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The Special Areas and the Location of Industry

Industrial Survey of South Wales

THE necessity for close attention to the location of industry has in recent months received repeated emphasis, and nowhere more than in the three volumes* comprising the Second Industrial Survey of South Wales, undertaken for the National Industrial Development Council of Wales and Monmouthshire by Prof. H. A. Marquand and a staff of assistants with the aid of a grant from the Commissioner for Special Areas. The First Industrial Survey of South Wales was made for the Board of Trade by University College, Cardiff, in 1931, and was designed merely to determine the surplus of labour attached to the existing industries of South Wales. Nevertheless, valuable work was done, and the significant reference in the present report to the difficulties which were experienced, simply because the limited resources of the College made it impossible to keep continuously up to date the information which had been prepared and collected in the Survey, will not be overlooked by those who appreciate the value and significance of such research.

The subsequent report of Lord Portal in 1934 was in no sense a survey but rather a collection of recommendations as to Government policy, and its information on industry and employment was restricted to the eastern section of the coalfield. The present survey, on the other hand, was designed to supply an answer to three specific practical questions :

(1) What is the present state of employment in the various industries in South Wales, and the probable future of employment in those industries ?

(2) What facilities can the region offer to new industries which may be established within it ?

(3) What new industries can most profitably be introduced into the region and where can they best be located ?

To each of these questions a volume is devoted, and if the thoroughness with which the Survey has been conducted has inevitably meant a bulky report, the report is none the less a model of the type of guidance required by Government and industry in the day-to-day and detailed task of reconstruction. It is authoritative, balanced, practical and constructive, and outside the region itself, the main findings of the Survey merit the careful consideration of administrators and business men who may be affected. A wide range of concrete problems is examined with detachment and common sense, and the consistent regard for sound economic principles, combined with the impressive grasp of industrial problems and technique which it displays, give it claims on the attention of all who are interested in Great Britain's industrial future. For the general reader, an admirable summary and survey of the report has been issued by Political and Economic Planning (PEP) ; but the scientific worker will at least turn to the first and third volumes of the full report, if the interest of the second volume with its detailed survey of facilities is mainly for industrialists considering possible locations for factories.

The first volume of the report, which discusses the size and distribution of the population of South Wales and attempts to forecast its probable

* The Second Industrial Survey of South Wales. (Published on behalf of the National Industrial Development Council of Wales and Monmouthshire.) Vol. 1 : Industries. Pp. 500. 15*s*. net. Vol. 2 : Facilities. Pp. 295. 10*s*. 6*d*. net. Vol. 3 : Development. Pp. 404. 10*s*. 6*d*. net. (Cardiff : University of Wales Press Board ; London : Oxford University Press, 1937.)

future development, in itself powerfully supports Sir Josiah Stamp's latest plea for the study of population questions. The Survey shows that while there has been some recovery from the depths of the depression of 1930–33, a mass of chronic unemployment remains which is peculiar to this and other depressed areas which have not developed large new industries to compensate for the contraction of basic activities such as coal mining and steel making.

Coal mining is by far the most important industry in South Wales, accounting for more than a third of the insured workers, although fourteen years ago it accounted for half. While the number of miners wholly unemployed remains at about its peak level, the number temporarily unemployed has been greatly reduced. The report estimates that there is a surplus of about 80,000 workers in the area, 70,000 of whom are from the mining industry, and a considerable proportion of this surplus consists of men too old to obtain employment on commercial terms. This is one of the important factors to which special attention is directed in the report.

This surplus is attributed partly to the inevitable results of technological development and partly to the growth of economic nationalism. Recognizing that it is an essential foundation of a rising standard of living that such commodities as steel, ships or bricks should be produced by a diminishing number of workers, and also that it is desirable that new and more economical methods of satisfying essential needs should be developed if possible, the report emphasizes the importance of re-absorbing the displaced labour after an interval in new industries and services as a normal remedy. Moreover, the case for State action to stimulate the introduction of new industries is strengthened by the fact that the over-expansion of the heavy industries, although probably unavoidable, was due to the needs of the State itself.

The problem, in fact, is not merely one of dealing with the hard core of unemployment by alleviating the lot of some thousands who have been unemployed for a prolonged period, but also the much larger problem of regional development. Even if employment in the heavy industries were fully restored, areas like South Wales would remain relatively depressed because of low wages, the large number of dependants per wage earner and the scarcity of employment for female labour. Throughout the report, emphasis is laid on the dangers of piecemeal or haphazard action, and the case for deliberate consideration by the State of regional development and the planned location of industry, as opposed to the almost accidental influence exerted in the past, is admirably argued. Only as the location of industry is considered in relation to long-term advantage can we hope for a successful policy, and the need for a careful statement of the theory of location is evident even if practical action and policy cannot wait for such a statement.

The present report, however, directs attention to several factors to be considered in arriving at decisions in the meantime. Thus, it indicates that technical developments have diminished the importance of location near coalfields or proximity to raw materials, and increased the strength of the pull exerted by other forces. The tractability, rather than the cheapness, of labour is now the important factor. At the same time the influence of local rates tends to increase, even though derating has removed much of the handicap under which the depressed areas laboured in competition with the south-east and south-west of England before 1929.

The review of industries and population leads to the conclusion that further State aid in encouragement of new industries in South Wales would be economically justified. Some transfer of labour to other parts of Great Britain should continue, but the main emphasis is laid on the introduction of new industries. Some such industries merely need certain inducements to overcome unjustified prejudices against location in South Wales. Some may need the assistance which the establishment of trading estates could give. The success of all, however, depends upon the width of the market to which they can easily have access, and it is for this reason that an improvement in the transport services connecting the region with the rest of England is so desirable.

The second and third volumes of the Survey are in fact mainly devoted to the examination of questions involved in the introduction and development of new industries. The second volume, which outlines in some detail the existing facilities, is naturally chiefly of interest to the industrialist considering a definite step in that direction ; but the third volume, which examines the new industries which might be established, and discusses the improvements in facilities necessary for their success, has a much wider interest and in particular a number of claims upon the attention of scientific workers.

The detailed treatment of labour supply and demand which occupies half this third volume

alone emphasizes the necessity for some rational treatment of the problem, if only to minimize the amount of waste in cross-travel and to deal with the needs of the 20,000 older men of fifty to sixty-five years of age who are unlikely to be employed again. Some extension of the social service club system might be of vital assistance in restoring a sense of function to these men, by enabling them to use their creative powers to supplement their family income. The removal of any deterrents to their migration and reunion with other members of their family in a new district is another promising and constructive line of approach to this problem of the growing preponderance of the middle and older age groups among the wholly unemployed in the Special Areas.

It is, however, in the third and fourth chapters of this volume that the scientific worker will find the material of most immediate concern to himself. In its discussion of possible new industries, the report lays special stress upon the possibilities of the plastics industry, and argues a strong case for consideration. If the manufacture of all or most types of plastics were undertaken on an economic scale in South Wales, in a few years the industry might provide as much employment in the region as it gives the whole country now. As a means of providing employment, the plastics industry is far superior to schemes for oil from coal or low-temperature carbonization, or synthetic nitrogen, though the report emphasizes the desirability of locating such plant in an area so much less vulnerable to attack than Billingham.

The soundness of the survey is indeed well illustrated by the way in which this question of the plastics industry is discussed. If the industry is introduced at all, it is highly desirable that a range of new materials as complete as possible should be made in the region, because plastic materials are competitive to some extent with each other as well as with other materials. Any one particular type of plastic material may easily be driven out of the market by a new, better and cheaper material made elsewhere.

Part of the value of the plastics industry to South Wales would lie, however, in the assistance it could give to other industries in the area by using products obtained in the area and by stimulating other industries such as the establishment of a new chemical industry, the paint industry, the electrical industry and many light industries. The question, as the report insists, needs considering in relation to a far-reaching policy of industrial location, and to discuss with the industry as a whole the possibility of giving a fair trial to such a region as South Wales is a manifest responsibility of the Government, in keeping with its recognized responsibility for securing fair play for British trades overseas.

In an admirably balanced review of possible improvements in facilities, a convincing case is urged for a Severn bridge scheme as well as for the improvement of railway services. Tourist development has hitherto been amateurish and piecemeal, and offers a distinct field, particularly in Pembrokeshire and the Gower Peninsula. A national park in the Vale of Neath is also proposed, while the threat which ugly and random development present to the amenities of South Wales once more attests the need for planned development.

The present investigation in itself accordingly underlines its own very modest and restrained recommendations in regard to research. The trading estates should provide for their tenants some form of market research and economic advisory service. A far better service should also be available than now exists to provide information and guidance on wider problems common to the whole region, at the very least on those affecting the basic industries. As a manufacturing region, South Wales suffers severely from the absence of such services as the economic research sections in the University of Pennsylvania or the University of Manchester perform for their respective regions. Subsidization of university research on these problems might yield very valuable results for very small expenditure.

No one can study this report or even the admirable summary and commentary on it issued by Political and Economic Planning without realizing the important function which dispassionate scientific inquiry can fulfil as a basis for action. The long-range planning of industry is indeed only possible in the light of the knowledge so acquired. Repeatedly in this admirable survey the necessity for considering the problems of the Special Areas in relation to the whole problem of national development or recovery appears, as does the futility of any narrow or rigid treatment of the boundaries of the areas in regard to financial or other facilities for development or planning. Scientific workers who have the patience to study these volumes for themselves cannot but be strengthened in their conviction that science has its own special contribution to make to the solution of these difficult problems.

Aspects of Palæogeography

(1) Die bionomische Einteilung der fossilen Meeresböden
Von Hermann Schmidt. (Fortschritte der Geologie und Palæontologie, herausgegeben von Prof. Dr. W. Soergel, Band 12, Heft 38.) Pp. vi+154. (Berlin: Gebrüder Borntraeger, 1935.) 16 gold marks.

(2) Geomorphologie der feuchten Tropen
Von Karl Sapper. (Geographische Schriften, herausgegeben von Alfred Hettner, Heft 7.) Pp. vi+154+4 plates. (Leipzig und Berlin: B. G Teubner, 1935.) 6 gold marks.

(3) Géologie stratigraphique
Par Prof. Maurice Gignoux. Deuxième édition entièrement refondue. Pp. vii+709. (Paris: Masson et Cie., 1936.) 95 francs.

(4) Paläogeographie und Tektonik
Von Prof. Dr. Franz Kossmat. Pp. xxiii+414+5 plates. (Berlin: Gebrüder Borntraeger, 1936.) 18.20 gold marks.

(5) Die Entwicklung der Kontinente und ihrer Lebewelt
Von Theodor Arldt. Zweite, vollständig neubearbeitete und erweiterte Auflage. Pp. 448. (Berlin: Gebrüder Borntraeger, 1936.) 28 gold marks.

THERE can be nothing duller than the detail of stratigraphical geology and, let us hasten to add, nothing more exciting than the vision of the endless succession of past geographies based upon that detail. In the great pile of sedimentary and igneous rocks that make the earth's crust, there lie records of an ever-changing distribution of lands and seas, of the growth and decay of great mountain ranges, of extreme variations in climate and of the continuous succession of life-forms. Each in its own fashion, the five volumes considered here are notable contributions to this science of palæogeography.

(1) In the first book, the advances in hydrobiology are applied to the interpretation of facies, that is, the sum of all lithological and palæontological characters of a sediment. The various lines of attack in the study of facies-differences are critically examined, and then the foundations of a bionomic classification of sea bottoms established. The oxygen content of the bottom waters is taken as the most important factor. Two chief classes of bottom conditions, sweet and stagnant, are developed and their subdivisions viewed in the light of modern oceanography. These bionomic concepts are then applied to the interpretation of the sediments of the stratigraphical column. The book concludes with a study of special facies problems, such as those of the flysch, black clays, etc., and of aspects of adaptive morphology of sea animals. Throughout are given comments upon the habitat and significance of a great number of common fossils, and the work as a whole is an important contribution to that branch of palæogeography which the author calls palæohydrobiology.

(2) Prof. Sapper's small volume, though largely concerned with the development of land forms in wet tropical regions, deals also with certain topics of great interest to the palæogeographer. Of these, one only can be mentioned here, and that is the complete confirmation of the view that coarse unweathered arkoses, so often taken as indexes of arid or semi-arid conditions, are typically developed in humid tropical areas. It may be observed, in passing, that Sapper's book should be read by all British geologists, as it supplies a much-needed corrective to the notions of many of them concerning the scale of erosional processes.

(3) The first edition of Prof. M. Gignoux's "Géologie Stratigraphique" has been a standard and invaluable text-book in Britain for a decade. This largely rewritten and expanded second edition is more than a text-book, for, by its wealth of references and inclusion of new work, often relatively inaccessible, it will be of value to the specialist as well as to the student. The chief modifications are these. The treatment of the Palæozoic has been remodelled, and includes new data on, for example, the Saar Coalfield, the Russian Carboniferous, and the Permian of Timor and China. Full accounts of North African stratigraphy and tectonics have been added. The history of Gondwanaland has been synthesized. A new treatment of Alpine stratigraphy brings out very clearly the relations between sedimentation and tectonics, and a new introductory chapter deals with these relations on more general lines.

We have in this book a charming presentation of the philosophy of stratigraphical geology. Lately, there seems to have developed a tendency for geologists to show their versatility by the inclusion of passages of music in their writings, and Prof. Gignoux ends with a few bars of Wagner.

(4) In the fourth volume to be noticed here, Prof. F. Kossmat deals with the relationships between palæogeography and the tectonic shaping of the earth's surface. He is concerned not so

much with the fluctuations of the margins of the continental masses during successive periods of earth history, that is, with palæogeography in a narrow sense, but more with the movements of the crust which gave rise to such fluctuations. Changes in the successive mountain belts of geological time are to be traced step by step.

The first part of the book gives a rather compressed summary of the geological history and facies observations for the whole world, and this is followed by a tectonic analysis of the major divisions. Two kinds of continental masses are separated, the circumarctic controlled by its folded margins, and the high plateaux of Gondwanaland. Finally, more general topics are discussed—among these being the polar asymmetry of the earth's crust, critical times in earth history, the cause of earth movements and many others. Throughout the work there are many new observations and, in part, new interpretations that will be of interest to tectonic geologists.

(5) The last volume before us forms the first part of the second edition of Prof. T. Arldt's great work dealing with the distribution of present and past life. At the beginning the question of the permanence of continents and oceans is asked, and the whole work will provide an answer to this question. After a stimulating essay on the methods of palæogeography, the author begins his heavy task by an exceedingly detailed examination of the distribution of present and Tertiary forms of life in the Australasian, South American and Madagascar regions, and this examination takes up the greater part of the volume.

Among this mass of detail there are several more general sections of interest to the palæogeographer, in which conclusions are drawn concerning connexions by land-bridges between the various regions dealt with. Arldt concludes that during the Mesozoic these regions were connected with the northern land masses. The first bridge to collapse was that between Australia and India, then that between India and Madagascar was broken, and finally that between South and North America. The equatorial connexion between the three regions dealt with lasted much longer, and junctions with the northern land masses, that had been severed in Eocene times, were re-established in the Pliocene. It seems, therefore, that land-bridges, in spite of Wegener and still more orthodox schools, are not yet a lost cause in palæogeography.

H. H. R.

David Gregory

David Gregory, Isaac Newton and their Circle Extracts from David Gregory's Memoranda, 1677–1708. Edited by W. G. Hiscock. Pp. ix+48. (Oxford: W. G. Hiscock, Conway, Squitchey Lane, 1937.) 10*s*.

THIS is one of the MSS. of David Gregory, preserved at Christ Church, Oxford, accompanied by some brief notes of the editor, Mr. Hiscock, who seems to have done them very well. The interest of this publication centres around the name of Newton. It is only by making available the views of his contemporaries that we can realize Newton. To print an account is very much the most effective way of making it available. If a thing is written down, it remains, and if it is printed, many people read it. Their views, even if diverse, and even if negligently formed, congeal about something common to all. It may be compared with the short issue of Stukeley's account, recently reviewed in NATURE (138, 617; 1936).

Reading the book through, one finds many differences from modern practice. One realizes, for example, that anti-Christ was a real person to them, and that they knew nothing at all about chemistry, and had not the means to produce any high temperatures, otherwise than by burning glasses. Newton was, in fact, the first of the moderns; he understood exactly the basis our conventions rest upon. We owe to him very much more than is usually ascribed; we owe him the whole direction of modern investigation.

The present transcript consists of personal notes about all sorts of subjects, most of them dated, for the use of David Gregory. Gregory's relations with Newton are well known, and they seem to have suffered from no cloud. Newton does not directly figure in these memoirs, but there are many references to him, and some important ones —one, for example, that Mr. Hiscock considers so important that he has photographed it and produced it as a frontispiece. It serves to emphasize Newton's conception of matter; it relates to the question of matter being proportional to weight. To quote two statements that strike us, from the text: "3 March 1698/9 . . . And its as universally received in England that the winters are milder as it is that the summers are colder" and "May 1708. Algebra is the Analysis of the Bunglers in Mathematicks. Sir Isaac Newton". R. A. S.

Contemporary American Philosophy

(1) A World of Chance:
or, Whence, Whither and Why? By Prof. E. G. Spaulding. Pp. xxxiv+293. (New York: The Macmillan Co., 1936.) 12*s*. 6*d*. net.

(2) The Logical Structure of Science
By Prof. A. Cornelius Benjamin. (Psyche Monographs, No. 9.) Pp. 344. (London: Kegan Paul and Co., Ltd., 1936.) 10*s*. 6*d*. net.

(3) Personal Realism
By James Bissett Pratt. Pp. xi+387. (New York: The Macmillan Co., 1937.) 15*s*. net.

(1) OF these three books, all by American philosophers, the first is concerned with the ultimate structure of the universe, the second with the nature of scientific thought and the third with metaphysical conclusions derived from a realistic epistemology. The first, by Prof. Spaulding of Princeton, is a further development of the new realism with which he has been identified and is, primarily, a defence of the thesis that ontological contingency is a logical necessity. Prof. Spaulding holds that there is no ultimate unity except the unity of totality, and his 'ultimates' or 'irreducibles' consist of five properties—possibility, contingency, propertiness, ultimacy and reality. Each of these is an instance of itself as well as of the other four; and, in order to obtain this finality, he deliberately violates the theory of types. Prof. Spaulding asserts that, while all existing entities are possibilities and all possibilities realities, not all possibilities are realized in Nature. He maintains that in the structure of reality, shot through with chance and indeterminism, Nature is but a chance instance which *is* but need not be, that there is no necessity for the existence of even that objective realm of possibilities one of which is realized as Nature, and, finally, that the whole of reality, including logical entities and values, is contingent.

The new development in Prof. Spaulding's philosophy consists largely in a synthesis of the results of research in symbolic logic, in the physical sciences, emergent evolution and the theories of knowledge and values. But here, quite apart from the possible complications arising from his violation of the theory of types in arriving at his ultimates, there is an epistemological chasm which, to the reviewer, he does not appear to have bridged satisfactorily even by his theory of external relations. In another instance of the theory of types, namely, the interpretation of the indeterminacy principle which asserts that nothing can be observed as it really is because observation disturbs that which is observed, Spaulding refutes the argument by declaring that this again leads to an infinite regress. For, if observation disturbs that which is observed, then that in turn becomes the observed to another observation, and so on, indefinitely. Thus he arrives at knowledge by refusing to accept an infinite regress.

Whether or not there are positive advantages to be gained by this freedom for postulation, Prof. Spaulding's method is undoubtedly a very interesting contribution to contemporary philosophy.

(2) Although mistrustful of labels, Prof. Benjamin calls himself a critical positivist and bases his inquiry into the nature of science upon the firm conviction that all philosophy and science must start with the given, which is subdivided into the realms of the clearly given and the obscurely given. The task of science is to symbolize the total realm of the given by discovering the relations connecting the clearly given with the obscurely given. Thus, in his view, methods of construction and reduction are essential; but he differs from the positivists in insisting that not all constructions and derivations should be given an unreal status. Hypothetical entities are not to be denied, but are to be relegated to the realm of the obscurely given.

In Prof. Benjamin's philosophy, an occurrent takes the place of an event, an object, or any other term representing the basic subject-matter of science. An occurrent has form and content, and genuine knowledge consists in being aware of an occurrent, of a symbol for the occurrent and also of a symbol for the relation between the two. In a careful argument he shows that if one of these is lacking, there is no science in the strict sense.

There is much of interest in Prof. Benjamin's thesis including, in particular, his operational theory of meaning. It is to be hoped that his tentative solutions of these problems will inspire the criticism and discussion which he invites.

(3) Prof. J. B. Pratt is one of the seven American authors of the famous "Essays in Critical Realism" which appeared in 1920. The present book is the outcome of his further deliberations on the problems of epistemology which were the subject of the earlier work and, more particularly, on the metaphysical consequences to be drawn from them. So far as epistemology is concerned, Prof. Pratt is still a critical or—as he now prefers to term it—dualistic realist, inasmuch as he

maintains that at least three factors are necessary in the knowledge situation, namely, the conscious subject, the mental content and the object. It is in the metaphysical conclusions that he parts company with some of his erstwhile colleagues. For Prof. Pratt is of the opinion that in many cases the naturalistic consequences which were drawn were unjustified, and that the doctrine of knowledge espoused by the group led "to the conception of a partial independence and spontaneity of mind and of the reality of a substantial self".

While it is obvious that, in working out his conclusions, Prof. Pratt has studied with great care the latest developments in logical and philosophical doctrine, yet, to the reviewer at least, there is a distinct flavour of 'other days' in his writing which is reminiscent of the pre-symbolic epoch when 'metaphysics was metaphysics'. But he is consistently suggestive rather than dogmatic; and even in the final chapter where his "over-beliefs" take the form of a spiritual pantheism, he only claims for them, as for the rest of his conclusions, a "balance of probability". A. v. Z.

Musical Instruments and their Distribution

Origine des instruments de musique: introduction ethnologique à l'histoire de la musique instrumentale. Par André Schaeffner. (Bibliothèque musicale.) Pp. 406+32 plates. (Paris: Libr. Payot, 1936.) 50 francs.

A COMPREHENSIVE account of the musical instruments and their distribution has been wanted for a long time by ethnologists and others, so this work on the simpler musical instruments by M. Schaeffner is very welcome. The author admits that it is not exhaustive; it is evident that he has done his best to cover the ground, but as might be expected, specialists in certain areas are acquainted with instruments that are not alluded to by Schaeffner. For example, there are on the Sepik River, New Guinea, drums without a tympanum which are struck on the ground or on the surface of water. Fig. 2 is drawn from a photograph which shows a *sede* lying on the ground, so Schaeffner supposed that it was played while resting on the ground, but it is played only on vessels, *lakatoi*, while on the great trading expeditions, *hiri*, of the Motu peoples. The remarkable *temes naainggol* of Malekula, described by Deacon, have also been overlooked.

The author begins with "origines corporelles": singing and other sounds are produced by the mouth and its parts, but the mouth may also act as a resonator in playing the musical bow or the jew's harp. Hand-clapping, striking various parts of the body with the hands and tapping the Adam's apple to produce a tremolo, and stamping with feet are primitive methods for the production of music or rhythm, of which definite appliances may be regarded as extensions. These are innumerable, but the author has contrived to describe or refer to a very great number, and the variations and affinities of the main types are clearly stated. The author criticizes the groupings of Hornbostel and Curt Sachs and gives in an appendix an elaborate classification of his own. This recognizes: (1) Instruments with a solid vibrant body (*a*) not susceptible of tension, (*b*) flexible, (*c*) susceptible of tension, either a cord or a membrane. (2) Instruments directly dependent upon air vibration or wind instruments. There are also chapters on organology of the theatre; on instruments derived from, or associated with, work and play; instruments employed in religion and magic; the evolution of music; primitive polyphony; evolution and diffusion of instruments.

While admitting the provisional utility of the stratigraphy of Curt Sachs in which he reconstructs, layer by layer, the successive diffusion of instruments across the world, to which Hornbostel had made corrections in details so far as Africa is concerned, Schaeffner points out that there is a danger in linking material objects such as musical instruments with a chronology, itself hazardous, of phenomena of social organization which do not yet admit of a uniform interpretation. He agrees with R. H. Lowie who says, "In this department of culture, as in others, contacts with other groups are significant: African music excels because of the Negro contacts with Egypt, India and Indonesia. The Negro deserves credit for adapting and using his instruments, but not for creating them" ("An Introduction to Cultural Anthropology", 1934, p. 208).

Owing to the absence of an index, it is rather difficult to find an account of any particular instrument; also it would have been a help if the legends of the photographs had references to their respective pages, and if references to pages had been added to the classification in the appendix to this excellent book. A. C. HADDON.

Wild Nature's Day

By Frances Pitt. (The 'Greenjacket' Books.) Pp. 200+27 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 3*s*. 6*d*. net.

MISS FRANCES PITT has done great service for her generation, in her endeavours to show the entrancing interest to be derived from the study of birds and beasts in their native wilds. There are very few who can compare with her in her ability to captivate those who have a kindly feeling for these creatures, but little or no time for first-hand observations of their ways. In this, her latest book, she has, we venture to think, surpassed all her previous efforts. Herein she presents the creatures of her choice as they are to be found during morn, noon and night. Even those who may claim to have more than a passing knowledge of the birds and beasts she describes will find something new that is worth knowing about their ways.

