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Work of the Forestry Commission: Progress and Promise.*

I.

THE Forestry Commission of Great Britain came into being as the result of the Forestry Act of 1919. Under the financial section of that Act, a sum of 3½ million pounds was to be provided for the first ten years of the Commission's work, the money to be voted annually by Parliament in instalments up to the total sum sanctioned for the period.

The Forestry Act was based to a great extent on the advice tendered by the Acland Committee, which reported in May 1917. The Act, quite correctly as many think, did not, however, embody in its clauses the recommendations of the Committee that a hard and fast annual planting programme should be adhered to, coupled with an attempt to procure land, by purchase or otherwise, on a scale sufficient to keep pace with a planting programme laid down in advance. In their review of the ten years' work, the Commissioners can state, and they do so with perhaps pardonable pride, that the two objects have been very nearly achieved, in spite of the set-back which many Government departments experienced when the 'Geddes axe' (1922) was being wielded over Whitehall. Even in the case of such a department as 'Forests', a profession of the open-air, we find that in 1929–30 the technical staff numbered 70, whilst clerical staff numbered 100! Unexpected difficulties also were encountered in obtaining the land required, especially in the north; and the mildest criticism on some of the areas obtained has been that the value of the forest crop they are likely to grow is problematical.

Every annual report since 1923 has referred to this 'Geddes axe' contretemps in the history of the work of the Forestry Commission. But to many practical foresters possessing administrative experience, the view and attitude so taken appear to be somewhat distorted. It is a well-accepted factor in forestry economics that any slump in trade in a country, or part of a country, will be immediately reflected in forestry revenue and returns, either of the country as a whole or in the part of the country affected, and forest officials are well aware that they will experience cuts in the expenditure side of their next forest budgets.

In the case of the Forestry Commission, it is held by a not inconsiderable section of expert opinion in Great Britain that it was, and is, a mistake to tie

* Forestry Commission. Tenth Annual Report of the Forestry Commissioners, year ending Sept. 30, 1929. Pp. 69. (London: H.M. Stationery Office, 1930.) 1*s.* 3*d.* net.

the forestry business to an annual programme of planting laid down in advance—and consequently to the necessity of endeavouring to acquire land for the purpose to at least a fixed annual amount. With the finances of the country in their present position, not even the keenest supporter of afforestation in Great Britain would agree to the sacredness of either the 1929–38 planting programme or its more or less prescribed land acquisition plan.

It must be admitted that the Forestry Commission deserves congratulation on its ten years' work. It may be suggested, however, that the Commissioners will be well advised not to pin their faith on adhering to a hard and fast policy of *annual* planting and land acquisition, by area. A clear-sighted forest administration knows full well that it has to 'cut its coat according to its cloth'. Should retrenchment have to come during the present ten years, the Commissioners have now in hand a forest area of considerable size, which doubtless can provide plenty of work for the existing staff; and no one expects the present forest estate, consisting for the major part of young plantations, to show a profit for years to come—so that worry has not to be faced.

It will be readily conceded, as the writer of the review in the report before us says—"The object of the ten-year programme was to avoid uncertainty. Uncertainty is the worst enemy of the Commissioners' work." Every forester should know that success in forestry depends upon continuity in working. What, however, is not so readily appreciated is that this well-recognised axiom applies to forest departments which have under their charge considerable areas of existing revenue-yielding forests. Here interruptions in continuity of working result in serious losses in revenue and check the due expansion and progress of forest management. Great Britain is not in such a position. Therefore it would be difficult to support, on economic grounds, the necessity for adhering to a hard and fast annual planting plan; though it may be a perfectly sound policy to prepare such a scheme and endeavour to work up to it. So far, the Commission has made a fetish of this branch of forest work—at the expense of reafforesting areas felled during the War, which had at least one forestry asset, an established forest soil.

The work carried out under the auspices of the Commissioners up to the end of the growing season of 1929 may be briefly summarised as follows. Of plantable land, 310,230 acres were acquired; of this area, 130,768 acres were planted with conifers and 7511 acres with hardwoods. State-aided planting (that is, by making money grants to private proprietors) was responsible for another 76,736 acres planted. The original programme did not envisage the creation of forest workers' holdings. As one outcome of the unemployment question this matter was taken up in 1924 and received a warm acceptance by the Government officials concerned; the result was that 618 holdings were completed by the end of the ten-year period and another 245 were in progress. Wherever possible, existing buildings have been converted for the purpose of the holdings. But in many cases new buildings have had to be erected and the work has proved somewhat costly. However, in the case of the forest workers' holdings, there are a good many questions of an economic nature to be weighed, apart from the purely financial one. So far as can be foreseen at the present time and under existing social conditions, the forest workers' holdings can be regarded as a sound departure.

