is composed, for on these its characteristics largely depend. This analysis aims at dividing the soil into a series of groups of particles, each within some prearranged limits of size, and determining, by weighing, the percentage weight of each group. It is here that Stokes's law comes in; separation by sieves is possible when dealing with the larger particles, but the smaller grains are far too small for this. After the largest particles are removed, the remainder is mixed with water and allowed to settle; the larger particles fall more quickly; after settling for a specified time—the time in which a sphere of a given radius r_1 takes to fall from the top to the bottom of the beaker of liquid—the turbid liquid is poured off; it contains

no particle of larger radius than r_1; the sediment is treated in a similar way, and thus, by varying the height and time of settling, the soil is divided into as many fractions as are required. Each of these is then weighed.

This is a long and tedious process; the result is best represented by drawing a summation curve, in which the abscissæ represent the radius of the particles, and the ordinates the percentage of particles having a radius equal to or less than the corresponding abscissa.*

Now this percentage can be obtained more rapidly by mixing the soil and water as above, allowing it to settle for a specified time t, taking a sample of known volume of the liquid mixture at a depth x, and determining the weight of its solid contents as a percentage of the whole weight. For at the time t, all the particles at a less distance from the top than x which have a velocity as great or greater than x/t, will have passed below the level at which the sample is taken; it will contain no particles of a size greater than that corresponding to this velocity, while smaller particles will be distributed in the same proportion as in the soil originally. A series of such samples enables a complete mechanical analysis to be made. The book gives a detailed account of the method, with a discussion of the errors to which it is liable, and the accuracy attainable.

Or to take another illustration: the motion of water in the soil is clearly of the utmost importance to plant life. What are the laws which regulate this? And what knowledge can physics give of these laws?

In the first attempts to answer this question the soil was treated as a bundle of capillary tubes in which the water rose and fell in accordance with the pressure changes and the ordinary laws of surface tension; another attempt was based on the supposed analogy between the flow of water in a porous space and the conduction of heat or electricity. Briggs in 1897 abandoned the capillary tube hypothesis, and, taking the porous space as an assemblage of cellular spaces, worked out the moisture distribution on the principle that the surface energy of the films distributed over the particles of soil tends to become a minimum. It was not realised until later that the shape and volume of the spaces between the grains rather than the surfaces of the grains themselves were the essential factors of the problem, and a chapter in the book gives a most interesting account of Haines's work at Rothamsted, both theoretical and experimental. He deals, as had been done earlier by Schlicter, with an ideal soil, a large number of small equal spheres, examining the shape and volume of the interstitial spaces which correspond to different modes of packing, and the air and water distribution within this cellular structure for different moisture contents. At first the water is distributed in discrete rings round each point of contact—this was called by Versluys the pendular stage; later the rings come into contact; the water is continuous throughout the volume but air still occupies some of the spaces; finally the air is entirely expelled, the spaces are filled with water, and the capillary stage begins. Experiments by Haines and others have verified this in a remarkable way, and while, of course, soil is not the ideal medium of the theory, there is no doubt that it does represent the processes actually in operation.

Or again, a primary object in cultivation is to secure a good tilth, and for this purpose the soil is broken up into finely divided particles by various implements, of which the plough is the most important. This leads naturally to the question: What are the forces required for disintegration and how does the soil respond to the action of these forces? A further question, discussed later, is: What should be the form of plough which will disintegrate the soil most satisfactorily? Now the finer particles of soil are mostly clay, and clay when wetted forms a plastic mass. Thus we have a discussion of the motion and changes of shape of a plastic mass under pressure and the modifications in Poiseuille's equation for the motion of a viscous liquid to fit it to represent the motion of a cylinder of plastic material forced along a tube. Four stages are recognised: at first there is no motion, as the pressure increases the paste moves forward as a rigid plug, then we find a central portion moving as a rigid body surrounded by a cylindrical shell in stream-line motion, and finally the composite motion is replaced by stream-line throughout. From this we pass on to the behaviour of these fine clay particles as the moisture content of the soil is increased, the properties of soil and clay suspensions, leading to problems of colloid physics; to the agriculturist the properties of clay particles of most interest are those concerned in the coagulation of a suspension, because the surface forces concerned in this probably operate in field conditions in connexion with the formation of compound particles, and thus we find in the book much valuable information as to theories of the mechanism of coagulation.

A most interesting chapter discusses the physical

* The abscissa might be the velocity acquired by a particle of radius r in falling, or the logarithm of either of these quantities.

properties of soil under cultivation, and the application to practice of some of the principles considered in previous pages.

An important question for the farmer is what power does he require to plough a field, and the ingenious dynamometer designed for this purpose is fully described. But experiments at Rothamsted in this connexion have led to one or two important results. A whole field may to the eye or to any other cursory examination appear of uniform character; a dynamometer test may, however, show over its surface marked variation in its resistance to the plough: the dynamometer records for various plots of a field of six acres selected for its apparently uniform character indicated variation on the dynamometer scale between 1150 and 1500, and these variations remain over a number of years.

Or again, what should be the form of ploughshare which will do its work with a minimum expenditure of energy? This has been discussed by W. R. Bousfield, among others, in a paper which was read before the Institution of Mechanical Engineers in 1880. One of the earliest to solve the problem was Thos. Jefferson, the third president of the United States.

Consider a plough cutting a furrow in a field in which the unploughed portion lies to the left of the ploughman. His object is to cut a continuous rectangular sod or ribbon from the ground and turn it over so that it may lie with the side uppermost which was originally below and at some suitable angle against the ridge of the furrow on his right. The working surfaces of the plough consist of the coulter and the ploughshare; the former of these is a vertical knife which cuts the left edge of the sod, the front edge of the ploughshare is a horizontal knife at the same depth as the bottom of the coulter; this cuts the under surface of the sod; as the plough proceeds, the sod thus produced moves up the mould board, the continuation of the ploughshare which is formed so as to rotate it, at first about its bottom right-hand corner until it has turned through 90°, and then about the point which was the top right-hand corner but has now become the bottom until, after turning through a further 40° or so, the sod passes off the end of the mould board and comes to rest against the preceding ridge.

From considerations such as these Bousfield developed the fundamental form of the mould board and discussed modifications required by practice.

In the United States, White found that the standard form of mould board used was either a portion of a hyperboloid of one sheet, or was composed of portions of two such surfaces.

Concluding chapters of this most interesting book, covering the history of the subject from ancient days to the present time, deal with meteorological questions, the temperature of the soil and the conduction of heat, the atmosphere of the soil, and the gases it contains; according to figures obtained in Sweden, there is, at a temperature of 15° C., an estimated production of from 7·5 to 10 litres of carbon dioxide per square metre per day.

Dr. Keen is to be congratulated on having written a book of very real value; few persons have any idea either of what has been achieved by the labours of a few interested workers with a knowledge of physics and the conviction that by careful application that knowledge could be used to solve some of the difficulties of the farmer, or of the opportunities which remain—and they are many—to gain from a study of the physical properties of the soil new knowledge which may help man in his struggle to make two blades of grass grow where there was one before. R. T. G.

Vocational Guidance.

Methods of Choosing a Career: a Description of an Experiment in Vocational Guidance conducted on Twelve Hundred London Elementary School Children. By F. M. Earle, and other members of the staff of the National Institute of Industrial Psychology. Edited with a Preface by Charles S. Myers. Pp. 334. (London: Chapman and Hall, Ltd., 1931.) 12*s.* 6*d.* net.

THE volume just issued by the National Institute of Industrial Psychology provides an account of the most extensive investigation carried out hitherto in the field of vocational guidance. Nearly ten years ago the Institute, in collaboration with the Industrial Health Research Board, carried out a preliminary research on a limited scale—the first of its kind in Great Britain. The experiment was too small to be conclusive, and was intended only as a preparatory trial. The data, however, were sufficient to indicate that the methods proposed were feasible and that the results were likely to be of value both theoretically and practically. As a consequence, with the generous aid of the Carnegie United Kingdom Trust, the Institute undertook a large co-operative inquiry in a number of elementary schools under the London County Council. Six hundred boys and girls were examined by a small band of psychologists. On the basis of the results, advice was

given to each of the children, indicating what kind of employment was most suited to their capacities; and their subsequent history was closely traced during a period of three or four years. Another 600 were taken as a control group. These were left to seek employment in the usual way, but were carefully followed up like the others. The primary object of the experiment was to compare the after-careers in the two cases.

The first section of the book describes in detail the procedure adopted. In their final form, the psychological methods employed show a great advance on those usually followed in making a vocational study of an individual child. The inquiries into home circumstances, physical condition, mental state (including intelligence, temperament, character, and predominating interests) are all fully discussed. Occupations and trade processes are classified; and the psychological requirements of each are analysed in detail. Together with the sample tests and record-forms printed in the appendix, the whole review furnishes a workable and scientific scheme of case-study.

The second section of the book describes the inquiry into the after-careers, and draws a detailed statistical comparison between the control group and the experimental group. Here the outstanding difficulty was the extreme complexity of the general problem. So many factors influence a child's actual choice of employment, so many conditions affect his subsequent industrial success, that it might seem at first sight an impossible task to compare two groups in this way. The analysis of the data, however, is masterly; and the final results form a striking confirmation of the value of scientific guidance. Where the boys and girls examined have been able to find occupations either identical with or similar to those originally recommended, there, it appears, they tend to keep their posts longer, their work more frequently gives satisfaction to those who employ them, and they themselves are more contented with their own situation and prospects. To some extent this happens even when the recommendations are based on the rough and ready procedure of the ordinary school conference. But the tabulated figures leave little doubt that when the advice is reached by a searching, scientific study of the needs of the individual child, then the results are far more satisfactory.

It is a high testimony to the Institute's team of investigators, and above all to Mr. Earle, who, as former head of its vocational section, has been mainly responsible for the work, that such an elaborate piece of co-operate research should be brought to so successful a termination. Dr. C. S. Myers, who, as head of the Institute, planned the general lines of the investigation and made the initial arrangements, contributes a preface and a lucid summary of the whole experiment. He puts the final conclusion in these terms: "despite unexpected difficulties, the experiment here under review does demonstrate the ability to predict vocational success in school children".

The volume itself ends with brief practical suggestions on the organisation of vocational guidance in schools. As Viscount D'Abernon remarks in his foreword, "the day cannot be far distant when in every type of school some such scheme as that adumbrated by the writers will be established, to the lasting benefit of the individual and of the community". For all such attempts at vocational guidance in the near future, the work carried out by Mr. Earle and his colleagues will form an invaluable model and guide.

German Glaciation.

Das Eiszeitalter: Grundlinien einer Geologie des Diluviums. Von Dr. Paul Woldstedt. Pp. xv + 406. (Stuttgart: Ferdinand Enke, 1929.) 29 gold marks.

DR. PAUL WOHLSTEDT of the Prussian Geological Survey is one of the leading authorities on German glacial geology, and in this concisely written volume he has compressed an account of the nature of glacial evidence and processes, a description of the glacial deposits in various countries, an account of the human remains associated with the glacial drifts, a discussion of the cause of former glaciations, and a long bibliography.

In his preliminary account of glacial phenomena Dr. Wohlstedt describes the various drifts and structures. Regarding the kar or corrie he gives no positive opinion as to its formation, but attributes it mainly to the action of frost. He distinguishes moraines from pseudo-moraines. Kames and osar he regards as both aqueous deposits, osar as banks laid down in narrow channels in the ice, and kames as broader sheets formed by the water that has spread over the country outside the ice. He does not mention the later British literature on these formations. He refers to the varied opinions as to the nature of drumlins, and quotes Fairchild's conclusion that they are due to the combined influence of ice, of the nature of the drift, of the local topography, and of weathering. Dr. Wohlstedt

gives an excellent account of stone-polygons illustrated by those of Spitsbergen. He belongs to the school that attributes to glaciers enormous powers of excavation and regards them as the cause of fiords, which he limits to glaciated coasts. He recognises the similarity of some mountain lakes to them, and calls the Walensee a typical fiord. In the chapter on fossil man he remarks that the age of the Taungs skull is uncertain.

The most valuable section of the book is the account of the north German glacial deposits, and its digest of the extensive literature upon them will be especially useful to students in other countries. The author describes the successive concentric ridges of glacial drifts formed along the edge of the Baltic ice in its successive invasions of the north German plain. Some of those ridges are not what would be expected from their identification as moraines. Some of them are unquestionably morainic and consist of typical morainic drift; but others are wide sheets of sand, with complex false bedding, no glaciated pebbles or boulders; but hundreds of stones that have been sand-cut into dreikanters. These deposits, as near Salzwedel, show none of the ordinary evidence of glacial action, and, though they are included on the small-scale maps in the moraines, they are recognised as beds of sand deposited by streams and wind outside the ice sheet. They are fluvioglacial and subaerial sands.

The international correlation of the drifts adopted by Dr. Wohlstedt is based on the German succession. He adopts four glaciations, with perhaps an earlier one of which the evidence is indefinite and is represented in England by the 'Weiburn' Crag. He correlates the four with the Penck-Bruckner Alpine series. His classification is perhaps forced and artificial. It assigns the main British glaciation to the Riss, with the Mindel doubtfully separated from it, and represented by the Norfolk Arctic Bed. The section on the British glacial deposits is probably the poorest in the book. The evidence is mainly collected from the compilations and not from the primary memoirs. The bibliography does not mention Goodchild, Carvell Lewis, J. Smith, Bailey, or Boswell. The chapters on the glaciation of Scandinavia and Finland and of North America are valuable summaries of the evidence for those countries; some other parts of the world receive brief notice.

The author's adoption of a fourfold correlation of the drifts in America and Europe forces him to attribute glaciations to a world-wide extra-terrestrial cause, which he connects with some variation in the sun. But he recognises that solar changes do not alone explain the facts: he considers that glaciations are due to a combination of variable factors, and that, though the initial cause may be astronomical, they are the product of a complex cycle of meteorological influences. He discusses the wandering of the poles and Koppen's conclusion that during the Pleistocene glaciation the north pole was in Greenland; he rejects that view from the evidence of the extensions of the glaciers in South America, which he regards as proving that the poles were at the time in their present positions. He concludes that the problem of former glaciations is still unsolved.

Short Reviews.

Problems and Methods of Research in Protozoölogy. Contributors: Justin Andrews, M. A. Barber, H. P. Barret, E. R. Becker, G. H. Boyd, Chas. F. Craig, Frank G. Haughwout, Robert Hegner, M. J. Hogue, Francis O. Holmes, T. S. Hsiung, John F. Kessel, Harold Kirby, Jr., Charles A. Kofoid, W. H. W. Komp, R. R. Kudo, M. S. MacDougall, Reginald D. Manwell, Maynard M. Metcalf, Herbert Ratcliffe, Lowell J. Reed, C. W. Rees, Bruce D. Reynolds, Nannie M. Smith, Lucy G. Taliaferro, W. H. Taliaferro, D. H. Wenrich. Edited by Prof. Robert Hegner and Justin Andrews. Pp. ix + 532. (New York: The Macmillan Co., 1930.) 21*s.* net.

THIS volume, to which twenty-seven American workers in protozoology contribute, was designed with the laudable objects of familiarising both students and specialists with recent developments in various fields of protozoological research and of propounding fresh problems and new methods of attack. It consists of 42 chapters, of which 14 are written by the joint editors, Profs. Hegner and Andrews, of the department of protozoology at Johns Hopkins University. They cover a wide range of subjects, and are obviously written not so much to display accepted facts as to stimulate speculative interest in the economics of protozoa and their host-parasite relationships. We have, for example, chapters on the protozoa of termites that apparently assist their hosts to digest a diet of cellulose, on methods of cultivating *Amœbæ* and flagellates, on the flagellates of the latex in Euphorbiaceæ and their insect vectors, on the development of serological methods for diagnosis and classification, and on recent advances in the study of malaria in man and birds, the latter now being freely used as test objects for chemotherapeutic experiment. Throughout the work attention is directed to lines of work that might yield results of interest. The chapter on experimental malaria in birds, for example, ends with a tabulated list of no fewer than 76 questions to which investigators are invited to apply their minds.

A bibliography of text-books and monographs

on protozoology, a list of journals in which papers on protozoology appear, and a list of some 800 references to original literature conclude the volume.

Elektroneninterferenzen. Herausgegeben von Prof. Dr. P. Debye. (Leipziger Vorträge, 1930.) Pp. vii + 85. (Leipzig: S. Hirzel, 1930.) 6 gold marks.

THIS important little book consists of seven lectures delivered at Leipzig during the summer of 1930. The first, by E. Rupp, treats of the internal potential and electrical conductivity of crystals, as manifested in the reflection of slow electrons from metallic and non-metallic crystals in such experiments as those of Davisson and Germer, Farnsworth and Rupp himself. The second lecture, by R. Wierl, describes experiments by himself and H. Mark on interference rings obtained by passing hard cathode rays through vapours like carbon tetrachloride, cyclopentane, and benzene. The third lecture, by H. Mark, discusses these experiments in the light of de Broglie's wave mechanics and Bethe's dispersion theory of electron diffraction. This is followed by a very brief discourse by N. F. Mott on the atom form-factor.

The latter half of the book is devoted to electrons in metals, and begins with a lecture by E. Grüneisen on the relation between the electrical and thermal resistances of metals and the temperature, in which he discusses recent experimental results in the light of the theories of F. Bloch and R. Peierls. The sixth lecture, by F. Bloch, deals with the interaction between the electrons in a metal, and the last, by R. Peierls, with the behaviour of metallic conductors in strong magnetic fields.

The book will no doubt prove very useful to students desiring an authoritative summary of recent experimental and theoretical researches in the fields of electron diffraction and metallic conduction, as well as to research workers seeking material for further investigations.

The Properties of Matter. By W. H. Spikes. Pp. vii + 152. (London: Sidgwick and Jackson, Ltd., 1930.) 4*s*.

AMONG the multiplicity of physics text-books to meet all types of students and all standards of examinations, there is little which falls under the heading of 'Properties of Matter', other than those of a fairly detailed or advanced type. In the past, a fair part of the subject matter has unfortunately fallen largely between the secondary school and the university. A work which aims at presenting a short and concise course is therefore to be welcomed, and the little book under review is stated by its author to have been drawn up to meet the needs of sixth forms in secondary schools.

A treatment under the conventional headings, in the space of some 140 pages of fairly large type, has necessarily involved considerable condensation, but the author's object appears to have been satisfactorily carried out. Emphasis is laid on the historical development, and the exposition is clear and attractive. A minimum of the simplest calculus is employed. The addition of a short section on dimensions of quantities and its illustration in the results deduced would seem desirable. On page 15, the invention of the astronomical telescope is incorrectly attributed to Kepler. A selection of test questions is appended. N. M. BLIGH.

Le littoral du nord de la France et son évolution morphologique, suivi d'un appendice: L'Évolution du rivage du nord de la France et l'activité de l'homme. Par Abel Briquet. Pp. v + 439 + 45. (Paris: Armand Colin, 1930.) 60 francs.

IN making a detailed study of the changes in the coastline of Picardy and Flanders, the author has produced a valuable study in physical geography. His region extends from about the estuary of the Somme to Flanders, and so includes two areas of coastal plain and the intermediate high coastline around Calais and Boulogne. The study is very detailed, and discusses at length the processes involved, and thus may be used to throw light on coastal changes in general. Particular attention is paid to the evolution of the estuaries, the formation of dunes, and the evolution of the drainage of the plains. An appendix discusses the problems of human settlement in relation to the physical geography, and brings together various considerations that have been mentioned in the main part of the book. There are many sketch maps and diagrams.

The Works of Aristotle. Translated into English. *Physica.* By R. P. Hardie and R. K. Gaye. Pp. viii + 260. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 10*s*. 6*d*. net.

THE publication of Aristotle's "Physica" is an important addition to this standard translation of his works into English. The book should be popular with men of science and philosophers alike, in so far as it refers particularly to fundamental doctrines concerning motion, space, time, and the different types of cause studied by the physicist. Aristotle's views on these topics are too well-known to be restated here. A careful study of his "Physica" would show, however, that the philosopher of Stagyra has a great deal to say with important bearings on our modified physical concepts. The translation itself, edited by Prof. Ross, satisfies the needs of real scholarship. T. G.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 331. Abt. 9: *Methoden der Erforschung der Leistungen des tierischen Organismus*, Teil 4, Heft 4 (Schluss). *Methoden und Technik der vergleichenden Stoffwechselphysiologie bei Wirbellosen.* Von H. P. Wolvekamp. Pp. 439-524 + xiv. (Berlin und Wien: Urban und Schwarzenberg, 1930.) 5.50 gold marks.

THIS small section of Abderhalden's great undertaking deals with the very specialised methods adopted in research into the metabolism of invertebrates. It is of especial interest to zoologists engaged in laboratory work, more particularly since the author has brought his account thoroughly up to date.

Influence of Modern Hydro-Electric Power Development on the British Coal Trade.

By Dr. BRYSSON CUNNINGHAM.

THE striking, and even astonishing, development during recent years of sources of hydraulic power for the generation of electricity, gives rise to a pertinent and interesting inquiry as to the influence this widespread creation of hydro-electric energy is having, and is likely to have, upon the output and use of coal for power production. It is a question of not inconsiderable importance to Great Britain, since exportations of coal represent a very remunerative source of revenue to colliery proprietors and shipowners, while to the country as a whole, coal, as one of its most abundant and valuable mineral deposits, is a factor of the highest importance in its industrial activities.

As regards the internal economy of Great Britain, the available supplies of water power are of minor account: they are too insignificant to affect British coal consumption in any appreciable degree. It is in regard to countries abroad, Canada, Italy, Scandinavia, and Switzerland, for example, where extensive mountainous regions afford abundant scope for the realisation of hydraulic power, that the consideration chiefly applies, and Great Britain is concerned so far as their development affects the quantities of coal which are exported to customers abroad.

The fuel equivalent of one installed horse-power produced by water wheel, or turbine, has been computed by the Canadian Department of the Interior at 5½ tons of coal per annum. This figure is, of course, variable according to conditions of a widely differing character, and it involves several assumptions which are not of universal application, but it affords some idea of relative values and may conveniently and justifiably be used in general terms for a brief review of the subject. As a matter of fact, it is based on the average annual coal consumption per kilowatt-hour of all public utility power plants in the United States. This consumption has ranged, on a gradually decreasing scale, from 3 lb. of coal per kw.h. in 1920 to 1·69 lb. per kw.h. in 1929—the last-named figure being convertible into the 5½ tons of coal per annum adopted by the Canadian Government as its standard of comparison.