From a book as full of charm as this, it seems impossible to choose passages for special mention; for once the attempt was made whole pages would have to be quoted. Of the three parts into which the little volume is divided, perhaps the first and the last will be most enjoyed, since few of us are energetic enough to rise at daybreak, as Miss Pitt has a habit of doing, to note the gradual awakening of the birds; and the homeward journeys of creatures such as the badgers! Again, few of us are enthusiastic enough to stay out, when night has fallen, to watch the habits of bats and badgers, and others which hunt while the world sleeps; or to find out where the birds "go to bed"!

This is a book professedly written for boys and girls—we would add 'old, and young', for it is surely one of the best of its kind ever written. In a way that few other natural history books have ever done, it will arouse an interest that will last a lifetime.

W. P. P.

Index Generalis 1937:

the Year-Book of the Universities, Libraries, Astronomical Observatories, Scientific Institutes, Museums, Academies, Learned Societies. Issued under the direction of Dr. R. de Montessus de Ballore. Pp. vii+BE232+US232+F180+2500. (Paris: Masson et Cie., 1937.) 275 francs.

THE new edition of this annual handbook, indispensable to universities, research institutes, libraries, etc., maintains the high standard achieved by the previous edition. Nearly two thousand pages are devoted to the constitution of the universities, technical institutions and other educational establishments throughout the world. Such information contains the officers, professors (with their subjects), number of faculties and students, etc. This is followed by more than seven hundred pages describing the constitution, staffs, etc., of astronomical and other observatories, museums, academies, institutions and learned societies. Valuable information concerning the most important libraries is also included. Altogether there are 6,500 entries.

Appended is a useful list of men of science and others who wish to exchange their publications with other workers in the same field. This list has been extended. A list of publishers is given; but the section dealing with Great Britain, at any rate, is of little value, for several well-known publishers are omitted. A new feature in this edition is a list of Nobel laureates since the foundation of the prizes in 1901. The index of names contains 95,000 entries, which make reference an easy task.

This volume, as a book of reference, is invaluable to workers in all branches of academic life.

The Engineer's Year-Book of Formulæ, Rules, Tables, Data and Memoranda for 1937:

a Compendium of the Modern Practice of Civil, Mechanical, Electrical, Marine, Gas, Aero, Mine and Metallurgical Engineering. Originally compiled by H. R. Kempe and W. Hanneford-Smith. 43rd. Annual Issue, revised under the direction of L. St. L. Pendred. Pp. lxi+xiv+2676. (London: Morgan Bros. (Publishers), Ltd., 1937.) 31*s*. 6*d*. net.

WE welcome the forty-third edition of this annual. The editor has picked out the sections on machine tools, metallurgy, aeronautics, paints and varnishes for revision, and the names of the contributors are a surety for the accuracy of the information given. We are so familiar with this work that we have long ceased to consider its unwieldiness. But it is an outsize in handbooks, and so it is probable in the future that it will split into two or more volumes, suffering what physicists call atomic disintegration.

The editor tells us that the forty-second edition is sold out and that this is not due to the astuteness of the publisher in estimating the probable demand or because intensive sales methods are used. He infers that because it goes well it gives the kind of information the purchaser needs. A survey of the book shows that his deduction is probably correct. The descriptive sections, a useful feature of this year book, contain full particulars of various products of a number of engineering firms.

Leçons de zoologie

Par Prof. M. Prenant. Prochordés: Amphioxus, Tuniciers. (1. Ascidies). Pp. 71+3 plates. 15 francs. (2. Pyrosomes), (3. Doliolides), (4. Salpes), (5. Appendiculaires). Pp. 49. 12 francs. (Actualités scientifiques et industrielles, 379, 380.) (Paris: Hermann et Cie., 1936.)

THE Protochordates have been dealt with in a general way by Prof. M. Prenant in these two brochures. *Amphioxus* and the simple and compound Ascidians in one (No. 379) and *Pyrosoma*, the Salps and the Appendicularians in the other (No. 380). Each is a straightforward and well-illustrated account of the animals indicated in the title, prepared in the light of present-day knowledge. Both are well indexed and after each group is a select bibliography of most important monographs and recent memoirs relating to it. The numerous illustrations are all in the form of text figures and quite clear. The two publications constitute a useful addition to a well-known series.

Montserrat and the West Indian Volcanoes*

By Sir Gerald Lenox-Conyngham, F.R.S.

ABOUT the beginning of 1934, Montserrat began to be troubled by earthquakes and tremors. They became very severe and numerous in May and again in December. In 1935 they were worse still; much damage was done to buildings and naturally a great deal of anxiety was engendered in the minds of the inhabitants. In the autumn of 1935, the Governor received a petition from the leading members of the population praying that steps should be taken to determine, if possible, whether there was danger of a volcanic eruption.

This anxiety was very natural, for by the inhabitants of that region the terrible events of 1902 are well remembered. In that year on May 7 the Soufrière of St. Vincent burst into eruption and on the following day Mt. Pelé in Martinique did so too. From both of these volcanoes there poured what the French have called a *nuée ardente*, and what other observers have called the "Great Black Cloud". That from Mt. Pelé swept down upon the town of St. Pierre with such violence and such deadly effect that in a few minutes the whole town and its 30,000 inhabitants were destroyed. In St. Vincent the death roll was not so great because, fortunately, there was no large town in the area over which the cloud flowed.

The island of Montserrat is wholly volcanic. It contains no less than six volcanic cones; of these four lie more or less in a straight line running from north to south and give the island that serrated appearance which is the origin of its name.

The only map of the island is one made by the Hydrographic Department of the Navy in 1867. A recent geological survey of the island, made under great difficulties because of the absence of an accurate topographical map, shows that the most recent of the volcanic cones is the one called Soufrière Hills or Chance's Mountain, which dominates the town of Plymouth. The island was discovered by Columbus in 1493 and was first colonized by the British in 1632. We know that there has been no volcanic eruption in the island since it has been known to Europe, and from the evidence of the erosion that has taken place since the last eruption we may conjecture that that eruption belonged to a much earlier date. But the island has undoubtedly in the past been the scene of repeated volcanic outbursts, and as we know nothing at all of the causes which determine the time and place of an eruption, it would be extremely rash to assert that there will never be another, and certainly the experiences through which Montserrat had passed had been very alarming. Fig. 1 gives the daily number of tremors from February 1934 to November 1935 and again from March to August 1936. As many as 100 were recorded in one day in May 1935, and three other days were nearly as bad, so that the people of Montserrat had ample cause for apprehension.

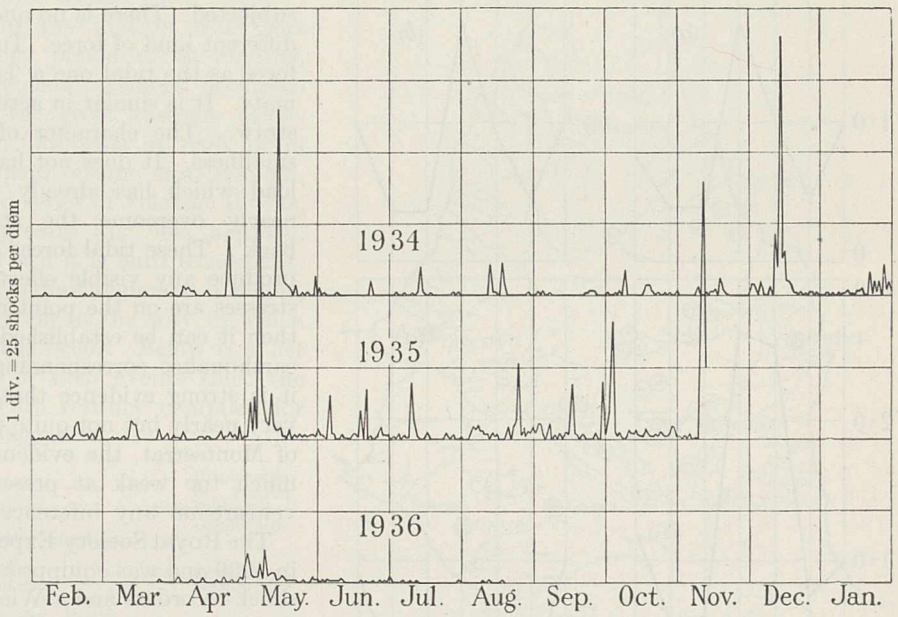

Fig. 1.

NUMBER OF SHOCKS PER DIEM.

The result of the petition mentioned above was that the Governor referred the matter to the Colonial Office and that the Colonial Office

* From a Friday evening discourse delivered at the Royal Institution on March 12.

consulted the Council of the Royal Society. It was decided to send out an expedition consisting of a geologist and a physicist to see what they could find out. The geologist selected was Mr. A. G. MacGregor, of the Geological Survey, and the physicist was Dr. C. F. Powell, of the University of Bristol. An invitation was also sent to Dr. T. A. Jaggar of the Volcano Observatory of Hawaii asking him to visit Montserrat and give the members of the expedition the benefit of his great experience. This invitation he accepted. He paid his visit during the months of May and

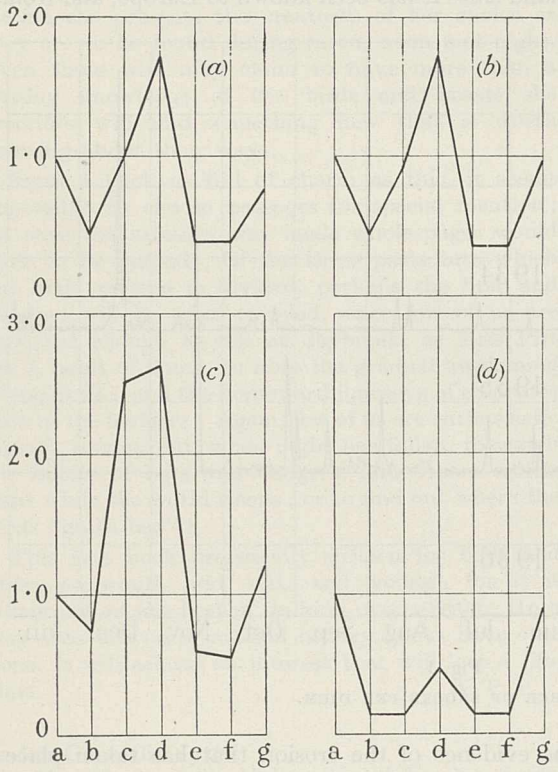

Fig. 2.

June and made a valuable report. The island was also visited several times by Mr. Perret. He is a volcanologist of long experience who has been spending a part of each year since 1929 in Martinique, observing the course of events since the eruption of September 16 of that year. Mr. Perret has made several very helpful reports.

It is worth noting that there is a recurrence of activity in May of each of the years 1934, 1935 and 1936. This may be accidental, for three years do not constitute a long enough period for the establishment of a cycle, but it may be noted that the eruptions of 1902 also began in the month of May, so that there is some evidence of an annual crisis. Unless, however, one can connect a cycle which seems to be indicated by the observations with a physical cause, it is necessary to be careful, and only the most unimpeachable evidence derived from long periods of observation ought to be accepted.

Some careful and trustworthy observers are convinced that a lunar period, similar to that which is to be discerned in the tides, is to be observed in the behaviour of volcanoes, and the action of these tidal forces has sometimes been described as 'trigger action.' That seems an inappropriate term. The essence of a trigger action is that the application of a small force of one kind releases a large force of a different kind. But the action of tidal forces would be to produce a small increase —or diminution—of pressure of the same kind as that to which the crust of the earth is already subjected. There is no question of the release of a different kind of force. To call the effect of such a force as the tidal one a 'last straw' effect is legitimate. It is similar in action to the proverbial last straw. The character of the 'last straw' is its smallness. It does not have any effect unless the load which has already been imposed has very nearly overcome the strength of the 'camel's back'. These tidal forces are small; they will not produce any visible effect unless the pre-existing stresses are on the point of causing a fracture. If then it can be established that there is a cycle of earthquakes corresponding with the tidal period, it is strong evidence that at all times fracture is very nearly but not quite taking place. In the case of Montserrat, the evidence of an annual cycle is much too weak at present for it to be safe to venture on any inferences.

The Royal Society Expedition left England early in 1936 and was equipped with a number of Jaggar shock-recorders and a Wiechert seismograph. The shock-recorders were designed by Dr. Jaggar, mentioned above. They are simple, satisfactory instruments, not very sensitive but well adapted for recording the sharp, local shocks which were likely to occur. These instruments were in Dr. Powell's charge, and his plan was to erect the shock-recorders at a number of places well distributed over the island so as to obtain information as to the relative severity with which the shocks were felt in the several localities, and thence to deduce the whereabouts of the epicentres.

Dr. Powell made use of his instruments as follows: he noted first that the distribution of amplitude for shocks coming from the same focus should be constant and independent of the individuality of the recording instruments. Thus, taking the amplitude of the movement recorded at a selected station as unity, the amplitude at each of the other stations will be expressed by its ratio to this standard amplitude. If these ratios are plotted, as in Fig. 2, where the ordinates are the ratios and the letters represent the stations, they form a pattern, and it is reasonable to suppose

that all shocks emanating from the same focus will produce the same pattern.

Then to determine the position of the focus which corresponds to a given pattern, we assume that the amplitude of the waves produced by an earthquake decreases inversely as the distance from the focus. We can estimate the position of the focus corresponding to each of the patterns. The results are shown in the map (Fig. 3). The open circles represent the positions of the epicentres and the shaded ones the positions of the instruments. The epicentres all lie on a belt which crosses the island from south-west to north-east and is rather less than four miles wide.

It is difficult to form any idea of what was going on during the long period of 30 months, during which these frequent tremors occurred. The nature of one of the great tectonic earthquakes, such as that in California in 1906, or in India in 1934, is in general outline clear enough. But these long-continued series of volcanic shocks, with their periods of greater and less activity, are manifestations for which it is hard to account.

Looking at the West Indian region as a whole, there is no apparent system in the way in which eruptions and earthquakes occur. Below is a list of the more important of such events since the beginning of the nineteenth century compiled for the most part by Dr. Jaggar.

1802	Eruption	Guadeloupe
1812–14	Eruptions	St. Vincent
1831	Submarine Eruptions	near Barbados
1837–38	Eruptions	Guadeloupe
1842	Greater Earthquake affecting many islands	
1843	Submarine Eruption	near Guadeloupe
1851	Eruption of Mont Pelé	Martinique
1867	Great sea wave after submarine earthquake. Felt in Grenada and elsewhere	
1880	Activity	St. Vincent & Dominica
1897–99	Earthquakes	Montserrat
1902–04	Eruptions	St. Vincent & Martinique
1906	Earthquakes	St. Lucia
1907	Earthquake	Jamaica
1918	Earthquake	Puerto Rico
1929–32	Eruptions Mont Pelé	Martinique
1930	Series of Earthquakes	Nevis
1934–36	Series of Earthquakes	Montserrat

No system or sequence is discernible in these events, but the records are not very complete and they are not based on instrumental observations. If each island were equipped with a recording instrument, there would be a fair prospect of movements being detected which might otherwise escape notice, and these movements might give some clue to the way in which the forces, whatever they are, traverse the region.

There is another line of approach to this problem. It seems to be generally agreed that the Lesser Antilles are oceanic islands which have grown as submarine volcanoes from the broad top of a tectonic arc. The islands are therefore only symptoms. The volcanoes have their origin in the tectonic arc, and it is its nature and origin that are of interest to us.

The West Indian island arc is by no means the only one of its kind, and no one who has made the comparison can fail to be struck by the general similarity between the West Indian and the East Indian island arcs. This similarity, however, would not be of much interest if it were not for one special circumstance. It is this. It was a Dutchman, Dr. Vening Meinesz of the Dutch Geodetic Commission, who invented the only

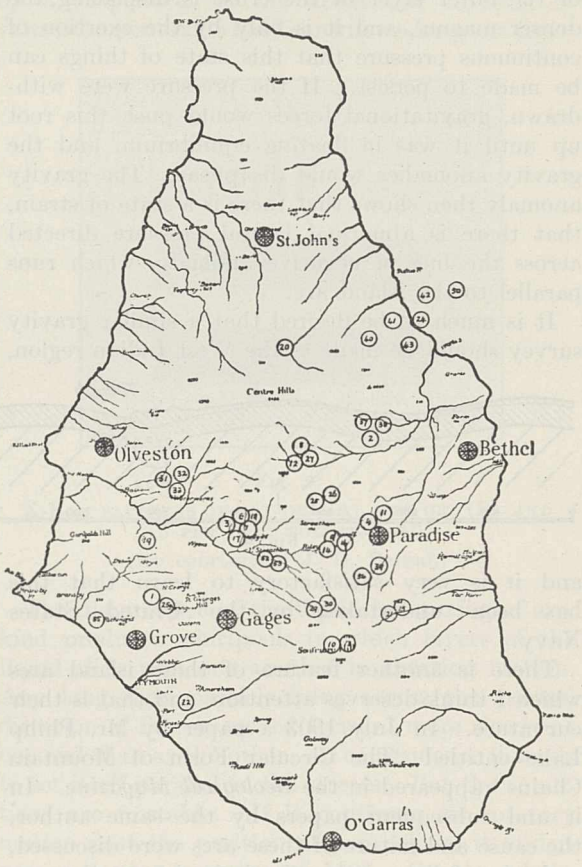

Fig. 3.

successful method, so far, of making determinations of gravity at sea, and these East Indian islands are Dutch possessions. It was not unnatural, therefore, that Dr. Vening Meinesz should see, in the waters surrounding these islands, not only an interesting region for a gravity survey, but also a region in which he would be among his own people and where he could rely on being allowed to call where he liked. His method can only be carried out on a submerged submarine, and as a submarine is essentially a ship of war, foreign harbours cannot be visited without some preliminary negotiation.

Dr. Meinesz made a number of cruises among these islands in the years 1929-30 and determined the value of gravity at more than two hundred places. He discovered, quite to his surprise, that

there is a continuous belt of negative gravity anomaly on the convex or outer side of the island chain. This line of negatives tells us something about the structure. It shows that along that line the less dense outer layer of the crust has been pressed downwards and has displaced the denser rock below. Dr. Meinesz has drawn a diagram (Fig. 4) to illustrate his conception of the state of things. In the diagram the less dense material of the outer layer of the crust is displacing the denser magma, and it is only by the exertion of continuous pressure that this state of things can be made to persist. If the pressure were withdrawn, gravitational forces would push this root up until it was in floating equilibrium, and the gravity anomalies would disappear. The gravity anomaly then shows that there is a state of strain, that there is abnormal lateral pressure directed across the line of negative anomaly, which runs parallel to the island arc.

It is much to be desired that a similar gravity survey should be made of the West Indian region,

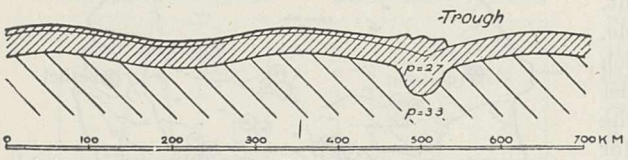

Fig. 4.

and it is very satisfactory to learn that this has been undertaken by the United States Navy.

There is another feature of these island arcs which I think deserves attention, and that is their curvature. In July 1903 a paper by Mr. Philip Lake entitled "The Circular Form of Mountain Chains" appeared in the *Geological Magazine*. In it and subsequent papers by the same author, the cause and nature of these arcs were discussed, and what follows is largely derived from them.

Whenever we see an arc of a circle on the surface of a sphere we cannot fail to perceive that it is the intersection of a plane with that surface, and when the arc is marked by a mountain chain or by a festoon of islands—by marks, that is to say, of force of some kind—it is natural to think of the plane as a thrust plane and to imagine that forces acting in that plane have been the cause of the formation of the islands or mountains as the case may be. If this is so, then there must have been some slipping of the matter above the plane on the matter below it. There will be a fault, and the dip of the fault can easily be shown to be equal to the radius of the circular arc.

Mr. Lake examined the arc formed by the Himalayas and suggested that its form is due to the fact that there is a thrust plane at its base. It is easy on a globe to find the position of the centre, or, to speak more correctly, the pole of the arc, and then to measure the distance from the pole to the arc in degrees of great circle. Making this measurement, Mr. Lake found that the radius was 14°, and concluded that this must be the dip of the basal thrust plane. In 1919, Mr. C. S. Middlemiss made the first actual measurements of the dip of the Main Boundary fault of the Himalayas. He found it to be between 12° and 15°. This Main Boundary Fault is the principal line of separation of the older tertiary rocks of the Himalayas from the younger rocks that lie along the foot of the mountains.

One cannot doubt that the great earthquakes which from time to time cause so much devastation in the Gangetic plain are the result of movement of the newer rocks on the older or of fracture resulting from the pressure of the one upon the other, but we need not expect that those earthquakes will find expression in movement along the visible faults, for the movement is much deeper. Mr. Middlemiss, for example, writing of the great earthquake of April 5, 1905, says that the earthquake was due to "a sudden rupture or release of strain occurring . . . where the strain was specially great owing to resistances to the well established forward march of the over-thrusting foot of the Himalayan range".

It appears, then, that the mountain arc is due to the overthrusting of the advancing range: that the real seat of the thrust is deep down under the alluvium, that the form of the arc is determined by what is going on down in those depths and that therefore, since the radius of the arc is 14°, the dip of the plane along which the thrust is taking place should also be 14°. It is probable that there are a number of fault planes parallel to the fundamental one, and since at the place where we can examine the matter we find a dip of 14°, we may reasonably infer that the fundamental thrust plane has this inclination also, which corroborates the evidence given by the radius of the arc.

Until, however, we know the results of the gravity survey made by the U. S. submarine, further conjecture on the West Indian problem would be premature. If by gravity observations we can arrive at some idea of the position of the point at which the front of the overriding rock is in contact with the old overridden rock, and if we know the slope of the plane which divides the one from the other, and if also we can form some estimate of the amount of deformation of the dense magma below by the intrusion of the lighter material which has been forced down into it, we shall arrive at some kind of picture of the structure that lies below these volcanic arcs, and that will at any rate be a step in the right direction.

Recent Crystallography*

By Sir William Bragg, O.M., K.B.E., P.R.S.

ALTHOUGH some of the considerations already discussed are admittedly provisional, they show how the knowledge of protein structure is steadily increasing, how, in fact, the examination of the structure can be looked on as a branch of crystallography. The X-ray methods furnish measurements of distances and angles which suggest the possible forms of the proteins in space, forms which must obey certain geometrical conditions. Some of these are carried over from examinations of other organic molecules; others are derived from direct X-ray measurements of the proteins themselves. It then becomes of great interest to connect the physical form with biological properties.

Quite recently a remarkable discovery by Dr. Stanley, of the Rockefeller Institute at Princeton, has shown that a certain virus, which causes disease in tobacco plants, is a protein. Its composition falls within the protein limits already quoted. Its molecular weight has been found by Svedberg to be of the order of 17 millions. It has reactions to polarized light which show that it is crystalline, and that the great molecule is needle-like in form. The conclusions follow from the fact that a solution of the virus shows when disturbed the effect known as 'streaming double refraction'. When minute crystals are suspended in a liquid medium they normally point in all directions. If the suspension is examined between crossed Nicol prisms, the field is dark. But if the suspension is so disturbed that the particles in any region are

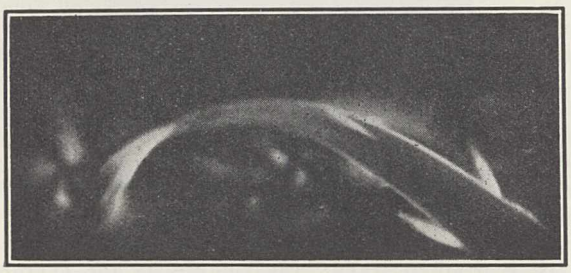

Fig. 3.

WAKE OF A GOLDFISH SWIMMING IN A DILUTE SOLUTION OF PROTEIN FROM A SAP INFECTED BY TOBACCO VIRUS, OBSERVED BETWEEN CROSSED NICOLS. (*Photo by Ramsey and Muspratt.*) (By courtesy of J. D. Bernal.)

arranged to point in the same direction, or at least so that on the average they point more in one direction than another, the whole behaves like a single crystal, and illumination appears in the field. The very beautiful display of this effect by a suspension of the needle-like crystals of vanadium pentoxide has been known for some time.

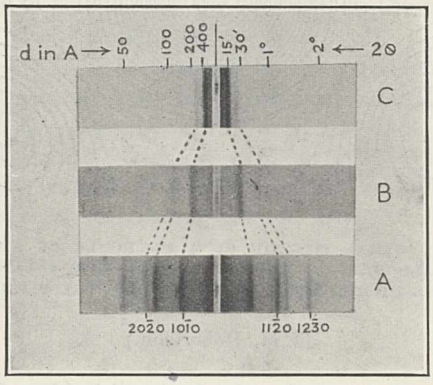

Fig. 4.

X-RAY PATTERNS OF DRY GEL (A), WET GEL (B), AND 13 PER CENT SOLUTION (C). (By courtesy of J. D. Bernal.)

The disturbance of the liquid by stirring of any kind produces whirlpools in which layers of the liquid slide past one another in shearing motion. Any long rigid particle lying across the general direction of flow is moved forward more slowly at one end than at the other. In consequence it tends to set itself parallel to the stream. But the conditions are unstable. If it continues its rotatory motion past the position of parallelism, it undergoes a further rotation of 180°. On the whole, however, one may expect the periods of parallelism to be much longer than those in which the particle lies across the stream. This effect can be shown by allowing glycerine to move along a narrow glass tube, carrying with it short lengths of a fine fibre.