At the end of September 1930 the Forestry Commission had under its charge 602,000 acres of land, of which 251,000 acres had been acquired by purchase, 231,000 acres by long lease or feu, and the balance, approximately 120,000 acres, consisting of Crown Woods, had been transferred to the Commissioners under the Transfer of Woods Act of 1923. The following extract from the report will indicate that sound views now prevail on the subject of land acquisition:

"In acquiring land the Commissioners have kept constantly in view their main functions, which are to establish forests and forest workers' holdings. The acquisition of assets surplus to those requirements has been avoided so far as possible, and where it has been necessary to acquire surplus assets in order to build up desirable forest properties the policy is to dispose of them as rapidly as sound business permits."

The activities of the Commissioners in the direction of forest education and research work are discussed at length. Expert opinion in Great Britain is by no means agreed either as to the value of some of the Commission's activities in these directions or the soundness of some of the advice given by the Commissioners. References have already been made to such matters in our columns; the points in question, moreover, are well known to those interested in these matters throughout the country and need no further emphasis here.

Weighed dispassionately, however, the consensus of opinion will be that the Commissioners in the work of the past ten years have deserved well of their country and have earned the thanks of their countrymen. The chairmen have been Lord Lovat,

one of the originators of the scheme (1919–27); Lord Clinton (1927 to 1929, end of ten-year period); Sir John Stirling Maxwell, the present chairman. Mr. R. L. Robinson has been the Technical Commissioner throughout the period.

The summary of the ten years' work is unfortunately drawn up on the most approved Whitehall lines. It bristles with statistics and tabular statements, resembling a report emanating from the Treasury or Board of Trade. From the point of view of the public the report is useless. Several of the reports of forestry departments issued in other parts of the Empire are nowadays human documents, often illustrated. The Commissioners have missed a great opportunity for propaganda to interest the public; whilst they would have set an example which might have had the beneficial result of brightening up Whitehall reports and Blue Books generally.

Concepts of Social Biology.

The Biological Basis of Human Nature. By Prof. H. S. Jennings. Pp. xviii + 384. (London: Faber and Faber, Ltd., 1930.) 15*s*. net.

ALMOST everything which has been written on the biological foundations of human society is based upon a false antithesis with a historical background, which should be evident to everyone who is familiar with the progress of animal biology during the last century. Before the emergence of the cell doctrine during the 'thirties, Kölliker's discovery that the sperm is produced by the transformation of a single cell in the testis of the male parent, and the elucidation of the phenomenon of fertilisation by Fol in 1879, the prevailing biological concept of inheritance was very much like the legal one. While the egg was still regarded as an adult in miniature, it was natural to think that we pass on our noses in much the same way as we pass on our mortgages. When the essential features of fertilisation were established, it was natural that biologists should challenge the legal view of inheritance associated by custom with the name of Lamarck. Had Weissmann confined himself to this modest task, his influence on biological theory would have been one of permanent usefulness. Unfortunately, he could not stop at that. From a total misconception of the rôle of the external environment in relation to the materials of inheritance, biological doctrine swung over to a total neglect of the rôle of environment in the process of development.

Weissmann's conception of development, elaborated in association with Roux, reduced the external medium to a perfect vacuum. As in Stevenson's fable, the gyves were firmly riveted on the left leg before the ulcer on the right had healed. To-day the progress of experimental embryology has relegated Weissmann's theory of development and the hypothesis of germinal selection to the same limbo as the Lamarckian doctrine. In animal biology, heredity and environment are used as classifications of two types of variables which interact at every stage of development, to produce at the end of the process one of a large number of possibilities called an individual. Heredity includes the class of variables which can be defined in terms of the material of which the sperm and egg are respectively composed. Environment includes that whole class of variables which are significant in the further development of the fertilised egg. A difference between two animals may be predominantly a genetic or predominantly an environmental one. To speak of characters as hereditary or environmental, innate or acquired, is, strictly speaking, meaningless.

In animal biology these are commonplaces. Unfortunately, in human affairs they are still startling and almost revolutionary ideas. The main concern of Prof. Jennings in "The Biological Basis of Human Nature" is to see that they shall become commonplace in social biology. He has performed this signal service with the lucidity, good humour, and terseness which have enhanced his reputation as one of the most penetrating and provocative thinkers in contemporary biology. "A burden of concepts and definitions", he says, "has come down from pre-existing days; the pouring of the new wine of experimental knowledge into these has resulted in confusion. And this confusion is worse confounded by the strange and strong propensity of workers in heredity to flout and deny and despise the observations of the workers in environmental action; the equally strange and strong propensity of students of environmental effects to flout and despise the work on inheritance." On behalf of the workers on heredity, it may be pointed out that extravagant dogmatism concerning the hereditary significance of human differences is less common among biologists than among statisticians, retired majors, and clergymen with journalistic propensities. The leading geneticists, and among them first and foremost T. H. Morgan himself, have usually shown extreme reserve in discussing the genetic aspect of social behaviour.