In the most recent report of the Dominion Water Power Bureau, dated Jan. 31, 1931, and reviewed in NATURE of April 18, it was pointed out that, on this basis, the then existing water power installation in Canada of 6,125,012 horse-power was capable of effecting a saving of nearly 33¾ million tons of coal per annum. With the marked economies which are continually being realised in coal consumption in fuel power stations, the equivalent unit value indicated in the preceding paragraph is falling, but the saving of nearly 34 million tons of coal annually is no over-statement at the present time and is believed to be a conservative estimate.

This is for Canada only. If thereto be added the corresponding figures for all other countries in which water power development is in active prosecution, the aggregate arrived at will be of considerable magnitude, and if, furthermore, there be taken into account the potential supplies as yet undeveloped, and, in most cases, greatly exceeding the capacity of the installations in actual operation, the grand total will be of dimensions which may well be described as colossal, and even startling. The United States Department of the Interior has recently issued a statistical statement, prepared by the Geological Survey, placing the world total of potential water horse-power at 447,000,000, of which slightly more than 10 per cent is, as yet, actually developed. This estimate is by no means excessive: it is probably too low from lack of sufficient data. Previous articles in NATURE have shown that there is more than forty million horse-power available in Canada and about twice as much in the United States [1], while several European countries have resources estimated at from five to ten million horse-power each.[2]

At first sight, it might appear that such enormous actual and potential savings in fuel consumption for power producing purposes are bound to affect the coal trade very adversely and to bring about a substantial reduction in British coal exports. Yet, strange to say, this is not the case so far, and on investigation it will be found that the matter is not quite so simple a sum in subtraction as it would appear to be.

The figures in the table on p. 398 show the coal consumption in, and British exports of coal to, five leading countries during the past four years, with corresponding pre-War figures for 1913. From this statement it can be seen that, on the whole, there is remarkably little change in the situation as regards solid fuel consumption. Within not undue limits, the consumption of coal in Switzerland, Norway, Sweden, and Canada has remained approximately uniform and fairly equal to that of nearly twenty years ago. Italy, the one exception, has actually increased its coal consumption.

This unlooked-for and apparently incongruous result can be explained on several grounds, not the least valid of which is that, by reason of the natural expansion of the world's industrial activities and the increase in the amenities of civilisation, there is a corresponding augmentation in the demand for power, which affords scope for supply from sources other than fuel without diminishing the demand for the latter. Omitting other considerations, the rate of hydro-electric development in countries of stationary fuel consumption should be a measure of the natural expansion of industry, but owing to economies effected in fuel utilisation and in manufacturing processes and output, this cannot be claimed as a rigorous standard.

In considering the quantities of fuel consumed, notice should not be omitted of the increasing use of oil and natural gas as substitutes for coal. As yet, however, the gross consumption of such

alternatives for power-production purposes appears to be of insufficient proportions to affect the main trend of this inquiry. The Report of the Electricity Commissioners for the twelve months ended Mar. 31, 1930, shows that for a total of nearly twelve thousand million units of electricity generated at 568 stations in Great Britain, the quantity of fuel oil used was about 0·3 per cent of that of coal. In other countries the proportions will naturally vary according to circumstances. In the United States, for example, where supplies of oil are plentiful, the percentage of liquid fuel used for generating electricity in public utility power plants during 1929 was nearly ten times as great, that is about 3 per cent. These two representative cases show that the influence of oil fuel is at present reasonably negligible and does not call for further examination.

Looking now at the British exportations of coal, it can be seen that, notwithstanding the uniformity of coal consumption, these exports have increased in relation to Canada, but have decreased very materially in relation to Norway and Sweden and less heavily in relation to Italy. Here some discrimination of explanation is necessary.

The decrease in coal exports to the last-named three countries is attributable mainly to foreign competition; particularly, in regard to Scandinavia, on the part of Poland, where the costs of production are much less than those of British coalfields, and where the rail haulage rate to the Baltic ports of Danzig and Gdynia is comparatively very cheap and the port and loading charges are on a lower scale than at British ports.[3] As regards Italy, the most formidable competitor of Great Britain is Germany. Before the War, 90 per cent of the coal imported into Italy was British. The percentage has since fallen to 55, while, owing to heavy deliveries of reparation coal, Germany now sends more than four times her pre-War quantity, representing 31 per cent of the total Italian imports of coal to-day.

Excluding the strike year, 1926, the annual coal output of Great Britain has not varied to any serious extent during the last ten years. In 1922, according to the Board of Trade returns, it was 249,606,864 tons; in 1930 it was 247,235,300 tons. The highest year was 1923 with 276,000,560 tons and the lowest, 1928, with 237,471,931 tons. Exports have shown a rather wider range, reaching 79,459,469 tons in 1923 and falling to 50,055,118 tons in 1928, the quantities for most of the years in the period lying between 50 and 60 million tons.[4]

The figures do not prove very much, one way or another. If there has been no progressive or ultimate increase, there has also been no appreciable decline of extended duration. Indeed, it has to be admitted that it is not possible to draw conclusions of a positive character from the official returns, and pending further evidence, the influence of current hydro-electric developments on the British coal industry must remain something of the nature of an interesting and elusive speculation.

QUANTITIES OF COAL CONSUMED IN, AND EXPORTS OF BRITISH COAL TO, ITALY, SWITZERLAND, NORWAY, SWEDEN, AND CANADA.
(Metric Tons)

Year.	1913.	1927.	1928.	1929.	1930.
ITALY :					
Consumption	10,643,126†	12,884,712	11,650,456	13,267,652	14,300,627*
British Exports	9,804,737	6,903,188	6,730,499	7,210,694	7,284,405
SWITZERLAND :					
Consumption	1,969,454	1,982,467	1,908,154	2,065,597	1,985,868
British Exports	30,358	129,244	127,262	137,324	127,180
NORWAY :					
Consumption	2,276,808	2,240,979	2,122,559	2,434,757	2,274,514
British Exports	2,335,886	1,599,818	1,135,348	1,468,061	1,221,862
SWEDEN :					
Consumption	5,241,786	5,265,345	4,455,852	5,389,127	5,169,141*
British Exports	4,637,609	2,217,836	1,564,903	2,374,009	1,795,364
CANADA :					
Consumption‡	26,789,734	28,794,988	27,723,969	28,401,960	25,802,449
British Exports	38,445	848,325	639,320	756,989	991,031

* Estimated. † Includes coke. ‡ Excluding lignite.

[1] NATURE, April 18, 1931, and May 31, 1930.
[2] NATURE, Sept. 6, 1930, gives figures for Italy and Switzerland at about the lower limit; France and Norway reach the higher.
[3] Report of British Coal Delegation to Sweden, Norway, and Denmark. H.M. Stationery Office, October 1930.
[4] Board of Trade Annual Journal, and Chamber of Shipping Annual Report, 1930–31.

Periodic Physico-Chemical Phenomena.

By Dr. ERNEST S. HEDGES.

PERIODIC phenomena of all types have a peculiar fascination to the human mind, possibly because they suggest some of the processes of life. On the largest scale, mechanical periodicity is inherent in the movements of celestial bodies and of the earth, producing secondary periodicities, which we recognise as the yearly seasons, alternating day and night, the ebb and flow of the tides, and in other ways. These time-periodicities in their turn leave their mark on earthly structures which are in the course of formation, producing spatial periodicities, such as the annual rings in the

trunks of trees, and probably the bands in many geological deposits. The seismologist and the meteorologist recognise periodicities in earthquakes, in thunderstorms and other climatic conditions, but periodicity is above all familiar to the biologist. To consider the processes of breathing and the heart-beat is sufficient to indicate the fundamental importance of periodic phenomena in biological systems, quite apart from the interest attached to structures having a spatial periodicity. In fact, periodicity both in space and in time has so come to be regarded as a characteristic of the biological sciences that when it is encountered in purely physical systems it almost constitutes a link between the two.

Although, during the last hundred years or so, periodic processes in physico-chemical systems have been reported from time to time, it is only during the last decade that a systematic study of this principle has been made.[1] The results have shown that both temporal and spatial periodicities are at least as frequently encountered in purely inorganic physico-chemical systems as in biological organisms. It is proposed to apply the term 'periodic structures' to banded and other structures showing a spatial periodicity, and to restrict the term 'periodic reactions' to chemical processes in which it can be shown that the reaction velocity varies periodically.

Periodic Chemical Reactions.

It is not possible within the limits of a short article to review more than a few types of the periodic reactions which have been investigated. One of the most striking is the curious intermittent action of mercury on hydrogen peroxide, which has been the subject of a considerable amount of research by Bredig [2] and several later investigators. When clean mercury is brought into contact with a solution of hydrogen peroxide, the alkalinity of which has been adjusted within certain rather narrow limits, oxygen is evolved at the interface at regular intervals of about one minute, and during the intervals between the pulses of gas the mercury becomes covered with a film of oxide. The simultaneous periodic changes of surface tension are shown by the pulsation of the mercury surface, and anyone who performs the experiment cannot but be struck with the remarkable similarity to the heart-beat. Bredig remarked upon the enormous influence of traces of catalytically active materials on the mercury-hydrogen peroxide pulse, the fact that both in this system and in the cardiac rhythm the pulse is accompanied by electrical disturbances, and also that both the biological system and its inorganic model are characterised by an unusually high temperature coefficient. He also recognised that both phenomena might be conditioned by the periodic formation and rupture of an unstable film.

The dissolution of metals in aqueous solutions of electrolytes has proved a fruitful field for the examination of periodic reactions. At the beginning of the present century, Ostwald [3] described the periodic dissolution of chromium in dilute hydrochloric acid. Certain (irreproducible) specimens of chromium gave rise to a pulsating evolution of hydrogen. The investigation had eventually to be abandoned, but the phenomenon was traced to the presence of some unknown impurity in the metal.

Hedges and Myers [4] recorded automatically and continuously the rate at which hydrogen is evolved in numerous reactions of this type, and observed a periodic rate of dissolution of zinc, iron, aluminium, magnesium, manganese, and sodium in a number of reagents, including acids, alkalis, neutral salt solutions, water, and alcohols, showing that, given the right conditions, the phenomenon is a general one and is not a special property of chromium. The cause of these periodic phenomena has never been completely elucidated, and subsequent research has been directed to the study of the anodic dissolution of metals under the external application of an electric current, where the velocity of dissolution and other factors can be kept under control. The experiments rendered it quite clear, however, that the periods are obtained only in the presence of some foreign substance, which may be present in extremely small amount. In some cases it was evident that the glass reaction vessel was capable of furnishing the required trace of 'catalyst', whilst in others the addition of colloids in so small amount as one part in a million brought about periodicity. Periodic dissolution was also brought about by placing the dissolving metal in contact with a more noble metal, which had previously been 'activated' by heating in a vacuum, by cold-rolling, by bombardment with cathode rays, or by coating with metal by electro-deposition at high current densities. The behaviour of these metallic couples is closely in line with the periodic anodic phenomena described in the next section, and may conceivably be connected with the formation of oxide films. Colloids might act by stabilising such a film, or, since they are known to be strongly adsorbed at metallic surfaces, might form a film which is broken down periodically by the reacting solution.

Small quantities of catalyst poisons (formaldehyde, potassium cyanide, or sodium arsenite) decreased the frequency of the periods greatly, and larger amounts stopped the periods, whilst not appreciably affecting the normal reaction. The periodicity was destroyed by the addition of one part in a million of chloroplatinic acid. The minuteness of the quantities involved rendered the work difficult, but it is in itself characteristic of biological systems.

Lillie [5] has pointed out the analogy between the alternating activity and passivity of iron in 70 per cent nitric acid and the cardiac rhythm. A regular rhythm is obtained when one end of an iron wire is inserted a few millimetres inside a narrow glass tube, then immersing both in the acid. It appears that the rhythm is always associated with a small local region of the enclosed part, in which the reaction between the wire and the acid is continuous, and from this region waves of activation travel rapidly and periodically over the entire specimen. The enclosed region is therefore similar to the nodal or 'pace-making' region of the heart. The transmission

of a wave of activation along a passive iron wire is the nearest analogy we have to transmission along a nerve, and in both instances there follows a temporary non-transmissive or refractory period. Lillie considers that the properties of surface films are involved in both cases. In the passive iron system the spread of the wave of activation is marked by the breakdown and subsequent reinstation of the protective oxide film, which is the cause of the passivity, and in biological systems surface films are believed to underlie the response of irritable tissues to irritation.

Periodic Phenomena in Electrolysis.

Studies of periodic phenomena at electrodes during electrolysis have established the conditions for periodicity at anodes of copper and silver,[6] magnesium, zinc, cadmium, mercury, tin, lead, and an unattackable electrode,[7] iron, cobalt, nickel, and aluminium.[8] Reactions at the cathode [9] have also been studied, and several examples of the periodic electro-deposition of metals through secondary reaction have been observed.

This electrochemical periodicity is manifested by periodic changes of considerable magnitude in electrode potential and in current density, generally accompanied by visible periodic changes at the electrode, such as the intermittent evolution of gas or the formation of a film. The investigations have made it possible to formulate the conditions necessary to secure periodic effects at the anode :

(1) A film must form over the anode.

(2) The film must be soluble in the electrolyte when the circuit is broken. It follows that the electrode may exist in one of two possible states—with or without the film.

(3) The current density must be between two well-defined limits, which depend on the temperature, concentration, and nature of the solution. Periodic phenomena can be realised by so arranging the current density that the electrode has almost equal chances of remaining in one state or passing into the other. The result is that the electrode oscillates continuously between the two states. The region over which this periodic effect can be observed is often very narrow, but is sometimes quite extensive.

In order further to elucidate the mechanism, experiments have been carried out using a rotating anode.[10] The system examined was the anodic dissolution of copper in hydrochloric acid, during which a visible film forms periodically over the anode. The principal results obtained were as follows : (1) At a rotating anode the frequency of the periods is independent of the current density over a wide range ; the frequency is not dependent, therefore, on the rate at which metal ions leave the electrode. (2) The ' characteristic frequency ', which is independent of current density, increases linearly with the speed of rotation. Variation of the speed of rotation can produce two effects : (*a*) The anodic product is washed away more quickly ; (*b*) chlorine ions are supplied to the anode at a greater rate. If the frequency were determined by the first of these effects, it would no longer be independent of the current density ; consequently, it may be inferred that the frequency is controlled by the rate of supply of chlorine ions to the anode. (3) The conclusion is supported by the fact that at constant speed of rotation the frequency is directly proportional to the concentration of hydrochloric acid.

The experiments showing that the frequency depends entirely on the rate of accumulation of chlorine ions appear to leave no escape from the conclusion that dissolution of the film does not occur until a certain critical concentration is reached, but that when reaction occurs in each ' pulse ' it is complete. This is analogous to the ' all-or-nothing ' law so familiar in physiology, according to which a system does not respond to a stimulus until this reaches a threshold value, but the response is complete when that value is reached.

Physiologists explain the periodicity of breathing in a similar way ; respiration occurs every time the carbon dioxide content (hydrogen-ion concentration) of the blood reaches a threshold value.

Experiments on the periodic electro-deposition of metals through secondary reaction afford strong support for the critical concentration view, and are difficult to explain in any other way. For example, in the electrolysis of potassium mercuricyanide solutions, under certain conditions the potassium liberated at the mercury cathode reacts alternately with water molecules and with the complex $Hg(CN)_4''$ ions or undissociated salt, the final effect being a periodic evolution of hydrogen alternating with deposition of mercury. The supposition here is that reaction of potassium with the complex ions does not take place until the ions reach a certain critical concentration by diffusion, and in the meantime reaction with water molecules occurs. The mechanism is similar in outline to the older idea that the heart-beat is caused by alternate reaction with or adsorption of calcium and potassium ions, although that view does not appear to be greatly favoured by present-day physiologists. It may also be pointed out that in colloid systems critical concentrations of ions are required for coagulation, and such systems appear to be particularly favourable for periodic phenomena.

Independent evidence of the existence of such critical concentrations has been obtained by the progressive addition of hydrochloric acid to copper rendered passive by anodic polarisation in hydrochloric acid, and to iron rendered passive by concentrated nitric acid.

Periodic Structures.

The study of periodic structures dates from 1896, when Liesegang [11] made the original observation that silver chromate is precipitated in the form of concentric rings when a concentrated solution of silver nitrate is allowed to diffuse into a gelatin gel containing dilute potassium chromate. Although numerous explanations have been advanced since that time, and in spite of the vast amount of experimental work which has been performed, it cannot be said that the phenomenon is completely understood. The principal fact which emerges from the

work of the past thirty years is that periodic precipitation is a very general phenomenon, and it is probable that, given the proper conditions, periodic structures can be obtained from any pair of salts which interact to give a precipitate.

Natural periodic structures resembling the Liesegang phenomenon in appearance are frequently encountered in both geology and biology, but whilst there is evidence to show that banded geological specimens, such as agates, can be traced to the diffusion of salts in silicic acid and other gels, and can thus be correlated with the formation of artificial periodic structures, it is not always safe to apply these principles to the biological specimens. This is partly because of the number of external periodic conditions which might account for their formation, such as alternating day and night, winter and summer, sleep and activity, and intermittent feeding. Typical examples are the form of starch grains and such layered concretions as gall-stones and urinary calculi. Attempts have also been made to apply the Liesegang principle to the markings on butterflies' wings and on the shells of certain molluscs.

Experiments by the author [12] have shown that the formation of periodic structures of this type can be separated into two stages: (*a*) chemical reaction without precipitation, and (*b*) precipitation by coagulation. The periodicity occurs in the second stage of the process. Similar periodic structures were obtained by the simple coagulation of colloidal solutions in gels and in glass capillary tubes. In some of the experiments in coagulation in capillary tubes the coagulum took the form of a spiral or uniplanar wavy fibre, showing an analogy with many natural colloidal fibres, such as wool. The formation of periodic structure was brought down to its simplest conditions, however, by causing concentrated hydrochloric acid to diffuse into glass capillary tubes containing sodium chloride solution, whereupon the sodium chloride was salted out in bands. The experiment eliminates both chemical reaction and colloidal phenomena, and is contrary to some of the best known theories of the formation of periodic structures.

It is concluded from this work that both in the formation of periodic structures and in the production of periodic reactions the essential condition for periodicity is the existence of some *critical condition* determining a change of state which proceeds to completion once the critical value is reached.

[1] See Hedges and Myers, "The Problem of Physico-Chemical Periodicity", Arnold and Co., 1926.
[2] *Z. physikal. Chem.*, **42**, 601; 1903.
[3] *Ibid.*, **35**, 33, 204; 1900.
[4] Hedges and Myers, *op. cit.*, chap. iv.
[5] *Science*, **67**, 593; 1928.
[6] Hedges, *J.C.S.*, 1533; 1926.
[7] Hedges, *ibid.*, 2580; 1926.
[8] Hedges, *ibid.*, 2878; 1926.
[9] Hedges, *ibid.*, 1077; 1927.
[10] Hedges, *ibid.*, 1028; 1929.
[11] *Phot. Archiv.*, 221; 1892.
[12] Hedges and Henley, *J.C.S.*, 2714; 1928. Hedges, *ibid.*, 2779; 1929. *Rev. gén. Colloid.*, **8**, 193; 1930.

Obituary.

PROF. W. E. DIXON, O.B.E., F.R.S.

THE death of Prof W. E. Dixon at his home near Cambridge on Aug. 16 is a loss which scientific medicine in general and pharmacology in particular can ill afford to bear. He was one of the few pharmacologists in Great Britain, and under his guidance the Cambridge School of Pharmacology made considerable progress.

Walter Ernest Dixon was the son of Robert B. Dixon, of Darlington, where he was born in 1871. He was educated at Dulwich and St. Thomas's Hospital, London, and, after holding the posts of house physician and demonstrator of physiology, he was elected professor of pharmacology at King's College, London. He went to Cambridge in 1902 as assistant to the Downing professor of medicine; he was appointed University lecturer in pharmacology in 1909 and reader in this subject and assessor to the regius professor of physic ten years later. During the War, his special knowledge was placed at the disposal of his country, and for this he was created O.B.E.

Dixon's reputation as a pharmacologist was international, and he was consulted frequently by important bodies with regard to those subjects of which he possessed a peculiar and intimate knowledge. He had been a member of several Government committees, more recently those on ethyl-lead petrol and drug addiction. He was a member of the League of Nations committee on drugs of addiction, and only a few weeks before his death he visited Geneva in this connexion. In particular, the British Medical Association, the Pharmaceutical Society, and the Society of Apothecaries will deplore his passing, for he had played an important part in the work and administration of these bodies.

In his laboratory Dixon was indefatigable; he was responsible for the University teaching in pharmacology at Cambridge, while in addition to supervising research work, he himself performed a great number of experiments. His literary output was considerable; he once told the writer that he had contributed to every important British medical periodical except one. He had written upon a large number of pharmacological and physiological subjects, the most important, perhaps, being his work, in conjunction with the late T. G. Brodie, upon the nature of asthma. His book, "A Manual of Pharmacology", first published in 1907, is a standard work upon the subject, and many pages of the British Pharmaceutical Codex came from his pen. He was joint editor of the *Journal of Pharmacology and Experimental Therapeutics*, and, in addition, he was on the editorial committee of several other publications.

Many honours came Dixon's way. He was elected a fellow of the Royal Society in 1911 and a fellow of the Royal College of Physicians in 1930. During his visit to Canada last year, the University of Manitoba conferred upon him the degree of LL.D. He had been president of the Section of

Pharmacology and Therapeutics of the Royal Society of Medicine, and, in 1929, he was president of Section I (Physiology) at the Cape Town meeting of the British Association.

Dixon possessed the faculty of explaining the most difficult problem in the simplest possible way. He was a fluent and ready speaker, and was often requested to lecture upon both scientific and semi-popular subjects. His addresses upon "Tobacco" and the "Cocktail Habit" are examples of his powers in this direction.