In a whirlpool, therefore, the rod-like crystalline particles tend to set themselves tangentially to the whirl. A beautiful illustration of this effect is given in Fig. 3, which is reproduced from a communication to NATURE[2], by Bernal and others. A small fish is moving in a virus suspension between crossed Nicols. The movements of the tail leave vortices behind them and the crystalline needles of the virus follow the movement of the liquid in spirals approximating to circles. The field shows bright spots arranged at the corners of a cross; because the line of movement makes an angle of 45° with the planes of the crossed Nicols at four points.

(*Continued from p.* 866.)

Bernal and his collaborators have been able to obtain X-ray diffraction photographs of the virus. These are shown in Fig. 4. The pure virus in a suspension stronger than 2 per cent separates into

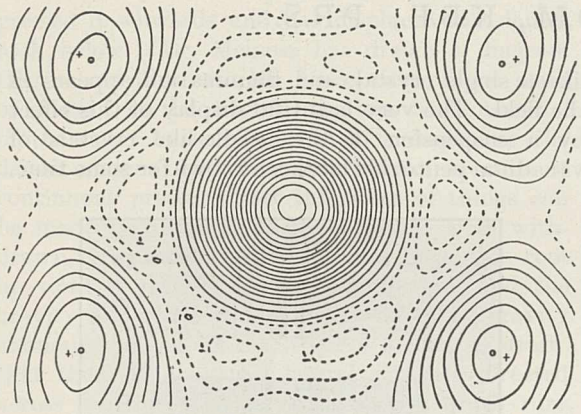

Fig. 5.

THE CENTRAL PORTION OF A MOLECULE OF NICKEL PHTHALOCYANINE, SHOWING THE ELECTRON DENSITY OF THE NICKEL ATOM, PROJECTED ON THE PLANE OF THE DIAGRAM.

(J. M. Robertson.)

layers which are sharply distinguishable. One of these (*B*) is "an extremely soft gel well orientated and with much higher birefringence, 0·007, than the liquid. The outer part of this wet gel shrinks by 50 per cent and forms a layer of higher refractive index, but lower birefringence, 0·003". These two layers give respectively the photographs *A* and *B* of Fig. 4. Photograph *C* is obtained from a 13 per cent solution in which the crystals are orientated by flow along a narrow tube. A similar set of lines is found in the three cases, indicating a hexagonal arrangement, such as would naturally be found in an arrangement of long rods put side by side. In *A* they are at a distance, rod to rod, of 152 A.; in *B*, 210 A. In *C* the distance is more vaguely defined, as one would expect, and ranges from about 300 A. to 470 A.

Besides these evidences of regularity in the side to side placing of the molecules, there is evidence in other photographs of much narrower spacings, which do not vary with the condition of the material and the arrangement of the molecules side by side. They refer obviously to regularities within the molecule. The length of the spacing is given as $3 \times 22{\cdot}2 \pm 0{\cdot}2$ A., a result in close agreement with measurements of Wyckoff and Corey on the tobacco virus and on a variety of it known as the *aucuba* virus. It is very remarkable that this virus, though a crystalline protein, appears to be capable of multiplying itself and of generating an anti-body, and to be liable to mutation.

Brief reference may be made to a few other examples of the development of crystallography by means of the X-ray methods, supplemented now by the methods of electron diffraction.

Dr. J. M. Robertson has investigated in much detail the nickel phthalocyanine. The shadow picture contains a beautiful display of the electron distribution in the nickel atom, projected upon the plane of the diagram. The central part of the molecule containing this atom and its immediate surroundings is shown in Fig. 5. The contour lines of the nickel atom are drawn so that from line to line there is a difference of two electrons per square Angström unit. In the other part of the figure the difference is one electron per unit area. The accuracy is high, and the figure must give a fairly accurate representation of the distribution of the electrons in the nickel atom. It can be represented closely by an empirical formula of the form Ae^{-kr^2} where r is the distance from the centre of the atom.

Applications of the new crystallographic tools to the study of practical problems of metallurgy and engineering have been numerous and important. As an example may be taken the study of the effects of cyclic stress upon a mild steel, recently described by Gough and Wood[3]. It is well known that metal structures can in certain cases be fractured by a sufficient application of intermittent or cyclic stresses; that, to use the

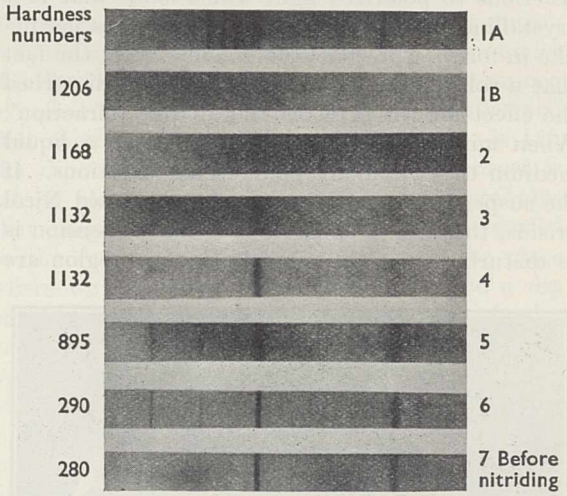

Fig. 6.

X-RAY PHOTOGRAPHS TAKEN AT DIFFERENT DEPTHS IN A NITRIDED STEEL: THE FIGURES ON THE LEFT REFER TO THE HARDNESS. THE TOP FIGURE SHOWS THAT AT THE VERY SURFACE IRON NITRIDES HAVE BEEN FORMED.

(From the Report of the National Physical Laboratory, 1933, by permission of the Controller, H.M. Stationery Office.)

technical term, they become fatigued. Gough and Wood establish the important point that "the application of cycles of a safe range of stress (strain) is unable to cause *progressive* damage to the state

of the structure". The X-ray powder photographs of a piece of mild steel show no change during the imposition of cyclic stresses of 9 tons to the square inch, up to 10^7 repetitions. This is just within the safe range of stress. But when the stress is increased to 9·7 tons, which lies outside the safe range, there is a gradual change. The X-ray photographs show that the crystal grains are being broken up into powder consisting of far smaller crystal portions, and the structure fractures after about half a million cycles or so. Thus the progressive deterioration of the specimen takes place only when a certain safe load has been exceeded.

In this case the appearance of the X-ray photograph indicates the condition of the material. In a number of instances the photographs are now used in this way; the spacings of the crystal planes which are determined by the positions of the lines are not in question. Thus the series of photographs of Fig. 6 shows the conditions of a steel at various depths below the surface when ammonia at 500° C. has been passed over it. The diffuse character of the lines shows that the crystallites have been broken up. Close to the surface the fragments are so small that the material is practically amorphous. At the surface itself iron nitrides have been formed. The physical effect is a very marked hardening, as indicated by the hardness numbers in the diagram. The whole effect is contained within a quarter of a millimetre from the surface. These photographs are due to Dr. G. Shearer, of the National Physical Laboratory.

Diffuseness in the photograph may also be caused by any distortion of the lattice, such as occurs when a specimen is severely strained. This is found to be the case, for example, in the operation of wire drawing.

One of the most remarkable developments of X-ray crystallography is the advance in our knowledge of the internal condition of an alloy. The 'order-disorder' theory, as it is termed, has been especially studied in the Manchester laboratories, and has been described by W. L. Bragg[4].

[2] NATURE, **138**, 1051 (1936).
[3] *Proc. Roy. Soc.*, A, **154**, 510 (1936), plates IX, X.
[4] *Proc. Roy. Soc.*, A, **145**, 699 (1934).

Obituary Notices

The Right Hon. Lord Conway

LORD CONWAY, whose death on April 18 at the age of eighty-one years will be widely regretted, was a many-sided man. He had very varied interests. He was a professor and lover of art; he was a collector of art treasures; he was a politician; and he was a mountaineer. In no one line did he achieve real greatness. But he always and everywhere derived keen enjoyment out of life and he had the knack of conveying his enjoyment to others. Everybody liked him.

Perhaps it was in mountaineering that Conway found his chief enjoyment. Among the mountains his love of beauty found an ample field. As he climbed not as an exercise in gymnastics but in order to get the real feel of the mountains from close contact with them, he was able to develop his true fundamental self among them. He climbed the Alps "from end to end". But not content with them, he ventured farther afield and travelled among the supreme mountains of the world. In the full maturity of his climbing powers, he set out for the Himalaya in search of a fairly accessible 25,000 ft. peak. He was not the first from Europe to attempt Himalayan peaks. Some forty years before him, the Schlagentweits had climbed to at least 22,000 ft. and more recently Graham had reached 23,000 ft. on Kabra. But Conway's expedition to the Karakoram Himalaya was the first to direct the attention of the world to the glory of the Himalaya. He chose as the scene of his operation what is perhaps the finest part of the whole range—the region of the Karakoram Himalaya. For sheer sublimity of natural beauty it is unsurpassed. It lies beyond the forest-class zone of lower altitudes. Here there is nothing but bare rock and ice and purest snow. All is of sternest grandeur. There are several peaks of 24,000 ft. and 25,000 ft. in height, four of 26,000 ft., one of 27,000 ft. and supreme over all, K_2—28,250 ft.—second only to Mount Everest itself in altitude but far nobler in aspect.

Here Conway was in his element. It was not in his nature to strive after records on climbing. Indeed, years after, he took no interest in attempts on Everest; to climb a mountain merely because it happened to be the highest in the world made no appeal to him. What really moved him in the Karakoram region was the glory of the mountains. There where even the valley bottom was higher than the summits of the Alps—there surrounded by peaks of towering grandeur—he felt his whole soul uplifted towards them. He entered into the spirit of the mountain. In his writings he tried to convey something of his own enjoyment; and he was successful. Others responded to the call. Since his time, German, Italians, and French, as well as other British have gone there too.

Conway was also a man of deep religious feeling. No such true lover of beauty, and especially of sublime mountain beauty, could help being religious. He could not help being in love with such beauty, which aroused in him such an ecstasy of delight.

FRANCIS YOUNGHUSBAND.

Sir George Hart, K.B.E., C.I.E.

WE regret to record the death, at Barberton, Transvaal, on April 16, of Sir George Hart, formerly inspector-general of forests to the Government of India. Born on April 14, 1866, he was educated at St. Paul's School and at the Royal Indian Engineering College, Coopers Hill. He joined the Indian Forest Service in 1887, and was posted as assistant conservator in the Punjab, where he served until 1906, when he was transferred to the Central Provinces as conservator of forests. Two years later, he went to Bengal as conservator, and in 1910 was re-transferred to the Central Provinces as chief conservator. In 1913 he was appointed inspector-general of forests, in which capacity he served until 1921, when he retired. He was made C.I.E. in 1911 and K.B.E. in 1919. On retiring from India he settled down at Coolmore, in the White River district, Transvaal, where he stayed until his death.

Hart's service covered an important and interesting period in the history of Indian forestry. Before his arrival, much pioneer work had been done in the way of saving the forests from destruction. Reservation and demarcation had made progress, and protective measures had been begun. Working-plans operations were being extended, and he took his full share in pushing on this important work. In the Punjab, large irrigated plantations, rendered necessary by the demand for timber and fuel in the canal colonies, were in process of creation and development.

At the time Hart assumed the duties of inspector-general of forests, forestry was more centralized under the control of the Government of India than it became some years later ; and although the functions of the inspector-general were purely advisory, he was able to exercise considerable control in working-plans matters, and thus on the management of the forests in the different provinces. He also exercised direct administrative control over the Forest Research Institute and College at Dehra Dun. Hart's term of office as inspector-general covered the War period, when the forest department's energies were taxed to the utmost in supplying timber for military purposes.

Hart will be remembered as a sound practical administrator rather than as a scientific investigator, for although his interest in science was by no means negligible, his strong point was the confidence which his personality inspired both in his Government and in those serving under him.

Prof. A. W. Borthwick, O.B.E.

THE death on April 19 of Albert William Borthwick, in spite of the fact that he had been in ill-health for some time, came as a shock to his many friends and admirers, perhaps more especially in Scotland, where he played a not inconsiderable part in the progress of forestry ; which cause had no more ardent or more enthusiastic supporter during the past quarter of a century.

Prof. Borthwick was born on October 16, 1872, the third son of the late Mr. W. H. Borthwick, of Crookston and Borthwick Castle, Midlothian, a descendant of ancient stock, dating back to the Scottish barony of 1452, now extinct or dormant, He was educated at Madras College, St. Andrews, and the University of St. Andrews, where he graduated B.Sc. in pure science, obtaining first-class honours in botany, physiology and mathematics. After graduation, he proceeded to Germany and passed four years in studying forestry and forest botany at Munich. On returning to Scotland he was appointed assistant to the professor of botany, the late Sir Isaac Bayley Balfour, and lecturer in plant physiology, at the University of Edinburgh. On the inauguration of the degree of B.Sc. in forestry at the University in 1910, Dr. Borthwick was appointed lecturer in forest botany. At the same time he lectured on forestry in the East of Scotland College of Agriculture and also gave the course in this subject at the Royal Botanic Gardens.

Dr. Borthwick did not remain at the University. In 1915 he was appointed chief advisory officer to the Board of Agriculture for Scotland. During the War, he served on the committee for the Supplies of Home Timber. From the Scottish Board, on the inauguration of the Forestry Commission in 1920, Dr. Borthwick was transferred to the Commission as chief research and education officer, and visited Canada as one of the representatives of the Commission at the meeting of the Empire Forestry Conference held in that Dominion. In May 1926, he was appointed to the new chair of forestry established in the University of Aberdeen, which he held to his death.

Borthwick's chief and best work was probably done in research. He was a first-class forest botanist, and this enabled him to play so great a part in advising private owners of woodlands, whose requirements at the time were chiefly on that border line where sylviculture and forest botany came into close affinity. He had another invaluable trait. He possessed in a high degree the power, at conferences of experts and others with varying interests in forestry, of assembling opposed points of view and placing them in a light which resulted in a general acceptance.

For some years Prof. Borthwick edited the *Journal* published by the Royal Scottish Arboricultural (now Forestry) Society, and was president for a period. He was unmarried. He was made an O.B.E. after the Great War. E. P. STEBBING.

WE regret to announce the following deaths :

Mr. J. H. Field, C.S.I., formerly director of observatories in India, on May 19, aged sixty-four years.

Prof. Albert Griffiths, formerly professor of physics in Birkbeck College, University of London, on May 24.

Prof. S. H. Langdon, F.B.A., professor of Assyriology in the University of Oxford since 1919, on May 19, aged sixty-one years.

Mr. J. D. Rockefeller, senior, founder of the Rockefeller Institute for Medical Research and of the Rockefeller Foundation, on May 23, aged ninety-seven years.

News and Views

Prof. A. M. Carr-Saunders

As announced in NATURE of May 22, p. 896, Prof. A. M. Carr-Saunders, Charles Booth professor of social science in the University of Liverpool, has been appointed director of the London School of Economics and Political Science. The University of Liverpool showed remarkable discrimination fourteen years ago in selecting for the newly established chair of social science a trained scientific investigator with an alert and critical mind. Prof. Carr-Saunders had already earned a considerable reputation as a writer and scholar of distinction, and his books bore evidence of wide reading and culture. Before he went to the Liverpool School of Social Studies, it was a small and struggling department: he leaves it one of an important group which has become the School of Social Sciences and Administration, attracting students and visitors from all parts of the world. He has done more than any single man to arouse Government and people to the importance of the impending decline in population and to call for more serious investigation into its causes. He has also been a pioneer in the study of the professions: What standards should be required of those who enter them, and what ties should bind the members of a group together? In seeking answers to such questions, Prof. Carr-Saunders has shown himself to be no dilettante theorist. Under his inspiration, a new Division of Public Administration has been added to the Liverpool School, and it is turning out a steady stream of young men who in the future will occupy important administrative posts in the country. There is indeed scarcely any department of university life upon which he has not left an enduring mark. The secret of this amazing capacity to play a leading part in so many important affairs lies in a habit of steady and systematic application to everything he takes in hand.

Linnean Society: Awards and Elections

AT the anniversary meeting of the Linnean Society of London held on May 24, the president, Dr. W. T. Calman, delivered his presidential address entitled "James Eights, a Pioneer Antarctic Naturalist". The Linnean Gold Medal was presented to Dr. F. F. Blackman, formerly reader in botany in the University of Cambridge. In making the presentation, the president said that the modern period of research on some of the fundamental problems of plant physiology began with the medallist's "Experimental Researches in Vegetable Assimilation and Respiration" in 1896. These "Researches", carried on with the aid of students, now number twenty-one, and recently a new series, "Analytical Studies in Plant Respiration", has been added. In 1905 Dr. Blackman published a paper entitled "Optima and Limiting Factors", which is a landmark in the study of the influence of external factors on physiological processes. His work, characterized by the invention of accurate and ingenious experimental methods, has influenced, directly or indirectly, a great part of the research on plant physiology in Great Britain, and it has been given to few to have so deep an influence on a whole generation of workers. The Trail Award of the Society, "to encourage study that throws light on the substance known as Protoplasm, or the physical basis of life" was made to Dr. C. F. A. Pantin, Harding lecturer in zoology in the University of Cambridge, for his work on the mechanism of amœboid movement showing that the protoplasmic changes involved are fundamentally similar to the processes which go in cilia and in muscle. The following were elected officers of the Society for the year 1937–38: *President*, Mr. John Ramsbottom; *Treasurer*, Francis Druce; *Secretaries*, I. Henry Burkill and Martin A. C. Hinton; *New members of Council*, I. Henry Burkill, Miss M. L. Green, Dr. H. S. Holden and Prof. F. E. Weiss.

Foreign Members of the Linnean Society

THE following have been elected foreign members of the Linnean Society: Dr. Reinhard Dohrn, director of the Marine Biological Station, Naples. Dr. Dohrn is the son of the founder of the station, the reputation and popularity of which have steadily increased under his government. The Great War and the years which succeeded threatened its existence; its survival was entirely due to the self-sacrificing enthusiasm of Dr. Dohrn. Dr. Herman Augustus Spoehr, director of sciences at the Carnegie Institution's Division of Plant Biology, Stanford University, California. Dr. Spoehr's work has been mainly on the physiology of plants, his first researches being concerned with photosynthesis; his text-book on "Photosynthesis" published in 1926 is of high merit. His study of photosynthesis and the nutritive problems of cacti opened up several lines of research; he has published results on the colloid behaviour of plant protoplasm, the reduction of carbon dioxide by ultra-violet light, growth and imbibition, the chemistry of leaf pigments, together with a series of papers on respiration—some of them in collaboration with other workers. Prof. Erik Anderson Stensiö, director of the Riksmuseets Paleontologiska Avdeling, Stockholm, distinguished for his researches upon Old Red Sandstone fishes. His success has been largely due to his admirable fertility in inventing new methods for the development of these fossils: by such means he gained a great deal of information about the nervous system, blood supply and mucus circulation in these ancient organisms, all matters of great morphological significance.

Prof. Nils Everherd Svedelius, director of the University Institute at Uppsala, who has been

associated with the University for more than forty years. He is well known for his contributions to the knowledge of the taxonomy, morphology and life-histories of marine algæ, the majority of these being written in German and English. As befits a successor of Linnæus in so old a University as Upsala, he has written on the history of botany. His writings on the taxonomy and morphology of various flowering plants include studies on *Juncus*, Gentianaceæ and the so-called sea grasses. He has travelled extensively in pursuit of his special interests in geographical distribution, algæ and cytology. He is treasurer of the Swedish Linnæan Society. Dr. Richard Woltereck, for many years professor of zoology in the University of Leipzig, and until recently director of the Zoological Institute, Ankara, Turkey. Prof. Woltereck has a world-wide reputation as a limnologist. He organized and was the first director of the Freshwater Biological Station at Lunz in Austria, and by his editorship of the *Internationale Revue der Gesamtes Hydrobiologie und Hydrographie* since its commencement in 1908, has rendered invaluable service to all students of aquatic biology.

Royal Astronomical Society: New Associates

THE recent election of Dr. B. Lyot and Profs. J. H. Oort and Shajn as associates of the Royal Astronomical Society is significant not only as a recognition of their contributions to astronomy, but also as emphasizing the modern tendency of the Society to give this honour for research rather than for official position alone. Ever since Lockyer's and Janssen's successful detection of prominences without an eclipse, the possibility of the daylight photography of the solar corona has exercised astronomers. It has, however, been left to the young French astronomer Lyot, one of the new associates, working with exquisitely designed though inexpensive apparatus, to detect the corona on the Pic du Midi by its polarized light, then afterwards to photograph the inner bright part, and finally to obtain high dispersion spectra in the visible and infra-red of its characteristic emission lines of unknown origin. Fully as distinguished in another field is Prof. Oort of Leyden. In addition to his numerous contributions to stellar statistics, he is especially known for his quantitative formulation of Lindblad's hypothesis of galactic rotation, a formulation which in Oort's hands has greatly clarified our ideas on stellar motions and our knowledge of the structure of the galactic system. Prof. Shajn is a representative of the growing school of young Russian astronomers. His work has been characterized especially by its versatility; he has made contributions of outstanding merit in fields so wide apart as the disturbing action of the earth on meteoric orbits and the study of complex multiplets in stellar spectra.

Museums of India

THE report on the museums and art galleries of India issued by the Museums Association, of which an account appears in another column of this issue of NATURE (see p. 934) will stand in the eyes of future generations as a grave indictment of an administration which has failed to appreciate the cultural needs of the population at large, outside a narrow view of educational and social policy, and at the same time has neglected its opportunity, not to say its duty, to preserve permanently a fully representative record of the material culture of the past and present civilizations of India. To say this is not to ignore either the many difficulties, financial and other, which have confronted past administrators as obstacles in the way of formulating a coherent and comprehensive policy for the provision of museums, or the efforts towards more adequate provision, such as were made under Lord Curzon, or the valuable system of local museums instituted recently in connexion with the work of the Archæological Survey; but these, except in the instance of the last-named, are matters of past history.

IT is the absence of any sign of a progressive attitude towards the provision and utilization of the museum as an instrument in raising the general cultural level, admittedly low, of the population of India that constitutes the gravest element implicit in the indictment. The lack of adequate financial support, as well as of systematic allocation of the funds available, the inadequacy, in every sense, of staff, and the failure to formulate any general policy, which would conduce to efficiency of management within, and consultation and co-operation outside the four walls of the individual museum, grave defects as they may be, are no more than symptoms of apathy, no doubt an unconscious apathy, in the higher authorities responsible for direction and control. Now that attention has been directed forcibly to this far-reaching lapse in the public policy of India, it will be the duty—and a test—of the new regime to set about its remedy with all dispatch.

Antiquities from Essex at the British Museum

AN exhibition of exceptional interest of antiquities from Essex is now on view in the Prehistoric Gallery of the British Museum (Bloomsbury). The objects were found on a site between Rainham and Upminster, about fourteen miles from London Bridge, and are lent by Mr. G. T. Carter with the permission of the Newbury Park Gravel Pit Co., from the excavation works of which they were derived. In part, the great interest of the discovery lies in the fact that all periods of prehistoric and early historic culture in Britain are represented from palæolithic to Saxon times. The finds include palæolithic hand-axes, polished neolithic axes of a type common in the Thames area, pottery of the Early Bronze Age, the most noteworthy example being a small beaker, of reddish ware, decorated with bands of lines and dots, and pottery of the Late Bronze Age, the Early Iron Age and the period of Roman occupation. This succession in evidence of occupation on one and the same site on the estuary of the Thames is of peculiar interest to the archæologist; but the remarkable feature of the discovery is the occurrence of Saxon relics, and more especially of a cemetery, at this

point. This is the first instance recorded of a Saxon settlement in the marsh and forest area of south Essex between London and Southend. The absence of cinerary urns and signs of cremation point to a probable date not prior to the sixth century B.C. Nor does there appear to be any ground for connecting this settlement with the East Saxons of the coastal area from Colchester to Ipswich. It is thought to belong to an estuarine Saxon group scarcely differing from that on the north coast of Kent. The finds, of which a selection is shown, include two remarkable curved drinking horns of olive green glass, both broken, but one of which it has been found possible to reconstruct, bronze brooches and rings, wooden buckets with bronze mounts, shield bosses, spearheads, a sword of iron and Roman coins, pierced for use as pendants. The levels of the pit in which the antiquities were found are shown in photographs. The finds will be on view for two months.

Tuberculosis in Wild Voles

TUBERCULOSIS among wild animals living in their natural state is almost unknown, and the announcement by Dr. A. Q. Wells of the Bureau of Animal Population, Oxford, of the discovery of this disease among wild voles is of great interest and, it may be, importance (*Lancet*, **1**, No. 21, 1221, May 22, 1937). Since last February, Dr. Wells has found in 134 voles caseous lesions, like those of tuberculosis, in which bacilli having the peculiar and characteristic 'acid-fast' staining reaction of the tubercle bacillus were present. In addition, cultures made from the lesions yielded growths resembling those of the tubercle bacillus, and guinea pigs inoculated with the material developed tuberculosis. The voles had been sent from seven different stations in the British Isles, so that the disease seems to be wide-spread among these animals and not a chance occurrence in one locality, and the existence of tuberculosis among them may be of importance in the spread of this disease to domestic animals and to man. The wild vole (*Microtus agrestis*), known as the short-tailed field or grass 'mouse', is a common rodent in meadows, and several sub-species occur in the north. It is of interest in respect to ecology and distribution, for the animals are subject to wide fluctuations in population, increasing over a period of three to four years, and then suddenly decreasing to a low figure in one or two months, and it has been surmised that the decrease may be caused by the occurrence of some epidemic disease among them.