"The Biological Basis of Human Nature" does not set out to be a comprehensive text-book of

social biology. It is the prolegomena to any genuinely biological analysis of human society. The *Corpus errorum biologicorum* in Chap. ix. should be read by everyone who has an interest in the relation of biological concepts to social science. Throughout the book Prof. Jennings emphasises the need for detachment and scepticism in approaching what is still a virgin field of inquiry. He discusses the possibilities of eugenic measures with a moderation and sanity which will compel the sympathy of many previously alienated by the manifest political bias or ludicrous exaggerations of propagandists determined to damage their own case. Having stressed the extreme difficulty of analysing social differences to which several gene mutations make a contribution, he states :

"We must know more as to what human troubles are due to definite single-pair gene defects. These are the defects with which eugenic measures can effectively deal ; and as yet but a small number of them are positively known. The great difficulty about this is that bad living conditions often produce the same kind of results that bad genes do. Persons may become idle and worthless, insane or criminal or tuberculous—either through bad genes or through bad living conditions, or through a combination of both. So long as living conditions are bad, we do not know what ills are due to bad genes. We must therefore correct the bad living conditions, not only for their directly beneficial effect, but also for the sake of eugenics. When this is done, it will be possible to discover what defects are primarily the result of defective genes, and then to plan measures for getting rid of these genes : measures for stopping the propagation of their carriers."

In the chapter on race mixture and its consequences the author maintains the balance between two conflicting sources of bias with judicious restraint in most of the conclusions he states. The reviewer is of the opinion that he attaches too much importance to the conclusions stated by Davenport and Steggerda at the conclusion of their monograph on "Race Crossing in Jamaica", and too little weight to the actual data contained in the text. Indeed, he himself departs from the high standard he has set elsewhere, when he states that the blacks "showed superiority in Mental Arithmetic and in following complicated directions for doing things. On the other hand, the Whites showed a distinct superiority in the tests of intellectual ability." In the Army Alpha tests the blacks excelled in one half and the whites in the others. The former category included all the numerical tests—simple or otherwise. It is not clear why the verbal tests should be classified as 'intellectual' in contradistinction to the numerical tests. Few biologists seem to be aware that the most recent investigations on the *I.Q.* of foster children and twins show how little justification there is for the belief that such tests distinguish differences which are of genetic and extrinsic origin. The implications of Spearman's work alone necessitate a very sceptical attitude to earlier views concerning the genetic status of psychological tests.

Those who are familiar with "Prometheus" will not be surprised to find that Prof. Jennings stresses the need of recognising that man has a natural history of his own. In the last chapter he attributes the neglect of the specifically human characteristics of human behaviour to the mechanistic tradition in the philosophy of the organism, and favours the emergent point of view as a more sympathetic setting for a humanism which draws its inspiration from biological knowledge. His statement of the emergent point of view is so carefully pruned that most biologists with a mechanistic bias will find it difficult to realise why Prof. Jennings goes to so much trouble to identify his own clear and unexceptionable views with what has now become a label for various species of contemporary philosophical obscurantism. It is doubtful whether the disposition to interpret the entire panorama of human history within the framework of our present biological hypotheses is generally associated with an explicitly materialistic bias in philosophy or a partiality for physico-chemical interpretations of vital phenomena. A consistent mechanist will be the first to recognise that the biology of Darwin's generation was neither sufficiently adequate to undertake an analysis of the structure of human society, nor even equipped to state, as we now can state, the fundamental requirements of the problem in biologically significant terms. The assumption that human nature is the product of heredity and environment owes its plausibility to the mechanistic point of view ; and this assumption is accepted as axiomatic throughout Prof. Jennings' book.

An Introduction to Plato.

The Growth of Plato's Ideal Theory : an Essay. By Sir James George Frazer. Pp. xi + 114. (London : Macmillan and Co., Ltd., 1930.) 7*s.* 6*d.* net.

THE little book before us is far the best introduction to the study of Plato which we know, and every reader will be grateful to Sir James Frazer for rescuing it from his pigeon-holes. It was written fifty years ago as a dissertation for

a fellowship at Trinity, and has therefore all the charm of youthful enthusiasm and newly acquired knowledge. This more than compensates for any corrections necessary in minor points—the dating of the dialogues and so forth. It is one of the book's outstanding merits. Another is that, taking one thread—the development of the ideal theory—as the clue, it is possible to connect all the dialogues by their most vital link and give both unity and evolution to the picture without overloading it with details.