It is impossible to enumerate all Dixon's interests and activities. He possessed a buoyant, kindly nature; he was always cheerful, always full of life and energy. He had a host of friends, and it has been remarked, with truth, that he never said an unkind word. The day before his death, he was, as usual, in his laboratory planning future work and apparently in normal health, while those with whom he was in daily contact little thought that this was the last occasion upon which they would enjoy his confidence. He died, as he would have wished, in harness; and pharmacology has sustained its greatest loss since the death of Schmiedeberg.

F. B. P.

PROF. J. W. HINCHLEY.

JOHN WILLIAM HINCHLEY was born at Grantham in 1871, but at an early age was resident in Lincoln, and was a pupil at the Grammar School. He obtained valuable experience as an engineer with Ruston, Proctor and Co. and with the Reliance Ironworks at Lincoln. In 1893, Hinchley gained a National Scholarship and became a student at the Royal College of Science and Royal School of Mines, South Kensington. Here his career was brilliant, and he obtained a Whitworth Exhibition (1894) and later a Whitworth Scholarship (1896), but he did not avail himself of this. Whilst a student, those keen interests, which he maintained throughout his life, in all that would help his fellows were evidenced by his activities in the Students' Union, on the committee of the old students' rooms—indeed a dreary place compared with the premises of to-day—and the debating society.

Hinchley took a first class Associateship of the Royal School of Mines, and after a short time as junior demonstrator went to Dublin, where he was engaged under Prof. Joly in perfecting Joly's three-colour photographic process. Here Hinchley gained very valuable mechanical experience in working out the intricate details of ruling the colour screens used. Returning to London, he was for a time with the late Mr. Oscar Guttmann. This was followed by a residence of some years in Bangkok as technical head of the newly established Siamese Mint. This period abroad, in a climate which did not suit him, undermined his health for some time.

On his return to England, Hinchley took up consulting work, and about this time developed his ideas of the association of the chemist and engineer in the individual as a 'chemical engineer', an association which has been much criticised, but which has won through, thanks largely to Hinchley. He was mainly instrumental in the formation of the Chemical Engineering Group of the Society of Chemical Industry and was its first chairman, and also in the formation of the Institution of Chemical Engineers, from the inception of which he was honorary secretary. Hinchley first lectured at the Battersea Polytechnic and later at the Imperial College of Science and Technology, where he was appointed as the first professor of chemical engineering.

On his return to South Kensington, Hinchley at once threw himself into the social life of the College, and was particularly interested in the new Students' Union, with its many amenities. He also took a very active part in the affairs of the Old Students' Association.

Hinchley became a freemason whilst in Siam and took a great interest in masonry on his return. He was largely instrumental in the formation of the Imperial College Lodge, of which he was a past-master, and took an active part in the formation of the Radium Lodge.

As a teacher of chemical engineering, Hinchley had exceptional qualifications by reason of his very practical engineering experience, combined with an extensive knowledge of chemistry and mathematics. Not only had he the requisite qualifications, but he also had the gift of getting the best out of his students. As Prof. H. E. Armstrong wrote in an appreciation in the *Times*, "he treated the subject with a common sense, a breadth of outlook, and in a practical way which made his pupils of altogether special value in industry".

All those who were privileged to know Hinchley intimately will always remember him as one whose greatest pleasure was to be doing something for others. It was the key-note of his life. Give him some project to organise which would be helpful to others and he never spared himself. His many friends were deeply distressed by the several weeks of suffering which he patiently endured before the end in the Freemasons' Hospital on August 13.

J. S. S. B.

GROUP-CAPT. MARTIN FLACK, C.B.E.

To Martin Flack, whose death at the age of forty-nine years occurred on Aug. 16, we are indebted for the clear setting out during the War of those principles which made high flying possible by the use of oxygen breathing apparatus, and for the tests which differentiated suitable from unsuitable candidates for flying. Moreover, he did excellent work in recommending the physical training required to make and keep those chosen for the air service in fit condition. In addition, at the time when cerebro-spinal fever caused great anxiety, he did first-class work in elucidating the means, by ventilation, spacing out beds, etc., of keeping down infection and for carrying out serum treatment.

Flack raised himself by his native genius and sterling character from the elementary school to the University of Oxford, and kept himself by scholarships up to the taking of his medical degrees. Then, beginning research with Sir Arthur Keith, he discovered anatomically the sinu-auricular node, and was first to prove by experiments on the living

heart that this is the pace-maker of the heart—a most notable discovery. Next, working with me as demonstrator of physiology at the London Hospital Medical School, he proved himself to be a splendid teacher, and was enthusiastic in showing to his class experiments which the student usually has no opportunity of seeing, such as those fundamental ones by which Harvey proved the circulation of the blood.

Flack and I together carried out researches on the influence of breathing excess of carbon dioxide and deficiency of oxygen, and on the increased power to do work which the breathing of oxygen gave. We showed that runners, boxers, and swimmers were improved in performance by breathing oxygen.

This work enabled Flack, when the need suddenly arose, to design the means for overcoming the failure of war-pilots to fly at high altitudes. Oxygen breathing apparatus was supplied and perfected so that flying became possible at extreme heights. Flack tested himself in a chamber at a pressure equal to a height of well over 40,000 feet—a very courageous performance. He also contrived the tests for pilots who had crashed, which showed whether their nervous system had become stable or was still unfit for flying. One of these tests was the ability to hold the breath long and the effect of this on the blood pressure, another the power to raise a column of mercury 40 mm. high and hold it by the breath as long as possible. He was able to classify pilots as good or bad, without knowing their records for crashing, and his classification agreed with the records. By the tests which Flack introduced, the efficiency of the air service was very greatly increased, and for this Great Britain owes him a great debt of gratitude.

Flack was troubled by a rheumatic heart, but, in spite of this, was a most cheery, humorous, and energetic man, and no one could be a better colleague than he. His far too early death will be lamented by many friends, and by the Air Service in particular.

LEONARD HILL.

MR. DAVID DAVIES.

BY the death, on Aug 15, of David Davies, of Gilfach Goch, Wales has lost one of her most industrious students, and the science of palæobotany an interesting personality.

Born near Merthyr Tydfil, sixty-one years ago, Davies began his working life as a 'door boy' in a local colliery, and as soon as he was old enough became a collier. He had a passion for knowledge, especially that relating to the rocks among which he worked, and took advantage of the evening class facilities then available in the Rhondda Valley, with the result that, after passing through the various grades of colliery official, he became, while still a comparatively young man, agent to the Britannic group of collieries of the Cambrian Combine.

The interest in fossil plants that, in his boyhood days, gained for him the nickname "Dafydd Ffossil", was maintained as he grew to manhood, and, encouraged by well-known palæobotanists, he began to collect systematically from each of the separate horizons at which fossil plants occurred in the eastern part of Glamorgan. His object was to record not merely the kinds of plants that were present, but also the associations of plants and the relative abundance of each species, genus, and class of plants, and thus to lay the foundations of an ecological study of the successive 'coal-forests' that occupied the site of the South Wales coalfield.

The results of Davies's work have been published in the *Quarterly Journal of the Geological Society*, the *Transactions of the Royal Society*, and other journals, and at the time of his death, which occurred suddenly while on holiday in Norway, he was nearing the completion of a series of parallel investigations in the more westerly regions of the coalfield. During the course of such intensive collecting, he got together a very large series of coal-measure fossils, the majority of which he presented to the National Museum of Wales for the use of future students: the remainder passed into the hands of the late Dr. Kidston, and are now in the collections of the Geological Survey.

It is a matter for regret that Davies did not live to complete the work upon which he had been engaged for nearly forty years, but his manuscripts have been so carefully arranged that the essential parts of his conclusions can still be published; and the 'David Davies' collection in the National Museum of Wales, probably the largest collection from any one coalfield in the world, is a permanent memorial to his industry and devotion to science. Some years ago his work was recognised by the University of Wales and the degree of M.Sc. conferred upon Davies, and he has served for a long period upon the Council and upon the Court of Governors of the National Museum of Wales.

David Davies did not allow his interest in science to interfere with the discharge of his official duties, and he had the satisfaction of seeing a colliery district that was threatening to become derelict when he assumed charge, in 1911, enter upon a new phase of activity, resulting in the growth of Gilfach Goch from a village of some two thousand inhabitants to a community five times as large.

F. J. N.

DR. W. E. DOWNEY.

BY the death of W. E. Downey, as a result of an accident on Aug. 19 while climbing the Jungfrau, the Research Laboratories of the G.E.C. lose a brilliant worker of outstanding promise; the staff of the Laboratories lose a colleague of unusually charming personality.

Downey entered the Wembley Laboratories five years ago, and his first task was the extremely difficult one of investigating the manufacture of carbon black, with a view to putting it on a more rational basis. To this he brought a combination of scientific ability and technical insight which enabled him to apply scientific principles, so far as that can be done, to what is inevitably a very empirical process. Later, he had an opportunity of applying the same qualities to other problems,

and showed at once that real talent for industrial research which depends on an ability to inspire other and less experienced workers and also to collaborate with colleagues engaged in other branches of work.

Downey, who was only thirty-one years of age, was educated at Huddersfield College and the Imperial College of Science and Technology. At the latter he had a distinguished career, culminating in the award of a Beit fellowship. During this period he published some papers on chemiluminescent oxidations; his death, coming when it did, robbed him of an opportunity of producing further work of a more fundamental kind which he would undoubtedly have originated.

Mr. J. Adamson, honorary secretary of the Institute of Marine Engineers since its foundation in 1889, on August 20, aged eighty-one years.

Dr. G. Bryce, president of the Royal Society of Canada in 1909 and one of the founders of the University of Manitoba, where in 1891 he was appointed head of the Department of Science and lecturer in biology and geology, aged eighty-seven years.

Mr. C. R. Hewitt, librarian of the Wellcome Historical Library and formerly assistant librarian of the Royal Society of Medicine, on Aug. 15, aged sixty-one years.

Lieut.-Col. J. R. Lord, C.B.E., medical superintendent of the Horton (County of London) Mental Hospital, Epsom, who was past president of the Royal Medico-Psychological Association and editor of the *Journal of Mental Science*, on Aug. 10, aged fifty-seven years.

Sir Thomas Stanton, C.B.E., F.R.S., formerly superintendent of the Engineering Department of the National Physical Laboratory, on Aug. 30, aged sixty-five years.

Prof. Richard Wettstein, professor of botany and director of the botanical gardens in the University of Vienna, known for his work in systematic botany, aged sixty-eight years.

News and Views.

FOR several centuries quinine has held its place as a specific in the treatment of malaria, but although it controls the disease it does not have a permanent curative action. Within the last few years, a quinoline derivative called 'plasmoquine' has been introduced to therapeutics as a substitute for quinine: investigation of its action suggests, however, that its value is rather complementary to the latter. Quinine attacks the asexual stages of the malarial organisms, except the sporozoites, but has little action on the sexual stage: plasmoquinine attacks the gametocytes. In the prevention of malaria, attention has been directed chiefly to the prevention of breeding by the mosquitoes in which the sexual stages of the developmental cycle of the malarial organisms take place, and to the prophylactic administration of small doses of quinine. The prevalence of the disease in the countries where it is endemic bears witness to the difficulty of eradicating it, although thorough destruction of all breeding-places is effective. A simpler method, available where the latter is impracticable, would therefore be of very great value.

COL. S. P. JAMES, W. D. Nicol, and P. G. Shute describe some recent experiments on the prevention of malarial infection in human beings by the ingestion of plasmoquine, in a recent issue of the *Lancet* (vol. 2, p. 341; 1931). Ten volunteers were infected by allowing half a dozen mosquitoes (*Anopheles maculipennis*), infected with the parasite of benign tertian malaria, to bite the forearm; 0·02 gm. plasmoquine was taken three times daily after food for six days, the first two doses being taken before infection. The controls were patients who were to undergo a course of malariotherapy. The result was that the controls developed their first febrile paroxysms about a fortnight after infection, whilst none of the volunteers showed at any time any sign of the disease for the next four weeks. Plasmoquine therefore prevents mosquito-borne infection in healthy individuals when given in prophylactic doses, presumably by completely destroying the sporozoites; quinine does not have this property. It appears probable that a valuable preventive agent is now available: the results of its trial in a population among which malaria is endemic will be awaited with interest.

IT has become platitudinous to talk of the educational possibilities of broadcasting. Everyone knows that the possibilities are there; but how many realise the machinery which the British Broadcasting Corporation has assembled in order that those possibilities may be realised? That machinery, sensitive to new impulses, and subject always to any alterations which will bring better results, ought to be better known. Briefly, two councils are responsible for what are vaguely known as 'talks': the Central Council for Broadcast Adult Education and the Central Council for School Broadcasting. For our present purpose we refer only to the former, but each council is composed of every kind of educational interest, and is divided into committees to which special tasks are assigned. For example, the Programmes and Publications Sub-Committee meets very frequently and deals with the important, difficult, and delicate task of planning talks and securing speakers who are not only expert in their subjects but who can speak in language of common currency.

A NEW pamphlet, which may be obtained from the B.B.C., shows how all this work is being developed. It presents, under the title of "The Changing World", the plan of talks from September 1931 to March 1932. We would emphasise the word *plan*. 'Talks' have never been confined to mere haphazard observations on topical subjects, and the present programme shows a series planned in advance for a special purpose. They involve greater continuity between courses on given subjects, and unity of theme and treatment.

The general titles are significant : the modern dilemma, industry and trade, literature and art, science, the modern state, education and leisure. All the speakers will be attempting to answer certain questions : What have been the forces of change which have affected the present century ? What has been the influence on social thought and circumstances ? *What is the significance to the future of these changes, and what responsibility rests with us to remodel our ways of life ?* We italicise the last question deliberately ; for, if a series of talks can help us to give a scientific answer to them, the process of broadcasting will have shown its supreme educational value, in the fullest sense of the phrase.

RESOLUTIONS passed at the second International Discussion Conference, held at Geneva on July 1–4 by the International Management Institute and attended by delegates from nineteen countries, afford some reply to certain criticisms of rationalisation, particularly those which suggest it is responsible for over-production, unemployment, the mechanisation of work, increased economic instability, and the imposition of handicaps on weaker businesses and countries. The exceptional depression in world business is attributed less to economic factors than to political and social disorder, especially unsatisfactory international relations. While technical rationalisation results in the production of larger quantities of goods at lower prices, remedy is not to be found in the retardation or restriction of this process but in the extension of the principles of rationalisation to the technique, organisation, and administration of industry, first on a national and then on an international basis, and in the more efficient organisation of distribution. Subject to adequate publicity to safeguard the interests of consumers, the considered establishment of voluntary agreements to eliminate over-production and irrational competition is recommended, and a scientific study of distribution problems, based on international information. The Conference considered that among the many causes of unemployment, rationalisation was economically justifiable, being productive and carrying its own remedy in improvements in production and economy of human effort. The importance of minimising the displacement, assisting the displaced workers during the transition period, and of co-operation between employers' and workers' organisations was emphasised.

THE elimination of exhausting and objectionable tasks, the improved hygienic conditions, and improvement in prospects of promotion, wages, and hours of work are among compensations which rationalisation can offer for the alleged increased mechanisation of work, and the Conference recommended further efforts to encourage the full utilisation and development of the capacity of the individuals. Mistaken judgment in rationalisation has contributed at times to economic instability, and the Conference urges the importance of the development of professional institutions on wider industrial lines, so as to provide all the basic facts essential to direction and reorganisation, and the practical extension of rationalisation principles to whole nations as well as to industry. The professional organisation thus visualised will assist in the insurance of the weaker members of national or international groups against excessive risk. The importance of a close study of the social consequences of rationalisation measures is reiterated, rationalisation being both a tool and a method, and consequently capable of abuse as well as rightful use. A vigorous development of management research group movements is indicated, and closer co-operation between industry and education.

A PROJECT of some interest to scientific workers is the proposal for the formation of an international bibliography of translations, which has been favoured by various international writers', publishers', and librarians' organisations, as well as by the Institute of Intellectual Co-operation. A sub-committee of the Committee on Intellectual Co-operation of the League of Nations, reporting in July on the project, considered that a publication of this type would render valuable service in art, literature, and science, facilitate the rational collection of information for writers, publishers, translators, etc., and prove a starting point for other endeavours to co-ordinate and systematise translation. The plenary committee was requested to take action with the view of securing the early publication of an international bibliography. Co-ordination of scientific bibliography is still a problem of fundamental importance, and the committee of scientific advisers in its July meeting considered the ways in which the obstacles to this and other problems of scientific co-ordination could be more effectively overcome. Scientific co-ordination has both a technical and a moral aspect, in so far as it not only improves the conditions of scientific work but promotes intellectual *rapprochement* and international understanding. Probably the most effective contributions in this field will be made by efficient national organisations and by international associations the chief task of which is the organisation of scientific work. The Committee on Intellectual Co-operation has, however, assisted in the creation of an atmosphere favourable to such developments.

A LARGE and interesting power station which utilises peat for fuel is operating at a distance of 75 miles from Moscow. It is called the Shatura power station, and is situated near three small lakes lying close together, and adjoins an immense peat bog. The present operations cover about fifty square miles. There are three large boiler-houses fitted with chain grate stokers specially adapted for burning peat. The turf is supplied in two forms, sods and dust, the dust dropping on the top of the sods in the furnace. The latest boiler put in is made to burn turf dust only ; it has a number of oil burners to heat up the furnace before commencing, but has no chain grate. The present way of collecting the turf is by means of powerful hydraulic hose jets which play on the turf and wash it down into an excavated pit as a wet sludge. It is pumped out of this on to the fields, where it is left to dry. Then a slicer on a caterpillar tractor runs over the field, cutting the turf into sods

and turning it over. A year's turf has to be collected and dried in four or five months. It is stated in an article by F. C. Wigham in the *Electrical Times* of Aug. 13 that other work must be found in the winter for the 5000 men employed on the turf field. The turf work is a separate business from the electric works and sells its product to the latter at a profit. All industries in Russia must now earn 6 per cent on the capital employed. In the annual report, it is stated that 920,000 tons of turf were consumed last year, the cost of the turf in the bunkers being a little more than 11 roubles per ton, the par value of the rouble being 2*s*. 1*d*. and its purchasing value being about half as much. The power is transmitted to Moscow at 115,000 volts, and the cost per unit last year was 2·20 kopeks, a kopek being equal to ¼*d*. In every five days, half the head staff are away on holiday on one day and the other half on another day.

In connexion with the Weir report on railway electrification, it is of interest to notice that the electrification of the G.I.P. railway between Bombay, Poona, and Igatpuri has revolutionised passenger and goods traffic and has been of immediate benefit to Bombay and its neighbourhood. It seems probable that considerable main line electrification will be undertaken in North and South India in the near future. The electrified section of the railway extends for 272 track miles. The total amount of the original estimate was about four million pounds, and Messrs. Merz and McLellan, of Westminster, were the consulting engineers. The power supply for the main line system is obtained from a steam power station, and coal of a lower grade than that utilised by the steam locomotive is used for the boilers. The transmission system consists of two high-pressure transmission lines extending 272 miles and supported on lattice type steel towers, of which there are about 2000, their average height being 70 feet. There are 840 miles of steel-core aluminium conductors used in the transmission. The distance between consecutive traction substations on the main line is twelve miles. The pressure of transmission is 95 kilovolts, and this is transformed into 560 volts at the open-air substations and then converted into 1500 volts direct current by rotary machines connected in series. Only five of the substations have attendants, the remaining substations being controlled from the former by electrical methods. The goods locomotives for the line were made by Messrs. Metropolitan Vickers Electric Co., and each weighs 120 tons, being the largest hitherto built in England. Smooth running has been obtained with speeds up to 80 miles per hour, and the scheduled time from Bombay to Poona has been reduced by 30 per cent. The whole scheme has been carried through in three years with practically no interruption of the normal traffic.

The British Drug Houses, Ltd., London, N.1, have recently issued various pamphlets describing certain of their products. The catalogue of fine chemicals includes both organic and inorganic compounds, analytical reagents, indicators and standard stains. All the commoner substances are stocked in standard packages of 25 gm., 100 gm., 250 gm., and 500 gm. A leaflet describes an outfit for the simple estimation of the blood area in 0·1 c.c. of blood according to the method of Osman and Close (*Brit. Med. Jour.*, Vol. 1, p. 1064; 1931). The urea is converted to ammonia by adding urease to the blood, and the process completed by precipitating the proteins with trichloroacetic acid, filtering and estimating the nitrogen in the filtrate colorimetrically against a series of standards. For the injection treatment of varicose veins, ampoules of sodium morrhuate (5-10 per cent solution) and of quinine and urethane solution are issued as sclerosing agents. When properly carried out, this treatment results in permanent cure and is much simpler than operative removal. It is well known that the liquid extract of ergot of the British Pharmacopœia contains little or no ergotoxine: moreover, most solutions of the latter deteriorate on keeping. The British Drug Houses are issuing a liquid extract guaranteed to contain, by physiological test, 0·03 per cent ergotoxine, and also, an improved preparation, 'Ergodex', of the same strength, which is miscible, contains the whole alkaloidal content of ergot and exerts the full therapeutic effect of the entire drug. It suffers no loss in activity after storage for 12 months when kept in well-closed containers protected from bright light.

In recent years our knowledge of the deep living pelagic fauna of the oceans has been greatly advanced through collections made by oceanographical research vessels. It is safe to say, however, that the larger part of the examination of the animals themselves has been undertaken on the preserved material either in museums or in other institutions. Such observations as can be made on the delicate organisms and on the living animals themselves have had to be noted on board ship, where vibration and other movements of the vessel do not make for ideal conditions. To be able to examine living collections on the day they are caught in the peace of a shore laboratory is therefore an ideal to be sought after. This possibility has recently been proved by the Bermuda Oceanographic Expedition of the New York Zoological Society under the leadership of William Beebe, who gives a short account in *Zoologica*, vol. 13, Nos. 1 and 2. The laboratory is established on Nonsuch Island, and with the aid of a tug, the *Gladisfen*, collections can be made in 1000 fathoms of water a little more than five miles from the shore; living material is brought to the laboratory in cooled water. It is hoped that in this way much interesting information otherwise unobtainable will become available.