A New Ceramic

EXPERIMENTAL work extending over a period of years at the Mellon Institute of Industrial Research has resulted in the production of a new laboratory table top material made of a porous, non-warping ceramic body that is impregnated with bituminous substances and then heated under special conditions to form coke in the pores. Unusually high resistance to thermal shock is imparted to the material because artificial cordierite, a mineral that has a very low thermal expansion, is used in making up the ceramic body. The material can be polished to velvety smoothness, and possesses sufficient hardness to resist scratching and abrasion, ample structural and impact strength, denseness that prevents absorption of liquids, resistance to solvent action and chemical attack, and the ability to withstand perfectly the effect of rapid heating and cooling. Thus "Kemite", as it has been called, has none of the disadvantages of the commonly used table-top materials. While Kemite was developed primarily as a laboratory table-top material, it can be fabricated in complicated shapes of large size without joints. When high resistance to thermal shock is not required, cordierite is not used in the ceramic body, and ware made from the non-cordieritic body is called 'Karcite'. Kemite should prove useful for vats, tanks and other apparatus, because of its resistance to the action of chemicals and its low thermal expansion. In the electrical industry, the basic body, properly impregnated, can be employed for switchboard panels, specially moulded parts and complex shapes, and as an insulating material.

Broadcasting an Eclipse

THE National Geographic Society, Washington, claims that the broadcasting of a series of programmes before and during the eclipse of June 8–9 from one of the (normally) uninhabited islands of the Phœnix Group will be the first instance of broadcasting "from a desert island". It will not be the first eclipse which has been broadcast from an eclipse camp, as Dean Eve broadcast to Canada the total eclipse of 1932 from a camp at Magog, but it will probably be the first time when an announcer and two engineers of a national broadcasting company have formed part of an eclipse expedition to a foreign country. The scientific details of the eclipse expedition arranged by the National Geographic Society were published in NATURE of April 24, p. 698; but one or two points of general interest may be added here. The duration of totality at noon will be longer than at any other eclipse over a stretch of 1,238 years; unfortunately, it takes place at a point 1,500 miles from the nearest land. A special self-bailing boat will be used to take the equipment ashore, and the U.S. naval seaplane tender will stand by the island during the expedition's stay ashore. A complete black and white motion picture record of the eclipse will be made and colour 'movies' may also be taken.

Development in the Arctic

RECENT economic developments in the Siberian Arctic lands bear some testimony to Mr. V. Stefansson's contention of a 'friendly arctic'. A paper in the *Geographical Journal* of April by Mr. H. P. Smolka describes some of the recent Soviet schemes on the Yenisei, Khatanga and other rivers, where a few years ago a little native fishing and hunting were the sole interests. Igarka, 600 miles up the Yenisei, and some distance north of the Arctic Circle, is now a city of 14,000 inhabitants with well-built timber houses and timber roads. There are schools, theatres

and other amenities, and the whole town is flood-lit in winter. The one interest is timber, which is exported by the river in late summer. Work goes on all the year round, and the inhabitants rarely suffer from cold even with temperatures of − 35° C. A modern port is being built. Norilsk, farther north than Igarka, is being built for new coal mines on the Pyasina River and is being connected by a 70-mile railway to its port of Dudinka, another new growth 400 miles up the Yenisei River. Nordvik, at the mouth of the Khatanga River, in nearly lat. 70° N., is an even more amazing growth. It was started last year as a town for the new salt mines. With these urban growths there are developing also experiments in arctic agriculture. In lat. 68° N., onions, radishes and cabbages have been grown in the open, and tomatoes, cucumbers and asparagus in hothouses. Experiments are being made in growing vegetables in electrically heated and lighted subterranean chambers, the current being provided by windmills.

Central Water Advisory Committee

THE Minister of Health has appointed a Central Water Advisory Committee under the chairmanship of Lord Milne. The following have been appointed to serve on the Committee : Sir Albert Atkey, Mr. E. T. L. Baker, Mr. H. K. Beale, Mr. R. Beddington, Mr. John Chaston, Lieut.-Colonel E. J. Clarke, Mr. A. E. Cornewall-Walker, Sir Robert Doncaster, Lieut.-Colonel A. P. Heneage, Capt. R. T. Hinckes, Mr. S. R. Hobday, Mr. J. E. James, Mr. E. W. Cemlyn Jones, Sir David Owen and Mr. D. Verity. The Committee's terms of reference are to advise the Government Departments on questions relating to the conservation and allocation of water resources ; on any questions which may be referred by the Departments with respect to matters arising in connexion with the execution of, or any proposed amendment of, the enactments relating to water ; and to consider the operation of the enactments relating to water and to make to the Government Departments such representations with respect to matters of general concern arising in connexion with the execution of those enactments, and with respect to further measures required, as the Committee thinks desirable. Any communications concerning the work of the Committee should be addressed to the Secretary, Mr. A. Titherley, at the Ministry of Health.

American Tour of British Research Organizations

BETWEEN twenty and thirty American executives and bankers are making a rapid tour of Great Britain, France and Germany to study European research organization at first hand lasting from May 24 until June 30. The tour is being arranged under the auspices of the American National Research Council by Mr. Maurice Holland, the director of the Division of Engineering and Industrial Research of the Council. The tour in Great Britain has been arranged in co-operation with the Department of Scientific and Industrial Research, and visits will be made to the National Physical Laboratory, the Building Research Station and the Fuel Research Station. The party will also spend a day at the Shirley Institute, the headquarters of the Cotton Research Association at Didsbury, and will be able to visit the laboratories of the Leather, the Boot and Shoe and the Rubber Research Associations. The party is visiting the research laboratories of several large firms. A visit is also being paid to the Cavendish Laboratory at Cambridge. During the tour, about thirty-five laboratories will have been visited, covering eighteen different fields of industrial research.

Scottish Science and the Industrial Revolution

FOR his inaugural address as regius professor of natural history in the University of Aberdeen, delivered on April 21, Prof. L. Hogben took for his subject "The Theoretical Leadership of Scottish Science in the English Industrial Revolution". In this he showed how eminent men trained in the biological sciences stimulated the progress of chemistry and physics, and thereby influenced the growth of various industries at the end of the eighteenth and the beginning of the nineteenth centuries. The Industrial Revolution was, of course, bound up with the development of the textile, iron and coal industries, but more especially with the introduction of the steam engine and to a lesser extent with the rise of the chemical industry. The part played by Watt and Murdock in the improvement of the steam engine is well known, but Prof. Hogben showed how to men such as Joseph Black, James Keir, John Roebuck and Francis Horne—all graduates of medicine—can be traced some of the advances in industry. Black's connexion with Watt is familiar to all, while Roebuck not only endeavoured to assist Watt, but also had a principal share in establishing the Carron Iron Works, and was a pioneer in the manufacture of sulphuric acid. The address contains some interesting notes on the early members of the Royal Society of Edinburgh when James Hutton and John Playfair were leaders of Scottish science, and it recalls that Hutton, though generally regarded as one of the fathers of modern geology, yet is also remembered as the founder of a manufactory for sal ammoniac. In concluding his review of the subject, Prof. Hogben said that "The restricted class basis of English education could not supply the theoretical leadership which its industrial expansion demanded. It had to rely largely on a fund of personnel from Scotland".

Flood-lighting and Broadcasting during the Paris Exhibition

DURING the Paris Exhibition, it has been arranged that some four hundred monuments and buildings in the smaller villages of France and in the open country will be flood-lighted by five mobile units carrying flood-lighting equipment. Each of the lorries will carry generating plant, and will be manned by three men. It will carry ten spotlights of 3 kilowatts each and ten floodlights of 1½ kilowatts.

There will also be apparatus for the production of chemical smoke, as well as an amplifier and a loud speaker installation permitting lectures or music, which will be broadcast during the displays. According to the *Electrician* of May 21, all the services of the Government broadcasting system will be transferred to the radio pavilion at the Paris Exhibition. For this purpose, three large studios with mixing desks and control room, two smaller studios for speakers and announcers, and a television studio are being installed. There will also be an installation for the registering and rebroadcasting of records. The installations will be entirely enclosed in glass so that the public can see all the equipment in operation and yet all risk of noise or crowds interfering with the operations will be prevented. As the stations are broadcasting all day, it will be possible for the public to see at least some part of the installation in operation at all hours of the day. The lighting tour has been organized to extend until the end of October. The general control of the whole system will be centred in a room near the entrance to the pavilion. It will have connexions with both French and foreign stations. In many places, the local authorities are being asked to provide flood-lighting for other buildings of interest.

Modern Applications of Psychology

DR. C. S. MYERS, in a paper before the Royal Society of Arts on March 10 on "Industrial Psychology and the Modern World", began by showing the indebtedness of this most recent application of psychology to the educational and medical applications that had preceded it. The field covered by it is very wide, since it is concerned with all grades of occupational life, with industrial relations, personnel management and with all the environmental conditions that can hinder or further the happiness, health and efficiency of those engaged in industry. Already the pioneer work done in England is being developed and adapted by many other countries. By a scientific study of individual differences and of the requirements for success in particular occupations, the industrial psychologist has been able to develop a technique which enables him to direct an entrant into the occupation for which he seems most fitted, and also to help the employer to select from a number of applicants those with the fundamental requirements. The young person is thereby saved from much futile groping and the attendant sense of failure. When, however, the right selection has been made, it becomes necessary to train the beginner in the right methods, instead of letting him pick up for himself methods that might be good or might be bad. In this field, the industrial psychologist has made a special study of the best movements and methods of work that should be taught, and of the suitable methods of teaching the required movements. He has also much to offer to management, and could prevent the unnecessary friction resulting from those in authority having more knowledge of the machinery and of the materials involved than of the human beings for whom they are responsible.

British Speleological Society

ALTHOUGH the British Speleological Society has been in existence for a brief period only, having been formed at Derby two years ago, there is evidence that the organization has fulfilled its purpose and indeed has prospered exceedingly under the presidency of Sir Arthur Keith in the announcement that it proposes to institute a museum of its own. The object of the Society is to co-ordinate the exploration and excavation of caves and potholes, and as was evident from the very successful first conference held at Buxton last year, much useful work on these lines has already been done. The Society now proposes to take over Cragdale, Settle, as its headquarters, and a museum will be formed to house photographs of underworld scenery, geological specimens, human and animal remains as well as other relics of cave man. A speleological library will also be formed and housed in the new headquarters. The second Speleological Conference and exhibition of photographs, surveys, prehistoric remains, geological specimens, etc., from British and foreign caves will be held in the University of Bristol on July 23–26. Further information can be obtained from the deputy secretary of the British Speleological Association, University College, Hull. On July 27–August 8, there will be a conducted tour to some of the more important caves in Germany, Austria and Czechoslovakia. Further information can be obtained from Mr. C. R. Hewer, Tallin, Kiriku Poik 4, Estonia.

Charles Darwin and the Modern Theory of Tropisms

PROF. BOYSEN JENSEN'S new book upon "Growth Hormones in Plants" directs attention to the conclusion drawn by Charles Darwin "that when seedlings are freely exposed to a lateral light, some influence is transmitted from the upper to the lower part, causing the latter to bend". Prof. N. Cholodny writes to the Editor from Kiev pointing out that a passage from "The Power of Movement in Plants" (1880) refers to the localization of phototropic sensibility in the tip of the coleoptile of *Phalaris* in these terms: "These results seem to imply the presence of some matter in the upper part which is acted on by light, and which transmits its effects to the lower part". Prof. Cholodny points out that this passage might be interpreted as foreshadowing modern theoretical interpretations of the same tropic phenomenon as due to the movement of growth-regulating substances or hormones.

Health Resorts of Britain and the Empire

THE British Health Resorts Association has issued its official handbook for the current year ("British Health Resorts: Spa, Seaside, Inland". Edited by Dr. R. Fortescue Fox. With a Foreword by Sir Kingsley Wood, Minister of Health. London: J. and A. Churchill, Ltd. 2*s*. 6*d*. net). The handbook follows the lines of previous editions, but the whole of the material has been carefully revised, and new information is given in a condensed form as regards the sunshine and rainfall in many resorts. A valuable chapter on climatology has been contributed by

Mr. L. C. W. Bonacina. A synopsis of the attractions offered by British resorts during the 'invalid's winter' is included, and the principal spas and climatic resorts of the British Commonwealth overseas are also mentioned.

Fauna of the North Sea

LIEF. 30 of "Die Tierwelt der Nord- und Ostsee" contains a mixed bag of monographs, dealing with nemertine worms (Hermann Friedrich), halophile and halobionic Hemiptera (Håkon Lindberg), and the Anthozoa included in the sea anemones and Alcyonaria (F. Pax). Short diagnoses of the characters of species and of their distribution are supplemented by accounts of the morphology, physiology, development, variation and biology in general of larger groups. Parts of this ambitious and very useful work have been appearing at the rate of slightly less than three a year since 1925, and there are still many to follow.

A Forestry Herbarium

THE forestry herbarium collected by the late Prof. A. H. Henry, formerly professor of forestry at University College, Dublin, has now been made available for inspection and reference at the Botanic Gardens, Glasnevin, Dublin. The collection comprises more than nine thousand specimens and was presented to the nation by Mrs. Henry on the death of her husband. Since then, Mrs. Henry has devoted much time to the work of classification and arrangement so as to make the collection readily accessible for reference purposes. This unique collection is a tribute to the memory of a distinguished scholar, and the admirable arrangement accomplished by Mrs. Henry enhances that tribute.

The Cerne Giant: A Correction

It would appear that the announcement of the impending sale of the Cerne Giant (see NATURE, May 22, p. 876) was due to a misunderstanding. The sale of Cerne Abbas property, which will take place on June 16, will include the remains of the famous Abbey and an Elizabethan farm-house; but the well-known hill 'carving' is not for sale. The Cerne Giant, we are reminded by the secretary of the National Trust, was presented to the National Trust in 1920 by Mr. A. E. Fox Pitt-Rivers and an endowment provided for its upkeep by Sir Henry Hoare.

The Night Sky in June

ON June 21 at 20^h, the sun enters the sign Cancer (the summer solstice). In the latitude of London, the length of night from sunset to sunrise is then only $7^h\ 26^m$. The moon is new on June $8^d\ 20{\cdot}7^h$ and full on June $23^d\ 23{\cdot}0^h$. On June 8, a total eclipse of the sun takes place and is visible in equatorial regions of the Pacific, but although the path of totality (of maximum breadth 153 miles) extends over nearly one hundred degrees of terrestrial longitude, there are very few possible land sites to which expeditions can be sent. The duration of totality at the noon point is $7^m\ 4^s$, making this eclipse the longest that has occurred for more than a thousand years. Of the planets visible during June, both Mercury and Venus are morning stars. On June 6, Mercury is at greatest elongation 24° west, and Venus at greatest western elongation (46°) on June 27. Venus is in conjunction with Uranus on June 18 at 11^h, when the two planets are separated by 2·7°. Mars is conspicuous low in the south as the sky darkens. The planet decreases in brightness from magnitude −1·7 to −1·2 during the month. On June 20 at 10^h, Mars is in conjunction with the moon and is then only 0·1° northwards of the latter (geocentric positions). The circumstances produce an occultation of Mars by the moon, the phenomenon not, however, being visible from the northern hemisphere. Jupiter rises in the evening twilight and souths about 2^h in the middle of the month; on June 25 at 21^h it is in conjunction with the moon. Saturn rises soon after midnight in mid-June; on June 4 at 2^h conjunction occurs with the moon. The apparent breadth of the minor axis of the ring system is 3″–4″. At 22^h in mid-June, the bright star Regulus is nearing the western horizon; Arcturus has passed the meridian, Spica and Antares are low down in the south, while Vega, Altair and Deneb are conspicuous eastwards of the meridian. The maximum of the Scorpiid meteors is due about June 4, the radiant point being nearly midway between α Scorpii (Antares) and η Ophiuchi. An ephemeris for the comet Grigg-Skjellerup, is given in the *B.A.A. Handbook* as follows:

	R.A.	Dec. (N.)
June 4	$9^h\ 36{\cdot}3^m$	23° 36′
,, 8	10 04·5	25 53
,, 12	10 36·0	28 02
,, 16	11 10·3	29 51
,, 20	11 46·8	31 10
,, 28	13 01·2	31 50

Commonwealth Fund Fellowships

THE following appointments, among others, to Commonwealth Fund fellowships tenable by British graduates in American universities for the two years beginning September, 1937, have been made: Dr. J. B. Bateman, King's College, London, and University of Cambridge, to the University of Pennsylvania, in biophysics; D. M. Douglas, University of St. Andrews, to the University of Minnesota, in medicine; J. A. Downes, Imperial College of Science and Technology, London, to the University of California, in zoology; Dr. R. N. Jones, University of Manchester, to Harvard University, in chemistry; N. F. McGrath, University College, Oxford, to the University of Chicago, in political science; Wilfred Merchant, Corpus Christi College, Oxford, to the Massachusetts Institute of Technology, in engineering; Dr. Arthur Porter, University of Manchester, to the Massachusetts Institute of Technology, in physics; H. O. Puls, University of Reading, to the Massachusetts Institute of Technology, in physics; Dr. F. D. Richardson, University College, London, to Princeton University, in chemistry; Dr. B. V. Rollin, Wadham College, Oxford, to the University of California, in physics; J. D. Spillane, University

of Wales, to Columbia University, in medicine; B. D. White, Queen's College, Oxford, to the University of Minnesota, in economics; D. M. de R. Winser, Corpus Christi College, Oxford, to Yale University, in physiology.

THE following has been appointed to a fellowship tenable by candidates from the British Dominions: I. F. G. Milner, University of New Zealand, and New College, Oxford, to the University of California, in international relations. The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas: W. I. B. Beveridge, University of Sydney, of the Council for Scientific and Industrial Research, Australia, to the Rockefeller Institute, Princeton, in veterinary science; W. J. Blackie, University of New Zealand, of the Department of Agriculture, Fiji, to Yale University, in biochemistry; E. T. A. Edwards, University of Sydney, of the Department of Agriculture, New South Wales, to the University of Wisconsin, in agriculture; Robert Galetti, Balliol College, Oxford, of the Indian Civil Service, Madras, to Stanford University, in agriculture; B. W. Wilson, University of Cape Town, of the Railways and Harbours Administration, South Africa, to the University of Illinois, in engineering. The following have been appointed to fellowships tenable by candidates holding appointments in the Home Civil Service; J. L. Blake, University College, University of London, of the Patent Office; R. N. Quirk, King's College, Cambridge, of the Mines Department.

Announcements

SIR FREDERICK GOWLAND HOPKINS has been elected president of the Association of Scientific Workers in succession to Dr. W. H. Eccles.

WE regret the omission from the Coronation Honours list printed in NATURE of May 15 of the name of Mr. C. S. Wright, director of scientific research at the Admiralty, who was appointed C.B.

DR. SYDNEY SMITH has been appointed works manager at the Wellcome Chemical Works, Dartford, the chief works of Messrs. Burroughs Wellcome and Co. It will be recalled that the previous holder of this post was Dr. H. A. D. Jowett, who met his death in a motor-car accident last August (see NATURE, Aug. 29, 1936). Dr. Smith has been associated with Messrs. Burroughs Wellcome and Co. for twenty-three years, and during that time has made highly important contributions to the study of the alkaloids of ergot and the glucosides of *Digitalis*.

IT is announced in *Science* that at the dinner of the U.S. National Academy of Sciences held on April 27, the following medals were awarded: James Craig Watson Medal to Prof. E. W. Brown, emeritus professor of mathematics in Yale University, for his work on lunar theory; Henry Draper Medal to Dr. C. E. Kenneth Mees, director of the Research Laboratory of the Eastman Kodak Company, for his work on the theory and perfection of photographic processes and materials; Agassiz Medal to Prof. Martin Knudsen, professor of physics in the University of Copenhagen, for his work on physical oceanography; Mary Clark Thompson Medal to Prof. A. W. Grabau, professor of palæontology in the National University of China and chief palæontologist to the Chinese Geological Survey, for his work on Chinese palæontology.

THE centenary of the Liverpool Medical Institution will be celebrated on May 30–June 1, when Prof. R. E. Kelly will deliver a presidential address on surgery a hundred years ago, and the Hugh Owen Thomas and Robert Jones memorial library of orthopædic surgery will be opened.

A SESSIONAL meeting of the Royal Sanitary Institute will be held at Newcastle-upon-Tyne on May 28, when a discussion on the difficulties of nutritional assessment will be opened by Dr. H. E. Magee of the Ministry of Health, Dr. G. C. M. M'Gonigle, medical officer of health of Stockton-on-Tees, and Dr. J. C. Spence, honorary assistant physician to the Royal Victoria Infirmary, Newcastle-upon-Tyne.

AN International Congress of Medicine applied to Physical Education and Sport will be held in Paris on July 11–17 under the presidency of Profs. Carnot and Latarjet. The subjects for discussion will be physical education in and after the school period, education and control of sport, and incidents and accidents of sport. Further information can be obtained from Dr. Collet, 45 rue de Clichy, Paris.

AN International Congress on Occupational Diseases and Industrial Welfare will be held in Paris on June 1–6 under the presidency of Dr. V. Balthazard, professor of forensic medicine in the University of Paris. Further information can be obtained from the Secretary-General of the Congress, Dr. G. Haussen, Institut Médico-Légal, Place Mazas, Paris, XII^{e}.

THE seventh English-Speaking Conference on Maternity and Child Welfare will be held at the British Medical Association House on June 1–3 under the presidency of the Minister of Health, and will be attended by 600 delegates. Further information can be obtained from the Honorary Secretary, Miss J. Halford, Carnegie House, 117 Piccadilly, W.1.

PROF. LOWELL J. REED, professor of biostatistics in the Johns Hopkins School of Hygiene and Public Health, has been appointed dean of the school in succession to Dr. Allen W. Freeman.

THE headmaster of a boys' secondary school in London desires to obtain issues of NATURE regularly two or three weeks after publication, for use by his senior students. We shall be glad to know the name and address of any reader or subscriber who would be willing to supply such copies at a reduced rate.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 931.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Isotopic Weight of ^{12}C

IN my last letter[1] I directed attention to the uncertainty in the value of this constant, which is particularly unfortunate as it is the most important sub-standard in the determination of isotopic weights by the mass-spectrograph. Since then I have been to great pains to make further measurements of it by as many independent methods as possible. The following is a summary of all my results in the order in which they were obtained.

(*a*) The doublet O—CH_4 was measured using a cylindrical discharge tube and varying the position of the doublet on the spectrum to minimize the effect of any local disturbances in the fields of the instrument. The results were used in fixing the fundamental isotopic weights[2].

(*b*) These measurements were repeated using a large spherical discharge tube[1].

The objections to the use of the O—CH_4 doublet to determine the isotopic weight of carbon are: (1) It is so wide (more than 22 units of packing fraction) that the effect of uncertainty in the absolute value of the dispersion coefficient may be serious. (2) The value obtained is dependent to the extent of about one third on the isotopic weight of ^1H. (3) The fact that one line is atomic and the other molecular may possibly cause asymmetry.

(*c*) The analogous doublet CO—C_2H_4 was measured. This is not so easy or accurate, but eliminates objection (3).

(*d*) The fortunate occurrence on one plate of a particularly well-matched doublet ^{40}A—C_3H_4 gave a useful check, for the values of the isotopic weight of ^{40}A show no serious discrepancy.

(*e*) The mass of ^{12}C was compared directly with that of ^{16}O by means of the close ratios $O^{++} : C \sim C : OH_2$ by artificial doublets made by applying electric fields in the ratio $3 \sim 2$. This is the method by which the packing fraction of ^{12}C was originally measured[3]. It reduces errors due to (1) and (2) each to about a third, but unfortunately the technical difficulty of controlling the intensity of the OH_2 line makes it somewhat unreliable.

(*f*) The ratio $O^{++} : C$ was now measured against $A^{+++} : A^{++}$. These artificial doublets were easier to produce, and gave very consistent results. The particles concerned are all atomic, the results are independent of hydrogen and of any reasonable error in the absolute dispersion coefficient as the ultimate difference is only 3 units of packing fraction.

(*g*) By long running with dry gases containing argon, the OH_2 line had been reduced to such an extent that three well-matched natural doublets $^{36}A^{++}$—OH_2 were obtained. In each of these the very faint intermediate line due to ^{18}O was clearly visible, enabling a provisional value for it to be found as given below. ^{36}A had already been paired with C_3, so that the packing fraction of C could be calculated from that of OH_2.

(*h*) As a further check, the ratios $^4He : C^{++} \sim A^{+++} : A^{++}$ were compared, there being no serious disagreement in the isotopic weight of He.

The accompanying table gives the mean values of the packing fraction of ^{12}C deduced from these experiments in estimated order of their reliability. My figures for the isotopic weights of hydrogen, helium and argon have been used in the calculations, and the appropriate small corrections for the mass of the electron have been applied in the case of artificial doublets.