The last, and to a scientific reader the most weighty, merit is that the author, while enjoying Plato to the utmost as a writer, a dramatist, and a poet, is under no illusions as to the fundamental fallacies of the Platonic ideas. The criticism, based on a simple but very careful examination of the language of Plato himself, establishes the fact that the ideal theory arose from the questioning of Socrates as to the nature of general ideas, especially of a moral kind; was then elaborated into an ontological construction in a middle period, represented chiefly in the "Phaedo" and the "Republic"; and was dispersed, by virtue of its own contradictions and a strong admixture of Pythagoreanism, in the last period, represented by the "Timaeus", the "Sophist", and the "Parmenides".

It is this sketch of the whole series of the dialogues, linked up by the ideal theory, which gives the book its high interest and value. By slight enlargement here and there it can be regarded not only as an introduction to Plato but also as a picture of the nature and development of Greek philosophic thinking as a whole. One point on which Sir James Frazer is most emphatic throws a flood of light on the subsequent history of Platonic idealism and its influence on Christian and modern thought. He makes it abundantly clear that Plato never contemplated an idea of evil or evil things. The model which was laid up in heaven was of heavenly things, and was at every stage permeated by the notion of perfection in the moral rather than the logical sense. Its connexion on these lines with Christian theology is obvious, and it brings us direct to the modern conception of 'values'.

On the other side the author has little trouble in making the true and obvious connexion with the weakness of Greek scientific thinking as a whole, in jumping precipitately from the contradictions of sense to an ideal unity or cause lying behind them. This, Plato, in common with most Greek thinkers, was ready to find in an abstract construction of the mind. The mind of the thinker, thus set to work by the impact of sense impressions, then proceeded to work untrammelled in its interior isolation, and produced a result eminently satisfactory to the inward eye but certain to be shattered so soon as later observation confronted it with obstinate fact. This intently abstract and mental quality of Greek thinking accounts for their brilliant contributions to mathematics and their comparative failure to build up any efficient system of laws in the actual physical universe of which we are a part. The analogy of certain modern mathematical thinkers whose work is noticed from time to time in these pages immediately comes to the mind. F. S. MARVIN.

Virus Diseases and the Bacteriophage.

Medical Research Council. A System of Bacteriology in relation to Medicine. Vol. 7. By C. H. Andrewes, J. A. Arkwright, S. P. Bedson, F. R. Blaxall, F. M. Burnet, J. Burton Cleland, A. Felix, G. Marshall Findlay, W. Fletcher, I. A. Galloway, M. H. Gordon, J. G. Greenfield, W. E. Gye, W. F. Harvey, E. Hindle, P. P. Laidlaw, J. C. G. Ledingham, R. J. Ludford, J. E. McCartney, J. McIntosh, A. G. McKendrick, H. B. Maitland, M. S. Mayou, R. St. John-Brooks, J. Henderson Smith, A. Theiler, C. Todd, J. Walker. Pp. 509. (London: H.M. Stationery Office, 1930.) 21*s*. net.

THIS volume deals wholly with virus diseases and the bacteriophage. A review of it is somewhat difficult because divergent opinions exist regarding these viruses and the diseases they produce, and much of the information is necessarily uncertain and based on somewhat feeble foundations. At the same time, the interest in the subject is widespread, and it is well to have collected the main facts and theories into one volume.

There is necessarily a considerable amount of irregularity in the merits of the various articles. Some of these are written by men who have themselves an intimate knowledge of the subjects they deal with, while others are mere compilations from the work of others; and sometimes one asks why this special author has been chosen when others with practical experience of the diseases described could be found. One always sympathises with an editor who has to find someone to do the work when the man who ought to do it has refused, and this may possibly be the explanation of the choice in some of the cases.

The introductory survey in Chap. i., by Gye and Ledingham, and the chapter on cell inclusions are well written and give all the essential facts for those

who propose studying these diseases; but they also discuss and criticise the theories that have been suggested, and this method of dealing with the subject is both interesting and helpful to the reader.

The illustrations in Chap. ii. will be welcomed, though we think that clearness would have been gained if some colour had been used.

Chap. v., on foot-and-mouth disease, gives an excellent account of the work on this subject up-to-date, though one misses any reference to the now proved spontaneous outbreak in rats, established quite clearly by the Ministry of Agriculture. Though this article is well written, we think some parts of it might have been improved by the association with the author of someone with wider knowledge of the veterinary aspect of the disease. The chapter on smallpox is excellent, and written in a truly critical way by a man evidently thoroughly familiar with his subject.