In the keeping of aquaria the opinion is current that the successful maintenance of fish and plants can be accomplished only if sunlight falls upon the tank at some part of the day. But the revision of this opinion is suggested by an article in the *Aquarium Review* for July, where the author describes his two years' experience of a community tank without sunlight. The tank in question measures 54 in. by 12 in. by 12 in., holds roughly about 30 gallons of water, and is heated to about 74° F. by a simple arrange-

ment of two fish-tail gas jets playing upon a distributing layer of sheet tin beneath the slate bottom. The room in the window of which the tank is placed faces due north and is situated on the fourth floor of a five-storey building in a London street. The success of the arrangement is shown by the fact that about forty tropical fishes, selected for their bright colouring and peaceable habits, live there in amity, and that by the cutting-off of a portion at the end of the tank by a partition of opaque glass many broods of viviparous fishes have been reared. The study of the article is commended to naturalists who have been deterred by apparently unpromising conditions from installing tropical aquaria.

IN the *Aquarist* for July-August, W. J. Pitt tells of a dwarf chamæleon (*Chamæleo pumilus*) having had two litters without a second impregnation. The reptile was bought in London on April 9 of last year, when it appeared to be pregnant, and—the species being viviparous—duly brought forth a dozen young, all perfect and (except three) living, on April 17. No male was kept with it, but nevertheless on Oct. 23 ten more young were born, but this time dead and, with the exception of two, one of which was perfect and the other nearly so, in an early stage of development. This, as the observer remarks, makes untenable the suggestion that the journey from South Africa had caused the first litter to be prematurely born; it may be added that a litter of twenty-two would be a very unlikely number—about double the normal expectation. It is mentioned that an occurrence like the above is apparently unrecorded for reptiles, though well-known in some viviparous fish, such as the swordtails (*Xiphophorus*), now familiar to aquarists.

THE Annual Report of the Joint Board of Research for Mental Diseases, formed by the City and University of Birmingham, for the year ending March 14, gives an outline of the work of the Laboratory. A general attack on the problems of mental disease is being made from the bacteriological, histological, and chemical points of view. Negative as well as positive results are recorded. Mention is made that a murder-suicide case was examined for nasal sinus disease. Presumably as this is a laboratory report, it represents the more physiological approach; parallel with this there should be a psychological study. Even granted that it could be shown that a suicidal-murderer had some physiological defect, this does not prove that this defect was related as cause and effect to his behaviour.

IN an article by Dr. Ellice McDonald on "Cancer Research and the Scientific Method" (*Science*, July 17, 1931, p. 55), the principal biochemical deviations from the normal in the cancer patient are detailed. These comprise increased glycolytic activity and diminished lactic acid formation of tumour tissues, increased alkalinity of the blood plasma, and diminished calcium and increased potassium content of cancer cells. It is considered, therefore, that any cure for cancer must be capable of altering these conditions and bringing them back to normal. At present these appear to be the only criteria that can be formulated for a cancer cure.

AN exhibition of modern optical instruments has been arranged at the Science Museum, South Kensington, and will remain on view until the end of October. Among the two hundred exhibits are apparatus for spectrophotometry in the ultra-violet, an aerial camera which takes 100 photographs with one filling, a projection microscope magnifying up to 5000 times, range-finders, theodolites, etc.

ON the evening of Aug. 10, one of the greatest earthquakes of the year occurred in western China (NATURE, Aug. 22, p. 299). Its epicentre has been determined by the U.S. Coast and Geodetic Survey, from a large number of records, as situated in lat. 42° N., long. 90° E. (Science Service, Washington, D.C., Aug. 11). The origin was thus in the Sinkiang province of China, on the west edge of the Gobi desert, an area so sparsely settled and so far from lines of communication that direct news of the earthquake can scarcely reach us for many weeks or months, if ever.

THE Institution of Heating and Ventilating Engineers is appealing to the industry for £2000 in order to construct an experimental room enclosed within a larger structure, so that the outer surfaces of the walls of the room may be exposed to controlled conditions and the efficiencies of different methods of heating the room determined. Promises may be sent to the Institution at 12 Russell Square, W.C.1, and are subject to the decision of the Department of Scientific and Industrial Research to proceed with the scheme.

WE have recently received from the British Museum (Natural History) part 2, fascicle 4, of a monographic work on the Diptera of Patagonia and South Chile, in course of publication. The present contribution deals with the Simuliidæ, by Dr. F. W. Edwards, and the Caratopogonidæ, by Drs. A. Ingram and J. W. S. Macfie. It is well up to the standard of its predecessors, and, when completed, the whole work will form an important addition to our knowledge of the fauna of the region concerned.

THE Imperial Bureau of Plant Genetics for Herbage Plants, which is located at the Agricultural Buildings, Alexandra Road, Aberystwyth, has issued the first number of its *Bulletin*. The numbers are to appear quarterly at 1*s*. 6*d*. per issue, 4*s*. for the present year, and 5*s*. annually thereafter. The first number contains abstracts of current papers on herbage, classified according to the decimal system, and indexed. *Bulletin* No. 3, issued at 3*s*., contains a detailed account, by Prof. R. G. Stapledon, Mr. T. J. Jenkin, and Mr. R. D. Williams, of the methods employed in herbage breeding at the Welsh Plant Breeding Station, Aberystwyth. This is illustrated by three plates, and the methods are explained particularly in connexion with various grasses, including cocksfoot grass, and such leguminous crops as the clovers and lucerne. These methods are of much value in connexion with the production and improvement of pasture grasses and fodder crops.

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.*]

The Corpuscular Explanation of Cosmic Rays.

WITH reference to the attempts that are being made to determine whether the cosmic radiations are corpuscular or undulatory in character, such as those described by Bruno Rossi,[1] there is one point which I have vainly tried to understand. Why is it assumed that such rays would or could have the high penetrating power of cosmic rays ? As I tried without success to point out at the recent discussion at the Royal Society, there is no experimental evidence of corpuscular rays being able to traverse more than 4 mm. of aluminium. It is, of course, known that a few of the β-rays of radium and thorium have energies, as measured by their magnetic deviability, up to some millions of volts. But what experimental evidence is there that these have greater penetrating power than rays of lower energy ? Is it not rather to be expected that it would be less, or do the ordinary conceptions of relativity not apply to the theory of relativity ? If we try to get the necessary penetrating power by the increase of mass of the particle due to its speed, is not the mass of every other particle with which it collides similarly increased ?

FREDERICK SODDY.

Oxford, Aug. 22, 1931.

[1] NATURE, **128**, 300, Aug. 22, 1931.

Measurements on the Absorption of the Penetrating Corpuscular Rays coming from Inclined Directions.

IN a recent discussion on the cosmic rays,[1] Prof. Geiger has pointed out that it would be of interest to make comparative measurements on the absorption of the penetrating corpuscular rays coming from different inclinations to the vertical.

Such an experiment was performed by me shortly before I read this paper, by measuring the diminution in the number of coincidences when a screen of lead 9 cm. thick was introduced between two Geiger-Müller's tube-counters (5 cm. in diameter and 15 cm. long) placed with their axes horizontally, at a distance of 17 cm.

By inclining more and more to the vertical line the plane containing the axes of the two tube-counters, thus increasing the thickness of the atmosphere in the direction of those rays which can determine the coincidences, I expected to find a progressive hardening of the corpuscular radiation, similar to the one which had been stated, by filtering the radiation through a lead screen.[2]

The experimental result did not confirm this expectation. Indeed, with the two counters placed vertically the one above the other, I measured an absorption of $23{\cdot}2 \pm 1{\cdot}6$ per cent; whilst when the plane of their axes was put at an angle of 60° to the vertical line, the absorption was found to be $32{\cdot}5 \pm 3{\cdot}5$ per cent.

It appears, therefore, that the slant rays are softer and not harder than the vertical ones.

This result may be accounted for by assuming that the corpuscular rays generate in the atmosphere a softer secondary corpuscular radiation, and that the relative amount of the latter is in an inclined direction larger than in the vertical one.

BRUNO ROSSI.

Physical Institute of the
University of Florence,
Arcetri, Italy, Aug. 10.

[1] NATURE, May 23, p. 785; *Proc. Roy. Soc.*, July 2.
[2] B. Rossi, *Zeit. für Phys.*, **68**, 64; 1931; and *Rend. Lincei*, **13**, 600; 1931.

Isotopic Displacement in Hyperfine Structure.

THE analysis of the hyperfine structure of several lines in thallium[1] indicates the existence of two distinct sets of energy levels, one for Tl 203 and the other for Tl 205. Each isotope has a nuclear spin $i = \frac{1}{2}$. For the line $6s\ 7s\ {}^3S_1 \longrightarrow 6s\ 7p\ {}^1P_1$ in Tl II, the doublet width is approximately the same size for the two isotopes, which signifies that the magnetic moments must also be approximately equal. The distance between the centres of gravity of the two doublets, however, is greater for Tl 205. Jackson,[2] studying rubidium, concludes that the lines are displaced toward the ultra-violet for the heavier isotope.

From existing theories of hyperfine structure, one is led to conclude that such a bodily displacement would occur even when both isotopes have zero magnetic moment. Experimental evidence as to this would be valuable.

It appears, then, plausible to assume that the electric field produced by the nucleus is not the same for the two isotopes. Whether the thallium nucleus, with a spin $i = \frac{1}{2}$, can have either a permanent dipole moment or a permanent higher moment is doubtful, if one may make an analogy with the case for the external electronic system.[3] Accordingly, the discussion will be confined to central fields, the difference between the two being in the radial dependence of the potential energy.

In order to determine the order of magnitude of the perturbation on a Schrödinger electron by deviations from the Coulomb law near the nucleus, it is probably sufficient to assume a potential energy curve as follows: $V = V_0$ for $r < r_m$, and $V = -\frac{Ze^2}{r}$ for $r > r_m$, where r_m indicates the radial extent of the nucleus. Since calculation showed that relativistic effects would not influence the result appreciably, the following treatment will not take them into account.

Sommerfeld ("Erganzungsband", p. 75) gives the radial function as $R = \frac{1}{N_r}\rho^l e^{-\rho/2} L_{n+l}^{2l+1}$, where $\rho = \frac{2Zr}{n}$ and $\frac{1}{N_r^2} = \frac{4(n-l-1)!}{n[(n+l)!]^3}$.

Atomic units are employed.

In the range from 0 to r_m. $\rho << 1$ and $e^{-\rho/2} \cong 1$. Consequently the only part of the Laguerre polynomial which makes an appreciable contribution is the constant term.

If w_1 and w_2 are the displacements of a $7s$ energy level, and of a $7p$ energy level respectively, then

$$w_1 = \frac{1}{N_r^2}\int_0^{r_m}\left(\frac{Z}{r} + V_0\right) r^2 dr [L_7^1(\rho)]^2 \cong 2Zr_m^2 + \tfrac{4}{3}V_0 r_m^3$$

$$w_2 = \frac{1}{N_r^2}\int_0^{r_m}\left(\frac{Z}{r} + V_0\right) r^2 dr [L_8^3(\rho)]^2 \cong \tfrac{1}{3}K^2 Z r_m^4 + \tfrac{4}{15}K^2 V_0 r_m^5$$

where $K = \frac{2Z}{n}$.

The displacement w_1 is much greater than w_2,

since electrons with $l>0$ do not approach as close to the nucleus as do the S electrons. Accordingly, in Tl II, the $6s\ 7s\ ^3S_1$ level should be displaced much more than is the $6s\ 7p\ ^1P_1$.

Neglecting w_2 then, and letting r_1 and r_2 be the nuclear radii of the two different isotopes, the difference in displacements is $\Delta w = 2Z(r_1^2 - r_2^2)$, if $V_0 = 0$. Experimentally, $\Delta w = 0{\cdot}2$ cm.$^{-1} = 10^{-6}$ atomic units. If we take $r_1 = 10^{-12}$ cm. and $r_2 = 9 \times 10^{-13}$ cm., then we obtain an effect of this order of magnitude. In any event, V_0 could be varied also, so that there seems to be no difficulty in accounting for the order of magnitude of the isotopic displacement on the hypothesis that the deviations from Coulomb's law near the nucleus are responsible.

My thanks are due Dr. Dirac for helpful discussion.

JAMES H. BARTLETT, JR.

Cavendish Laboratory,
Cambridge,
July 21.

[1] Schüler and Keyston, *Zeit. f. Phys.*, **70**, 1; 1931.
[2] NATURE, **128**, 34; 1931.
[3] See Unsöld, *Ann. d. Phys.*, **82**, 378; 1927.

Hyperfine Structure of Thallium II.

THE hyperfine structure of Tl II has been investigated by McLennan [1] and co-workers and partially by Schüler and Keyston.[2] Certain discrepancies in the results of the former authors can be attributed mainly to the low resolving power of the instrument employed (3 metre grating). The absence of characteristic fine structures in the magnetic analyses of the same authors is probably of the same origin.

With the large grating and the Weiss magnet at the Physical Institute at Tübingen, we have investigated the magnetic transitions of the hyperfine energy levels of singly-ionised thallium employing field-strengths of

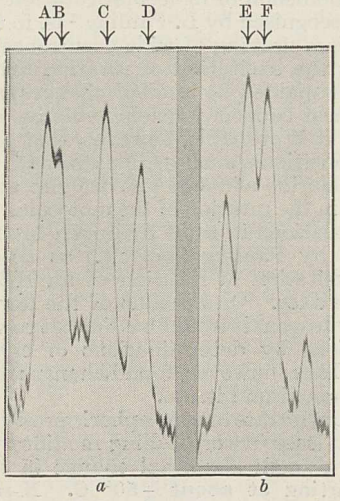

FIG. 1.—*a*, Perpendicular polarisation; *b*, parallel polarisation. H = 14,700 gauss.

15,000–43,350 gauss, in a manner similar to that employed by one of us [3] for the principal arc lines of thallium. A typical example of such transitions is the line λ 3092. In this case, the magnetic field disturbs only the $^1P_1$ levels (classified as $6s6p\ ^1P_1 - 6s7s\ ^1S_0$). The photometer curves, reproduced in Figs. 1 and 2 (magnification 30), made from fifth order plates, show quite clearly the effect of changing fields on the separations. In the perpendicular polarisation, the separation AB increases while CD decreases with increasing field; the sum of the two distances, however, remains practically constant. If the Paschen-Back effect were complete, the separations would be equal. The separation EF in the parallel components decreases with increasing field strength and is not resolvable at 43,350 gauss.

The above analysis gives us a value of $0{\cdot}092 \pm 0{\cdot}002$A.,

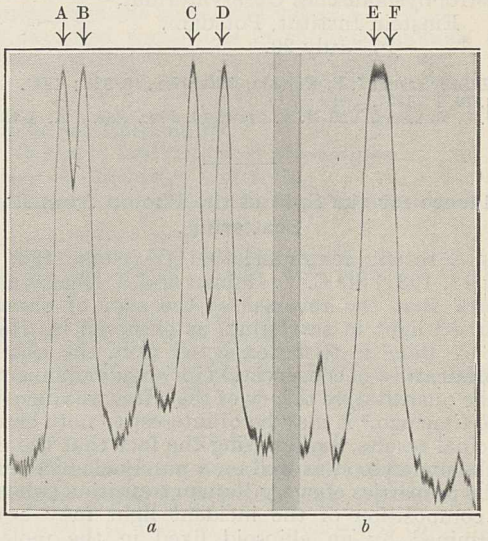

FIG. 2.—*a*, Perpendicular polarisation; *b*, parallel polarisation. $H = 32{,}500$ gauss.

or $0{\cdot}96 \pm 0{\cdot}02$ cm.$^{-1}$ for the hyperfine structure of the doublet λ 3092 in a zero field, and shows that the levels of $6s6p\ ^1P_1$ are inverted.

A complete study of the Zeeman analyses of this and other lines of thallium II will be reported elsewhere.

J. B. GREEN
(Guggenheim Fellow).
JOHN WULFF
(National Research Fellow).

Physical Institute,
University of Tübingen,
July 14.

[1] McLennan, McLay, and Crawford, *Proc. Roy. Soc.*, A **125**, 570; 1929. McLennan and Durnford, *Proc. Roy. Soc.*, A **129**, 48; 1930. McLennan and Crawford, *Proc. Roy. Soc.*, A **132**, July 1931.
[2] Schüler and Keyston, *Zeit. f. Phys.*, **70**, 1; 1931.
[3] Back and Wulff, *Zeit. f. Phys.*, **66**, 31; 1930. Wulff, *Zeit. f. Phys.*, **69**, 70; 1931.

WE have recently published two communications [1] concerning an isotope displacement effect in the hyperfine structure of thallium II. On the other hand, in a recent paper on this subject,[2] J. C. McLennan and M. F. Crawford state that they have discovered no trace of an isotope effect. In order to avoid misunderstanding, we wish to point out that this apparent contradiction is entirely due to the fact that the resolving power of the grating used by McLennan and Crawford is insufficient to separate the lines due to the two isotopes. The smallest separation resolved by McLennan is $\Delta\nu = 0{\cdot}370$ cm.$^{-1}$; the largest isotope displacement is $\Delta\nu = 0{\cdot}280$ cm.$^{-1}$. With a Fabry-Perot étalon we were able to resolve separations of $\Delta\nu = 0{\cdot}040$ cm.$^{-1}$, that is, a tenth of the resolution obtained by McLennan.

When this fact is taken into consideration, the results are in complete agreement. McLennan's revised term analysis shows that the term which he previously denoted as $6s7p\ ^1P_1$ is really a 1_1^0 term of the complex group $5d^9 6s^2 6p$; this correction must therefore be made in the notation of the lines 5490 and 4765 which we investigated. This change is of

importance, since it shows that the two large isotope displacements arise from terms of this complex group, whilst the ordinary singlet and triplet terms exhibit smaller displacements.

H. SCHULER.
J. E. KEYSTON.

Astrophysikalisches Observatorium,
Einstein Institut, Potsdam,
July 20.

[1] H. Schüler and J. E. Keyston, *Naturwiss.*, **19**, 320; 1931. *Zeit. f. Phys.*, **70**, 1; 1931.
[2] J. C. McLennan and M. F. Crawford, *Proc. Roy. Soc.*, A **132**, 10; 1931.

Evidence for the Spin of the Photon from Light-Scattering.

IN a recent communication (NATURE, **128**, 114, July 18, 1931) Sir C. V. Raman and S. Bhagavantam remark that the reversal of the sign of circularly polarised light in scattering, as observed by Hanle [1] and by Bär,[2] is to be expected from the quantum theoretical law of conservation for angular momentum. As the quantitative theory of the effect was developed some time ago,[3] it may be of interest to note here the principal results, emphasising the fact that the effect can be understood as well on a purely classical basis.

The properties of every Raman transition (whatever the composition of the incident light may be) are determined by an ellipsoid fixed in the molecule, which gives the deformation of the polarisability-ellipsoid, caused by the nuclear motion corresponding to the transition.[4] From this it follows immediately that the state of polarisation of the scattered radiation for circularly polarised incident light is already completely determined by the depolarisation ρ for linearly polarised incident light, defined in the usual way. More especially, if I_r and I_u are the intensities of the reversed and the unreversed part of the scattered light in the *forward* direction, the following relation holds, both in classical and in quantum theory:

$$\frac{I_r}{I_u} = \frac{2\rho}{1-\rho}. \quad . \quad . \quad . \quad . \quad . \quad (1)$$

This is analogous to the well-known relation for natural incident light

$$\rho_n = \frac{2\rho}{1+\rho} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

which, besides, also remains valid for circularly polarised incident light, when observed in directions *transverse* to the primary ray.

From (1) it follows that we get reversal of the sign of circular polarisation always if $\rho > \frac{1}{3}$. This is always the case for rotational or rotational-vibrational transitions $\left(\rho = \frac{3}{4},\ \frac{I_r}{I_u} = 6\right)$; it can be the case, too—contrary to the statement of Raman and Bhagavantam—for purely vibrational transitions, as ρ can vary here from 0 to $\frac{3}{4}$ (loc. cit.[4]); reversal cannot take place for the undisplaced (Rayleigh-) line, its depolarisation ρ remaining necessarily less than $\frac{1}{3}$.

From the point of view of the conservation law it is important to note that in general a molecule can change its angular momentum without changing its spin energy. The scattered light quantum in this case will have the same frequency, but the sign of circular polarisation is changed. In the quantum theory, these changes are described by jumps in the magnetic quantum number m. The selection rules in scattering are for circularly polarised incident radiation: $\Delta m = 0, 1, 2$, corresponding respectively to unchanged circular, linear, and reversed circular polarisation. From this consideration it is easily understood that purely vibrational lines can also show the reversal.

It may be remarked that in the usual observations and also in those of Hanle and Bär, owing to the insufficient dispersion available, the purely vibrational line (Q-branch) and the vibration-rotation branches are measured together. Under these conditions, it has been shown [4] that $\rho > \frac{1}{3}$ (1) for all degenerate vibrations, (2) for vibrations connected with a simultaneous increase of some and decrease of other components of the polarisability-tensor (loc. cit.[3, 4]). For the same cases reversal of the circular polarisation has to take place. This is in good agreement with all the observations on CCl_4, $CHCl_3$, C_6H_6, etc.

Recently also the distribution of intensity over the different branches of a line has been calculated by Dr. Teller and myself.[5] As in the theory of classical scattering, the scattering can be divided into a part dependent only upon the sum of the three principal values of the ellipsoid, this part alone contributing to the Q-branch, and the anisotropy scattering. For the latter, for example, the relation of the intensity of the Q-branch to that of the sum of all rotational branches, is found to be 1 : 2 for symmetrical top molecules, while it is 1 : 3 for the rotator (diatomic or linear triatomic molecules).

G. PLACZEK.

Institute for Theoretical Physics,
University, Leipzig, July 31.

[1] W. Hanle, *Naturwiss.*, **19**, 375; 1931. *Phys. Zeitsch.*, **32**, 556; 1931.
[2] R. Bär, *Naturwiss.*, **19**, 463; 1931. *Helv. Phys. Acta.*, **4**, 131; 1931.
[3] G. Placzek, *Leipziger Vorträge*, 1931.
[4] G. Placzek, *Zeit. f. Phys.*, **70**, 84; 1931.
[5] G. Placzek and E. Teller, to appear in *Zeit. f. Phys.*

Group Rotation in Solid Ammonium and Calcium Nitrates.