	Method	Number of independent observations	Packing fraction of ^{12}C deduced
(*a*)	O—CH_4	14	2·96
(*b*)	O—CH_4	13	2·97
(*c*)	CO—C_2H_4	18	2·91
(*f*)	$O^{++} : C \sim A^{+++} : A^{++}$	15	2·91
(*g*)	$^{36}A^{++}$—OH_2, ^{36}A—C_3	3,6	2·99
(*e*)	$O^{++} : C \sim C : OH_2$	18	3·11
(*h*)	$He : C^{++} \sim A^{+++} : A^{++}$	5	3·00
(*d*)	^{40}A—C_3H_4	1	3·0

These results justify the value 2·96 which I have been using, and enable its probable error to be reduced. The following are the values deduced:

Symbol	Packing fraction	Isotopic weight
^{12}C	2·96	12·00355 ±0·00015
^{18}O	3·2	18·0057 ±0·0002
^{36}A	−6·10	35·9780 ±0·0010

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May 6.

[1] NATURE, **138**, 1094 (December 26, 1936).
[2] NATURE, **137**, 357 (February 29, 1936).
[3] *Proc. Roy. Soc.*, A, **115**, 499 (1927).

Temperature Equilibrium of C-Neutrons

THE slow neutrons leaving a block of paraffin wax, containing a source of fast neutrons, mostly possess thermal energies. The existence of such thermal neutrons has been established by the discovery[1] that the temperature T of the paraffin has an influence on the activities induced in various elements. Since the neutrons penetrating a screen of cadmium do not show this effect[2], cadmium may be used to discriminate between the slowest neutrons (C-neutrons[3]) and the faster ones.

The dependence on temperature of the absorption of C-neutrons has been studied by a number of investigators[4]. If the C-neutrons are in thermal

equilibrium with the paraffin, their absorption in boron, lithium and silver should be proportional to $1/\sqrt{T}$ because the capture cross-section for slow neutrons of these elements should be inversely proportional to neutron velocity (the $1/v$ law[5,6]). (In the case of silver the $1/v$ law has been checked experimentally[7].) While the results of Preiswerk and v. Halban[2] were not in direct disagreement with the $1/\sqrt{T}$ law, other investigators obtained definitely smaller variations with temperature than this law predicted.

TABLE 1.

T	80°	195°	290°	415°
μ_T/μ_{290}	1·50±0·05	1·25±0·04	1	0·89±0·04
$\sqrt{(290/T)}$	1·9	1·22	1	0·84
μ_T/μ_{290} calc.	1·71	1·21	1	0·84

In an investigation of this question, we have obtained the relative values, given in the accompanying table, of the absorption coefficient μ of silver for C-neutrons emerging from a paraffin block at different temperatures. The neutrons were counted by a boron-lined ionization chamber connected to an amplifier and mechanical counter. At the three higher temperatures, the $1/\sqrt{T}$ law is seen to be nearly fulfilled; μ^{80}, however, is distinctly too small. For boron and lithium absorbers the values of μ^{80}/μ^{290} were found to be the same as for silver.

In discussing these results, the following points must be considered:

(1) The energy spectrum of C-neutrons includes—apart from the thermal neutrons—a tail of faster neutrons (tail neutrons) extending to the absorption limit of the cadmium screen ($\sim$ 1 eV.[4]).

(2) The H nuclei in the paraffin are very inefficient in slowing down neutrons below the lowest hydrogen oscillation energy, that is, below 0·1 eV. On account of this, the neutrons are crowded in the region below 0·1 eV. We may try to estimate this effect by treating the neutrons as if they were colliding with free particles of mass 14 (CH_2-nuclei).

(3) The number of collisions required to bring a neutron from 0·1 eV. down to room temperature is about ten (estimated according to ref. 2), and as many as ten more collisions are needed to bring it down to 80° K. On the other hand, the mean number of collisions suffered by a slow neutron before emerging from a paraffin block is about 100. (We obtained this figure by studying the influence of small amounts of boric acid on the intensity of neutrons slowed down in water under similar geometrical conditions to those in our temperature experiments.) It follows that neutrons spend a considerable part of their life between the cadmium absorption limit and thermal energy; correspondingly, a considerable fraction of the neutrons leaving a paraffin block have energies in this region. Therefore the C-group is inhomogeneous, especially at low temperatures.

(4) The mean life of neutrons in paraffin, if limited only by capture in the paraffin, is independent of temperature; it is not affected by the zero point oscillations of the protons.

Taking these points into account, we have calculated quite roughly the relative mean absorption coefficients of C-neutrons. While the exact theory of slowing down must consider collisions with bound protons, the present treatment using the idea of 'CH_2-nuclei' can at least be taken as illustrative of the trend of the results to be expected. Since the experimental results deviate from the $1/\sqrt{T}$-law in roughly the same way as the calculated ones (see Table 1.), we believe that our explanation is correct in principle and that there is no reason whatever to doubt the $1/v$ law as a result of such experiments.

The experiments are being continued and a detailed account is to appear soon.

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H. VON HALBAN, JUN.
JØRGEN KOCH.

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Copenhagen.
April 14.

[1] Moon, P. B., and Tillman, J. R., NATURE, **135**, 904 (1935).
[2] Preiswerk, P., and v. Halban, jun., H., NATURE, **136**, 1027 (1935).
[3] Fermi, E., Amaldi, E., *Ric. sci.*, A, VI/2, 544 (1935).
[4] Fomin, V., and others, NATURE, **138**, 326 (1936). Fink, G. H., *Phys. Rev.*, **50**, 738 (1936).
[5] Frisch, O. R., and Placzek, G., NATURE, **137**, 357 (1936).
[6] Weekes, D. F., Livingstone, M. S., and Bethe, H. A., *Phys. Rev.*, **49**, 471 (1936).
[7] Rasetti, F., and others, *Phys. Rev.*, **49**, 104 (1936).

Structure Types of Protein 'Crystals' from Virus-infected Plants

FURTHER work on preparations of proteins from virus-infected plants tends to confirm and extend the conclusions expressed in our previous letter[1]. We had there shown that both concentrated solutions of these proteins and the material prepared from them by drying gave orientated paracrystals. We have now succeeded in preparing the 'crystals' of Stanley and Wyckoff in an orientated form, after trying unsuccessfully a number of methods, such as flow orientation. The method finally used was that of forcing mother liquor out of the 'crystals' by centrifuging in an unglazed porcelain tube, in a saturated atmosphere. The resulting mush was orientated by rolling between glass slides, at 0° to avoid evaporation, becoming completely transparent in the process. It was mounted in a sealed brass case with bubble thin lindeman glass windows and examined by X-ray and optical methods without loss of water. It proved to be practically indistinguishable—in water content (50 per cent), optics and X-ray pattern at low and high angles—from the preparation previously called wet gel. On being allowed to dry, it likewise turns into a horny mass giving similar X-ray photographs to 'dry gel', though fainter and with slightly larger spacings, probably due to internal strain. The X-ray pattern obtained from the unorientated crystals shows all the main lines given by Wyckoff and Corey[2] for their crystals, and we have been able to assign all but four very weak lines on these photographs to definite spots given by the orientated gel. There can therefore remain little doubt that their 'crystals' are substantially identical with ours and with our previously described paracrystals.

As many deductions have already been drawn from the crystalline nature of these proteins, it is important to state precisely in what sense the word 'crystalline' should be used in respect of them on the basis of interpretation of X-ray photographs. Normally, crystallinity presupposes an indefinite repetition of identical units in three-dimensional space. These proteins appear not to possess this degree of regularity. The degree of regularity which seems to be the only one consistent with the X-ray

evidence has thus far not been described, though it has been predicted theoretically as one of the types of liquid crystal. The long molecules of the protein

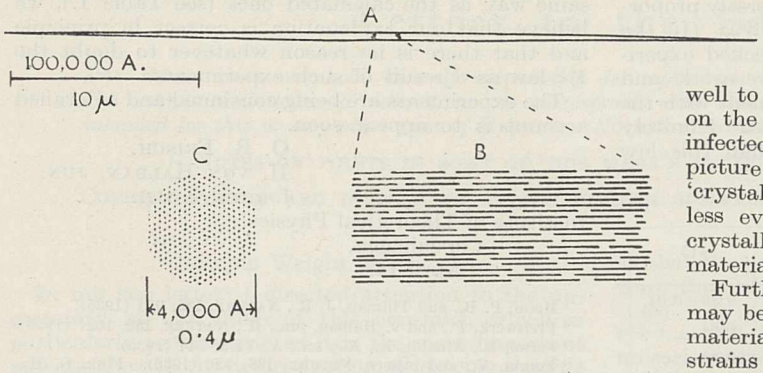

Fig. 1. DIAGRAMMATIC.
A. TYPICAL 'CRYSTAL'. B. LONGITUDINAL SECTION.
C. TRANSVERSE SECTION.

are packed with a perfect hexagonal two-dimensional regularity at right angles to their length, but there is no evidence of regularity of molecular arrangement in the direction of their length. None of the reflections in directions other than at right angles to the molecular length is due to the packing of the molecules, but rather to regularities within them, as shown by the fact that such reflections persist unchanged when the molecules are in dilute solution. Lines observed by Wyckoff refer not to the regular packing of equivalent molecules but to regularities within the molecule. They can only be said to be evidence for crystallinity if by that it is understood that each molecule is itself a crystal. The relatively small lateral dimensions of the molecules, 150 A., can only permit of imperfect diffraction effects in these directions as shown by the diffuseness of the spots, while the great length of the molecule is indicated by the extreme sharpness of the reflections from planes perpendicular to its length. A complete interpretation of this intramolecular pattern has not yet been possible; but a rough survey indicates that the molecule is made of piles of sub-molecules of dimensions 22 A. × 20 A. × 20 A., somewhat smaller than the normal protein molecule, and themselves divided into nearly identical units with half these dimensions.

The microscopic appearance of the Stanley 'crystals' is quite consistent with their liquid crystal character, for although fairly long, about 40 μ, they are extremely thin, about 0·4 μ thick, and have gently tapering ends. This is quite different from the prismatic or pyramidal forms of true protein crystals and more like the 'micro tactoids' observed in colloidal solutions of the fibrous type. On pressing they readily fuse together into a homogeneous mass, emphasizing their partially liquid nature. Their most probable internal arrangement is that shown in Fig. 1. This arrangement would also serve very well to explain the observations of R. J. Best[3] on the formation of mesomorphic fibres from infected sap. A further consequence of this picture of the internal structure of these 'crystals' is that their formation furnishes even less evidence than is provided by ordinary crystallization as to the homogeneity of the material.

Further light on the structure of the protein may be given by comparative study of similar materials. We have so far examined three strains of tobacco virus: mosaic, enation and aucuba, as well as two varieties of cucumber virus prepared by Bawden and Pirie[4]. The intramolecular patterns resemble one another very closely, but interesting and significant differences appear in the intermolecular patterns. All three varieties of tobacco virus show the same intermolecular distance in dry gels prepared in the same way, but show consistent differences of relative intensity of the different lines (see Table). The cucumber virus protein shows even more marked intensity differences and also a different intermolecular distance, 146 A., 4 per cent smaller than that of tobacco virus. There was no marked difference in spacing between the two cucumber strains.

RELATIVE INTENSITIES OF INTERMOLECULAR REFLECTIONS OBTAINED FROM VARIOUS VIRUS STRAINS.

$h^2 + k^2 + hk$	$hkil$	Tobacco mosaic	Enation	Aucuba	Cucumber 3	Cucumber 4
1	$10\bar{1}0$	$s+$	$w-m$	m	m	w
3	$11\bar{2}0$	s	s	s	m	$w-m$
4	$20\bar{2}0$	m	m	$w-m$	w	vw
7	$21\bar{3}0$	$m-s$	$m-s$	$m-s$	s	s
9	$30\bar{3}0$	vvw	0	0	0	0
12	$22\bar{4}0$	0	vvw	0	$m-s$	m
13	$31\bar{4}0$					

The significance of these observations is that all the protein molecules have substantially the same general shape and size and are made of similar sub-units, but that these are arranged somewhat differently in the various tobacco virus strains and more markedly so in the cucumber virus. These results indicate the possibility of deriving a system of classification of viruses on the basis of their X-ray patterns.

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[1] Bawden, F. C., Pirie, H. W., Bernal, J. D., and Fankuchen, I., NATURE, **138**, 1051 (1936).
[2] Wyckoff, Ralph W. G., and Corey, Robert B., *J. Biol. Chem.*, **116**, 51 (Nov. 1936).
[3] Best, R. J., NATURE, **139**, 628 (1937).
[4] Bawden, F. C., and Pirie, N. W., NATURE, **139**, 546 (March 27, 1937).

Acquired Immunity against the 'Y' Potato Virus

Two years ago, thanks to Messrs. Sutton and Sons, Ltd., I obtained a couple of plants of *Schizanthus retusus*. At the base of each grew a mass of axillary shoots, forming a sort of 'witch's broom'. The plants were otherwise healthy, vigorous and in full bloom.

Sap inoculations were made from these axillary shoots to young schizanthus plants, tobaccos, and daturas, as well as grafts to older schizanthus plants. The daturas remained unaffected; the tobaccos developed a dull vein clearing, followed by a faint mottle and a weakly-developed vein-banding on the older leaves, all characters of Kenneth Smith's 'Y'

virus in a weakened form. Such a variant I had long sought as a basis for protective inoculation of the potato. *Passage* through schizanthus induced a further weakening of the virus, as judged by its reaction on tobacco, in such manner that if the normal reaction were valued at 10, the weaker might be assessed so low as 3, though it was more often recorded as between 4 and 6. It was shown[1] that this new strain protected tobaccos against further infection with the normal 'Y' virus.

As the new strain of the virus was insufficiently attenuated to serve as a protective inoculation for potatoes, further attempts at reduction were made. Root fibres of tobacco plants, infected with the weak and strong forms of 'Y' respectively, were set up under sterile conditions in Erlenmeyer flasks, containing nutrient fluid, and incubated at room temperature, 22° C., 35° C., and 40° C. After about a week the virus extracted from the cultures was generally reduced, and it made little difference whether the cultured root had come from a plant infected with the common or the weak strain of 'Y', nor did the temperature greatly affect the process, though on the whole the best results were obtained at the higher ones. Nearly a hundred such strains have been obtained, most of which, when compared on tobaccos with the full 'Y', were valued at figures so low as 1 and 0·5; they have remained unaltered for three months.

In every single case it has been shown that the weak form affords complete protection against later inoculation with the normal 'Y' in tobacco. In the potato, variety "President" and "Up-to-Date", the weak strains produce a much reduced reaction—a mottle in the upper leaves, and in some cases a few fine streaks of necrosis on the under surface of some of the veins, whilst two or three lower leaves may drop. Second year symptoms in the glasshouse may be so slight as almost to escape observation. It has not been sufficiently established as yet, though it appears most probable, that the weak form protects in the potato, as in the tobacco, against subsequent infection with the strong virus.

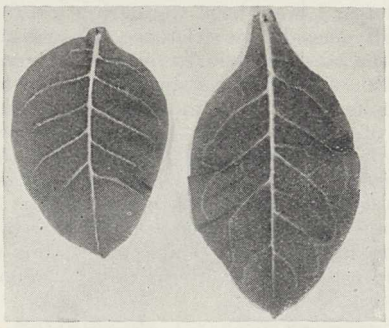

Fig. 1.

LEAVES FROM TOBACCO PLANT OF SAME AGE AND SIZE, AT THE VEIN-CLEARING STAGE; INOCULATED WITH THE COMMON 'Y' VIRUS (LEFT); A MUTANT FORM (RIGHT).

The possibility of inducing an immunity against one of the most destructive viruses met with in the potato field, is thus brought appreciably nearer.

Köhler[2,3] described what he thought to be weak forms of 'Y', but found that they did not protect against the common 'Y'. They were in fact infectious with the 'A' virus. In a communication just received[4] he reports that he has found a form of 'Y' which does protect; it is obvious from its reaction on tobacco, that it is of considerably higher virulence than the strains described above.

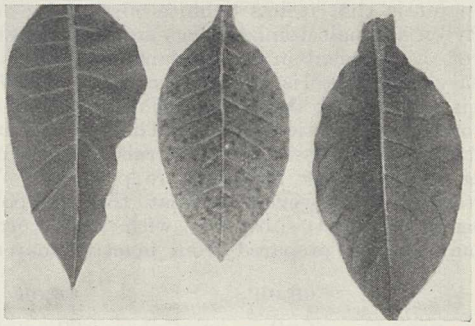

Fig. 2.

LEAVES FROM TOBACCO PLANTS OF SAME AGE AND SIZE, AT THE VEIN-BANDING STAGE; UNINOCULATED (LEFT); INFECTED WITH THE COMMON 'Y' VIRUS (CENTRE); AND A MUTANT FORM (RIGHT).

It should be stated that the weak 'Y' virus here described was not responsible for the 'witch's broom'.

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[1] Salaman, R. N., III Intern. Congr. Comp. Path., **1**, 167 (1936).
[2] Köhler, E., *Phytopath. Z.*, **7**, 1 (1934).
[3] Köhler. E., *Phytopath. Z.*, **10**, 1 (1937);
[4] Köhler, E., *Nachrichtenbl. f. d. D. Pflanzen Schutzdienst.*, No. 4, 1 (1937).

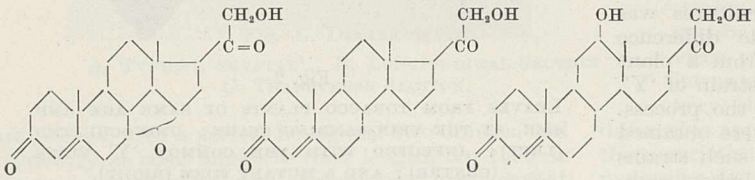
Partial Synthesis of a Crystallized Compound with the Biological Activity of the Adrenal-cortical Hormone

IN a letter to NATURE, Laqueur, Reichstein *et al.*[1] reported the isolation of a new crystallized compound in pure form which they named corticosterone (m.p. 180°–182° corr.) and which possesses the biological activity of the adrenal cortical hormone.

The empirical formula of corticosterone is $C_{21}H_{28-30}O_4$ and the structure which suggested itself is given in formula (1)[2]. This structure is chiefly based upon analogy with five pure compounds of the C_{21}-O_5-series (*A*, *C*, *D*, *E* and *Fa*) isolated from adrenals, the structures of which were definitely proved by degradations which furnished androstane as an end product. Only the function and position of one oxygen was left open. In consideration of the fact that corticosterone has a reducing group, gives the cholestenone band ultra-violet absorption spectrum and by chromic acid oxidation yields not a ketone of the C_{19}-series like the above mentioned compounds but an acid with 20 carbon atoms, no other formula was possible if the analogy were to be maintained. Function and position of the last (inert) oxygen is again left open.

Meanwhile, it seemed of more practical interest to check this assumption by synthetic models rather than by degradation experiments. Starting with stigmasterol and following a series of degradations and synthetic reactions, 21-oxy-progesterone (II) was prepared. The details will be given later. If formula (I) is correct, this compound differs from cortico-

sterone only by the absence of the fourth oxygen, and can therefore also be called 'desox-corticosterone'. It shows striking resemblance with corticosterone. Its reducing capacity and the cholestenone-like ultra-violet absorption spectrum are in accordance with the function of the three oxygen atoms. But the chief point is that it has definite cortical hormone activity on adrenalectomized dogs and rats as shown by Prof. E. Laqueur in Amsterdam*. The minimal necessary daily dose is not yet exactly established, but it is certain that the activity is not less than one third of that of corticosterone. The crystals have 136°–138°, which possibly may be raised a few m.p. degrees when greater amounts are prepared. The important fact, however, is that this compound represents the first substance with high cortical hormone activity prepared from inactive material.



(I) (II) (III)

In a paper which arrived here a few days ago, Kendall *et al.*[3] state that corticosterone is identical with their compound *B* [4]. They now give the m.p. of the latter as 177°–179° (uncorr.) which is in excellent agreement with our value for corticosterone. Also the biological activity is quite of the same order as that reported by us. Kendall states that this substance has a higher cortical hormone activity than that of any other pure compound so far isolated. The empirical composition is given as $C_{21}H_{30}O_4$ and the structure is expressed in formula (III). While Kendall is thus the first to have published an appropriate structure for corticosterone, it must be pointed out that in his original paper[4], Kendall stated that compound *B* had a melting point 135°–139°, which is more than 40° lower than that now given, and an empirical composition of $C_{24}H_{34}O_5$. Nothing was said of its biological activity, while activity for compound *E* was claimed[5]. It is therefore scarcely possible that his original compound *B* is identical with corticosterone ; it may have been a mixture.

On the other hand, we agree with Kendall, that his new results bring considerable evidence for his suggestion that the unknown fourth oxygen is contained in a secondary hydroxy group. If this suggestion can be proved conclusively, there will remain very few positions in which this hydroxy group can be placed. In the meantime, there exists evidence which would suggest its presence at position 11, rather than at position 12.

MARGUERITE STEIGER.
T. REICHSTEIN.

Chem. Institut,
Eidg. Tech. Hochschule,
Zürich.
April 6.

* The biological tests were made with the acetate.

[1] de Fremery, Laqueur, Reichstein, Spanhoff, Uyldert, NATURE **139**, 26 (1937).

[2] This formula was not published, but deposited in a Swiss patent filed December 1936.

[3] Kendall, Mason, Hoehn, McKenzie, *Proc. Staff Meet. Mayo Clinic*, **12**, 136 (1937).

[4] Mason, Myers, Kendall, *J. biol. Chem.*, **114**, 613 (1936).

[5] Kendall, Mason, Myers, *Proc. Staff Meet. Mayo Clinic*, **11**, 361 (1936).

Variation of Wind with Height

IN the Professional Note of the Meteorological Office, Air Ministry, referred to in NATURE of April 24 in a Research Item (p. 721) on the "Variation of Wind with Height" at Wadi Halfa, Mr. J. Durward remarks upon an apparent discrepancy of nearly 70° between observation and theory when the results of observations of the winds by means of pilot balloons between 10,000 ft. and 13,000 ft. are compared with the run of the isobars at 4,000 metres as shown on Teisserenc de Bort's map.

I should like to remark that the discrepancy really emphasizes the necessity for further investigation of the meteorology of the equatorial region. Our general ideas of the relation of wind to the distribution of pressure, initiated by Buys Ballot's law, are based on the experience of temperate latitudes. As the equator is approached, the term in the equation depending on the earth's rotation gradually loses its significance and at the equator itself is altogether inoperative. In that region, if air 'comes to rest', it is by, somehow, acquiring a velocity of 1,000 miles an hour in order to keep pace with the ground on which it 'rests', a velocity which in temperate or arctic latitudes would be intolerable.

The equatorial region, therefore, cannot be regarded as amenable to the ideas of the relation of air-motion to the gradient of pressure which are illustrated by our weather-maps. Special investigation is needed to put the meteorologists of the equatorial zone in a corresponding position of advantage.

Special maps are certainly required ; but what form the maps should take also requires consideration. Monthly means are not likely to be of much service where the geostrophic effect is negligible. Years ago, Mr. Lempfert and I got a good deal of insight into the working of that effect in the temperate zone by the construction of hourly maps compiled from the available records, and now that records of pressure are required for other purposes besides weather-maps, I have been wondering whether there are enough records in existence of pressure over land and sea to make hourly maps of the equatorial regions, if the records for a single week, for example, could be collected. The demonstration of the diurnal variation of pressure might be a test of the reality of the representation, and incidentally the local divergencies from the smooth curve would no doubt be expressed as weather. I have already an offer from Colombo of any information that is available there, and with the aid of ships and sealing-wax the walrus's idea of talking about many things might be realized !

NAPIER SHAW.

10 Moreton Gardens, S.W.5.
April 28

Aldehyde Mutase

WITH reference to the note by M. Dixon and C. Lutwak-Mann, published in NATURE of March 27, p. 548, on the non-identity of aldehyde mutase with the aldehyde oxidase, I would point out that this fact was first established so far back as 1931 by Michlin and Severin and published in *Biochemische*

Zeitschrift, **237**, 339 (1931) under the title "Über die Nichtidentität der pflanzlichen Aldehydrase und Mutase".

We used the enzyme preparations of peas and potatoes. No traces of mutase was to be discovered in the purified preparations of potato-aldehydrase.

D. MICHLIN.

Biochemical Institute,
Academy of Sciences,
Moscow.
April 15.

WE cannot admit Dr. Michlin's claim to have been the first to show the non-identity of aldehyde mutase with aldehyde oxidase. It is well known from the work of Bernheim and others that the aldehydrase of the potato is a completely different enzyme from the aldehyde oxidase of animal tissues and milk (Schardinger enzyme). The fact that the potato aldehydrase has no mutase activity obviously does not show that the mutase and the Schardinger oxidase are distinct enzymes. Dr. Michlin indeed says in the paper referred to: "It has not yet been possible, as far as we know, to separate the mutase from the aldehydrase or Schardinger enzyme, either in milk or in animal tissues or yeasts. Wieland's supposition, based on kinetic considerations, that the mutase and aldehydrase of milk are identical, has once again been established by Wieland and Macrae." Dr. Michlin himself therefore evidently accepted the identification of the mutase with the Schardinger aldehyde oxidase. We have now separated these two enzymes and proved their non-identity.

M. DIXON.
C. LUTWAK-MANN.

Biochemical Laboratory,
Cambridge.