Among the other outstanding chapters are those on encephalitis lethargica and acute poliomyelitis, by Prof. McIntosh; dog distemper, by Dr. Laidlaw; pleuro-pneumonia of bovines, by Walker; and typhus fever, by Arkwright and Felix. Though we may not agree with all the statements in these chapters, yet the facts are extremely well put, and the case for the conclusions strongly supported by evidence largely obtained by personal practical work by the authors. Virus disease work will no doubt produce many facts in the future which may bring about considerable changes in our present views, but the work in these chapters will largely remain as fundamental.

Yellow fever is a disease which has led to much controversy, but in Chap. xxxviii. Hindle has put the present position clearly and has given a well-considered account of the disease and its virus. The bacteriophage, even a more controversial subject, has been well and adequately treated by Dr. Burnet.

The virus diseases of plants and of insects have also been dealt with. There is a short but interesting chapter on acute disseminated encephalomyelitis and its relation to vaccinia, measles, etc., by Dr. Greenfield, which is well worth attention. In view of much recent work, the chapters on herpes and varicella are of value. Rabies is very fully dealt with by Harvey and McKendrick, and the chapter on measles is also worthy of careful study.

Of the rest of the volume little need be said. Those who are interested in such animal diseases as fowl plague, fowl pox, cattle plague, swine fever, etc., will find most of the information on the bacteriology of these diseases in various chapters, and practically all the diseases attributed to viruses are included. Most of these chapters are interesting, though many of them are mere compilations from papers by various authors. The advisability of having included some of them, considering the present uncertainty of our knowledge, is at least questionable, unless we are to have revised editions at frequent intervals. Even since some of the articles have been written, new information has been gained which might modify some of the views propounded. To take one example, we find no mention of the work on psittacosis.

Considering our lack of knowledge of the nature of the viruses, and the mass of literature—much of it undigested and contradictory—which has, within recent years, found its way into the journals, we congratulate the authors, as a whole, on the completion of what must have been a somewhat difficult task. They have produced a volume which will prove very helpful to all workers on the subject, and will prove to be not the least valuable of the volumes already issued. J. M. BEATTIE.

Early Beliefs.

(1) *Ghosts and Spirits in the Ancient World.* By Dr. E. J. Dingwall. (Psyche Miniatures: General Series No. 28.) Pp. 124. (London: Kegan Paul and Co., Ltd., 1930.) 2*s.* 6*d.* net.

(2) *Possession, Demoniacal and other: among Primitive Races, in Antiquity, the Middle Ages, and Modern Times.* By Prof. T. K. Oesterreich. Authorised translation by D. Ibberson. Pp. xi+400. (London: Kegan Paul and Co., Ltd., 1930.) 21*s.* net.

(3) *Animism, Magic and the Divine King.* By Dr. Géza Róheim. Pp. xviii+390. (London: Kegan Paul and Co., Ltd., 1930.) 21*s.* net.

INTEREST in what the second-hand booksellers' catalogues call 'the occult' is perennial. Here, if anywhere, is common meeting-ground for civilisations widely apart in time and space. The mascot is the fetish reborn: spiritualism and the cult of the dead are at one in their belief in the near presence of those who have 'passed over', and their concepts of the spirit-world might well be regarded as interchangeable.

Both Dr. Dingwall and Prof. Oesterreich suggest this reflection, the one specifically, the other by implication. The former points out that many early records of apparitions might have been written almost word for word to describe phenomena of

modern spiritualism: the latter places the data of possession among primitive races side by side with descriptions of the consciously induced states of the medium.

(1) Dr. Dingwall writes from the viewpoint of a scientific historian. He gives an account of the means employed in ancient times—in Egypt, Mesopotamia, among the Hebrews, and in the classical world—in order to make effective the belief in the existence of spirits, good and bad. Such, for example, are divination and other magical practices. The use of the waxen image, familiar in modern witchcraft, goes back to ancient Egypt. Dr. Dingwall also recalls some of the well-known cases of apparitions in Greek and Roman literature, as well as the remarkable spiritistic phenomena from ancient China. Chinese records of clairvoyance and telepathy, telekinesis, poltergeists, spirit-writing, and so forth, afford a remarkable parallel with the performances of the modern medium. The real problem is, however, how far these records may be regarded as constituting evidence which bears upon the quest of modern psychical research. Is there behind these stories, asks Dr. Dingwall, something which we are not yet in a position to explain?

Dr. Dingwall's conclusion is cautious, but he does hold finally that the records throughout the ages show that there have been manifestations which, after making allowances for fraud and delusion, point to something which is still unexplained and offers a field for research on strictly defined scientific lines.

(2) Prof. Oesterreich's treatise is a translation of a work which first appeared in German so long ago as 1921. It may be mentioned here as the direct antithesis to Dr. Dingwall's method of attacking the problem. Prof. Oesterreich's wide survey of the phenomena of possession among primitive races, in antiquity and in modern times, deals with the subject on psychological lines as the manifestation of an abnormality, whether automatic or induced. A translation of this work is very welcome, especially as its free use of verbatim quotation makes it a mine of information for the student.