THE phenomenon of molecular rotation in the solid state first recognised by L. Pauling [1] is, in accord with his prediction, proving of wide occurrence. In many compounds the excitation of rotation about various axes is accompanied by *gradual* changes in such properties as heat capacity, specific volume, and crystal structure. It is probable, however, that certain *polymorphic* transitions, such as, for example, the one in hydrogen chloride at 93·36° K, are also accompanied by changes in the rotation of the molecules. The three *gradual* transitions in solid hydrogen bromide [2] were interpreted by Pauling (loc. cit.) as accompanying stepwise excitation of rotation of an HBr molecule about three axes. On account of the low scattering power of hydrogen, it would be difficult to verify these interpretations by determinations of crystal structures. We have, however, found changes of the above types in ammonium nitrate.

Ammonium nitrate at atmospheric pressure is known to exist in at least five crystalline modifications.[3] The salt shows a small abnormal change in the specific volume starting at about −50° C. X-ray powder diffraction photographs of the solid at −33° C. and at −78° C. are closely similar, as would be expected if rotations of the *ammonium* groups alone are excited between these temperatures.

Most of the transitions in ammonium nitrate show decided hysteresis. Near −16° C., with ascending temperature, the low temperature modification changes to the usual orthorhombic form,[4] which in turn changes to a monoclinic form near 32° C. The structures of these three modifications are complex and are not yet completely elucidated. It is quite probable, however, that the oxygen atoms are in fixed positions in all. Upon further heating, the monoclinic

modification inverts rapidly, near 84°, to a tetragonal form. Upon cooling, this tetragonal phase often persists to approximately 50° C. It inverts reversibly near this temperature to the metastable orthorhombic form ; [5] on further cooling, in the region of the metastable transition, the stable monoclinic phase is often produced.[6]

We have observed the transition from the tetragonal to the stable monoclinic form in the presence of a small amount of solvent. Cooling at the rate of about 0·5° per minute, the transition was initiated at 76°, and the temperature then rose to 81° C., due to liberation of the heat of transition. Powder photographs of the tetragonal modification at 105° C. indicate that the unit of structure with $a = 5{\cdot}77$ A., $c = 5{\cdot}00$ A., contains two molecules of ammonium nitrate (NH_4NO_3). The observed intensities of interference maxima are best to be explained by a structure with the nitrogen atoms of NH_4^+ groups at 000, $\frac{1}{2}\frac{1}{2}\frac{1}{2}$, and the nitrogen atoms of NO_3^- groups at $\frac{1}{2}\,0\,\frac{1}{2}$, $0\,\frac{1}{2}\,\frac{1}{2}$, the nitrate groups rotating in (100) and (010) respectively about axes normal to their planes. The separations of the rotating NH_4^+ and NO_3^- groups in the plane of the NO_3^- groups are 3·80 A.

The tetragonal modification inverts near 125° C. to a cubic phase which persists to the melting-point at 169·5° C. This is the most rapid of ammonium nitrate inversions, but even in this case there is an appreciable hysteresis loop between heating and cooling curves. In one experiment, upon heating, the inversion in the dry salt was initiated at 127·15° and ended at 130° ; upon cooling, the inversion was initiated at 123·52°, the temperature of the sample rising to 124·35°, and ended at 123°. Powder photographs of this cubic modification at 135° C. and 155° C. indicate that the unit of structure contains one molecule of ammonium nitrate with $a = 4{\cdot}40$ A. (155° C.). Since the lattice is a cubic one, it follows that the oxygen atoms cannot be in fixed positions. The intensities of reflection are best to be explained by a structure with nitrogen atoms at 000 and $\frac{1}{2}\frac{1}{2}\frac{1}{2}$ and with the centres of the oxygen atoms statistically distributed on a sphere of 1·25 A. radius around one of these points. The separation of the rotating NH_4^+ and NO_3^- groups is 3·79 A. On the basis of such a structure, it is possible to account for the formation of a limited series of solid solutions between ammonium chloride (NH_4Cl) and cubic ammonium nitrate.[7]

It is thus probable that in solid ammonium nitrate above 125°, all the rotational degrees of freedom of both the ammonium and of the nitrate ion are fully excited. Of the three transitions in the solid that are accompanied by changes in molecular rotations, one is *gradual* ; another, although of the polymorphic type and previously not considered unusual, is remarkable for the extent and kind of its hysteresis ; while the third is a typical rapid *polymorphic* transition.

The results of this work and of our previous study of the *gradual* transition in sodium nitrate [8] indicate that rotation of the nitrate group is often to be found in crystalline nitrates. Published X-ray diffraction data obtained from calcium, barium, strontium, and lead nitrates [9] and nickel nitrate hexammoniate [10] are extremely unsatisfactory. The crystal structures suggested for these various compounds are probably quite incorrect. The symmetry of barium nitrate determined from piezo-electric and unambiguous optical measurements is different from that of the structure described. The structure of nickel nitrate hexammoniate is known to be incompatible with the symmetry indicated by Laue photographs.

It is probable that the nitrate group has spherical symmetry at room temperatures in all of the compounds mentioned immediately above. The structures are probably similar to that of fluorite, the fluorine ions being replaced by rotating nitrate ions, and the calcium ions by the metallic ions or the $Ni(NH_3)_6^{++}$ group, which is not rotating at room temperatures. In calcium nitrate, on the basis of such a structure, the Ca^{++} to NO_3^- distances are about 3·30 A., in close agreement with the calculated value.

The expected transitions in these compounds are now being studied.

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E. POSNJAK.

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Bureau of Chemistry and Soils,
Department of Agriculture, Washington, D.C.

[1] *Phys. Rev.*, **36**, 430 ; 1930.
[2] Giauque and Wiebe, *Jour. Am. Chem. Soc.*, **51**, 1441 ; 1929.
[3] Lehmann, *Zeit. f. Kryst.*, **1**, 106 ; 1877 : Wallerant, *Bull. Soc. Franc. Min.*, **28**, 311 ; 1905.
[4] Grossner, *Zeit. f. Kryst.*, **38**, 144 ; 1904.
[5] Bowen, *J. Phys. Chem.*, **30**, 721 ; 1926.
[6] Behn, *Proc. Roy. Soc.*, **80**, 449 ; 1908.
[7] N. L. Bowen, *J. Phys. Chem.*, **30**, 726 ; 1926.
[8] Kracek, Posnjak, and Hendricks, *Jour. Am. Chem. Soc.*, in press.
[9] Vegard, *Zeit. f. Phys.*, **9**, 395 ; 1922.
[10] Wyckoff, *Jour. Am. Chem. Soc.*, **44**, 1260 ; 1922.

Apparent Dissociation Constants of Carbon Dioxide in Sea-water of Different Salt Contents.

IN addition to neutral salts, sea-water contains a small quantity of 'excess base' in the form of bicarbonate and of carbonate, together with free carbonic acid. The ratio of HCO_3' to CO_3'', free CO_2, and consequently hydrogen ion concentration, varies with time and place, dependent upon the intensity of assimilation by plants, of respiration by animals and plants, exchange with the carbon dioxide of the atmosphere, production of calcium carbonate in the skeletons of coccolithophores and animals, and its solution from calcareous sediments. Further, the interrelation between carbon dioxide tension, hydrogen ion concentration, and excess base in saline physiological fluids has been the subject of much research, concerning which there is a considerable and growing literature.

With the object of extending recent researches by one of us (K. B.) concerning the first and second apparent dissociation constants K_1' and K_2' of carbonic acid in sea-water of varying salinity, and of developing suitable analytical methods of estimating 'excess base' (*Alkalinität*) and *p*H on board research vessels, collaboration was arranged by the International Council for the Exploration of the Sea. With a knowledge of these two constants and the above two variables, one can calculate the carbon dioxide tension, the total carbon dioxide, and the proportion of bicarbonate to carbonate.

Values for K_1' were obtained by shaking sea-water of varying salinity into equilibrium with sufficient carbon dioxide to bring its *p*H between 5 and 6, as measured by means of a quinhydrone electrode, the free carbon dioxide being obtained from the carbon dioxide tension as measured gasometrically. The variation of K_1' with content of neutral salts was found to follow closely a formula of cubic root type as employed by Bjerrum,

$$pK_1' = 6{\cdot}518 - 0{\cdot}588\sqrt[3]{C}, \qquad t = 18°,$$

where pK_1' is the negative logarithm of K_1' and C is the concentration in terms of normality of all the cations. Since the composition of the salts in ocean-water is almost constant, the cations are in direct proportion to the salinity, from which they were calculated.

The value of K_2' was measured at a pH of about 9, when the free carbon dioxide may be neglected, $HCO_3' + CO_3''$ equals the bound carbon dioxide as found by gas analysis and $HCO_3' + 2\ CO_3''$ equals the carbon dioxide in combination with 'excess base' as found by titration.

The temperature coefficient of K_1, for which the values found by previous workers do not agree closely, remains to be investigated. The results will in due course be published in the *Rapports et Procès-verbaux* of the International Council for the Exploration of the Sea.

KURT BUCH.

Helsingfors.

H. WATTENBERG.

Munich.

H. W. HARVEY.

Plymouth.

Hydrolytic Adsorption of Activated Charcoal.

THERE is a difference of opinion regarding the behaviour of charcoal as a gas electrode in explaining its hydrolytic adsorption (Frumkin, Schilow). It has been suggested alternatively that acidic or basic oxides formed during activation are responsible for such adsorption, and that charcoal is a negative adsorbent possessing a negative charge in water (Schilow). On the gas electrode theory, charcoal should be positively charged and adsorb acids. Negatively charged oxygen charcoal which adsorbs alkali is known. Both positively and negatively charged charcoals are possible. A relationship between the electric charge, as measured electrokinetically, and the hydrolytic adsorption of either acid or alkali has been pointed out, and it was suggested [1] that 'acid' adsorbing activated sugar charcoal would be positively charged. Negatively charged charcoal with hydrogen or weakly basic cations in the mobile sheet of the double layer should adsorb alkali and liberate acid from a neutral chloride solution. This relationship between the sign of the charge and hydrolytic adsorption has been confirmed with charcoal.

In view of the fact that it is recognised (Frumkin) that the gas electrode theory does not apply to the observation of one of us, the results obtained recently (Roychoudhury) are of interest as showing (*a*) that activated charcoals have generally a negative charge but become positive on sustained washing; (*b*) a relationship between the sign of the electric charge and acid or alkali adsorption; (*c*) the primary adsorption of $H^{\cdot}$, OH', Cl', and SO_4'' ions; (*d*) an anomalous effect of the mass of the adsorbent on the adsorption of acids; (*e*) that alkaline extracts can be obtained even from activated sugar charcoal; (*f*) that both cations and anions are possibly formed during activation, their nature and amount depending on the treatment.

Moreover, the facts observed previously (Frumkin, Schilow), that the adsorption of acid is not determined by the activity of hydrogen ions, that both hydrogen and oxygen charcoals adsorb benzoic acid equally, that hydrogen charcoal adsorbs acids, and the part played by the ash constituents, also suggest a limit to the applicability of the gas electrode theory in this instance.

J. N. MUKHERJEE.
S. P. ROYCHOUDHURY.

Department of Chemistry,
University College of Science and Technology,
Calcutta, July 8.

[1] *J. Indian Chem. Soc.*, **2**, 219; 1925.

Orientated Deposits of Copper on Bismuth.

WHEN copper is deposited electrolytically from copper sulphate solution on a cleavage surface (0001) of bismuth with extremely low current density, the minute copper crystals show distinct orientations under the microscope (Fig. 1).

The triangular shaped crystals, nearly equilateral, are of light bluish colour and their sides are parallel

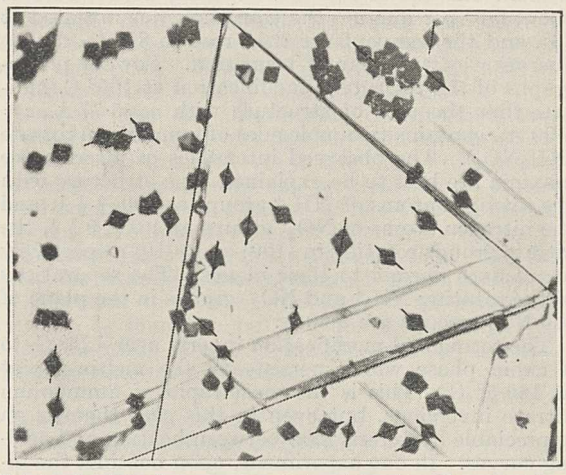

FIG. 1.—Crystals of copper deposited on bismuth. Lines have been drawn marking the long axes of the copper crystals and outlining the bismuth crystal.

to the cleavages $(02\bar{2}1)$ on the surface (0001) of bismuth. The parallelogrammatic shaped crystals, dark in colour, have their longer axes parallel to any of the three directions.

The reason for this may be explained by the hypothesis of 'epitaxie' of L. Royer.[1] The details of this investigation will be published in the near future, in the *Memoirs of the Faculty of Engineering*, Hokkaido Imperial University, Japan.

YOSIMITI HORI.

Faculty of Engineering,
Hokkaido Imperial University,
Sapporo, Japan,
July 11.

[1] L. Royer, *Bull. soc. franç. minéral.*, **51**, 7; 1928: *Compt. rend.*, **182**, 326; 1926: **191**, 1346; 1930, etc.

Rotation of 'Dust Devils'.

THE direction of rotation of 'dust devils' has been noted in Lower Egypt and Iraq during the past four years, and the reports received in this office indicate that in about 50 per cent of cases the direction of rotation is clockwise, and in the other 50 per cent anti-clockwise. This seems a surprising result, because if a 'dust devil' is due to the raising of dust and sand by the vigorous upward movement of air over a limited area, the rising column should assume an anti-clockwise rotation. I had an opportunity recently of watching the formation of numerous small whirls over a hot sandy space. The whirls did not attain a height of more than 2 ft., and the objects raised were leaves and feathers (not sand); the eye of the observer, being at a height of about 4 ft. 6 in., was well above the rotating column. Thirty disturbances were observed in about twenty minutes, and in no case was the rotation other than anti-clockwise (that is, cyclonic).

It occurred to me then that perhaps a discrepancy was being introduced in observers' reports, because the level of the eye in relation to the part of the column where rotation was observed is important. A clockwise rotation looked at from below is anti-clockwise

looked at from above, and an observer may be likely to look up in many cases when the ' devil ' is not well defined at the ground.

An analysis of reports in which the sense of rotation is given with the observer looking down on the whirl, shows that 27 out of a total of 29 are reported as anti-clockwise (or cyclonic). Most of these observations came from one station, and observations are required from other stations before the apparently anomalous behaviour of ' dust devils ' can be explained.

J. DURWARD.

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July 23.

Constitution of Anthocyanins.

As the result of synthetical work in Great Britain, combined with analytical observations by Karrer and his collaborators in Zurich, the position of the sugar groups in the main anthocyanins of the pelargonidin, cyanidin, and malvidin series can be fixed with a tolerably close approach to certainty.

We suggest that pelargonin, peonin, cyanin, and malvin are not biosides at all, but are di-monosides with separate glucose residues attached to positions 3 and 5 in the anthocyanidin nucleus. Mecocyanin, prunicyanin, keracyanin, and others of similar type, are, however, biosides; the biose group being in position 3. The arguments are a little too involved to put forward here in detail, but we wish to point out that the new idea of the constitution has an important consequence.

The anthocyanins are now considered to be related as follows:

3-Bioside (necocyanin)
↗
3-Monoside (chrysanthemin, œnin)
↘
3 : 5-Dimonoside (cyanin, etc.)
↓
Complex Diglycoside (monardæin, etc.)

This rather destroys the contrast which is the basis of Miss Scott Moncrieff's interesting letter in NATURE of June 27, because the two types of anthocyanin are to be regarded as brethren rather than as cousins. Nevertheless, Miss Scott Moncrieff's rule holds in the majority of cases.

We have recently examined a large number of related varieties of garden flowers, and find that the two sugar types occasionally occur in varieties of a single species; thus both types of pelargonidin diglycoside *and* both types of cyanidin diglycoside are found in different sweet-peas.

G. M. ROBINSON.
R. ROBINSON.

Dyson Perrins Laboratory,
Oxford, Aug. 18.

Reaction between Hydrogen Sulphide and Sulphur Dioxide.

IT is known that there is no reaction between hydrogen sulphide and sulphur dioxide in the dry state, and that mercury, benzene, or carbon tetrachloride have no effect on a mixture of the dry gases.

In the course of an investigation on the reaction between hydrogen sulphide and sulphur dioxide in non-aqueous solutions, we have found that the two gases when dissolved in benzene or carbon tetrachloride do react in the presence of mercury even when suitable precautions are taken to exclude moisture and oxygen from the reaction vessel. But a solution of hydrogen sulphide or of sulphur dioxide in either of the organic solvents has no action on the metal.

We have reason to believe that thiosulphonic acid is the primary product of the reaction between the gases:

$$SO_2 + H_2S \rightleftharpoons O_2S\begin{matrix}SH\\H\end{matrix}$$

and that at the interface between the organic solvent and mercury the thiosulphonic acid is decomposed, producing sulphoxylic acid and the metallic sulphide. Displacement of the equilibrium in the above equation is caused by the formation of the sulphide, which lowers the interfacial tension between mercury and the organic liquid.

Further work is in progress.

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Central College (Mysore University),
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July 16.

A Method of Studying Surface Films.

IF a substance, for example, ergosterol, is spread in a mono-molecular layer on the surface of water contained in the tray of a Langmuir-Adam apparatus for the measurement of surface films, it is possible to make the following observations.

Where a continuous mono-molecular film is formed, one is able to see that waves, produced at the surface by a tuning-fork, show a very strong diminution of their amplitude. The experiment is very easily performed: waves are produced by an electrically-driven tuning-fork, which is in contact with the surface of the water in the tray by a dipple: the wave-length of these waves can be about 0·4 centimetre. A beam of parallel rays is thrown vertically on the surface, where it is reflected. The reflected light is concentrated by a lens (5 dioptr.) in a single point on a scale. As soon as waves disturb the surface, the point is distorted into a straight line. Now, the influence of the spreading substances is to diminish the amplitude of the waves, and this is determined by a shortening of the line of reflected light.

We have studied different substances, and have observed that not every spreading substance shows the phenomenon in the same very striking way. Nevertheless, we believe that this method of studying surface films has some advantages. It is possible to make measurements at zero pressure, and the method gives results that are very well reproducible.

Proteins also show the phenomenon.

We hope that exact quantitative measurements of the effect will enable new capillarity constants to be determined.

E. GORTER.
W. A. SEEDER.

Leyden.

Insectivorous Snakes.

IN the letter of Messrs. Miller and Pagden in NATURE of May 9 it is stated that "records of insects having been devoured by snakes do not appear to be abundant". During some work on the parasites of snakes at Thandaung fifteen *Simotes violaceus* were dissected. In all cases the stomach and intestine were full of insect remains, sometimes very tightly packed and completely filling the lumen, chiefly those of a small brown grasshopper. In only one case were any vertebrate structures found: a small newt and a viper's tooth. Remains of insects were also found in *Natrix piscator*, *N. chrysargus*, and *Trimeresurus gramineus*.

F. J. MEGGITT.

Biological Department,
University of Rangoon.

Research Items.

Social Organisation in Manoa.—Miss Margaret Mead, while engaged during 1925–26 in a study of the adolescent girl in Samoa, was brought into exceptionally intimate touch with every household group in three villages on the north-west coast of the island of Tau, Luma, Siufaga, and Faleasao. Her observation of Samoan theory and practice in social organisation, which differ considerably *inter se*, are published as *Bull.* 76 of the Bernice P. Bishop Museum. The Samoan social organisation is an amalgamation and recombination of several distinct principles: hereditary rank, the functions and privileges of relationship groups, and the recognition of the organised village community with rights and privileges of its own. The dominant note in Samoan society is that all a Samoan's interest, all his emotion, is centred in his relationship with his fellows within an elaborate social pattern. Individual work and play, religious activity, art and personal relationship have never been admitted and receive scant attention from the society. All attempts at a development of personality along other than social lines are neglected and wither away. The taboo against a woman touching the bonito canoe is a survival, for such a taboo on women against the canoe as is found in the Marquesas and New Zealand has no place in Samoan culture, because neither men nor women in Samoa have any importance in themselves until translated into a social scheme. Thus the entry into a kava ceremony by a woman who had no right to be there might completely invalidate a whole communal undertaking, but not on account of her essential female potency, which here is negligible. With this emphasis on things done within the social pattern goes the complementary feeling that things done alone are suspect, if not downright wrong. The expectant mother, the young chief, and the bride-to-be must never be alone. This militated against the development of individual communion with the supernatural and against the formation of secretly cherished magical formulæ.

Indian Terra-cottas.—In the *Indian Antiquary* for August, Mr. K. de B. Codrington discusses the difficulties of dating Indian terra-cottas. Very few have been placed stratigraphically. There are four main groups of material for dating. (1) Two figurines, a rabbit, or cow, and a bridled horse, were found on the level of the brick floor two feet above the plinth of the southern of the two Râmpurvâ pillars. (2) *a*, Group of four figurines from Nilgiri graves, mostly from pot-covers, in the British and Madras Museums: these are roughly modelled figures of men, women, and animals, hand-moulded with sticked-in details; *b*, a group excavated at the Bhir mound, among them a toy horse ascribed to the 'pre-Mauryan' period; *c*, fragmentary terra-cottas found in the monastery mound at Shâh-jî-kî-Dherî, a Græco-Buddhist site with Gupta surface finds. (3) Numerous terra-cotta figures excavated at Basârh, attributed to Kushan, Sunga, and Mauryan age, on slender evidence. A second group from this site is of importance. The figurines are of coarse workmanship, the eyes being represented by circles. They are from the same level as a seal ascribed palæographically to the fourth century. (4) Gupta fifth and sixth century terra-cottas. Dr. Coomaraswamy has recently compared figurines with the terra-cottas of the 'Indo-Sumerian' culture of Harappa and Mohenjo-Daro of 4000–3000 B.C.; but nothing from the two sites affords exact parallels. They are primitive only in the sense that they are very crude. Five of these figures have recently been acquired by the Indian Museum, South Kensington. Though technically they partake of the tradition of both Basârh and Shâh-jî-kî-Dherî, they belong rather to the finer Basârh. The technique and the details of the hairdressing and jewellery all point to the late second-first century B.C. as the date of origin.