Two-Dimensional Crystals of Silicon Pentoxide (Si_2O_5)

IT has been shown recently by me that vitreous silica and pumice, which have been considered up to the present as non-crystalline bodies, yield electron diagrams with surprisingly well-defined rings[1].

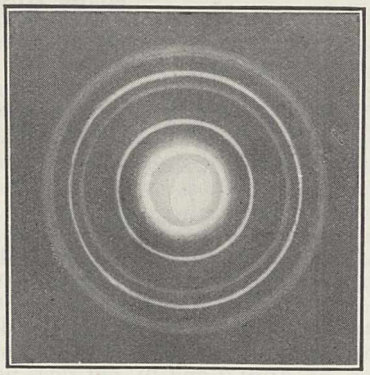


Fig. 1.

Further experiments, which were carried out last year in the Cement Institute, have shown that many other pozzolanic materials yield the same diffraction patterns, the only difference being that the latter did not contain certain rings, which were observed with vitreous silica and pumice. The most striking observation was that exactly the same diffraction pattern was given by every clay, in spite of the low order of symmetry of clay minerals. Such a typical diagram without 'extra' rings is shown in Fig. 1. The following table shows the corresponding Bragg spacings which were found from electron diagrams of some clays and pozzolanes with added pure sodium chloride as a standard substance (a = 5·626 A.).

Intensities	d	a	hkl
20	4·450	5·138	(100)
15	2·561	5·122	(110)
0·5	2·235	5·162	(200)
5	1·688	5·157	(210)
9	1·491	5·165	(300)
3	1·291	5·164	(220)
3	1·240	5·162	(310)
1	1·120	5·173	(400)
0·5	1·028	5·174	(320)
0·5	0·974	5·154	(410)
0·5	0·895	5·167	(500)
0·25	0·858	5·148	(330)
0·25	0·842	5·145	(420)
Traces	0·808	5·195	(510)
,,	0·720	5·195	(520)

It follows from this table that the constant a, which was found by assuming that the lattice is hexagonal, is closely the same for all reflections and that the third index is zero throughout. This last condition indicates that the crystals in question are two-dimensional. The fact that such reflections are all observed also in the case of pure silica glass, suggests that the crystals are constituted only of silica. It follows from this that the bonds between tetrahedra of SiO_4 are here the same as in silicates of mica type and clay minerals, that is, the crystals have the form of endless firm sheets of composition Si_2O_5. This is confirmed by the close agreement of their parameters taken in orthohexagonal co-ordinates: a = 5·161 A. and $b = a\sqrt{3}$ = 8·939 A. with that of some micas and clay minerals. We have, thus, for muscovite, a = 5·17 A. and b = 8·94 A.; for kaolinite a = 5·14 A. and b = 8·90 A.; and for metahalloysite a = 5·15 A. and b = 8·90 A.

The presence of only a few prominent rings in the case of clay minerals, instead of many weak reflections expected by reason of their low symmetry, is readily explained if one remembers that they are unstable at temperatures of 400°–500 C. The effect of cathode rays, which are, of course, partly absorbed by the specimen, would be similar. As to alumina, which is set free at such decomposition, it is probable that it is amorphous, and its influence on the diffraction pattern from Si_2O_5 crystals is as negligible as is that of a celluloid film.

The full account of this work will be published elsewhere.

N. A. SHISHACOW.

Colloid-Electrochemical Institute,
Academy of Sciences,
Moscow, 49.
March 8.

[1] Shishacow, N. A., NATURE, **136**, 514 (1935); *J. Tech. Phys.* (*Russ.* **5**, 1834 (1935) *Comptes rendus U.R.S.S.*, **1** (10), 15 (1935).

Abnormally High Magnetic Permeability of Nickel Wire obtained by Surface Treatment

A LENGTH of 0·125 in. diameter pure nickel wire was heated to a temperature of 1,150° C. in a steady stream of hydrogen gas by means of an electric resistance furnace, and the maximum value of the permeability was measured periodically when cold. The results so obtained are plotted as Curve I in Fig. 1. It will be seen that the maximum permeability attains a value of 2,100 after about 7 hours. The greatest value for the permeability of nickel previously recorded[1] is 1,400.

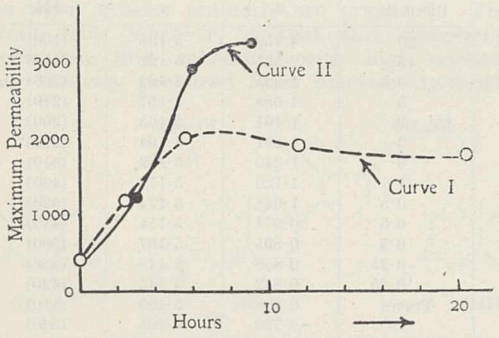


Fig. 1.

A length of nickel wire from the same coil was then electro-plated with copper to a thickness of about 0·003 in. and heated to a temperature of 1,030° C. in a steady stream of hydrogen, and the value of the maximum permeability was again measured at intervals when cold. The results are given in Curve II, Fig. 1. It will be seen that the maximum permeability now reaches the value 3,250. The value of the coercive force when the wire was demagnetized from an induction density of 5,150 gauss was found to be 0·24 oersted and the remanent induction density was 1,270 gauss.

The investigations are being extended to examine the effects of thin coatings of other metals such as aluminium, iron, cobalt.

T. F. WALL.

Dept. of Electrical Engineering,
University, Sheffield.
April 10.

[1] See *The Engineer*, April 2, 1937.

Rotational Analysis of the '3*A*' Bands of CO

THE so-called '3*A*' bands of CO in the region 2200–2600 A. have been excited with high intensity in a discharge through neon in a Geissler tube with carbon electrodes, and the (0,1), (0,2) and (0,3) bands at 2389, 2489 and 2596 A. have been photographed in the first order of a large 'Hochheimized' concave grating (dispersion 1·3 A./mm.). By fine-structure analysis twelve branches have been detected in each band, the others being weak and overlapped. Of these twelve branches, six form heads, namely, O_3, O_2, P_3, P_2, P_1, Q_1 in order of diminishing wave-lengths, and six do not form heads, namely, R_3, R_2, R_1, Q_3, Q_2, S_1. This shows the upper state to be a $^3\Sigma$ state, the rotational constant of which is found to be 1·9563 cm.$^{-1}$ from the average of three times six double combinations for the upper state.

The lines of the (0,1) '3*A*' band extend to the red-degraded (9,18) Fourth Positive band, the upper state for which predissociates[1] at 9·57 V. above the ground state of CO. The rotational analysis of the '3*A*' bands shows that the apparent increases of intensity of some of the Fourth Positive band lines (shown in plate I of the paper cited) behind the point of predissociation are caused by the superposition of certain '3*A*' band lines.

R. SCHMID.
L. GERÖ.

Physical Institute,
Royal Hungarian University for
Technical and Economic Sciences,
Budapest.
March 27.

[1] Gerö, L., *Z. Phys.*, **100**, 374 (1936).

Structure of $BrSiCl_3$ studied by means of Electron Diffraction

USING a de Laszlo apparatus similar to that used for the study of $HSiCl_3$[1] and $HSiBr_3$[2], we have been able to measure the distances between the atoms of $BrSiCl_3$. These appear to be : Br-Cl = 3·41 ± 0·03 A. ; Cl-Cl = 3·39 ± 0·01 A. ; Si-Cl = 2·05 ± 0·05 A. ; Br-Si = 2·19 ± 0·05 A.

In our work on $HSiBr_3$[2], we mentioned that the accuracy of the distance measurements of atoms in a molecule of this kind is very different for the different atoms involved. The distances between the halogens may be considered as measured with considerable accuracy, but on the other hand the distance between the halogens and the silicon atom is not so accurate. This is due to the fact that small variations of the Cl-Cl or Br-Cl distances affect greatly the positions of the different maxima of the curve giving relative intensity as a function of half diffraction angle ; variations of Si-Cl and Si-Br distances have very little effect on this angle.

At the end of our earlier letter, "Geometrical Constitution of Silicichloroform"[1], we gave the following dimensions for angle and height of the pyramid $SiCl_3$: height, 0·65 A. ; angle, 113° 30′. These should read : height, 0·62 ± 0·20 A. ; angle, 111° ± 4° ; as can be calculated from the distances Si-Cl and Cl-Cl given in that letter.

M. DE HEMPTINNE.
J. WOUTERS.

Physical Laboratory,
University, Louvain.

[1] de Hemptinne, M., and Wouters, J., NATURE, **138**, 884 (1936).
[2] Wouters, J., de Hemptinne, M., and Capron, P., *Ann. Soc. Scientif. Brux.*, **57** (1937).

Fire-Walking

I SHALL be glad to be permitted to supplement the report in NATURE of April 17 on the fire-walking experiments which I organized for the University of London Council for Psychical Investigation. The article records the results of two tests (at Carshalton, on April 7 and 9), but does not mention the third—and final—demonstration with the Indian professional.

This was staged in the grounds of Alexandra Palace on April 20. The trench was 12 ft. long, 4 ft. wide, and 9 in. deep. Some four tons of oak

logs were used in preparing the fire. At the time of 'walking', the surface temperature (measured by a representative of the Cambridge Instrument Co., Ltd.) was 800° C. This high temperature (the hottest fire we have managed to produce at any test) was due to the exposed position of the trench, and to the fact that a stiff breeze was blowing.

The first to walk was Ahmed Hussain (weighing 126 pounds), who took four steps in 1·6 sec. His feet were uninjured. Then Mr. Reginald Adcock (weighing 160 pounds), a young Cambridge graduate, walked the trench in 1·8 sec., taking three steps. His feet were not blistered or injured in any way. This was the third occasion on which he has done the fire-walk for us. Both walkers started off with the right foot. The slow-motion film I took of the demonstrators reveals no apparent superiority in walking technique on the part of the professional.

In the report in NATURE of our last fire-walking experiments, it is stated that "two steps with the same foot could only be done without injury by the practised professional". But Mr. Adcock demonstrated to us at Alexandra Palace that he, too, can take two steps with the same foot on a very hot fire without the slightest injury. Although he took three steps against the Indian's four, the time taken was 0·2 sec. longer; and the Englishman weighed 34 pounds more than the Indian. The times were taken by Dr. E. J. Dingwall, and Prof. J. C. Flugel, and I washed and examined the feet of the walkers both before and after the walks.

It is interesting to compare Mr. Adcock's feat with that of Kuda Bux's when the latter gave us his performance at Carshalton on September 17, 1935[1]. Bux walked on a trench 11 ft. long, with a surface temperature of 430° C. He weighed 120 pounds. Each foot was in contact with the embers twice. Adcock's performance surpassed that of the Indian's because the surface of the fire was nearly twice as hot, he walked farther, and the Englishman weighed 40 pounds more—the extra weight being a great disadvantage in fire-walking.

HARRY PRICE.

19 Berkeley Street,
London, W.1.
May 18.

See Bulletin 2, Univer. Lon. Council for Psy. Invest., 1936.

Instructional Tours for Students of Forestry

THE review of the future policy of the Imperial Forestry Institute in NATURE of May 1 contains a criticism of the proposal to replace tours of instruction in Germany, France and Switzerland by tours in the Scandinavian countries where forestry has not reached such an advanced or specialized stage. It is pointed out that whereas students in British forestry schools probably receive sufficient grounding in European forestry, those officers whose training has been outside Europe should be given an opportunity of seeing the best examples of organized forestry in countries like Germany, France and Switzerland, where the ecological, economic and sociological foundations have been most fully worked out.

On this point everyone who has kept in close touch with the developments of European forestry in recent times will, I think, be in agreement with the writer. Broadly speaking, it is possible to divide practical instruction in Continental forestry into two parts; (1) the essential grounding in well-established systems, to be obtained in France, Germany and certain other countries, (2) 'extension tours' to countries where forestry is in a less advanced stage. Without a good grounding in the methods covered by (1), extension tours must lose much of their value, and this would apply to the projected tour in Finland, however interesting and instructive it may prove to be on its own account.

In effect, the future policy of the Institute aims at substituting tours of the second category for those of the first, and the fear expressed in the article in NATURE that this may prejudice the chances of giving the essential grounding referred to above to those who have not already received it, is a very natural one. Fortunately, the machinery exists for meeting this difficulty. A good grounding in the fundamental principles of Continental forestry has always been a tradition of the Oxford School of Forestry, and, in order that these principles may be demonstrated on the spot, annual instructional tours have been organized by the School for many years past in France, Switzerland, Germany and occasionally in Austria and Czechoslovakia. Apart from undergraduate members of the School, it has been the regular custom in the past to include on these tours forest officers on leave and others who may wish to take advantage of them. Similar facilities will continue to be afforded in the future, and it is hoped, therefore, that the new policy of the Imperial Forestry Institute will in no way prevent those who desire to do so from obtaining a grounding in, or refreshing their knowledge of, the essential principles of European forestry.

The principal reason for selecting France, Switzerland and Germany for these School tours is that there is probably no region in the world, of similar size, which can show so great a variety of conditions, ideas and methods, whether from the point of view of administration and policy, economic conditions, sylviculture and forest management, extraction and utilization of timber, or any other branch of forestry. Practically all the standardized sylvicultural systems are to be seen, with various modifications to suit different species and conditions. These systems have formed the basis of scientific forestry in India, and their application is being extended to other parts of the Empire; it is therefore important that those entrusted with the management of our vast forest estate should be well grounded in the fundamentals of the subject.

R. S. TROUP.

School of Forestry,
Oxford.
May 3.

THOUGH the study tours of the Oxford Forestry School, and perhaps also those of other schools, offer opportunities to forest officers who have had their training outside Europe to obtain a first-hand acquaintance with some of the standard systems of forestry in France, Germany and Switzerland, the fact remains that the officers in question have to go outside the Institute for these facilities. The disturbing thing is that there is nothing in the declared policy of the Institute to encourage them to do so; rather are such tours criticized on the ground that "the highly specialized forms of forestry seen have little application to average conditions overseas". Prof. Troup says "it is hoped ... that the new policy of the Imperial Forestry Institute will in no way

prevent those who may desire to do so from obtaining a grounding in, or refreshing their knowledge of, the essential principles of European forestry". It is felt that this is not sufficient and that something more positive is required. It was because of the fear that the value of a sound training in European forestry as an equipment for tackling the special forestry problems of the various parts of the Empire is being minimized, that adverse comment was passed upon the policy of the Institute in this particular.

THE WRITER OF THE ARTICLE.

The University of Göttingen

MAY an English university teacher, who is at present enjoying the hospitality of a scientific institute in Göttingen, protest against the article in NATURE of April 24? It is undeniable that the University of Göttingen has suffered serious losses under the Nazi regime, and many features of the present university administration are entirely deplorable. On the other hand, there still remain in Göttingen men of considerable distinction (to mention only four outstanding names: Eucken, physical chemist; Windaus, organic chemist and Nobel prizeman; Prandtl, hydrodynamics; Rein, physiologist), who are continuing in the face of difficulties to maintain a high standard of scientific research and teaching. They are in no way responsible for the present administration; the statement that "Göttingen ceased in 1933 to be a scientific centre" is an unjustified insult and a discouragement which they feel most bitterly. The removal of the Jews from German universities, much as we may deplore it, is now complete and irrevocable. We have already indicated our disapproval with more than sufficient force, and a continuation of the campaign of abuse and boycott serves no conceivable purpose except to irritate the extremists to still further excesses and hurt the feelings of those moderates whose efforts to maintain the standard of academic learning need and deserve all the encouragement we can give.

"Any stick will do to beat a dog with." The anti-Semitic and anti-Catholic literature in circulation here illustrates how pathetically easy it is to make up a plausible case from odd statistics and excerpts, and it is regrettable that English attacks on Germany are beginning to show signs of the same fanaticism and lack of taste. Your anonymous correspondent is perhaps unaware that the speech which he quotes resulted in disciplinary measures being taken by the ministry of Education against Dr. Kahrstedt. The quotation about duelling is scarcely even relevant to the point at issue: an equally distorted view of English academic learning would be gained by a foreigner reading our Press at the time of the Oxford and Cambridge Boat Race. My present colleagues, mostly appointed since 1933, are men of high scientific ability in spite of the "complex apparatus" which apparently should have "prevented them from joining the junior teaching staff", and we do not find ourselves in any way hindered or disturbed in scientific work. Is it too late to make a plea to English universities and periodicals for that dignified tolerance and restraint which we like to regard as a national virtue and which is the only effective counter to political hysteria? Nothing will be gained and much lost by cutting off all contact with an academic society which, in spite of all that can be justly said against it, is still producing, and will continue to produce, positive scientific work of real value.

J. D. LAMBERT.
(Lecturer of Trinity College, Oxford.)

Physikalisch-chemisches Institut,
Göttingen.
May 10.

MR. LAMBERT points out, what has never been doubted, that there are distinguished men of science at Göttingen who are not responsible for the present administration. It cannot be to their advantage that representatives from English universities should fraternize with precisely those officials who are most closely associated with the features which he tells us that he (and implies that his German friends) most deplore.

The figures quoted in the article on Göttingen are not "odd statistics and excerpts"; they are figures carefully gathered by competent, trained and impartial observers who have spent several months on this particular task. The inquiry shows that the careers of approximately one fifth of the scholars and men of science in Germany have been ruined and the scientific opportunities and intellectual integrity of the remaining four fifths have been gravely injured. It must take generations for the profession of learning in Germany to recover the dignity and esteem which it has lost.

The Minister of Education, Herr Rust, has spoken in terms as extreme as Dr. Kahrstedt, so that the disciplinary measures to which Mr. Lambert refers can be intended only for external consumption. Mr. Lambert should read the address given by Herr Rust at the "jubilee" of the University of Heidelberg last year.

Mr. Lambert and certain of his colleagues "do not find themselves disturbed . . . in scientific work". Others are less fortunate. Dismissals continue, and at Göttingen itself a professor of long service and high standing was dismissed a few days before Mr. Lambert wrote.

Mr. Lambert makes no mention of the choice of June 30 for the celebrations both at Heidelberg and Göttingen, or of the association of that day, in every German mind, with the greatest political massacre of modern times. He does not mention the entire failure of the appearance of any *Göttinger Sieben* to protest against the assaults on learning and liberty. He does not mention that more than a fifth of the staff of the University was dismissed with scarcely a word of protest or sympathy.

The difficulty of recruiting staffs for the German universities is as well known in Germany as in England. A special decree was recently issued by the Ministry of Education, and circulated in a confidential leaflet to university teachers expressly forbidding public discussion of this subject.

Mr. Lambert states that "the quotation about duelling is scarcely even relevant to the point at issue". If duelling be compulsory in the German universities, it must effect the recruitment of the staff in very many ways. To mention one only, it must exclude practising Catholics, to whom duelling is forbidden. Nearly one third of the population of Germany is Catholic.

THE WRITER OF THE ARTICLE.

Boltzmann's *H*-Theorem

WHEN Boltzmann first published the celebrated theorem now generally known as the *H*-theorem, he used the symbol *E* (presumably as the first letter of *entropy*), not *H*. It has been suggested that when *H* was first used for this theorem it was intended to be the capital Greek letter *eta*: but the first paper known to me in which *H* is used for Boltzmann's entropy function is one by Burbury[1], who seems to have changed Boltzmann's symbol *E* to *H* for no special reason; later Burbury used *B* for an almost identical function, which he called Boltzmann's minimum function[2]. Boltzmann himself wrote *E* so late as 1893[3], but in 1895[4] he used the letter *H*. This use of *H* must have seemed mysterious to many generations of students, and it would be interesting to know whether any reader can account for its use or give an earlier instance of it.

S. CHAPMAN.

Imperial College,
South Kensington.

[1] *Phil. Mag.*, **30**, 301 (1890).
[2] NATURE, **49**, 151 (Dec. 14, 1893). *Phil. Mag.*, **37**, 157 (1894).
[3] *Phil. Mag.*, **35**, 161 (1893).
[4] *Phil. Mag.*, **51**, 414 (1895).

Points from Foregoing Letters

FROM mass-spectrographic measurements of several doublets (atoms and groups of atoms having the same mass/charge ratio), Dr. F. W. Aston has deduced with a greater degree of accuracy the 'packing fractions' and isotopic weights of the atoms of carbon, ^{12}C, oxygen, ^{18}O, and argon, ^{36}A.

The absorption by silver of 'thermal neutrons' (which at a given temperature have energy corresponding to that of thermal agitation of atoms in the surrounding medium) has been determined by Drs. O. R. Frisch, H. von Halban, jun. and Jorgen Koch at several temperatures up to 415°. The authors point out that there is a discrepancy between the observed values and those deduced on the assumption that the absorption is inversely proportional to the velocity of the neutrons. This discrepancy, they consider, may be due to the inhomogeneity of the thermal neutrons, due on one hand to the presence of a certain number with energy greater than the thermal range, and on the other hand to an excess of thermal neutrons of energy less than 0·1 eV.

Drs. J. D. Bernal and I. Fankuchen submit diagrams indicating the structure of the so-called crystalline virus protein prepared by the method of Stanley and Wyckoff. There is a two-dimensional hexagonal regularity at right angles to the long protein molecules, but none in the direction of their length. The molecule is made up of piles of submolecules of dimensions 20 A. × 20 A. × 20 A., somewhat smaller than the normal protein molecule. The structure of the 'crystals' is somewhat like that of the colloidal 'micro tactoids'. The authors also give a table of the inter-molecular distances in several tobacco and cucumber viruses, and suggest that viruses may eventually be classified on the basis of their X-ray patterns.

Methods of preparing an attenuated form of the 'Y' potato virus which affords complete protection to tobacco plants, and partial protection to potato plants against the more virulent form, are described by Dr. R. N. Salaman. To obtain this immunizing preparation, the virus is either passed through a schizanthus plant or is first inoculated into root fibres of tobacco plants, under controlled conditions.

The synthesis of a compound (21-oxy-progesterone) which has activity similar to that of the adrenal-cortical hormone (corticosterone) is announced by M. Steiger and Dr. T. Reichstein. This, the authors state, is the first instance of a substance with high biological activity (tested on dogs and mice from which the adrenal glands have been removed) and brings nearer the final elucidation of the molecular structure of corticosterone.

Sir Napier Shaw directs attention to the fact that our knowledge of the relation between wind and pressure distribution is based on experience in temperate latitudes and is not applicable to equatorial regions. He appeals for further data to enable meteorologists to deal with the latter conditions.

Two-dimensional crystallinity is deduced by N. A. Shishacow in the case of vitreous silica and pumice, from their electron-diffraction patterns, which show well-defined rings. The author gives a table of intensities and Bragg spacings, as deduced from the electron diagrams of some clays and pozzolanes.

When pure nickel wire of diameter $\frac{1}{8}$ in. has been plated with a thin skin of copper and heated to a temperature of 1,030° C. in hydrogen, Dr. T. F. Wall finds that a maximum permeability of 3,250 is attained. When demagnetized from an induction density of 5,150, the coercive force is 0·24 and the remanent induction density is 1,270.

The fine structure of the so-called '3*A*' bands of the carbon monoxide spectrum in the ultra-violet (2200–2600 A. region) obtained by means of a high-intensity discharge between carbon electrodes in neon gas is described by Dr. R. Schmid and Dr. L. Gerö.

The distances between various atoms in the molecule of bromsilicichloroform $BrSiCl_3$, as obtained by means of electron-diffraction measurements, are given by Prof. M. de Hemptinne and J. Wouters. From the nature of the experiments, the accuracy of the determinations is not the same for all atoms, being greater for the distances between chlorine and bromine than between these and silicon atoms.

Details of comparative experiments on fire-walking, under controlled conditions, carried out by an Indian professional and an English amateur are given by Harry Price. Neither suffered injury. Though the professional took four steps to the amateur's three, the slow motion film shows no superiority in walking technique on the part of the professional.

Prof. S. Chapman, referring to the use of the letter *H* by Burbury to designate, in 1890, Boltzmann's entropy function (for which Boltzmann himself had used the symbol *E*), inquires if any reader can account for the use of the letter *H* in this context at an earlier date.

Research Items

Anthropometry of Beaver and other Indians of Canada

In the third of a series of reports on the physical characters of Canadian Indians of Athapascan stock, Mr. J. C. Boileau Grant analyses observations of Beaver Indians made by himself in 1929, and compares them with measurements of Sekani and Carrier Indians made by Mr. Diamond Jenness in 1923 (*Nat. Mus. Canada, Bull.* **81**, Anthrop. Series, 18). Out of 185 individuals measured by Mr. Grant only pure Beaver, 35 men and 13 women, are considered. The Sekani and Carrier number 35 men and 31 women. Taken as a whole in one group, these people are short in stature, broad-headed with very high cephalo-facial index, ranging by tribes from 96·2 to 98·4 for the men, and from 95·5 to 96·4 for the women. A notable feature is the high percentage of eyes of a lighter shade among the Carrier and Sekani Indians. The principal measurements and indices (men) are as follows: Beaver—stature, 168·3; cephalic index, 80·5; cephalo-facial index, 96·8; facial index, 82·9; nasal index, 70·6. Carrier and Sekani—stature, 169·7; cephalic index, 81·4; cephalo-facial index, 96·2; facial index, 84·5; nasal index, 70·5. Compared with measurements of Chippewayan, they show that the Chippewayan are shorter in stature, have a lower cephalic index, a longer head, and a greater cephalo-facial index. A further notable feature in the observations of the Beaver is the high percentage of the *A* group in the blood group observations, which is remarkable in view of the stress laid on their racial purity. Of forty observations, twenty-one were *O* and nineteen *A*, which is quite at variance with observations made among the Chippewayan in 1928 (80 per cent, 10 per cent, 10 per cent and 0 per cent), and observations by Ruggles Gates on the Mackenzie River (85 per cent, 15 per cent, 0 per cent and 0 per cent). The blood of sixty-one various other Indians and mixed breeds in the Peace River area, from which the Beaver were taken, showed a similar distribution to the Beaver. There is evidently an unusually high distribution of the *A* group in the Peace River area.