(3) Dr. Róheim's work is a re-examination of early forms of belief and ritual, especially those conceptions relating to magic and fertility with which "The Golden Bough" has made us familiar. They are here translated into a whole-hearted sexual symbolism. In this extreme form the argument will scarcely convince anyone but an already fervent disciple of Freudian psychology.

Our Bookshelf.

Handbook of Chemical Microscopy. By Prof. Émile Monnin Chamot and Prof. Clyde Walter Mason. Vol. 1: *Principles and Use of Microscopes and Accessories, Physical Methods for the Study of Chemical Problems.* Pp. xiii + 474. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 22*s.* 6*d.* net.

ALTHOUGH the microscope has now become firmly established in the chemical laboratory, the average chemist is none too familiar with the instrument, and its possibilities are likely to be under-estimated. This volume offers to research worker, analyst, or technical chemist a useful compendium of microscopic technique, together with a clear explanation of the theory of the microscope, an understanding of which is essential for trustworthy and accurate work, especially at the higher magnifications. The various methods of illumination are set out, and their effects on resolution and contrast well explained.

Short sections devoted to ultra-microscopy, photomicrography, and the quantitative analysis of mixtures by microscopic methods dependent on counting or measurement will offer little fresh to the specialist, but should greatly assist the worker in another field, especially as there are adequate literature references.

One of the most valuable uses of the microscope to the chemist is in the determination of the optical properties of crystalline material for determinative or research purposes, and here the treatment appears somewhat cramped. The average chemist knows little of optics and less of crystallography, and so short a summary of crystal optics is likely to deter rather than to encourage him to refer to one of the text-books on this subject. The bibliography, too, is inadequate in this direction—a most disappointing perpetuation of the neglect of this field. Much space is devoted to the description of microscopes and accessories; this is a useful feature, but, unfortunately, dealt with almost exclusively from an American point of view. M. H. H.

The Economics of Forestry. By W. E. Hiley. (Oxford Manuals of Forestry.) Pp. xiv + 256. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 21*s.* net.

THIS book, the author states, is founded upon courses of lectures given in the Oxford School of Forestry and the Imperial Forestry Institute. The treatment of the subject differs from that followed by Schlich in his well-known "Forestry Manual", which has been used by generations of British-trained foresters. It is not at first sight easy to follow the author in his methods. The first part of the book is devoted to timber supplies, consumption, and prices, compiled from trade statistics in several parts of the world, and from other authors. In Part II. Hiley treats of finance and its importance. But it differs from Schlich's well-known "Valuation and Management" (vol. 3) in that Hiley has jettisoned most of the accepted formulæ of 'forest valuation'. The author admits that

some of the formulæ omitted may in the future prove useful. If this is the case, the student should be made acquainted with them.

Formulæ are not the only omissions. The author writes: "I have said nothing about the selection system of forest management, because I have been unable to find any reliable data on which to estimate profitableness under this system". A very large proportion of the forests of the British Empire are managed on some form of selection system, and must continue to be so managed for a long time to come. Further, Hiley states that the financial aspects of forestry have not received in the past sufficient notice, "since the care for forestry has been based on the objective of general human welfare rather than financial gain, and emphasis has been placed on the indirect benefits which forest maintenance often confers". In many of the forests of the British Isles the indirect benefits outweigh the direct financial ones, and a text-book should place the two aspects before the student. There are many good things in this book, but the omissions appear serious.

Electrical Power Transmission and Interconnexion. By C. Dannatt and J. W. Dalgleish. (The Specialists' Series.) Pp. xi + 424. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 30*s.* net.

THE transmission of electrical energy has now become a very important engineering problem. It is not surprising, therefore, that the literature on the subject is increasing very rapidly. The expert finds a difficulty in keeping abreast of the advancing tide of knowledge. Consequently, there is room for a book which describes the latest developments in the theory of transmission. This book is written by two capable engineers, and it is interesting to notice how they have collected, from the advanced treatises and papers they have studied, the theorems which have great practical value whether they are easy to understand or not. On p. 11, for example, we come across Maxwell's coefficients of capacity and potential. The schoolmaster in us objects, however, to such statements as "It will be obvious that $p_{12}=p_{21}$". This kind of assertion we come across in examination papers. In these cases we take it to mean that the examinee does not see it himself but hopes that it is obvious to the examiner.