Mammals of an Island Group (Pityusa).—The island group of Pityusa, of which the chief island is Ibiza (or in the "Times Atlas", "Iviza", grouped with the Balearic Islands), lies between the Balearics and the mainland of Spain. The mammal fauna, described by Dr. Otto Koller (*Sitzunsber. Akad. Wien*, Abt. 1, Bd. 140, p. 57; 1931), includes only ten species, but like most island faunas, presents features of great interest. There are endemic forms such as *Genetta* and *Erinaceus* and, perhaps, also *Crocidura*, all derived from the original fauna of the southern Spanish mainland; and it is evident that the basic fauna is common to the Balearic Islands and Pityusa. The separation from the mainland must have taken place in Pliocene times, but only later were the two island groups themselves separated. Thereafter, two new linkages appear to have taken place: a land-bridge between Pityusa and southern Spain permitted the immigration of *Martes foina mediterranea* and *Crocidura russula pulchra*, which are absent from the Balearics; while a union between the latter and the Corsica-Sardinia region gave them, instead, *Martes martes latinorum* and *Mustela nivalis boccamela*.

Disease-Resisting Turnips.—Trials with turnips at Craibstone, Scotland, described by W. M. Findlay (*Scottish Journal of Agriculture* (vol. 14), on land which is badly infected with finger-and-toe disease, have brought to light a disease-resisting variety. Although the history of this turnip, recorded under a variety of names, can be traced back for nearly one hundred years, its valuable properties do not seem to have been fully recognised. The Bruce, as it is proposed to call it, is a purple-top yellow turnip, of the dark-coloured bottom and flesh type, with certain additional characteristics such as purple colour in the ribs and veins of the leaf. The percentage of the dry matter in the Bruce, a property usually taken as an indication of quality, was found to be higher than that in a number of other types of turnip, and it also proved of equal feeding value to Green-Top Yellow (Challenger) in a milk production trial. As regards cropping on healthy soil, the Bruce headed the list of five varieties if the yield was reckoned on a dry matter basis; and when grown on land infected with finger-and-toe disease, it was the only strain that produced a good crop. Complete immunity is not claimed for the Bruce. Infection, however, appears to be confined to the roots, the bulbs themselves being rarely injured. The seed is small but germinates well, and is recommended in preference to larger seed of an inferior strain. Sowing on infected ground is advised if the crop is to be grown for seed, in order to maintain, and increase if possible, its disease-resisting properties.

Kansas Permian Insects.—A series of papers on Kansas Permian insects by Dr. R. J. Tillyard has been published during the last few years in the *American Journal of Science*. The present contribution (Part 13) deals with the new order Protelytroptera and appears in vol. 21 (March 1931) of the periodical mentioned. The fossils in question include seventeen specimens, of which four are more or less complete,

and from a study of their characters Dr. Tillyard concludes that they are neither true Coleoptera nor ancestral to that order. After taking various possibilities into account, he comes to the decision that these fossils represent the ancestral group from which the existing order Dermaptera, or earwigs, has been derived. At the same time he suggests that the fossil remains that form the order Protocoleoptera may have been a remnant, which found refuge in Australia, of this new order. The solution of the affinities of the Protelytroptera is bound up with the venation and the method of folding of the hind wings, which appear to approach the earwig type more closely than any other. The elytra, or fore wings, on the other hand, are very much less shortened and of the nature of normal convex, hard wing covers. Not very much evidence is to be obtained from other parts of the body, but there appears to be no features directly contrary to the hypothesis that the order is ancestral to the Dermaptera. The new order is divided by Dr. Tillyard into no less than five families, including seven genera and eleven species.

Phenomena of the Upper Atmosphere.—Prof. S. Chapman's Bakerian Lecture, which is published in the August issue of the *Proceedings of the Royal Society*, summarises a number of efforts which have been made to attack mathematically the problems connected with dissociation and allied phenomena in the upper air. Although many of the numerical values of atomic constants which it is necessary to introduce are known only approximately, very considerable progress has been made, largely by Prof. Chapman himself, in the interpretation of existing observational data. Prof. Chapman has shown, for example, that the quite large amount of energy which is emitted in the form of general green auroral radiation during the course of a night is probably stored up as energy of dissociation—perhaps including ionisation—during the daytime ; recombination is a process the rate of which is largely controlled by density, whilst the emission of light from the metastable atoms of oxygen which give the green line takes place, so far as is known, within a second or less of the formation of the atom, independently of the presence of other atoms or molecules, and hence these metastable atoms must have relatively long-lived ' parents '. It follows from similar considerations that the emission of the green line probably occurs between heights of 100 km. and 200 km. Prof. Chapman discusses the origin of the ionisation in the main 100 km. layer which is responsible for the majority of ordinary atmospheric wireless phenomena, and shows that there is much support for the view that it is caused by a stream of neutral particles from the sun ; he also suggests that the positive ions present in this layer are mainly molecular nitrogen, whilst those in Appleton's upper ionised layer are atomic oxygen. The position of the upper layer and the maximum density of electrons in it can be predicted very satisfactorily from the hypothesis that its ionisation is due to ultra-violet radiation.

Origin of γ-Rays.—In a paper in the August number of the *Proceedings of the Royal Society*, Lord Rutherford and Dr. C. D. Ellis discuss the nature of the nuclear changes which lead to the emission of γ-rays. Their starting point is the now well-established fact that many α-particle emitters give not a single α-particle but a group. The implication is that the α-particles in the nucleus can exist in states of different energy, and it is a reasonable hypothesis that transitions of the α-particles between these states occur in which γ-rays are emitted or the available energy is transferred directly to an extranuclear electron in the atom. There is strong evidence that energy differences in the α-particle groups for a given element are connected numerically with the energy of its γ-rays, but since the energy of α-particles can be found only rather less accurately than the energies of γ-rays, the numerical data used in this paper are drawn from measurements made upon the latter. The particular model of the nucleus of which use is made is one in which different numbers of α-particles are excited to the same quantum state, apparently the exact opposite of what occurs with the extranuclear electronic systems, where such an arrangement is eliminated by the Pauli exclusion principle. From this it is shown that it would be expected that the energies set free in transitions should be given to a first approximation by an expression of the form $E=pE_1-qE_2$, p and q being integers, E_1 a difference in energy of two states (in the ordinary sense), and E_2 a smaller energy of interaction. This prediction is finally tested by making a diagram with the energies of the γ-rays shown as ordinates against integers as abscissæ, the points being placed so as to lie on diagonal lines. In the diagram given for radium C′, six diagonals are required for some forty γ-rays, and the fit is, on the whole, excellent. The same is true for a smaller number of rays from radium B. In addition to this detailed numerical work, the paper contains a discussion of a number of other points—in particular, the probability for various types of transitions of the α-particles.

The Photoelectric Effect.—The first July number of the *Physical Review* contains a paper by R. H. Fowler, analysing some recent careful experimental work on the effect of temperature on the photoelectric current from clean metals in monochromatic light. The experiments show that there is no sharply defined maximum wave-length for emission of photoelectrons, but that the photoelectric sensitivity falls off gradually at low frequencies, especially at the higher temperatures, so that the sensitivity curve can be followed to a frequency determined primarily by the delicacy of the current measuring device used. Mr. Fowler shows that these results are to be expected from Sommerfeld's theory of metals, and can be completely accounted for by the change in the velocity distribution of the electrons inside the metal with temperature. From the theory a graphical method has been developed for finding the work required to extract an electron from the surface, which makes use of the general form of a whole family of sensitivity curves, and is more certain than previous methods for finding the work function from similar data. At the same time, Mr. Fowler shows there is a necessary uncertainty of about one per cent in the results, so long as an ambiguity in the theory of photoelectric emission remains unresolved. The work-functions for silver, gold, and tantalum are 4·74 volts, 4·90 volts, and 4·12 volts respectively.

Organic Acids in Plants.—Nelson and Mottern, in the August number of the *Journal of the American Chemical Society*, describe investigations of the organic acids in barley, maize, oat, and rye plants. These all contain aconitic acid, which is also present in wheat, sugar cane, and sorghum. Oxalic, malic, and citric acids are also present. Barley contains malonic and tricarballylic acids, whilst maize contains no malonic acid but tricarbalyllic acid. The percentages of oxalic acid in the fresh plants varied from 0·019 (barley) to 0·048 (rye).

Organic Gold Compounds.—The use of the Grignard reagent in the preparation of organic gold compounds has been shown to be limited to the ethyl radical and less electronegative radicals. In the August

number of the *Journal of the American Chemical Society*, Kharasch and Isbell describe the action of anhydrous gold chloride on aromatic compounds, which is found to lead to the introduction of gold into the aromatic nucleus and the formation of a compound, $RAuX_2$. Direct 'auration' is thought to be as general a reaction as nitration, halogenation, or mercuration, except that it is much more rapid and the products are much less stable. Nitrobenzene, however, dissolves gold chloride without undergoing reaction. Phenyl, tolyl, and diphenyl auric dichlorides, methyl salicylate auric dichloride, and *o*-nitroanisole auric dichloride are described. The second paper deals with the gold imide compounds. The gold imide complexes are very stable, and do not give tests for gold with stannous chloride or oxalic acid. They are represented by the general formula $H^+[Au(imide)_4]^-$, and are called imido-auric acids on account of the similarity of their structure to that of chlorauric acid. They are obtained by direct combination of auric hydroxide and the imide. Succinimido-auric acid is a stronger acid than carbonic acid.

Insulation of Overhead Transmission Cables.—At the international conference of high-voltage electrical engineers which met in Paris recently, H. O. Austin read a useful paper on the insulation of overhead lines for high pressures, an account of which is given in the *Electrician* for Aug. 7. He stated that increasing the number of insulators does not necessarily diminish the number of breakdowns on a transmission line. It may, in fact, increase the number of transient currents due to switching operations or to lightning. Many operating records show that troubles arising from sudden 'flashovers' of the current over strings of insulators, due to the line either being directly struck or having high voltages induced in it by lightning flashes, are greatly increased by great height. He mentioned that the 220-kilovolt line of the Hydro-Electric Commission of Ontario, which uses short spans and has the earth and conductor wires at relatively low heights above the ground, has been working very satisfactorily. Owing to the appearance of corona discharges when the three-phase lines are close together, it is usual to put them several feet apart. This increases the reactance of the line and the cost of its erection. He suggests that the conductors should be coated with a suitable insulating paint or covering so as to prevent the formation of the corona and permit close spacing. This seems to us an excellent suggestion. If the thermal conductivity of the paint were high, its use would appreciably increase the carrying capacity of the line. In addition, it would go a long way towards preventing interference with radio communication, which is serious when brush discharges take place. The presence of dew in the early mornings on lightly loaded lines favours these discharges and sometimes causes the line to flashover. A slight temperature increase of the lines, obtained, for example, by allowing a large current to flow for brief periods, would prevent the formation of dew.

Astronomical Topics.

The Mass of Neptune's Satellite, Triton.—We learn from a *Daily Science News Bulletin* dated July 30, issued by Science Service, Washington D.C., that an attempt has been made to obtain this mass with the 60-inch reflector at Mount Wilson by Dr. S. B. Nicholson, Dr. A. van Maanen, and Mr. H. C. Willis. A series of photographs of Neptune were taken when near its stationary point, so that the same comparison stars could be employed for several nights. The method, of course, involves the determination of the small shift of Neptune due to its motion round the common centre of gravity of itself and Triton. The problem is evidently rather too difficult for solution at present, as the values obtained for the mass range from 0·01 to 0·04 of that of the earth. The first value is a little less than that of our moon, the second is about equal to that of Mercury and to the largest satellites of Jupiter and Saturn. It might have been anticipated *a priori* that the mass of Triton probably lies between these limits. It is conjectured in the above *Bulletin* that the mass of Pluto may be about the same as that of Triton; but there seems to be good reason for thinking that Pluto's mass is considerably greater than the above values.

Lunar Circles.—In a note appearing in the issue of *Scientiarum Nuncius Radiophonicus* for June 25, under the heading "Johannes Boccardi—De efformatione circorum lunarium", the ballistic theory of the origin of lunar circles is discussed. This theory regards the circles as the results of deformations of the moon's surface caused by shocks produced by enormous celestial projectiles. It does not seem possible that such projectiles could have been small satellites of the earth captured by the moon, so that they could only have been gigantic meteorites. This view the author decides to be improbable for various reasons. First, although the earth has a surface area thirteen times as great as that of the moon, there is no evidence that it has ever been struck by projectiles of the dimensions necessary to form the lunar circles. The only terrestrial formations analogous in any way to these circles occur in Arizona and are on a vastly smaller scale. Moreover, the fact that the lunar circles lie in chains indicates a common and approximately simultaneous origin. The most powerful telescopes fail to reveal any such circles on the planet Mars. In the light of these considerations, the author deems the ballistic theory of this phenomenon to be untenable.

Comet Notes.—Prof. G. van Biesbroeck contributes to *Astr. Jour.* No. 958 a discussion of the definitive orbit of the comet 1925 j = 1925 VII, which he himself discovered on Nov. 1, 1925, in the same telescopic field as 1925 c (Orkisz), which he was observing. 280 observations are used, extending over seven months. The following hyperbolic orbit was obtained:

T	1925 Oct. 2·97348 U.T.	
ω	106° 24′ 12·0″	1925·0
Ω	334 33 43·4	1925·0
i	49 19 15·9	1925·0
$\log q$	0·1948557	
e	1·0004276	

The excess of e over unity is eighteen times its mean error, so it is well established. He then applied perturbations by Jupiter and Saturn for the seven preceding years (on the lines adopted by Prof. E. Strömgren), and found that on Feb. 19, 1918, the orbit was elliptical with e 0·999820 and period 811,000 years. This is referred to the centre of gravity of sun, Jupiter, Saturn. It is shown that the orbit previously to 1918 was permanently elliptical. This result agrees with that for all other comets that have been similarly tested.

It would be interesting in these cases to trace the comet's course in the future, as well as in the past. The departure of a comet from the solar system would be nearly as interesting as the introduction of a comet from outside the system.

Echinoderm Larvæ.

PROF. MORTENSEN'S "Studies of the Larval Forms of Echinoderms", reviewed in NATURE for Dec. 8, 1921, is well known. He has now issued two sets of additional notes,* one resulting from a visit to Amboina and the Kei Islands in 1922 and a journey to Java, Mauritius, Cape Town, and St. Helena in 1929–30, the other describing observations made at the Swedish Zoological Station of Kristineberg in 1918. These notes are directed to making known the form of the various larvæ, with the view, first of correlating the larvæ with the adults of their species, and secondly of seeing what light their comparison may throw on the relationships of species, genera, and families. The memoir includes a summary of similar observations published since 1921 and is noteworthy for the beautiful illustrations, many in natural colours, by the author himself.

Difficulties inseparable from travel and especially an unfortunate accident with fouled water make the notes less complete than was hoped, but many points of interest are recorded. For example, the form previously described as *Echinopluteus transversus* is now unexpectedly found to belong to *Diadema* and possibly allied genera. The inference from its muscular system that this larva must swim by moving its long post-oral arms is now confirmed by observation; the movements are quick, rhythmical, and interrupted, recalling the jerky motion of puppets. Certain observations on cultures of these larvæ showed how dependent the rate of development is on physical conditions. Retardation increases the possibility of transport by currents, and is a factor in the geographical distribution of adults.

Turning to brittle-stars, one notes that two species of *Ophiactis* prove to have the same type of larva, so that in this class also the larval form may have a bearing on classification. On the other hand, a star-fish, *Archaster typicus*, differs from the somewhat similar *Astropecten* in the possession by its larval form of a Brachiolaria stage. The question arises whether the Brachiolaria or Bipinnaria stage is the more primitive, and Prof. Mortensen again gives reasons for regarding the simpler Bipinnaria as the forerunner of the Brachiolaria. This may be, and yet the conclusion that the brachiolarian sucker is not homologous with the pelmatozoan stalk may not follow, for, as Prof. MacBride insists, the fixed stage may have been dropped by *Astropecten* and similar forms as unsuited to their muddy or sandy habitat. It is to be noted that the two or possible three species in which Prof. Mortensen detects a brachiolarian stage live on or near hard coral-reef.

The larvæ of allied forms often manifest other differences, which, while seeming to be fortuitous variations, may depend on some physical factor. Thus in many ophiurid larvæ the front 'arm' on the right is longer than that on the left, and in one species it also loses its band of cilia. More curious is a difference in the development of the hydrocoel ring (the rudiment of the water-vascular system): in *Amphiura filiformis* the hydrocoel in forming this ring grows upwards and bends round above the œsophagus; in *Ophiura albida* it bends below the œsophagus to achieve the same ultimate result.

This selection may conclude with a couple of notes on adult sea-stars. In two species of *Archaster* "a kind of copulation takes place, the male lying on the back of the female", his rays alternating with hers. A small fish, *Fierasfer*, has long been known to take shelter within various Cœlentera and Echinoderma, but Prof. Mortensen has found it within the actual body-cavity of two species of the cushion-shaped sea-star *Culcita*. Since the body-cavity of an echinoderm has no direct opening to the exterior, the occurrence offers as great a puzzle as how the apples got into the dumplings. Prof. Mortensen suggests that the fish enters the sea-star's mouth and bites a hole in the stomach wall through which it enters the body-cavity; it probably feeds on the genital organs, and, when it wants to breed, bites its passage out again.

Prof. Mortensen has brought back much from his travels and has shown how much more there is to be learned in these tropical regions if only better aquarium facilities could be provided. F. A. BATHER.

* Det Kgl. Danske Videnskabernes Selskabs Skrifter: Naturvidenskabelig og mathematisk Afdeling. 9 Række, IV, 1: Contributions to the Study of the Development and Larval Forms of Echinoderms, I-II. By Th. Mortensen. Pp. 39+7 plates. (København: Andr. Fred. Høst and Søn, 1931.)

The Artificial Coniferous Plantation and its Place in Forestry.

THE afforestation programmes being undertaken in New Zealand by private companies and the State Forest Department have been the subject of comment in NATURE (Feb. 14 and April 18, 1931). That further consideration of these programmes would appear to be not without its importance is brought about by the opinions expressed by the Director of the State Department on the subject of artificial coniferous plantations versus indigenous forest, a question which at the present day has almost a world-wide importance. Mr. E. Phillips Turner, Director of Forestry in New Zealand, in answer to frequent demands on the subject, has prepared a brochure (*Circ.* No. 31, N.Z. State F.S., 1931) entitled "Trees used in State Afforestation in New Zealand". The Circular should be consulted for the valuable information given under each of the chief species (mainly conifers) made use of. These may be noted as *Pinus ponderosa*, *P. laricio*, *P. radiata*, Douglas fir, larch (*Larix europæa* and *leptolepis*), *Sequoia sempervirens*, *Cupressus Lawsoniana*, *Thuya plicata*, *Pinus strobus*, *P. muricata*; and a few others of lesser importance. Eucalypts were originally grown on a considerable scale in the early years of the work of the State Forest Department; they are, however, so subject to attacks of various insects that they are not now being planted. Poplars are being experimented with and are thought to have a considerable future.

The great temptation to concentrate on the artificial conifer plantation is due to the extraordinary rapidity of the growth of some of the exotics in New Zealand.

That every country is adopting a correct policy in endeavouring to provide, in so far as possible, for its own requirements in coniferous softwoods is conceded. But the time would appear to have arrived when a halt should be called in a policy which seeks to substitute the artificial coniferous plantation (planted, it may be admitted, on areas of poorer soil) for the valuable indigenous hardwood forests of the country, the ultimate disappearance of which under the axe of the exploiter or by fire is being accepted as inevitable.

The Director of Forestry states that experiments are being made to test the practicability of re-establishing

the native softwoods in cut-over State forests, when the land is not suitable for farming. Experiments are being made with Kauri, the New Zealand valuable timber tree, "to test the practicability of working a Kauri forest on a sustained yield plan" and the possibility of re-establishing Kauri on tea-tree scrub lands which formerly carried Kauri forest. As regards indigenous hardwoods, the various species of southern beech (*Nothofagus*) are said to be quick growing. Beech forests are therefore to be managed for the production of future hardwood requirements.

The concluding paragraphs of the brochure sum up the opinions held by the State Forest Department. It is pointed out that, after the naturally-grown forests of native trees have been cut over, there will be an end of the splendid wide and clean boards now being obtained, and that thence boards of natural timber will be mostly narrow and more or less knotty, such as the red and white Baltic deals exported to Great Britain (the writer must be confusing the British-grown material with that of the Baltic, which usually is free from knots). Secondly, it is anticipated that fabricated boards, etc., made from disintegrated wood will largely replace natural timber, and knotty timber can be used for the former without any serious difficulty. Thirdly, and in spite of the recognition by the Forest Department that they must eventually disappear, it is said that it will be apparent to all "that the remaining splendid stands of indigenous timber, which Nature has provided us, should be used with the greatest care and economy".

Attention has been directed (NATURE, Feb. 14) to the private companies which have been formed in New Zealand to promote afforestation work. Many of these companies have been federated into an Association which represents a combined capital of £5,000,000. The objective of these companies is the ultimate afforestation of a million acres of exotics. It is recognised that this work to be done expeditiously is a purely business proposition, quite outside the capacity of a State Department, which could not be granted the funds from the public purse to carry it on with such rapidity.

As a result of the War, several of the European countries are making arrangements to increase their areas of coniferous softwoods. In France, for example, there are extensive stretches of very poor heather, etc., clad lands in the Plateau Central, for the afforestation of which an extensive propaganda is being carried on. Whilst the Government Forest Department is undertaking a certain amount of work, the aim is that the greater part of the afforestation work shall ultimately be done (with grants when necessary from the State) by the private proprietor and the village communities owning the land. But this recognition does not involve the sacrifice of her magnificent hardwood forests, chiefly of oak and beech, which have been under an increasingly fine management since the days when Colbert (1660) first ordered an investigation into the methods in force in the State forests.

With such examples before her, it would appear to be an irremediable disaster for New Zealand to sacrifice those of her fine indigenous forests still left, without an effort to save them, and the markets dependent upon them, for future generations.

The Mellon Institute.