Influence of Recreation on Sedentary Workers

An interesting account is given in the January-February issue of the Polish journal, *Przeglad Fizjologii Ruchu* (Review of the Physiology of Movement), by Dr. W. Missiuro of an investigation on the effect of active recreation upon the output of female sedentary workers. These were between twenty-two and twenty-nine years of age, engaged (seated) in teams of eleven in making shoes. A daily ten minutes interval for physical exercise was introduced, and produced favourable results upon the health and the output of the workers. Dr. Missiuro made a comprehensive physiological study of the effect of this active recreation upon the individual's intake of oxygen and output of carbon dioxide, rise in energy consumption, pulse frequency, 'hæmoglobin value', urea, chloride and sugar content of blood and urine, etc. Among the results observed were a definite diminution of diuresis during work. No case of increase in acidity or albumen in urine was recorded. Perhaps the improvement was most marked in its psychological effects.

Studies of the Grasshopper's Egg

The formation of the membranes of the acridian (grasshopper) egg has been re-investigated by Eleanor H. Slifer (*Quart. J. Micro. Sci.*, **79**. Pt. 3, March 1937, p. 493). She finds that in four species of different genera, the eggs possess a delicate vitelline membrane, as described by earlier, but overlooked by recent, investigators. In eggs of *Melanoplus differentialis*, the yellow cuticle is deposited by the serosa at 25° C. during the sixth and seventh days after laying. As soon as this layer is completed, the serosa begins to deposit a second layer, which is white, very tough, and though fibrous in appearance is chitinous in composition. So tough is this membrane that it would prove an obstacle to the emergence of the young grasshopper, but three days before hatching it begins to be dissolved by an enzyme, so that finally the merest trace of it remains. It has been supposed that this enzyme is secreted from the embryo's mouth, but Miss Slifer shows that this is not the case. She applied ligatures at various levels to a series of eggs due to hatch seven or eight days later, so as to isolate the digestive fluid in different regions, if present. The enzyme was finally located in the region of the pleuropodia (appendages of the first abdominal segment), and its formation by these structures was confirmed by removing them. After this operation, the white cuticle remained undissolved, and the embryos in the eggs, though working vigorously to free themselves, were unable to do so. The pleuropodia of *M. differentialis* are trilobed stalked bodies about ½ mm. in diameter, and are made up of a single layer of very large cells. Similar structures occur in other insects, and their function has long been a puzzle; possibly, it is the same as in the grasshopper.

Snakes of Maryland

The Natural History Society of Maryland is credited by the publication of a well-printed and illustrated pamphlet on the snakes of Maryland (pp. 103+10 plates) by Dr. Howard A. Kelly, A. W. Davis and H. C. Robertson (Baltimore: Natural History Society of Maryland). The Maryland snake fauna comprises 26 non-venomous and 2 venomous snakes, the copperhead and timber rattlesnake. The identification of the species is simplified by keys to the salient characters of adult and young individuals, by short descriptions of form, coloration and habits, and by excellent plates in colour and photographs. A general introduction and a chapter on the treatment of snake bites completes the work. One cannot but admire the presence of mind of the individual who, being breathed upon by the dreaded blowsnake (a harmless puff-adder), immediately "took a pint of whisky to quiet his heart, and couldn't work again for two years".

Mole Crickets and their Allies

The attention of students of insect morphology is directed to an elaborate paper by F. Carpentier on the structure of the thorax in mole crickets and their allies (*Mém. Mus. Roy. d'Hist. Nat. Belgique*, Fasc. 4; 1936). For a long time past, true mole

crickets have been grouped with the series Gryllotalpides, while certain other forms or false 'mole crickets' constituted the Tridactylides. The author examines the detailed structure of the thorax, wings and legs and, on the basis of the morphological criteria thus afforded, assesses the mutual affinities of *Gryllotalpa*, *Tridactylus* and *Cylindroryctes*.

Care of Ornamental Trees

THE contribution which certain trees and shrubs can make to garden beauty is so great that the gardener naturally desires to prolong their good growth as much as possible. Mr. A. D. C. Le Sueur lectured to the Royal Horticultural Society in January of this year on "The Care of Ornamental Trees", and the text of his lecture appears in the Society's *Journal* of April (62, Pt. 4, 141–152). Many factors of disease, of damage by birds, and of the interaction of urban conditions, are discussed. The beech disease, caused by the insect *Cryptococcus fagi*, is deemed to be only a secondary infestation which masks some previous weakness of nutrition, or prior attack by a virulent fungus. Slimy fluxes from wounds of various trees sometimes prevent their healing, but a thick application of hot tar will provide effective treatment. The action of lightning, and damage by electrical transmission lines, may cause wounds upon desirable trees. It is interesting to find the statement that groups of trees may be killed as a result of electric discharge when the earth acts as a positive potential during thunderstorms. Poisoning of trees by coal gas escaping from defective mains, or by sewage leaking from pipes or cesspools, are two factors which may damage trees growing in an urban environment. The paper deals with the practical treatment of these, and other maladies which might diminish arboreal splendour.

Distribution of Destructive Earthquakes

IN the recent issue of the *Matériaux pour l'Étude des Calamités* (No. 37, 3; 1936), Ugo Vanni deals in great detail with the distribution of destructive earthquakes. His work is based on Milne's well-known catalogue and on its extension from 1900 to 1921. From the year 1850 onwards, he notices that Milne's catalogue becomes stable in the annual number of earthquakes, while, in the preceding half-century, the number gradually increases, the average annual numbers for the two half-centuries being 11·6 and 30·7. During the years 1850–99, Milne records 955 earthquakes of his intensity I, 366 of intensity II and 217 of intensity III. In considering the relative frequency of earthquakes in different countries, Vanni takes no account of their area. Including only shocks of the two higher degrees, he gives the following order: Philippines with 78 earthquakes, Asia Minor with 42, Italy 29 and Greece 26, while Chile occupies the eleventh place with 15, and New Zealand the thirty-fourth with 5. Or, again, dividing Milne's degree III into two grades and taking only those of the higher (corresponding to public catastrophes), he finds for the years 1850–1921 the following order: Asia Minor, China, Japan, Italy, with Chile in the eighth place and Greece in the eleventh. In the same issue of the *Materiaux* (p. 64), C. Bois continues his valuable catalogue of destructive earthquakes for the first half of 1936, during which the number fell so low as 12, including five in China and Japan, three in the Balkan peninsula and two in South America.

Correlation of Ozone with Atmospheric Phenomena

AT a meeting of the Royal Meteorological Society held on April 21, A. R. Meetham read a paper dealing with the upper atmosphere. The author described a statistical investigation that he had made with the view of finding an explanation of the observed connexion between the total amount of ozone in the atmosphere and various other geophysical phenomena, including the distribution of barometric pressure at sea-level—which last has for some time past been known to be correlated in some way with the total amount of ozone. The author obtained correlation coefficients between the daily values of the ozone, after these last had been corrected for their known annual variation (maximum in April), and a number of variables in the upper air such as the height of the tropopause and pressure and temperature at various points in the troposphere and the stratosphere. He found that the ozone was more closely connected with entropy and potential temperature in the stratosphere than with any other function of pressure and temperature, or with any other geophysical phenomenon yet investigated. The last part of his paper is occupied with a very speculative attempt to arrive at an explanation of the statistical results, and in it the author is obliged to assume that there is an appreciable amount of vertical circulation of the air in the stratosphere, notwithstanding the very stable distribution of temperature in that region, an assumption that will not readily be acceptable to meteorologists in general.

Photosensitized Reactions involving Deuterium

DURING the past two years, Prof. H. S. Taylor and his collaborators have studied the mercury photosensitized reactions between methane and deuterium, tetradeuteromethane (CD_4) and hydrogen, and methane and CD_4. Of the processes which occur, some yield deuteromethanes of varying deuterium content whilst others give condensation products of the hydrocarbon (*J. Chem. Phys.*, **5**, 212; 1937). The composition of the deuteromethanes in the reaction products is estimated quantitatively by comparing the relative intensity of absorption of a particular mixture at various characteristic wave-lengths in the infra-red with the values for 'standard' compounds of definite deuterium content (*ibid.*, **5**, 1; 1937). From a study of the influence of temperature and light intensity on the reaction, it has been shown that the reaction processes must be interpreted by a chain mechanism. The rates of exchange in the reactions CH_4+D_2 and CD_4+H_2 are practically identical and much more rapid than in the reaction CH_4+CD_4. The products of the condensation reactions are saturated hydrocarbons at all temperatures, except 490° C., where small traces of unsaturated hydrocarbons were identifiable. It was also found that methane condensed to a greater extent in the presence of deuterium than in the presence of hydrogen. Below 200° C., the recombination of methyl radicals and atomic deuterium, both produced in primary processes, probably predominates; at 200° C. there is mostly exchange between methyl radicals and deuterium molecules yielding CH_3D and D; whilst around 300° C. the exchange is effected most probably by $CH_4+D \rightarrow CH_3+HD$. The condensation process is thought to take place by recombination of alkyl radicals. On the basis of these processes, the experimental data have been satisfactorily interpreted.

The Museums of India*

THE report of the Museums Association on the museums and art galleries of India completes a series of reports, which not only comprises a full directory of the museums of the British Empire, but also contains critical commentaries on every phase of their activities. In the course of six or seven years, nearly two thousand museums in all parts of the Empire have been visited. The funds for this survey were provided by the generosity of the Carnegie Corporation of New York, excepting the grant for the British survey of 1926–27, for the expenses of which the Carnegie United Kingdom Trust was responsible.

The survey of the museums of India began in October 1935. It was carried out by Mr. S. F. Markham, M.P., Empire secretary of the Museums Association, and Mr. H. Hargreaves, formerly director-general of archæology in India. Personal visits were made to the greater number of the museums of India, and for purposes of comparison Ceylon, Malaya and the Dutch East Indies were visited. The funds, as already mentioned, were provided by the Carnegie Corporation of New York, to fill the gap in the Empire survey, but on the distinct understanding that assistance could not be provided for the Indian museums, such as had been made available for the museums of the Empire.

In a brief historical survey the report points out that the institution of museums in India began so long ago as 1796, when the Asiatic Society of Bengal decided that the many curiosities it had accumulated should be suitably housed in Calcutta. Donations were invited; but the plan proved premature, and it was not until 1814 that the Society was able to establish a proper museum. The scope of the museum was defined as "the illustration of Oriental manners and history and to elucidate the peculiarities of art and nature in the East". After persistent pressure, official financial assistance was received from the Court of Directors of the Honourable East India Company in 1839, a grant being made for the salary of a curator, and the Government of India was authorized to make grants for special purposes. Four years previously the Government itself, being anxious to develop the country's mineral resources, had decided to found a Museum of Economic Geology in Calcutta. This was opened in 1840. The Central Museum of Madras was opened in 1851 as the result of a decision of the East India Company, "impressed with the advantage of storing up in some one place the knowledge and the material which had been acquired by the investigators working in different parts of the Peninsula, and with the object of fostering scientific enquiries and pursuits". This was due to the activity of the Madras Literary Society, a branch of the Royal Asiatic Society, but the proposal was mooted so long before as 1819. By 1857 there were twelve museums in India. Further growth was checked by the Mutiny of 1857, and thereafter was slow until the jubilee of Queen Victoria in 1887. This was responsible for the foundation of a number of museums; and a further stimulus was provided, especially in the foundation of archæological museums, during the viceroyalty of Lord Curzon of Keddlestone, 1899–1907, whose personal interest and munificent benefactions did much to encourage study of Indian art and culture. The most recent development, commendable though not without its drawbacks, is the institution of museums on the sites of archæological excavation, in which the local finds are housed, while in some instances excavated buildings are preserved so far as possible intact.

It is, however, significant that notwithstanding activity since 1914, and especially in the last decade, a number of museums formerly in existence have closed, the most recent being Quetta, which has not been reopened since the earthquake of 1935. The Phayre Museum in Rangoon has been closed for thirty-three years, though the collections are reported to be still in existence.

There are now a hundred and five museums in India. These have a quadruple origin: first, the scientific museums at the great centres of government established by the Governments and their European servants; secondly, the museums established by the Indian States, which have followed this example; thirdly, the local museums established by the Archæological Survey; and fourthly, the museums created by the teaching institutions and learned societies for their own requirements. The great majority of the museums are under Government, municipal or provincial control. It is noted, however, that there are fifteen towns with populations of more than 100,000 which have no public museums. Nowhere, except in China, it is pointed out, are there so many large towns without a public museum. Burma, with a population of more than fourteen millions, has no Provincial Government museum which is now open. Yet 35,000 visitors annually pass through the small Palace Museum at Mandalay.

Neither in British India nor in the Indian States, the report points out, have museums been distributed in a rational manner—some of the smaller towns, such as Dehra Dun, have museums of which any great city could be proud, while populous centres, such as Ahmedabad or Amritsar, have no museum at all. There is not a single province or Indian State that does not compare poorly with the leading countries of Europe, the British Commonwealth or the United States. In fact, with the exception of the most backward countries of the world, there is not an area where museums count for so little, are so meagrely supported, or are so few and far between.

Finance repeats the same story in another idiom. The financial provision for the museums is absurdly inadequate. The total amount spent on the one hundred and five museums is no more than £58,000 per annum, and out of this the largest five museums have an income larger than the remaining hundred put together. The total amount, in fact, is less than is spent on a single great museum in the capital cities of Europe or America.

It is not difficult to diagnose the causes that lie at the root of most of the defects in the provision of museums in India. A general apathy and neglect,

* The Museums of India. By S. F. Markham and H. Hargreaves. Pp. v+229+25 plates. (London: The Museums Association, 1936.) 5*s*. net.

combined with and in part the cause of an inadequate provision of funds, is responsible for failures in maintenance, an insufficiently high standard in staffing, both as to numbers and qualification, and a lack of energy in administration, which has failed to keep abreast of museum development in other countries, while allowing exhibits to deteriorate and perish through neglect of proper care and attention. Unless immediate steps are taken, the report says, proof of India's cultural greatness in past time, of her technical and artistic skill in perishable materials, will vanish for ever from India itself and will only be found in the vast repositories of Europe and elsewhere.

Notwithstanding the illiteracy of the population, generally estimated at ninety per cent, the inadequacy of the museum cannot be excused on the ground of the lack of interest of its public. It is stated that during a recent festival in Madras, no less than 130,000 individuals passed through the Museum in one day, while the Mysore Government Museum, Bangalore, has 260,000 visitors annually.

As is indicated by the directory of Indian museums, which forms Part 2 of the report, the character of the Indian collections on the whole is sufficiently varied. The predominant place is taken by exhibits illustrating the archæology, history and art of India whether in specialized institutions or as part of a larger institution. The variety and extent of the fauna of India are well shown in the famous collections of the Indian Museum, in the Prince of Wales Museum, Bombay, and the museums at Madras, Nagpur and Darjeeling. The Geological Survey has four galleries in the Indian Museum, which are fully representative of the geology of India. One deficiency to which attention is directed is the inadequacy of the ethnological collections illustrating the culture of the varied peoples of India, although the collections demonstrating the culture of the aboriginal tribes at Lucknow, Calcutta, Nagpur, Madras and Trivandrum are noted. The importance of agriculture and forestry in India is responsible for the efficiency of the Forest Research Institute at Dehra Dun, with its world-famed collections devoted to botany, sylviculture, entomology, timber and other forest products, while systematic botany is covered by the Herbarium of the Royal Botanic Gardens, Sibpur, where there are more than 2,000,000 specimens. There are also agricultural museums at Coimbatore and Lyallpur. The Indianization of the staffs is now virtually complete.

Of the recommendations appended to the report, the most important is that the Government should appoint immediately an Inspector General of Museums with European experience, and an assistant to be trained overseas. Further, that the constitution of the Indian Museum should be reorganized to permit the appointment of a director with full powers and freed from other duties. In view of the criticisms of the standard of staffing and of the lack of general appreciation in museum administration of advance in technique and development of museums as centres of cultural organization, special emphasis should be laid on the recommendation that the Standing Committee on Museums and Museum Conferences should be revived, and funds provided to meet the cost of Committee, travelling allowances and printing; while the provinces and municipalities are advised to provide more funds for maintenance and also adequate and competent staffs.

The Service of Unified Knowledge

MR. H. G. WELLS'S recent discourse* on the disastrous inco-ordination and waste of modern knowledge and thought concluded with a warning that "without a World Encyclopædia to hold men's minds together in something like a common interpretation of reality, there is no hope whatever of anything but an accidental and transitory alleviation to any of our world's troubles".

To Mr. Wells's appeal to the learned world to set its house in order comes an answer from Prof. A. B. Dobrowolski, director of the Meteorological Service of Poland, president of the Warsaw Geophysical Society and professor of pedagogic sciences in the Free University of Warsaw. Prof. Dobrowolski, while recognizing the potential value of Mr. Wells's project, suggests that it does not go deep enough. If men's minds are to be held together in something like a common interpretation of reality, it is essential that they should have sufficient general culture for an insight into and appraisal of the rich and complicated life of the civilized world of to-day.

This means that there must be a revival of the ideal of a liberal education and efficacious means for realizing it at a level higher than that of the secondary school. A boy or girl leaves school with a certain capacity for self-education. This capacity ought to be cherished and utilized as a means towards higher general education; but encouragement and support are needed. Society ignores the need. The universities are concerned to form, not cultivated men and women, but specialists. Such general culture as is acquired after school-days are over is derived from no systematic cultivation of the arts of observing and thinking, with study to understand and appraise the observations and thoughts of others; but from a purely haphazard succession of experiences, chance readings, conversations, attendances at exhibitions, public meetings, concerts. So, in the vast majority of cases, the intellectual worker's conception of the civilized world, his philosophy of life, if such it may be called, which will determine his reactions to circumstances throughout his life, is the haphazard product of a series of accidents, a thing of shreds and patches.

Prof. Dobrowolski suggests that the remedy lies in creating, in every university, a new 'faculty of general knowledge', the function of which would be to arouse, especially among the young, a lively sense of the value of higher general culture and to stimulate and guide efforts to attain to it through self-education. The mere existence of such an institution would be,

* Delivered at the Royal Institution on November 20 and published as a Supplement to NATURE of November 28, 1936, under the title "The Idea of a World Encyclopaedia".

already, a most effective piece of propaganda. Among its activities would be, in addition to classes, discussions, exercises, seminars and individual counsel and advice; also publication of specially prepared handbooks for aspirants to self-culture, since the popular manuals now on the market do not meet the case.

Prof. Dobrowolski has won for his ideas the support of a group of some fifteen of his colleagues, and a working model of the suggested university faculty has been brought into being under the significant name "Universitas Rediviva". For eight months, thirty students of varying ages and professions have taken part in this experiment. The work is organized in two stages: first, evening classes and exercises extending over four semesters (two years) and occupying eight hours a week; secondly, tutorial counsel given, orally or by correspondence, by various specialists, and group discussions.

The subject-matters of the course range over the widest fields: the art of thinking, general history of ideas, science and technology, art, literature, psychological sciences, economics and sociology, education, the use of leisure, ideologies and criteria of values. In practice, they are divided into six groups: (1) physics, chemistry and astronomy, with mathematics; (2) natural and geographical sciences; (3) psychological sciences; (4) social sciences; (5) pedagogic sciences, and, in relation thereto, the technique of intellectual work, conceptions of the world, philosophies, etc.; (6) art and literature.

Embracing, though it does, the whole of civilization, the programme is intended to be taken in its entirety by every student, and, in order to ensure unity of treatment the professors keep ever before themselves their common aim: the acquisition by the student of the capacity to judge, to appraise, to estimate.

Association of Teachers in Technical Institutions

THE twenty-eighth annual conference of the Association of Teachers in Technical Institutions was held in Coventry during Whitsuntide. On May 17, the president for 1937–38, Mr. W. E. Park, principal of the Technical School, Luton, was installed by Mr. W. T. Maccall, of Sunderland Technical College, who had filled the presidential office during 1936–37. A civic welcome to the Association was accorded by the Deputy Mayor of Coventry, the chairman of the Education Committee and the chairman of the Technical Schools Sub-Committee of Coventry.

"In no town more than Coventry," said Mr. Park in his presidential address, "can we see so well exemplified the changes which are so rapidly taking place. Its industries, built up on the tradition of skilled craftsmanship, are being adapted to the means of the defence of our realm, and as the adaptation proceeds the serious shortage of skilled workers and trained technicians is being realized". It is the business of technical educationists to solve such problems as these, Mr. Park continued. But it must be remembered that, whatever the needs of the immediate present, the fundamental business of technical education is to serve the industrial and commercial civilization which is ours. To that end, the system must be carefully and scientifically planned. For this reason, he emphasized the value of a report on "Co-operation in Technical Education" recently prepared by a conference of representatives of the associations of local education authorities and the London County Council and issued by the Board of Education. Mr. Park directed special attention to the passages of that report which recommended consultation between authorities in regard to the provision and planning of new buildings, and the need for co-operation in connexion with the distribution and delimitation of different stages or types of instruction. Association between authorities to deal with problems of industrial regions as a whole facilitates negotiations with industrial and commercial organizations for the region, and will enable possibilities in connexion with the utilization of teachers, particularly with those possessing high qualifications of a specialized character, to be examined much more carefully than has hitherto been the case.

Mr. Park insisted that technical education will fail its ultimate purpose if it neglects training for citizenship. Merely to train technicians either for the purposes of re-armament or for the bare needs of industry and commerce would lead to the creation of a nation of robots. Hence the Association's activity in conjunction with its sister associations in producing a "Report on Education for Citizenship" which was discussed and accepted during the Conference. Whether 'citizenship' be taught directly or indirectly in technical colleges, the question of "bringing politics into the college" must be faced. It is important in this connexion to remember three things: First, that in the initial stages the social sciences are mainly descriptive and non-controversial; second, that the average teacher is conscientious and knows that he can and must distinguish between facts and his own opinions; and third, that if a scientific approach to social and political problems is not taught in the class room, young people will be left completely unprotected against propaganda in later life.

Among the resolutions passed by the Conference was one which urged the release of technical teachers, after seven years' teaching service, for further periods of industrial service without loss of salary or superannuation rights. Another resolution urged the advisability of increasing facilities for the attendance of young persons at part-time day technical classes in preference to evening classes. This arrangement the Conference held to be in the best interests of students, physically and mentally, and ultimately to be most beneficial to the nation and to industry. In a resolution dealing with the Factory Act, the Conference expressed the view that no overtime should be worked by young persons less than eighteen years of age.

Science News a Century Ago

General Registration of Diseases

IN connexion with the Act for registering births, deaths and marriages in England, the issues of the *Lancet* and *London Medical Gazette* of May 27, 1837, contained the following letter signed by Henry Halford, Astley Cooper and J. Hingston: "We, the undersigned, President of the Royal College of Physicians, President of the Royal College of Surgeons and Master of the Worshipful Society of Apothecaries, having authority from the several bodies whom we represent, do resolve to fulfil the intentions of the legislature in procuring a better registration of the causes of death, being convinced that such an improved report cannot fail to lead to a more accurate statistical account of the prevalence of particular diseases from time to time.

"We pledge ourselves, therefore, to give in every instance which may fall under our care an authentic name of the fatal disease. And we entreat all authorized practitioners throughout the country to follow our example and adopt the same practice, and so assist in establishing a better registration in future throughout England."

Ventilation of Mines

ON May 30, 1837, Mr. Horne contributed to the Institution of Civil Engineers a paper dealing with a method which had been successfully adopted for the ventilation of mines by means of air forced under pressure through pipes. The pipes were 5 inches in diameter and extended a mile, and the ventilation produced, it was said, was complete. A discussion took place on the friction of air and gases passing through pipes of different lengths and diameters. It was stated that the loss on forcing gas through 1,000 feet of pipe amounted to 75 per cent; that is, if 100 cubic feet of gas were delivered through an aperture under a given pressure, only 25 cubic feet under the same pressure would be delivered through a pipe 1,000 feet long. At the same meeting, the Institution was presented with a model of one of the ribs of the centring employed in the construction of Waterloo Bridge.

Darwin on Coral Formations

AT a meeting of the Geological Society, held on May 31, 1837, Rev. W. Whewell, president, being in the chair, Darwin read a paper "On certain areas of elevation and of subsidence in the Pacific and Indian Oceans as deduced from the study of coral formations". After noticing the structure of lagoon islands, encircling reefs and barrier reefs, Darwin went on to give his views on their formation. "The theory which Mr. Darwin then offered," said the *Athenæum*, "so as to include every kind of structure is simply that as the land with the attached reefs subsides very gradually from the action of subterranean causes, the coral-building polypi soon again raise their solid masses to the level of the water, but not so with the land. Every inch lost is irreclaimably gone; as the whole gradually sinks, the water gains foot by foot on the shore, till the last and highest peak is finally submerged. The author then proceeded to offer some considerations on the probability of general subsidences in the Pacific, where many causes tend to its production, and the difficulty of explaining the existence of a vast number of reefs on one level, unless we suppose one mountain top after another becomes submerged, the zoophytes always bringing up their stony masses to the surface of the water. Subsidence being granted, it was shown that a fringing reef would be converted by the upward growth of the coral, into one of the encircling order; and thus by the disappearance of the central land into a lagoon island."