What pleases us most about the book is that it is thoroughly up-to-date, and that only really important practical theorems are given. There are some defects in methods of proof, but in no case, so far as we have noticed, is the defect serious. We confess to feeling annoyed every time we come across Kirchhoff's name spelt with only one *h*. One of the most valuable chapters in the book is on the relative value of earthing as compared with insulating overhead high tension networks. In Great Britain we generally use solidly earthed neutrals. In Germany they are earthed through Petersen coils, so called after their inventor, Prof. Petersen, of Darmstadt. At the present time, there is scarcely sufficient operating experience available to determine which system is the best; but the authors state the problem clearly.

Dictionary of Biological Equivalents: German-English. By Ernst Artschwager. Pp. 239 (6 plates). (London: Baillière, Tindall and Cox, 1930.) 20*s.* net.

IN 1921, Dr. Ernst Artschwager and Edwina M. Smiley published a small "Dictionary of Botanical Equivalents", which was concerned with accurate translations of French-English, German-English terms employed in botanical science. Now Dr. Artschwager has prepared another dictionary of German-English equivalents embracing the wide field of terms employed in biological science. Owing to the extreme specialisation in biology which, as the author points out in his preface, "has increasingly narrowed the working sphere of the individual", the need for accurate, easily found translations of the technical terms employed is obvious, since every worker must needs keep abreast with related aspects of his own branch of natural science.

The book contains lists of abbreviations used, the common German abbreviations, irregular verbs, metrical equivalents, references used in compilation, as well as the dictionary itself. At the end of the book are six plates dealing with the morphology of plants and animals, which enable the reader to see at a glance the required equivalent, since the drawings are numbered and the key faces the illustrations. Dr. Artschwager is to be congratulated on producing a book so comprehensive in scope; and the publishers on the clear printing. The book is strongly recommended to those who have little knowledge of German technical terms which are employed in the various aspects of biological science.

The Structure and Meaning of Psycho-analysis as related to Personality and Behavior. By Dr. William Healy, Dr. Augusta F. Bronner, and Anna Mae Bowers. Pp. xx + 482 + xxiv. (London and New York: Alfred A. Knopf, Ltd., 1930.) 21*s.*

IT is difficult to imagine the audience for which this book is intended. It purports to be the outcome of an attempt to show "psycho-analysis as one of the scientific approaches to understanding of personality in a projected manual of methods of personality study", and the maze of material prompted the authors to compile "an organised statement of what had been contributed to date in psycho-analysis". On the left-hand page are given what are considered to be the orthodox theories as presented by Freud, while on the right-hand page are the various modifications suggested by other writers. The result, while being an admirable testimonial to the patience of the compilers, can scarcely be called useful. For serious students the best approach is the original work of first-hand exponents, while for those who want to get a general idea of such work there are innumerable popular manuals; if it is to be considered as a reference book, then far more bibliographical references are needed. Neither the structure nor the meaning of any subject can be adequately presented in this way.

Letters to the Editor.

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

Stellar Structure.

IT has frequently been stated, by myself amongst others, that it is necessary to assume in the inside of stars a temperature of the order of mc^2/k in order to explain the generation of energy by the annihilation of matter, m being the mass destroyed in each process, c the velocity of light, and k Boltzmann's constant. This letter is written in order to make clear that this assumption is not necessary. It is perfectly true that the equilibrium constant of a process, subject to the laws of thermodynamics, is of the order $e^{-\epsilon/kT}$, ϵ the energy of the process in this case, of course, being equal to mc^2. The equilibrium constant does not, however, determine the generation of energy. What one is concerned with in the case of a star is the rate at which energy is produced; in other words, if one presupposes the simplest process of annihilation, the rate at which protons and electrons disappear in the form of radiation. This is analogous to the rate of chemical reaction, not to the equilibrium constant of a reversible reaction.

In most chemical processes the rate of reaction is governed by the number of molecules activated per second, which again depends upon the number of particles the energy of which exceeds a certain value, say, ϵ_1. This number is proportional to $e^{-\epsilon_1/kT}$, and one therefore finds, roughly speaking, that the rates of reaction are negligible unless the temperature is such that the mean energy of the molecule is comparable with the energy of excitation. Since this activation energy is usually of the same order as the energy of the reaction, the conclusion is often extended without great inaccuracy to the total energy of the process.

In the case under consideration, the annihilation of protons and electrons, it seems difficult to imagine any form of excitation, and the rate at which it proceeds can therefore scarcely depend upon a function of this type. Presumably, in such collisions as are effective, certain circumstances, which occur but rarely, have to be fulfilled. When these are fulfilled, and they may not be such as require any high velocities, matter is converted into radiation; in the vast majority of cases, a collision has no such result. If this view is correct, the rate of annihilation, and therefore the rate of generation of energy, will depend in the first instance on the number of collisions per second, which of course varies with the density and with something like the square root of the temperature; and in the second instance, upon the special circumstances which render a collision effective, and which may, or may not, depend upon the temperature. In either event the simple exponential expression is not applicable, and the conclusion that matter can only be annihilated and energy produced in stars where interiors are at temperatures of the order mc^2/k, that is, $1{\cdot}1 \times 10^{13}$ degrees, is valid.