ON the occasion of the award of its medal to Messrs. A. W. Mellon and R. B. Mellon, the founders of the Mellon Institute of Industrial Research, Pittsburgh, U.S.A., the American Institute of Chemists has devoted an issue of its bulletin to an account of the inception and progress of the Institute. According to the *Chemist* for April, its foundation in 1913 was a direct result of the success of the inauguration of the industrial fellowship system in the University of Pittsburgh. Twenty years after the adoption by Dr. R. K. Duncan of this method of combining education with industrial profit there are in operation sixty-four such fellowships, the work being conducted by 109 fellows and 31 assistants. The extent to which the value of the Institute as a servant to industry has been realised may be gauged by the fact that for ten years after its establishment, in accommodation believed to provide for future growth, the waiting list was almost as long as the list of companies whose problems were already being investigated.

A new home, some three hundred feet square and eight stories high, and designed in the Ionic style, will be a notable monument to the economic success of industrial research and the esteem in which the organisation is held in a progressive industrial country.

The industrial research carried out by the Institute is organised on a contract basis. The problem is set by, and the results become the property of, the donor of the fellowship; the worker is found and engaged by the Institute and provided with the broadest facilities for a minimum period of one year. Only one investigation is carried out on a particular subject at any one time. The prosecution of fundamental scientific investigations is not neglected, funds being available for application to this essential precursor of industrial development. All questions of publication, patent protection, or advertisement are determined by consultation with the donor, whilst all forms of co-operation which do not violate the necessary limits of confidential operation are encouraged.

The Institute stimulates the holders of fellowships to put forth their best efforts by affording both freedom and sustained support. Besides creating new industries and strengthening old ones it has thus produced a body of trained and practised investigators, who have played no small part in advancing the industrial position of the United States of America.

On its educational side, the Mellon Institute is worthy of special attention. The education which is afforded is not merely scientific, but also social; it is concerned with the personal and official duties of research staffs, with commercial procedure, with professional ethics, and with industrial psychology. The worker is trained to convey and interpret the results of his scientific work to the non-scientific business man in such a way that the latter can estimate its commercial value and appreciate its possibilities. The effort is being made to raise the professional status of the research worker by encouraging the proper type of man to engage in scientific professional work, and by improving his economic position. Equally important is the effect on the outlook of those entrusted with the direction of affairs, both in individual industries and in national and international trade.

The increasingly dominant position of science cannot be overlooked, and it becomes essential in the modern world that those who are given responsibility should also be equipped with knowledge. America is justly proud of the Mellon Institute; it is an institution which deserves the careful study of progressive nations.

Rock-Paintings in North-West Australia.

THE paintings in rock-shelters and caves of north-west Australia, which differ in type from those of other parts of the continent, were first seen and described by Sir George Grey in 1839. These paintings and others from adjacent sites have now been examined by Mr. A. P. Elkin, who has discussed their meaning with the Ungarinyin tribe of Walcot Inlet. The results are published in *Oceania*, vol. 1, No. 3.

In one of the caves, it has been customary to deposit the bones of the dead after they have been exposed in platform-burial and 'cried over'. This is a great honour, only conferred on fully initiated men who die before they are old enough to be considered 'close up' dead. The bones are painted with red ochre "to keep them clean". Each horde has its own picture gallery. The paintings are in black, white, red, and yellow. One case of the use of blue is recorded. The most remarkable painting is that of a man placed horizontally and thirteen feet from crown of the head to sole of the foot. Smaller figures near-by, two of them female, are his 'children'. He has eyes and nose but no mouth, a peculiarity of all the human figures, the natives saying that "it cannot be done". The face is partly surrounded by a horseshoe-shaped head-dress representing the band of red ochre which the natives paint on the forehead and the face. Projecting from this are red lines with black tips representing the hair. Small round rings near the feet are a ground fruit, *nalgo*.

The paintings as a whole may be divided into representations of the human figure, especially the head; various objects, such as the sun, water-lilies, *nalgo* fruits, snakes, crocodiles, kangaroos, and the like; and, lastly, stencilled hands. Some of the paintings are obviously of a considerable age and are partly obliterated. The natives say they do not make these pictures; but they retouch them. The heads without mouths are retouched as a rain charm, usually just before the wet season, but the charm is effective even in the dry season. Rain is the totem of the horde. If the headman dreams that he has retouched the figures, it is equally efficacious. Connected with their significance as the power that brings rain is the association with the 'rainbow-serpent', which is sometimes regarded as the totem of the head figures, a snake being shown with them. The retouching of the female figures causes an increase in babies, which the rainbow spirit makes and brings to the water-holes in the rain. Retouching the animal and vegetable figures leads to an increase of the species depicted.

Radioactivity and Earth Movements.

THE Geological Society of Glasgow has published (*Trans.*, vol. 18, pp. 559–606) a lecture by Prof. A. Holmes, given in 1928, which he has expanded into a valuable memoir on the cause and distribution of the major movements in the earth's crust.

The fundamental fact in geological history is the alternation of periods of powerful earth movements and active vulcanism with long intervals of repose. Prof. Joly explained this alternation as due to the accumulation of radioactive heat and its escape at periods of diastrophism. That theory has been generally rejected owing to its lack of agreement with the main facts of geological history. Prof. Holmes upheld it in a modified form; but he has now abandoned it. He retains the action of radioactive heating, and rejects J. W. Evans's suggestion that the heat thus generated has been used in physical changes in the minerals around the disintegrating radioactive material.

Prof. Holmes attributes the main earth movements and crustal disturbances to convection currents in the fluid substratum. He establishes the existence of this fluid layer in his preliminary discussion, which includes a critical summary of recent literature on the major structure of the earth's crust, and of the evidence given by near earthquakes. Amongst other instructive conclusions are that "we may regard the Pacific crust as being like that of the continents" (p. 570). Prof. Holmes regards the primary convection currents in the fluid substratum as analogous in direction to those in the atmosphere, and corresponding in directions to those of the trade winds and monsoons. The persistent trend in one direction would therefore occasion continental drift, at a rate which Prof. Holmes estimates at three miles in 100,000 years. The formation of the Atlantic basin by such drift would take 100 million years.

The paper shows many striking agreements between the main mountain lines, the ocean basins, the distribution and origin of rift valleys, and oceanic transgressions and those that would result from such deep-seated currents. Isostasy is accepted for minor modifications of the main structures.

Acceleration of Fermentation by Algæ and Sea-water.

THE results of investigations carried out during the past few years show that alcoholic fermentation is accelerated (1) by the various vitamins to different extents, and (2) by cholesterol and ergosterol, which are supposed to contain, in greater or less proportion, the provitamin of growth. In view of the fact that, apart from the organic materials dissolved or suspended in sea-water, marine algæ constitute, either directly or indirectly, the sole food of marine animals, it seemed of interest to ascertain what effects these algæ would exert on the course of fermentation.

In the *Atti della Reale Accademia Nazionale dei Lincei* for Jan. 18, Dr. Pirrone, of Messina, describes experiments which demonstrate that *Ulva lactuca* (*L.*) *Lejol*, either in the fresh state or when dried, accelerates the fermentation of glucose very considerably. This effect is due to the presence in the alga of one or more organic substances, probably existing as sols, which are soluble in water, alcohol, or ether at the ordinary temperature.

Experiments made by De Fazi in 1927 yielded results which indicated that the velocity of the alcoholic fermentation of glucose solutions prepared with distilled water, previously sterilised and subjected to the radiations from a quartz mercury vapour lamp, was appreciably greater than that of a similar solution made with sterilised water which had not been exposed to such radiations.

Further experimental data communicated by Sanzo and Pirrone to the Accademia dei Lincei on Jan. 18 now show that freshly collected sea-water, if added to glucose solutions in proportions not exceeding 20 per cent, causes a marked increase in the velocity with which such solutions are fermented by yeast. If the sea-water is kept for about twenty-four hours after collection before being added to the glucose solution, this accelerating influence diminishes slightly in degree to a value which does not change with further storage of the water. The maximum effect is observed when the glucose solution contains about 13 per cent of sea-water, and increase of the percentage above 20 is accompanied by progressive diminution in the velocity of fermentation.

University and Educational Intelligence.

CAMBRIDGE.—Dr. A. Harker, St. John's College, has resigned his readership in petrology as on Sept. 30, and, in view of the recent replacement of the professorship of mineralogy by a professorship of mineralogy and petrology, the General Board does not intend to recommend to the University the continuation of the readership.

Dr. F. R. Winton, Clare College, has been appointed University lecturer in physiology for three years, and Dr. E. G. Holmes, Christ's College, has been appointed University lecturer in pharmacology for three years. Dr. T. W. Wormell, St. John's College, has been reappointed observer in meteorological physics for five years.

THE Council of the Institution of Naval Architects has awarded the Elgar Scholarship in Naval Architecture (1931)—£130 per annum for three years at Armstrong College, Newcastle-on-Tyne—to Mr. H. Lackenby, of Messrs. R. and W. Hawthorn Leslie and Co., Hebburn-on-Tyne, and the Earl of Durham Prize to Mr. J. A. Price, of H.M. Dockyard, Sheerness.

THE University of Cambridge has issued a pamphlet containing summaries, extending, on an average, to a page and a half, of 72 dissertations approved during 1929–30 for the Ph.D., M.Sc., and M.Litt. degrees. More than half of the candidates had come to Cambridge after taking their first degrees in other universities—14 in English universities, 5 in Australian, 16 in universities in other parts of the British Empire, and 4 in the United States of America. Ten were women. The dissertations are classified under departmental headings as follows: mathematics 10, physics 9, chemistry 8, botany 8, biochemistry 6, other departments of science 16, other departments 12. The corresponding figures for the preceding year are: chemistry 9, agriculture 6, geology 6, biochemistry 6, mathematics 4, botany 4, other science departments 9, other departments 12. Of the three candidates in the department of English, two were from the United States of America and one was from Aberdeen. It would be unscientific to infer that English, like the proverbial prophet, is not without honour save in her own country, but this distribution of the Cambridge candidates for higher degrees in English seems significant.

AMERICAN educational progress in 1930 is briefly reviewed in the January issue of *School Life* by a member of the staff of the Federal Office of Education. The enthusiasm for educational research displayed by Federal and State authorities and voluntary organisations is astonishing. The Federal Government has just completed a survey begun in 1927 of land-grant colleges, is half-way through a survey of secondary education to be finished in 1932, and has begun a survey, for which Congress appropriated 200,000 dollars, of the professional education of teachers. Educational problems of every kind are being subjected throughout the country to scientific examination with scant regard for traditional prejudices and with confidence in America's ability to find the right solutions. "No longer do school boards send delegates abroad to bring back ideas for our democracy. Our rapid advance in the sciences basic to education and our supremacy in mechanical lines open for us the road to world leadership." There is likewise a remarkably widespread ambition on the part of teachers to improve their qualifications. Summer schools in 1930 were attended by 421,000 teachers, or about 45 per cent of the total number.

Birthdays and Research Centres.

Sept. 6, 1870.—Prof. F. G. DONNAN, C.B.E., F.R.S., professor of general chemistry in the University of London, the Sir William Ramsay Laboratories of Inorganic and Physical Chemistry, University College.

The chief subjects under investigation at present in the laboratory which I have the honour to direct are as follows: Colloid sols and gels, electrochemistry, photochemical actions, absorption of light in the visible and ultra-violet, X-ray analysis, surface phenomena and molecular films, catalysis, heterogeneous reaction kinetics, chemical and other effects of electrical discharges in gases (active molecules and atoms), infra-red absorption and molecular structure, magnetic susceptibilities of chemical systems, dielectric phenomena and dipole moments, properties of highly dried liquids, scattering of light in liquids. The possibility of investigating such a wide variety of phenomena is due to the generosity of Imperial Chemical Industries, Ltd.

Sept. 6, 1876.—Prof. J. J. R. MACLEOD, F.R.S., regius professor of physiology in the University of Aberdeen.

It is generally recognised that carbohydrate metabolism is partly under the control of the nervous system, and so-called diabetic centres have been described in various regions of the brain. Donhoffer and I are finding that a lesion involving the anterior region of the pons but of no other region of the brain causes a marked hyperglycæmia, and that this occurs whether or not glycogen is present in the liver. The muscle glycogen is rapidly used up as a result of the lesion. It fails to produce hyperglycæmia after removal of the adrenal glands. Its effects are annulled by insulin. A method has also been evolved for the measurement of the amount of insulin in blood, and it is hoped that it will be possible by its use to supply direct evidence as to whether the internal secretion of this hormone varies under various physiological and pathological conditions in the manner described by other investigators using indirect methods.

Sept. 6, 1892.—Prof. E. V. APPLETON, F.R.S., Wheatstone professor of physics, King's College, London.

For some years now I have been specially interested in various geophysical problems, the chief of which has been the determination of the electrical structure of the upper atmosphere, using wireless waves as the exploring probe. The method of experimental attack used has been to send vertically upwards wireless waves of different frequencies and make observations on them when they return after being reflected at high levels. Thanks largely to the energy and skill of a group of investigators working for the Radio Research Board of the Department of Scientific and Industrial Research, whose efforts I have been permitted to direct, a large mass of information relating to the heights reached by waves of different length has been accumulated. Since different concentrations of ionisation are required to turn back waves of different length, it is readily seen that the data mentioned yield information relating to the variation of ionisation content with height.

Up to the present a fairly complete study has been made of the diurnal and seasonal variation of the ionisation in the lower of the two ionised regions which have been found to exist, and attention is now being directed to similar observations for the upper region,

which is found to be richer in ionisation. It is hoped to continue these measurements for at least one eleven-year sunspot cycle.

The results of such observations in England have directed my attention to the possibility of making similar observations at a place within the Arctic Circle, and in particular in the region of marked auroral activity; and next autumn it is hoped to send out a group of workers from England to investigate the upper-atmospheric ionisation at Tromsö in Norway. Such work will, I think, form a suitable item for the 1932–33 International Polar Year programme.

Sept. 7, 1877.—Sir JOHN CADMAN, G.C.M.G., past president of the Institution of Mining Engineers and of the Institution of Petroleum Technologists.

After occupying the chair of mining and petroleum engineering in the University of Birmingham, and controlling the petroleum executive during the War period, I became technical director and eventually chairman of the group of companies controlled by the Anglo-Persian Oil Company. In these capacities I have been able to apply my scientific and administrative experience to the complex organisation of a great industrial concern in which there existed a maximum opportunity for the application of science to industry.

I have given particular attention to the application of geophysics to geological work, of improved chemical and physical methods to the treatment of petroleum, to the elaboration of new oil products, and to the hydrogenation of coal and oils. The problem which is particularly engaging my attention at present relates to the balancing of the world's fuel supplies, having regard to their relative physical availability and the relevant economic factors.

Sept. 9, 1867.—Dr. Robert Mond, president of the Faraday Society and of the Egypt Exploration Society, honorary secretary of the Davy Faraday Research Laboratory, joint treasurer of the Palestine Exploration Fund and treasurer of the British School of Archæology at Jerusalem, and honorary trustee of the Royal Ontario Museum.

I am engaged in assisting astronomical, chemical, medical, agricultural, archæological, and prehistoric research in England, Egypt, Palestine, and Brittany, as well as keeping in touch with general scientific and technical progress.

Problems which are worthy of investigation are: (1) Preventive inoculation of cows against tuberculosis. (2) Production of clean, cool, raw milk of a quality fit for conversion to human food (specialised feeding of cows). (3) Methods of modification of such milk to suit individuals.

Subjects to which I have given attention and which require further elucidation are: (1) Study of rotary gas engines. (2) Alloys. (3) The time-lag between wholesale and retail prices.

Sept. 12, 1851.—Sir ARTHUR SCHUSTER, F.R.S., formerly secretary (1912–19) and foreign secretary (1920–24) of the Royal Society; honorary professor of physics in the University of Manchester.

Old age and failing health prevent my taking any further active part in scientific investigation; but the reminiscences of a long life, which I am collecting, may direct attention to matters of scientific interest.

Societies and Academies.

PARIS.

Academy of Sciences, July 6.—R. Fosse, A. Brunel, and P. E. Thomas: The application of the quantitative spectrophotometric analysis of allantoin to the blood of some mammals and to the seed of numerous plants. Figures are given for the allantoin found in the blood of some mammals and in a large variety of seeds. Two seeds are remarkable for the high proportion of allantoin they contain, *Phaseolus mungo* (0·18 per cent) and *Dolichos sinensis* (0·33 per cent).—L. Cayeux: The existence of organic residues and especially of verticiliate siphon Algæ in the limestone schist system of the Belgian Congo.—S. Stoïlow: The values of the analytical functions in the neighbourhood of the boundary of a domain of regularity.—M. Fekete: Suites of factors retaining the class of a Fourier's series and also of certain local individual properties of the corresponding function.—Laurent and Augustin Seguin and André Labarthe: An apparatus for the study of the phenomena of injection and of combustion in motors by the ultra-cinematograph. By means of a special arrangement of a neon tube and condensers, the apparatus described can take up to 100 photographs at the rate of 30,000 per second.—Pan Tcheng Kao: The velocity of propagation of aerial ultra-sound waves. A study of the velocity of propagation of ultra-sounds by Pierce's method.—Ch. Dietsch: A method of measuring high intensities of continuous current.—Edouard Belin: The secrecy of telegraphic and radiotelegraphic transmissions. The message is transmitted in its original form (telephotography or teleautography) and distorted by a special machine before transmission. At the receiving end is a similar machine worked the reverse way.—G. Mahoux: The influence of electromagnetic waves on the resistance and hardness of metals and alloys.—Mme. M. Châtelet-Lavollay: The comparative absorption spectra of complex salts of chromium and of trivalent cobalt.—C. Marie and N. Thon: The phenomena of expansion presented by certain electrolytic deposits of metals. The experimental method is based on the direct observation of the deformations undergone by a thin flexible cathode, one side of which is covered with an insulating material. Metallic deposits have a general tendency either to contract or dilate. The results vary with the conditions (nature of the solution, acidity, nature of the cathode, state of the surface, and so on) and have a practical interest from the point of view of the adherence of deposits and their defects.—Mme. P. Curie and S. Rosenblum: The magnetic spectra of the α-rays of the active deposit of actinon.—A. Bates: Temper and ageing of extra-mild steels.—W. Broniewski and J. Król: The cold hardening of iron.—A. Michel-Lévy and H. Muraour: The temperature of deflagration of colloidal (explosive) powders. In order to ensure identity of temperature of explosive and surroundings, the tests were made on shavings weighing from 1 mgm. to 2 mgm. For more than 150 explosives examined the deflagration temperature was round about 200° C. and not 170° as generally accepted.—Grégoire: The number of pairs of ions produced in air by an α-ray of polonium.—Augustin Boutaric and Jean Bouchard: The influence of light on the flocculation of colloidal solutions in a fluorescent medium. Rôle of coloured inhibitors and of the viscosity of the medium.—Marcel Ballay: Some properties of austentitic grey cast irons.—M. and Mme. M. Lemarchands: Concerning chemical inertia.—J. J. Rutgers: Modification of Pregl's method for determining nitrogen. The changes suggested are mainly directed towards reducing the time required for the determination.—A. Sanfourche and A. Portevin: The attack of various alloys by

phosphoric acid solutions.—P. Brenans and B. Rapilly: Mercury salicylate.—L. Debucquet and L. Velluz: Organic compounds of tungsten and molybdenum containing sulphur. These metals form double sulphides with piperazine and piperidine: these are crystalline substances of definite composition.—A. Mailhe and Creusot: The transformation of benzene into methane. A quantitative study of the production of methane from a mixture of benzene and hydrogen in presence of reduced nickel as catalyst. Much higher yields of methane were obtained with benzene carefully freed from thiophene.—Charles Dufraisse and Marius Badoche: Researches on the dissociable organic oxides. Dihydroxy-dihydrorubrene, $C_{42}H_{28}(OH)_2$, a fourth product of oxidation reducible to rubrene.—Yves Milon: The evolution of the coast-line and the formation of tombolos in the Paimpol region (Côtes-du-Nord).—François Ruellan: The decomposition and disaggregation of the biotite granites in Japan and Corea and the resulting forms.—Caulle and Idrac: The phenomena of the whistling pits near Caux.—M. Bridel and R. Lavieille: The sweet principle of Kaáhé-é (*Stevia Rebaudiana*). The products of diastase hydrolysis of stevioside; glucose and steviol.—Pierre Chouard: Specific correlations proved for some Portuguese Scilla (*Scilla monophyllos*, *S. Ramburei*, *S. odorata*).—Emery: Bacterial origin of the tumours of the elm. These tumours are proved to be of bacterial origin. They are caused by *Bacterium tumefaciens*. This organism has been isolated by the author from one of the tumours, and the process of invasion has been reproduced experimentally on another young elm.—L. Lavauden: A new *Propithecus* (*Propithecus Perrieri*) of Madagascar.—E. Le Breton, F. Mocoroa, and E. Stulz: The proteolytic ferments of the intestinal juice and of the pancreatic juice. It is concluded that only abnormal pancreatic juices contain ereptic ferments or kinase, or sometimes both. Independently of any kinase of pancreatic origin, the intestinal juice always contains ereptic ferments and enterokinase.—Albert Leulier and Mme. Andrée Roche: The mechanism of the antiglycosuric action of santonine. From the therapeutic point of view, santonine ought to be a useful adjunct to insulin in the treatment of certain forms of diabetes.—Maurice Piettre and Boris Celan: The formation of articular humours of fibrin apart from the fibrinogen of blood origin. The function of the white cells.—Mme. J. Kostitzine: The statistics of the infestation of hermit crabs by *Chlorogaster*.—Néda Marinesco: The electromotive force of filtration produced by the ascent of the sap in plants. It has been shown that it is possible to make the sap rise or fall more or less rapidly in plants by applying a potential difference to the stems. The results afford an explanation of the results obtained by acting with a high frequency field on some plant species.—Jean Troisier and Roger Cattan: Exanthematic fever in man, without visible symptoms, caused by *Rhipicephalus sanguineus*, its virulence for the ape and guinea-pig. A man inoculated with crushed *Rhipicephalus* showed no symptoms of the disease, but his blood was virulent to an ape (*Cercopithecus Patas*). A guinea-pig was also infected by the blood. The inoculated man, although showing neither fever nor eruption, gave a positive Weil-Felix reaction.—Félix Bertyn: The poisonous effect of the fogs of the Meuse valley is due to industrial emanations. The fatal effects of the fog in the Meuse valley during December 1930 have been variously attributed to the fog alone, or to this with some contamination with micro-organisms. The author puts forward evidence that neither of these hypotheses can account for the facts, and it is much more probable that the fumes from chimneys and from zinc works were responsible for the fatalities.