The Restoration of Condamine's Pyramid at Quito

WHEN in 1735 the Paris Academy of Sciences sent an expedition to South America to measure a degree of meridian near the equator, work was begun in a valley of the Cordilleras running about two hundred miles south of Quito. On June 3, 1837, the *Athenæum* contained a note stating that the pyramid erected in 1736 by the celebrated mathematician Condamine and his associates Bouguer and Godin, to commemorate their labours in that part of the world, having been soon after thrown down by the order of the Court of Madrid, was being restored by direction of the President Rocafuerte. The foundation stone was relaid in November 1836, on which occasion an address was given by our countryman General Miller, the Minister Plenipotentiary from Peru. In the course of his remarks, General Miller said: "I cannot pass this opportunity without recalling to mind the names of Juan Jorge and Ulloa—companions of the illustrious Frenchmen—Spaniards who prove that men most distinguished for their love of the sciences are precisely those who most endeavour to promote the welfare of humanity. The report which these two learned men made to the King of Spain, lately published under the title of 'Noticias Secretas' is a production which ought to immortalize them. It is an exact account of the abject and cruel servitude under which the unhappy aboriginal race then groaned, and, I am sorry to say still groan . . . it is to be hoped that the present enlightened President will better the conditions of these unfortunates, and that while he fosters the arts and sciences, he will as efficaciously employ his zeal in abolishing a system of tyranny a thousand times worse than slavery itself." General Miller, who was born in 1795 and died in 1864, served in the Peninsula and North America, was long associated with Chile and Peru, and from 1843 was British consul-general in the Pacific.

Chemistry and the Art of Painting in Enamel

THE June 1837 number of the *Philosophical Magazine* contained an interesting article entitled "Some Account of the Art of Painting in Enamel", by Alfred Essex, the son of William Essex (1784?–1869), enamel-painter to Queen Victoria. In the course of his article, Essex wrote: "To obtain the richness of the master-colourists it is obviously necessary that the painter in enamel should be in possession of colours capable of emulating those of painters in oil. In this, however, the artists of former times were sadly deficient. But, fortunately for this durable and beautiful art the discoveries of modern chemistry have afforded the materials to supply this long-sought desideratum. From three of the metals which till lately were known but to chemists, and which were regarded as curiosities only, namely platinum, uranium and chromium, are already produced four of the richest and most useful of the colours on the palette of the painter in enamel. And doubtless we may look to this source for the means of further improvements."

University Events

CAMBRIDGE.—Dr. J. A. Todd, of Trinity College, has been appointed University lecturer in mathematics, Dr. D. Stockdale, of King's College, and Dr. F. B. Kipping, of Trinity College, University lecturers in chemistry and Dr. P. Tate, of Christ's College, University lecturer in parasitology.

It is proposed that Prof. O. T. Jones and Prof. C. E. Tilley be appointed to represent the University at the International Geological Congress to be held in Moscow on July 21–29.

The electors to the Isaac Newton studentships give notice that an election to a studentship will be held early in the Michaelmas Term 1937. These studentships are for the furtherance of advanced study and research in astronomy (especially gravitational astronomy, but also including the other branches of astronomy and astronomical physics) and physical optics. The studentship will be tenable for three years from October 1937. The emolument of the student is £250 a year. Candidates are invited to send in their applications to the Registrary between October 8 and October 14.

The Michael Perkins Prize of £25 is awarded biennially for the best essay, on a subject to be chosen by the candidate, involving original investigation or interpretation of the natural history of animals. Candidates should send their essays to the Professor of Zoology by September 30.

LONDON.—Mr. John Kirk has been appointed, as from October 1, to the S. A. Courtauld chair of anatomy tenable at the Middlesex Hospital Medical School. Since 1930, he has been senior demonstrator of anatomy at University College.

The title of professor of morbid anatomy in the University has been conferred on Dr. W. D. Newcomb, in respect of the post held by him at St. Mary's Hospital Medical School.

The following doctorates have been conferred: D.Sc. in mathematics on B. R. Seth (University College); D.Sc. in zoology on C. H. N. Jackson (University College); D.Sc. (Engineering) on H. J. Nichols (Northampton Polytechnic Institute).

The Petrie Medal for distinguished work in archæology has been awarded for 1937 to Prof. J. D. Beazley, professor of classical archæology in the University of Oxford.

The Dunn Exhibitions in Anatomy and Physiology for 1937 have been awarded to J. W. Paulley (of Middlesex Hospital Medical School) and Philip Harvey (of Guy's Hospital Medical School) respectively.

OXFORD.—Dr. A. G. Gibson (Christ Church) has been appointed Nuffield reader in morbid anatomy while holding the office of honorary pathologist at the Radcliffe Infirmary.

Prof. H. J. Paton (Queen's College) of the University of Glasgow, has been appointed White's professor of moral philosophy as from October 1.

M. L. Jacks (Wadham College), headmaster of Mill Hill School, has been appointed to succeed Mr. George Smith as director of the Department of Education as from January 1, 1938.

Societies and Academies

Paris

Academy of Sciences, April 19 (*C.R.*, **204**, 1145–1224).

CHARLES ACHARD and MAURICE PIETTRE: The plasma of the smooth muscular fibres studied by means of the acetone method at low temperatures.

ANDRÉ MERCIER: The equation $\nabla \rightarrow C = \alpha C$.

PAUL DELENS: The figures of Lemoine and of Brocard in the tetrahedron.

LOUIS PASQUALINI: The conditions of convexity of a variety V_{p-1} of $p-1$ dimensions plunged in Euclidian space R_p of p dimensions.

THÉODORE ANGHELUTZA: A property which characterizes conformal transformation.

PAUL LÉVY: Integral series representing exponentials of polynomials.

CARLOS BIGGERI: A theorem on the singularities of analytical functions.

LÉON BESCHKINE: A particular solution relating to rings (plane problems).

RÉMY BOURGEAT, DENIS CAHUZAC and JACQUES DEULLIN: The phenomena presented by the calibration of velocity meters in calm water.

PIERRE CHEVENARD and XAVIER WACHE: The intercrystalline corrosion of chrome nickel steels, cold hardened after tempering.

LÉON AUGER: The frequencies of the sounds given by a cylindrical pipe with beating reed.

MME. IRÈNE MIHUL and CONSTANTIN MIHUL: The ionization of the upper part of the atmosphere. The varying heights and discontinuities in the reflecting layer are explained as being due to the variation of the electronic density gradient of the ionosphere with height with the position of the sun.

FRANTZ PERRIER: The ionization of air by electrified dielectrics. G. Reboul explains the inversions of current produced by a dielectric discharging in an ionization chamber as the effect of the ionization of the air surrounding the dielectric, but W. Eichenberger considers that the air does not take part in this phenomenon. The author's experiments agree with Reboul's conclusions.

O. DONY-HÉNAULT and A. DE JAER: Electrolysis with a mercury cathode. Study of the effect of stirring the mercury cathode in the preparation of sodium and potassium amalgams by the electrolysis of solutions of sodium and potassium chlorides. A new form of anode was devised (tantalum wrapped up with platinum gauze). This was found preferable to graphite for the high current densities employed.

ALBERT GRUMBACH and FÉLIX TABOURY: A new phenomenon observed in batteries with one polished electrode. The role of the Beilby layer.

HANNES ALFVÉN: The origin of the cosmic radiation. It is known that the earth and the sun are surrounded with magnetic fields, and if this is the case with the stars the rotation could set up very high electromotive forces. Charged particles accelerated by such voltages could possess the same energy as the cosmic rays. Some of the consequences of this theory are discussed (see also NATURE, **138**, 761 (1936); **139**, 245 (1937)).

VITOMIR H. PAVLOVIĆ: Tesla currents applied to stroboscopy.

ERNST OLSSON: The induced predissociation of the tellurium molecule submitted to intense magnetic fields. Study of the changes produced in the absorption spectrum of tellurium vapour by the Bellevue magnet, field 45,000 gauss.

PIERRE BARCHEWITZ : The (OH) and (CH=) bands of phenol and its derivatives between 6000 A. and 9500 A.

JEAN LECOMTE : The infra-red absorption spectra of some mono- and disubstituted derivatives of benzene. The symmetry of benzene.

PIERRE JOLIBOIS and ROBERT BOSSUET : The quantitative analysis of metallic solutions by means of the spectrograph. The spark spectrum is obtained with direct current (5000 volt circuit), and an apparatus is figured securing a constantly renewed surface of cooled solution.

JEAN ROULLEAU : The influence of the luminous intensity on the sensibility of photo-electric meters.

RENÉ AUDUBERT : The activation energy of the photogenic reactions accompanying the thermolysis of hydrazoates. Measurements of the ultra-violet radiation emitted during the thermal decomposition of NaN_3, AgN_3 and $Pb(N_3)_2$.

JULES GUÉRON : The wall effect in the evolution of aqueous solutions of ferric chloride.

FRANÇOIS OLMER : The study by photographic recording of the reduction of oxides of iron in the presence of their natural impurities.

OSIAS BINDER : The green basic copper carbonates.

ROGER PAJEAU : The bromination of some aromatic compounds in the presence of beryllium and ethyl ether.

ANDRÉ MEYER and PAUL HEIMANN : A new method of synthesis of derivatives of 2,4-dihydroxyquinoline (4-hydroxycarbostyril) starting from malonic esters and aromatic amines.

ANTONIO DE MEDEIROS GOUVÊA and GEORGES-ZBYSZEWSKI : New observations on the Quaternary of the coast of southern Portugal between Cap Sagres and the mouth of the River Odesseixe.

CONSTANTIN T. POPESCO : The prolongation of the duration of life in the aubergine grafted on the sweet almond.

PIERRE CHOUARD and RENÉ CASTAU : The tuberization of stems and hypocotyls by longitudinal diffusion of hetero-auxine.

BASILE LUYET : The mechanism of cell death by high pressures. The intensity and duration of the lethal pressures for yeast. The yeast cells do not all die at a given pressure : the lethal pressure commences at about 4,000 atmospheres, under which some cells die in some minutes ; at 7,000 atmospheres all are killed in some seconds.

JEAN LOUIS PERROT : The impregnation chamber of *Helix pomatia* and the presence of spermatozoids at this level.

LÉON KÉPINOV : The synergy of adrenaline and of the pituitary hormone. The role of the pituitary hormone in the mechanism of the glycogenolytic action of adrenaline.

R. JONNARD : The magnetic susceptibility of normal and pathological blood serum.

MARCEL LÉVY BRUHL, GEORGES UNGAR and MLLE. ALBERTE LEVILLAIN : The production by means of bacteria, starting with urea, of a substance identifiable physiologically with histamine.

Moscow

Academy of Sciences, (*C.R.*, 14, No. 3, 1937).

M. KRAVČUK : Some approximations in the generalized problem of moments.

J. GERONIMUS : The problem of coefficients for limited functions.

B. A. WENKOV : The automorphic group of an indefinite quadratic form.

P. A. ČERENKOV : (1) Visible luminosity of pure fluids under the influence of hard β-rays. The luminosity is caused mainly by the electrons with β greater than 0·8. (2) Angular distribution of the intensity of the luminosity caused in pure fluids by γ-rays.

I. FRANK and IG. TAMM : Coherent visible radiation due to fast electrons passing through matter. A theory is put forward and supported by calculations that an electron moving in a medium radiates light even if it is moving uniformly, provided that its velocity is greater than the velocity of light in the same medium.

F. M. ŠEMIAKIN : Colour reactions of rare earths with alkaloids (3). New colour reactions with morphine and brucine are proposed. The brucine reaction may be used for colorimetric determination of cerium.

A. A. GRÜNBERG and D. I. RIABČIKOV : Application of oxidometric titration for the determination of the constitution of complex compounds.

K. K. MATVEIEV : Occurrence of nickel in the biotite shales of the Ural emerald mines and of other emerald deposits.

A. LEBEDEV : Lead-bearing tourmaline from the Maly Khingan.

P. A. KOSMINSKIJ and N. P. ERŠOVA : A new eighth linkage group in *Bombyx mori* L.

P. A. KOSMINSKIJ and N. A. MORDOVKINA : Inheritance of yellow colour in cocoons of *Bombyx mori* L.

Z. F. FEDOROVA : An investigation of inversions in the third chromosome of *Drosophila melanogaster*, and the production of new inversions which completely suppress crossing over along its whole length.

S. O. GREBINSKIJ : Accumulation of citric acid in makhorka (*Nicotiana rustica* L.).

E. D. BOUSLOVA and V. N. LUBIMENKO : Influence of luminous induction on the development of *Perilla ocymoides* (1).

V. N. LUBIMENKO and E. D. BOUSLOVA : Contribution to the theory of photo-periodicity (2).

Vienna

Academy of Sciences, February 25.

E. ABEL and J. PROISL : Mechanism of the lead chamber reaction. The reaction between nitric and sulphuric acids under various conditions.

KARL VANEK : Radius of curvature of plane curves.

K. W. F. KOHLRAUSCH, A. PONGRATZ and R. SEKA : Studies of the Raman effect (65). Various organic substances.

K. W. F. KOHLRAUSCH and A. PONGRATZ : Studies of the Raman effect (66). Nitrogenous substances.

KARL KRAMMER : Reflection of α-rays of radium C′ by heavy nuclei.

OTTO PESTA : Ponds in the East Alps.

RUDOLF ZIMARA : Observations on mammals from New Guinea.

OTTO KOLLER : Report of a second zoological expedition to Asia Minor in 1936.

March 4.

M. PESTEMER and E. MAYER-PITSCH : Influence of substituents on the ultra-violet absorption of two conjugated benzene chromophores.

O. FRUHWIRTH : Study of the association of water by measurements of dielectric polarization.

M. PESTEMER and O. FRUHWIRTH : Ultra-violet absorption and orientation polarization of the binary systems acetone-benzene and nitromethane-carbon tetrachloride.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :

LECTURER IN MECHANICAL ENGINEERING in Armstrong College, Newcastle-upon-Tyne, 2—The Registrar (May 31).

DEMONSTRATOR IN MATHEMATICS in the City and Guilds College—The Secretary, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W.7 (May 31).

MUSEUM ASSISTANT for the Woolwich Borough Museum—The Town Clerk, Town Hall, Woolwich (June 4).

ASSISTANT IN BIOLOGY AND PHARMACY in Dundee Technical College—The Clerk and Treasurer, Bell Street, Dundee (June 5).

EDITOR of *Science Abstracts* (Electrical Engineering Section)—The Secretary, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2 (June 7).

CURATOR in the Horniman Museum, Forest Hill, S.E.23—The Education Officer (G.P./M), County Hall, S.E.1 (June 10).

ASSISTANT LECTURER IN PHYSICS in the University of Manchester—The Registrar (June 12).

ASSISTANT LECTURER IN GEOGRAPHY in the University of Bristol—The Registrar (June 14).

FOREST OFFICER in the Forest Service of Burma—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (June 18).

RESEARCH ENGINEER for the Institution of Automobile Engineers, Great West Road, Brentford, Middlesex—The Secretary.

CHEMISTS for the War Department Chemist—The Under-Secretary of State (C.5), The War Office, S.W.1 (quote Appts./30).

ASSISTANT SECRETARY of the Council for the Preservation of Rural England—The Secretary, C.P.R.E., 4 Hobart Place, S.W.1.

ASSISTANT CIVIL ENGINEERS in the Air Ministry—The Secretary (W.9), Room 712, Air Ministry, Adastral House, Kingsway, London, W.C.2.

INSTRUCTOR LIEUTENANT (mathematics, chemistry, physics or engineering) in the Royal Navy—The Director, Education Department, Admiralty, S.W.1.

ASSISTANT DIVISIONAL ENGINEER in the Sudan Irrigation Department—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1.

ASSISTANT TEACHER OF ELECTRICAL ENGINEERING AND ASSISTANT TEACHER OF MATHEMATICS in the Acton Technical College, High Street, W.3—The Principal (June 4).

DEMONSTRATOR IN MATHEMATICS in the University of Cambridge—Dr. H. M. Taylor, Clare College, Cambridge (June 5).

LECTURER IN MECHANICAL ENGINEERING in the Chesterfield Technical College—The Clerk to the Governors (June 7).

ASSISTANT LECTURER IN CHEMISTRY AND BOTANY OR ZOOLOGY OR PHYSICS in the Studley Horticultural and Agricultural College for Women, Warwickshire—The Secretary (June 7).

DEMONSTRATOR IN GEOLOGY in the University of Cambridge—Dr. F. C. Phillips, Department of Mineralogy and Petrology, Downing Street, Cambridge (June 8).

LECTURER IN CHEMISTRY and LECTURER IN MECHANICAL ENGINEERING in the Northampton Polytechnic, St. John Street, London, E.C.1—The Secretary (June 14).

HEAD OF THE DEPARTMENT OF ELECTRICAL ENGINEERING AND PHYSICS in the Royal Technical College, Salford—The Director of Education, Education Office, Salford, 3.

LECTURER IN ENGINEERING in the Shrewsbury Technical College—The Clerk to the Governors, County Buildings, Shrewsbury.

PART-TIME EVENING INSTRUCTORS IN ENGINEERING, PHYSICS AND MATHEMATICS in the Northampton Polytechnic, St. John Street, London, E.C.1—The Secretary.

Official Publications Received

Great Britain and Ireland

Seale-Hayne Agricultural College : Department of Plant Pathology. Pamphlet No. 47 : Thirteenth Annual Report for the Year ending September 30th, 1936. Pp. 35. (Newton Abbot : Seale-Hayne Agricultural College.) [284

Ministry of Health. Report on an Investigation into Maternal Mortality. (Cmd. 5422.) Pp. 353. 5*s*. 6*d*. net. Report on Maternal Mortality in Wales. (Cmd. 5423.) Pp. 156. 2*s*. 6*d*. net. (London : H.M. Stationery Office.) [294

Memoirs of the Cotton Research Station, Trinidad. Series A, Genetics, No. 14 : Cytological Studies in Cotton, 4 : Chromosome Conjugation in Interspecific Hybrids. By A. Skovsted. Pp. 97–134+3 plates. (London : Empire Cotton Growing Corporation.) 2*s*. 6d. [294

Technical Publications of the International Tin Research and Development Council. Series A, No. 52 : The Tinning of Steel Strip by Electrodeposition. By D. J. Macnaughtan, W. H. Tait, S. Baier and J. C. Prytherch. Pp. ii+36+8 plates. Series B, No. 3 : The Use of Tin in Refrigerating Equipment. By E. J. Daniels and D. J. Macnaughtan. Pp. ii+8. (London : International Tin Research and Development Council.) Free. [294

Annual Reports on the Progress of Chemistry for 1936. Vol. 33. Pp. 512. (London : Chemical Society.) 10*s*. 6*d*. [304

Institution of Professional Civil Servants. Annual Report of Council for the Year 1936. Pp. xiv+54. (London : Institution of Professional Civil Servants.) [304

Other Countries

Ministry of Agriculture and Fisheries. Fifth Progress Report of the Foot-and-Mouth Disease Research Committee. Pp. 386+26 plates. (London : H.M. Stationery Office.) 7*s*. net. [75

Survey of India. Geodetic Report, 1936. Pp. iv+97+19 plates. (Dehra Dun : Survey of India.) 3 rupees ; 5*s*. 3*d*. [35

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1936. Pp. 27. (Entebbe : Government Printer.) 3*s*. [35

Université de Liège : Institut de Physique. Univers isomorphes et constantes physiques. Par Prof. L. Counson. Pp. 40. (Liège : Éditions E.D.K.) [35

Tanganyika Territory : Department of Lands and Mines, Geological Division. Bulletin No. 9 : A Stratigraphical Classification and Table of Tanganyika Territory. By F. B. Wade. Pp. 60. (Dar es Salaam : Government Printer.) 4*s*. [35

Annual Report of the Indian Institute for Medical Research, 1935–36. Pp. iv+84. (Calcutta : Indian Institute for Medical Research.) [35

Transactions of the National Institute of Sciences of India. Vol. 1, No. 10 : The Characteristic Properties of Colloidal Solutions of Acidic Substances which distinguish them from Acids in True Solution. By Dr. J. N. Mukhurjee, R. P. Mittra and S. Mukherjee. Pp. 227–292. (Calcutta : National Institute of Sciences of India.) [35

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 22, Memoir No. 6 : A Permo-Carboniferous Fauna from South-West Persia (Iran). By Dr. J. A. Douglas. Pp. v+59+5 plates. (Calcutta : Geological Survey of India.) 4.4 rupees ; 7*s*. [35

Union of South Africa : Department of Commerce and Industries, Fisheries and Marine Biological Survey Division. Report No. 13, for the Year ended December 1935. By Dr. Cecil von Bonde. Pp. 56+3 plates. (Pretoria : Government Printer.) [45

Department of Science and Agriculture, Jamaica. Bulletin No. 6 : Insecticides to Control Insect Pests in Jamaica. By W. H. Edwards. Pp. iv+50+4 plates. Bulletin No. 7 : Dairy Farming in Jamaica. By J. W. Howe. Pp. 32. Bulletin No. 8 : A Survey of the Yields of Sugar Cane in Jamaica, 1934–1935. Report by H. H. Croucher. Pp. ii+47. (Jamaica : Government Printing Office.) [45

University of Denver : Department of Anthropology. The Archaeological Survey of the High Western Plains. Ninth Report : Northeastern New Mexico, Seasons 1929, 1934 and 1935. By E. B. Renaud. Pp. 68. (Denver, Colo. : University of Denver.) [75

U.S. Department of Agriculture. Farmers' Bulletin No. 1768 : Trapping and Transplanting Live Beavers. By Leo K. Couch. Pp. ii+18. (Washington, D.C. : Government Printing Office.) 5 cents. [75

U.S. Department of the Interior : Office of Education. Bulletin, 1936, No. 13 : The Deaf and the Hard-of-Hearing in the Occupational World. Report of a Survey directed by the U.S. Office of Education. By Elise H. Martens, with the collaboration of Kenneth Braly, Percival Hall, Jr., Helmer Myklebust, Sam D. Palmer, Alice F. Rowell, Isabelle Walker. Pp. x+95. (Washington, D.C. : Government Printing Office.) 15 cents. [75

Department of the Interior. Palæontological Bulletin No. 2 : The Larger Foraminifera of the Lower Miocene of Victoria. By Irene Crespin. Pp. 15 (3 plates). (Canberra : Commonwealth Government Printer.) [105

Memoirs of the Geological Survey of India. Vol. 69, Part 1 : The Mineral Deposits of Eastern Singhbhum and Surrounding Areas. By Dr. J. A. Dunn. Pp. ix+279+xxiii+23 plates. (Calcutta : Geological Survey of India.) 9.8 rupees ; 16*s*. [105

Industrial Research Bureau. Bulletin No. 8 : Development of the Heavy Chemical Industries in India. By N. N. Sen Gupta. Pp. vi+45+9 plates. (Delhi : Manager of Publications.)

Bulletin of the American Museum of Natural History. Vol. 73, Art. 2 : Abnormal Dentition in Sharks, Selachii. By E. W. Gudger. Pp. 249–280. Vol. 73, Art. 3 : Results of the Oxford University Sarawak (Borneo) Expedition—Bornean Stingless Bees of the Genus Trigona. By Herbert F. Schwarz. Pp. 281–329. (New York : American Museum of Natural History.) [115

Field Museum of Natural History. Report Series, Vol. 11, No. 1 : Annual Report of the Director to the Board of Trustees for the Year 1936. (Publication 382.) Pp. 147+14 plates. (Chicago : Field Museum of Natural History.) 1 dollar. [115

Catalogues, etc.

The Chainomatic Balance. Pp. 4. Microid Balances, Weights and Accessories. Pp. 12. Microid Stainless Steel Analytical Weights. Pp. 6. (London : Griffin and Tatlock, Ltd.)

Die Askania-Warte. Nr. 1, October 1936. Pp. 20. Nr. 2, Dezember 1936. Pp. 24. Nr. 4, März-April 1937. Pp. 24. (Berlin-Friedenau : Askania-Werke A.-G.)

Apparatus for the Measurement of Dielectric Constants. (Dipol 36.) Pp. 8. (Delft : P. J. Kipp and Zonen ; London : W. Edwards and Co.)

Cambridge Dynamometers and A.C. Test Sets. (Folder No. 57.) Pp. 6. (London : Cambridge Instrument Co., Ltd.)

The Kodak Clinical Camera Outfit. Pp. 12. (London : Kodak, Ltd.)

Botanica Generalis. (No. 92.) Pp. 66. (Den Haag : W. Junk.)

Billige Bücher aus allen Gebieten der Unterhaltung und des Wissens. (Antiquariats-Anzeiger No. 168.) Pp. 70. (Leipzig : Gustav Fock, G.m.b.H.)

Eastman Organic Chemicals. List No. 28. Pp. 124. (Rochester, N.Y. : Eastman Kodak Co.)

Apparatus for Testing Petroleum, Tar, Asphalt and their Products. (List No. 96A.) Pp. 64. (London : A. Gallenkamp and Co., Ltd.)