Leningrad.

Academy of Sciences, *Comptes Rendus*, 1931, No. 1.—G. A. Nadson and G. Filippov: The formation of new stable races of micro-organisms under the influence of X-rays. (2) Description of races of *Sporobolomyces*. New races obtained in cultures of *Sporobolomyces* under the influence of X-rays are described in detail. The races retain their morphological and physiological characteristics after hundreds of generations on different media, without exhibiting any tendency to revert to the original form. Some of the races differ from the original to such an extent that they might be considered as distinct species and even genera.—N. F. Alexeenko: Diatoms growing on stones on the Black Sea littoral near Sebastopol. The following species were found in large numbers: *Synegra gracilis* Kutz. var. *commutata* Grun., *Mastogloia interrupta* Hantzsch, *M. pontica* sp. n. and *Nitzschia reinhardi* sp. n. The two new species are described and figured, and comparative tables of species of *Mastogloia* and *Nitzschia* are given.—A. Zachvatkin: Periodic variations in the level and in the chemical composition of the water of Lake Gusinœ, Transbaikalia. Lake Gusinœ, like Lake Baikal, belongs to the system of post-Tertiary lakes. During the last two centuries the lake has sometimes been reduced to two small lakes, and then has again become very large in area. The chemical composition of the water has changed accordingly, the lake having been reported by some authors as a salt lake, while at present it contains fresh water. The fauna is very poor, which can be explained by the frequent changes in the salinity of the lake.—A. Frank-Kamenetskii and V. Koncevich: The chemical composition of the water of the hot springs in northern Transbaikalia. Twenty-seven groups of thermal springs have been investigated by the authors, who report on the chemical composition of the waters. Sodium sulphate is the main component of the water, while silicic acid and its salts are also common. The temperature of the water in different springs ranges from 32° to 80° C.—D. Beliankin: Anemusite (with reference to pacifites of Barth). The author, on the basis of analyses of anemusite and of pacifites, expresses the opinion that they are not basalts with anemusite, in the sense of Wright and Washington, but simply basalts with the excess of the aluminate, or aluminated basalts. The excessive aluminate is contained not only in plagioclase, but also in the pyroxene of the rock.

Washington, D.C.

National Academy of Sciences (*Proc.*, vol. 17, No. 5, May 15).—A. L. Dryden, jr.: Accuracy in percentage representation of heavy mineral frequencies. The present tendency is to count mineral grains in a section and express the result as a percentage. This can give higher accuracy than inspection of samples, but statistical methods indicate the importance of stating exactly how the result is obtained.—Harvey Cushing: (4) The method of action of pituitrin introduced into the ventricle. The characteristic effects of intraventricular injection of pituitrin are not observed when the hypothalamic nuclei are out of action.—(5) The counteractive effect of tribromethanol (avertin) on the stimulating response to pituitrin injected in the ventricle. The conclusions of the previous paper are supported by the fact that avertin, which is believed to act on centres in the diencephalon, counteracts the effect of pituitrin.—(6) Concerning a possible 'parasympathetic centre' in the diencephalon. Includes a review of the evidence of the foregoing five papers; it is suggested that the

neuro-hypophysis bears a similar relation to the parasympathetic division that the adrenal medulla does to the sympathetic division of the autonomic nervous system.—**A. H. Sturtevant** and **Jack Schultz**: The inadequacy of the sub-gene hypothesis of the nature of the scute allelomorphs of *Drosophila* (see NATURE, Aug. 15, p. 273).—**L. V. Morgan**: Proof that bar changes to not-bar by unequal crossing-over.—**Chas. W. Metz** and **M. Louise Schmuck**: Differences between chromosome groups of soma and germ-line in *Sciara*. Deductions as to inheritance in *Sciara* based on chromosome counts in germ tissue require modification in view of the fact that the chromosome group for body tissue differs from that for germ tissue in both sexes.—**Myron Gordon**: The hereditary basis for melanosis in hybrids of Mexican killifishes.—**Mary Sears**: The responses of the deep-seated melanophores in the frog to adrenalin and pituitrin. The responses are similar but take place more slowly.—**Earle B. Perkins** and **Theodore Snook**: Control of pigment migration in the chromatophores of crustaceans. Pigment migration appears to be due to a substance produced by the eye-stalks and is of the nature of an interspecific hormone; the efficiency of the substance is increased by boiling the sea-water extract.—**Forrest Clements**: The correlation between tanning and unexposed skin colour as recorded by the colour top. Field studies on American Indians show high correlation between unexposed skin colour and degree of colour change by exposure; this correlation is negative for the black and red elements of the colour top and positive for the yellow and white. Thus, the darker the skin, that is, the greater the proportion of the black and red elements and the less the proportion of yellow and white, the less will be the amount of tanning on exposure. This suggests a possible exposure-index for ultra-violet light therapy.—**Henry B. Bull** and **Ross Aiken Gortner**: Studies on electrokinetic potentials (9). The electrical field of force at liquid-liquid interfaces. Salt solution is forced as a spray through a hole in one electrode and the charge carried to another electrode measured, the electrodes being immersed in oil. The curves obtained resemble closely the electrokinetic potential curves at cellulose-aqueous solution and glass-aqueous solution interfaces.—**Wilder D. Bancroft** and **G. H. Richter**: Reversible coagulation in living tissue (3). Evidence from the treatment of lunatics supporting the hypothesis that excessive dispersion or excessive coagulation of nerve colloids can cause insanity; these two forms of insanity obviously require different treatment.—**R. J. Seeger**: A critique of recent quantum theories.—**Paul S. Bauer**: Dissipative dynamical systems (1).—**B. O. Koopman**: Hamiltonian systems and transformations in Hilbert space.—**Marston Morse**: The order of vanishing of the determinant of a conjugate base.—**G. A. Miller**: Automorphisms of order 2 of an Abelian group.—**Tracy Yerkes Thomas**: On the unified field theory (6).

Official Publications Received.

BRITISH.

Journal of the British Wood Preserving Association. Vol. 1. Pp. viii+99. (London.) 7*s*. 6*d*.

Annual Report of the Council to the Members of the City and Guilds of London Institute to be presented at the Yearly Meeting in June 1931. Pp. lvii+85. (London.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1384 (Ae. 509—T. 3077): Tests of various Lateral Controls fitted to a Siskin Aircraft. By W. G. Jennings. Pp. 10+12 plates. 9*d*. net. No. 1386 (M. 71—A. 77): The Influence of Titanium Tetrachloride on Cast Aluminium Alloys. By Dr. W. Rosenhain, J. D. Grogan and T. H. Schofield. Pp. 10+5 plates. 1*s*. net. No. 1387 (M. 72—A. 81): Gas Removal and Grain Refinement in Aluminium Alloys. By Dr. W. Rosenhain, J. D. Grogan and T. H. Schofield. Pp. 8+3 plates. 9*d*. net. (London: H.M. Stationery Office.)

The North of Scotland College of Agriculture. Calendar, Session 1931–1932. Pp. viii+118. (Aberdeen.)

Mean Hourly Values of the Magnetic Elements at Toolangi, 1928 and 1929. Observed and reduced under the direction of Dr. J. M. Baldwin. Pp. iv+7. (Melbourne: H. J. Green.)

FOREIGN.

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Isforholdene i de Danske Farvande i Vinteren 1930–1931 (The State of the Ice in the Danish Waters during the Winter 1930–1931). Pp. 12. (København: G. E. C. Gad.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Supplement to Bulletin No. 91: The Soils of the Libyan Oases. By Dr. R. R. Le G. Worsley. 8 plates. (Cairo: Government Press.) 2 P.T.

Union Géodésique et Géophysique Internationale: Section de Magnétisme et Électricité terrestres. Bulletin No. 8: Comptes rendus de l'assemblée de Stockholm, 15-23 août 1930. Publiés par les soins de Ch. Maurain. Pp. x+479. (Paris: Les Presses universitaires de France.)

Journal of the College of Agriculture, Imperial University of Tokyo. Vol. 11, No. 2, March 28th. Pp. 75-240+plates 8-15. (Tokyo: Maruzen Co., Ltd.) 3.00 yen.

U.S. Department of Agriculture. Circular No. 167: Moss Peat, its Uses and Distribution in the United States. By A. P. Dachnowski-Stokes. Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents.

Diary of Societies.

TUESDAY, SEPTEMBER 8.

INSTITUTE OF MARINE ENGINEERS, at 6.—President's Address.

LONDON NATURAL HISTORY SOCIETY (Botany Section) (at London School of Hygiene and Tropical Medicine), at 6.30.—A. W. Robbins: Some Preliminary Remarks on Brambles.

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.

FRIDAY, SEPTEMBER 11.

INSTITUTE OF MARINE ENGINEERS (Official Visit to the Shipping, Engineering and Machinery Exhibition at Olympia). At 3.—A. C. Hardy: Marine Engineering as a Marketing Proposition. At 6.—A. R. T. Woods: The History of Marine Refrigeration.

CONGRESSES.

SEPTEMBER 1 TO 19.

INTERNATIONAL ILLUMINATION CONGRESS. (For Programme see NATURE, Aug. 29.)

SEPTEMBER 6 TO 12.

INTERNATIONAL CONGRESS FOR TESTING MATERIALS (at Zürich).

Tuesday, Sept. 8.—Dr. W. Rosenhain: Chairman's Address. (Group A.)
J. G. Pearce: The Structure and Mechanical Properties of Cast Iron.
Prof. E. Piwowarsky: Der Grauguss und seine Prüfmethoden.
Prof. A. Portevin: Caractérisation des propriétés mécaniques des pièces moulées en fonte grise.
Prof. F. Pisek: Tests on Cast Iron—A Consideration of Test Results Obtained in Czechoslovakia.
Dr. E. Dübi: Beitrag zu der Frage der Prüfungsverfahren für Gusseisen.
Prof. J. Galibourg: Les métaux aux températures élevées.
Dr. A. Pomp and Dr. W. Enders: Abkürzungsverfahren zur Bestimmung der Dauerstandfestigkeit des Stahles.
R. G. Batson and H. J. Tapsell: Materials at High Temperatures.

Wednesday, Sept. 9.—Prof. P. Ludwik: Ermüdung.
Dr. H. J. Gough: The Present State of Knowledge of Fatigue of Metals.
Dr. D. J. McAdam: Fatigue.
Dr. P. Forcella: L'essai aux chocs répétés à flexion alternée sur les rails des chemins de fer italiens; essais de torsion alternée de 360° sur fils de cables métalliques pour voies ferrées aériennes et funiculaires.
Dr. E. Schulz and Dr. H. Buchholtz: Über die Entwicklung der Dauerprüfung in Deutschland.

Thursday, Sept. 10.—Dr. M. Moser: Der Stand der Kerbschlagproben-Frage in Deutschland.
Prof. R. Zoja: Essais au choc sur barreaux entaillés.
Dr. M. Schmidt: Kerbschlagproben, Normenprobe.
Dr. R. H. Greaves: Meaning of the Notched-Bar Impact Test for Investigation and for Acceptance Test Purposes.
A. Steccanella: L'essai de résilience comme essai de réception.

Friday, Sept. 11.—F. F. Lucas: Advances in Microscopy.
Prof. C. Benedicks and H. Löfquist: Progress of the Knowledge regarding Slag Inclusions in Iron and Steel.
Dr. J. L. Haughton: Progress of Metallography.
Prof. W. Guertler: Die neuere Entwicklung der Konstitutionsforschung der Legierungen.
Prof. A. Westgren: X-Ray Investigations of the Constitution of Alloys.

Tuesday, Sept. 8.—Prof. M. Roš: Chairman's Address. (Group B.)
Prof. R. Grengg: Anwendung mineralogischer und petrographischer Erkenntnisse auf die technische Materialprüfung nichtmetallischer anorganischer Stoffe.
Prof. P. Niggli: Anwendung mineralogischer-petrographischer Erkenntnisse auf die technische Materialprüfung nichtmetallischer anorganischer Stoffe.
Prof. G. Berg: Welche petrographischen Eigenschaften sind für die technische Eignung der Gesteine von besonderer Wichtigkeit?

Prof. H. Burchartz: Die Verfahren zur Prüfung von Strassenbau- und Gleisbettungsstoffen auf Widerstandsfähigkeit gegen statische und dynamische Beanspruchungen.
J. F. Cellerier: Étude des moyens de préservation des pierres naturelles.
Prof. J. O. Roos af Hjelmsäter: Chemical Action of Aggressive Waters on Cement.
Prof. G. Wiegner: Chemische Einflüsse auf Zement und Beton im Boden.
Prof. I. Vandone: L'unification mondiale des essais des mortiers et des bétons de ciment.
Dr. G. Haegermann: Die Zementprüfung.
Dr. L. Lili: Propriétés intimes du ciment portland et de leurs conséquences.
Prof. Q. Sestini and Prof. L. Santarelli: Le fer dans la constitution des ciments et les ciments ferreux.
C. Vigliani: Comportement des ciments naturels et artificiels après de longs délais.
Dr. A. Perfetti and Dr. E. Palumbo: Influence des variations de température des ambiants de préparation et de conservation des éprouvettes de mortier normal sur leur résistance mécanique.
Dr. A. Perfetti: Influence de la quantité d'eau de gâchage sur la résistance des mortiers normaux de ciment aux essais mécaniques.
Prof. F. Klokner: Rapport entre la ténacité et la résistance des différentes sortes de ciment.
A. Maitre-Devallon: Détermination du dosage des mortiers et bétons en ciment ou chaux hydraulique.

Wednesday, Sept. 9.—Prof. R. Grün: Zemente mit hydraulischen Zuschlägen.
Prof. F. Ferrari: Ciments et substances pouzzolaniques.
Dr. C. Vittori: Les ciments pouzzolaniques rationnels de Segni.
B. L. Katzigheras: Einige Ergebnisse von Untersuchungen mit Santorinerde.
Dr. E. Rengade: Les ciments alumineux.
P. H. Bates: Suggested Investigations of High Alumina Cements.

Thursday, Sept. 10.—A. Pena Bœuf: Élasticité et résistance des bétons.
Prof. O. Graf: Über die wichtigsten Eigenschaften des Betons, über ihre praktische Bedeutung und über die Nutzbarmachung der Erkenntnisse.
Prof. L. Santarella: Résistance et élasticité du béton.
Prof. W. A. Slater: Designing Concrete for High Strength, Low Permeability, and Low Shrinkage.

Friday, Sept. 11.—Prof. W. Gehler: Festigkeit, Elastizität und Schwinden von Eisenbeton.
Prof. F. E. Richart: Stresses and Strains in Reinforced Concrete Columns.
Dr. F. Emperger: Die Stauchungsfähigkeit des Betons.
Prof. J. A. Bakker: L'état des constructions en béton armé âgées de 20 ans et plus.

Tuesday, Sept. 8.—Prof. J. O. Roos: Chairman's Address. (Group C.)
Prof. H. Suida and W. Janisch: Asphalte und Bitumen. Eignung im Bau- und Strassenbauwesen.
P. Hubbard and C. S. Reeve: Methods of Tests or Bituminous Materials.
Dr. J. P. Pfeiffer.—Summary of Investigations made in Holland and her Colonies with Respect to the Description of the Identification of Woods, with a View to drawing up a Method applicable in Practice.
R. Schlyter: Researches into Durability and Strength Properties of Swedish Coniferous Timber.

Wednesday, Sept. 9.—C. J. Chaplain: The Development of Mechanical Testing of Timber in Great Britain with a Note on Preservative Treatments.
M. L. Monnin: Essai des bois.
Dr. A. Perfetti: Étude des caractéristiques mécaniques de quelques qualités de bois.
Prof. E. Casati: Essais comparés sur éprouvettes de dimensions différentes de quelques essences de bois.
Prof. K. Ryska: Einige Fragen aus dem Gebiete der technischen Prüfungsmethoden für Hölzer.
Prof. M. Roš and Dr. J. Brunner: Die Knickfestigkeit der Bauhölzer.

Thursday, Sept. 10.—Dr. M. van Rysselberge: Le vieillissement artificiel des huiles minérales spéciales.
Prof. F. Frank: Alterung organischer Stoffe, wie Kautschuk, Öle, Harze, Fasern usw.
Dr. G. Barr: Ageing of Organic Materials.
Dr. H. Stäger: Die Alterung organischer Werkstoffe.
Dr. C. H. Weiss and P. Woog: Unification de la désignation de la viscosité. Nécessité d'employer le coefficient de viscosité absolu statique ou le coefficient de viscosité absolu cinématique pour la mesure pratique de la viscosité.

Friday, Sept. 11.—Prof. K. Bunte: Probenahme von Kohlen, Koks und anderen Brennstoffen, sowie von Schlacken und Aschen.
Dr. E. S. Grumell and Dr. J. G. King: The Sampling of Coal and Coke.
W. A. Selvig: Sampling Coal.
Dr. F. S. Sinnatt: The Determination of the Fusion Point of Coal Ash.
Prof. K. Bunte: Methoden zur Bestimmung des Schmelzverfahrens der Asche.
Dr. R. de Benedetti and Dr. G. Rossi: Détermination des matières volatiles dans les combustibles solides.
Prof. P. Schläpfer: Untersuchungsmethoden zur Bestimmung des Back- und Blähvermögens und des Treibdruckes von Steinkohlen.

Monday, Sept. 7.—Prof. W. v. Moellendorff: Chairman's Address. (Group D.)
L. R. Feret: La grosseur des grains des matières pulvérulentes.
Prof. A. H. M. Andreasen: Theoretisches und experimentelles über Korngrösse und Feinheit.
Prof. L. T. Work: Present Status of Particle Size Determination.
Dr. H. W. Gonell: Zur Frage der Bestimmung der Grösse loser Körner.

Tuesday, Sept. 8.—Prof. H. F. Moore: The Calibration of Testing Machines.
Prof. F. C. Lea: Accuracy of Measurement and Variability of Test.
W. Ermlich: Eichung und Genauigkeit von Prüfmaschinen.

Thursday, Sept. 10.—Prof. M. Roš and A. Eichinger: Begriffliche und prüfmethodische Beziehung zwischen Elastizität und Plastizität, Zähigkeit und Sprödigkeit.
P. Regnauld: Relations entre l'élasticité et la plasticité, la ténacité et la fragilité. Moyens pratiques de les caractériser.
Prof. G. Sachs: Elastizität und Plastizität, Zähigkeit und Sprödigkeit.
Prof. F. B. Seely: Ideal and Practical (Test) Relations between Elasticity and Plasticity, Tenacity and Brittleness.
Prof. A. Schob: Begriffliche und prüfmethodische Beziehung zwischen Elastizität, Plastizität, Zähigkeit und Sprödigkeit.

SEPTEMBER 7 TO 10.

INTERNATIONAL PSYCHO-ANALYTICAL ASSOCIATION (at Interlaken).

SEPTEMBER 7 TO 10.

INTERNATIONAL CONGRESS FOR STUDIES REGARDING POPULATION (at Rome).

SEPTEMBER 7 TO 12.

INTERNATIONAL CONGRESS OF ORIENTALISTS (at Leyden).

SEPTEMBER 9 TO 12.

INTERNATIONAL PROFESSIONAL ASSOCIATION OF MEDICAL PRACTITIONERS (at Budapest).

SEPTEMBER 13 TO 18.

INSTITUTE OF METALS (at Zürich).

Sunday, Sept. 13, at 7.30.—Ulick R. Evans: Thin Films on Metals in Relation to Corrosion Problems (Autumn Lecture).

Monday, Sept. 14 and *Tuesday, Sept.* 15.—Alkins and Cartwright: Experiments in Wire-Drawing. Part I.—Behaviour of a Composite Rod.
Alkins: Experiments in Wire-Drawing. Part II.—Notes on the Relation between Reduction of Area by Cold-Drawing and Tensile Strength of H. C. Copper.
Blazey: Brittleness in Copper.
Brownsdon and van Someren: The Application of the Spectrograph to the Analysis of Non-Ferrous Metals and Alloys.
Cooke and Larke: The Physical Testing of Copper and Copper-Rich Alloys in the Form of Thin Strip.
Daniels: The Attack on Mild Steel in Hot-Galvanizing.
Dunn: The Oxidation of some Copper Alloys.
Francis and Thompson: The Drawing of Non-Ferrous Wires.
Hanson and Slater: Unsoundness in Aluminium Sand-Castings. Part I.—Pinholes: Their Causes and Prevention.
Hanson and Slater: Unsoundness in Aluminium Sand-Castings. Part II.—The Effects of Using Metal Previously Subjected to Corrosive Conditions.
Haughton and Payne: Transformations in the Gold-Copper Alloys. With an Appendix on X-Ray Examination of Gold-Copper Alloys, by G. D. Preston.
Hume-Rothery: The Marco-Etching of Aluminium-Silicon Alloys.
Jones, Pfeil, and Griffiths: Nickel-Copper Alloys of High Elastic Limit.
Jones: The Copper-Magnesium Alloys. Part IV.—The Equilibrium Diagram.
Kloninger, Keller, and Meuche: Applications of the Electric Furnace for Non-Ferrous Metals, with Special Reference to the Bright Annealing Process.
Kurnakow and Ageew: Physico-Chemical Study of the Gold-Copper Solid Solutions.
Murphy: Constitution of the Alloys of Silver and Mercury.
Newson and Wragg: Note on the Failure of a High-Strength Brass.
O'Neill: Note on the Diameter Measurement of Certain Brinell Indentations in Cold-Rolled Metal.
O'Neill and Cuthbertson: The Work-Hardening Capacity and Elongation Properties of Copper.
Smith: The Spectrographic Assay of some Alloys of Lead.
Smithells, Williams, and Grimwood: Melting Nickel-Chromium Alloys in Hydrogen.
Sutton and Le Brocq: The Protection of Magnesium Alloys against Corrosion.
Waterhouse and Willows: The Effects of Cold-Rolling and of Heat-Treatment of some Lead Alloys.
V. Zeerleder: Influence of Variations in Heat-Treatment and Ageing on Duralumin.

SEPTEMBER 13 TO 19.

INTERNATIONAL MEDICAL EDUCATIONAL CONGRESS (with special reference to Balneology) (at Carlsbad).

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

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

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