It would be true if the matter-radiation equilibrium has been attained and any further production required a change in the equilibrium constant. It is incorrect if the system has not reached equilibrium, for in this case thermodynamical reasoning is insufficient to determine the rate at which equilibrium will be approached.

F. A. LINDEMANN.

Clarendon Laboratory,
Oxford, Feb. 5.

REFERRING to Sir James Jeans's letter in NATURE of Jan. 17, p. 89, I may say that I fully acknowledged in my paper of November 1929 (*Mon. Not. Roy. Ast. Soc.*, **90**, p. 20) that Sir James was the first to recognise the principle that the mass M and luminosity L of a star are independent variables as regards steady state considerations. On p. 53 of that same paper (a page of which Jeans himself quotes in another connexion) I made a general reference of obligation to his work. In my last paper (*Mon. Not. Roy. Ast. Soc.*, **91**) I build on Jeans's permanent contributions to science in three places, mentioning him by name (pp. 4, 9, 51). I could not, however, adduce any of the specific results of his theory of stellar equilibrium in support of my conclusions, for they are totally different; and I could not contrast his results with mine without venturing to discuss his mathematics.

I cannot assent to Jeans's mathematics, because his theory of stellar equilibrium is in formal contradiction with his own (L, M) independence principle. It is an immediate consequence of this principle that for a given mass M in equilibrium the ratio λ of gas pressure to radiation pressure may have any value whatever between zero and infinity, depending on the arbitrarily assigned L. This is fundamental in my analysis. According to Jeans ("Astronomy and Cosmogony", pp. 88, 89) λ is small for large masses and large for small masses, and is calculable in terms of M (p. 97). Jeans may claim the principle, but his theory is not consistent with it.

The point of my analysis is the construction of configurations which satisfy the (L, M) independence principle, even for models for which $\kappa\eta$ is constant. The special properties attributed to these models by both Jeans and Eddington then disappear, and the new general properties which emerge (explaining as they do why some stars are very dense and others not) are shared by other models, since they depend only upon the occurrence of the central singularity $r = 0$ in a certain system of differential equations. Jeans uses throughout Emden's solutions, which possess no singularities.

As regards the branching-out of solutions near the boundary of a star, Jeans is considering a variety of models. *For any one model*, the solution is unique up to the boundary. The work of Mr. Fowler, Mr. Fairclough, and myself published in *Mon. Not. Roy. Ast. Soc.*, **91** (November 1930), discusses the family of such solutions arising from Emden's equation; with any definite configuration, of arbitrarily assigned mass, luminosity, and opacity, there is associated *one* member of the family of solutions, selected by a boundary condition which ensures that the boundary layers, of the prescribed opacity, enclose M and radiate L.

E. A. MILNE.

Wadham College, Oxford,
Feb. 5.

Generalisations and Modern Cosmogonies.

PROF. R. A. MILLIKAN in his retiring presidential address of the American Association for the Advancement of Science (NATURE, Jan. 31, p. 167), refers to the assumption "that the radiation laws which seem to us to hold here cannot possibly have any exception anywhere" as "precisely the sort of sweeping generalisation that has led us physicists into error half a dozen times during the past century". This emboldens me to ask again whether there is any evidence whatever for the uniform propagation of radiation in all directions in space from a sun or a star. I asked it (NATURE, Nov. 29, 1913, p. 339) at the time of Millikan's "fifth significant discovery", when radioactivity was indicating the necessity of extending

the cosmical time scale. Since then all modern cosmogonists, it seems to me, have constructed systems designed primarily to account for the maintenance of solar and cosmical energy on the scale demanded by this natural, but perhaps unwarranted, assumption.

Although I have no desire to trespass in the controversies concerning the nature of cosmical radiation, I may say that Millikan's views have always had a singular attraction to me because of the very difficulties to which he refers of finding a satisfactory kinetic picture of the instantaneous conversion of, say, 56 separate hydrogen atoms into one iron atom. This, to a chemist, a reaction of the 56th order, seems bizarre: for has not Sir Joseph Larmor educated us to regard a reaction even of the third order as difficult to form any kinetic picture of? But I like to think of these 56 atoms (or shall we say 55?) holding a committee meeting in the spacious regions of zero temperature and concentration, with infinite time ahead of them, and nothing to disturb them arriving at a decision (or possibly only awaiting a chairman) to rush into one another's arms and flash to us the birth of an iron atom.

FREDERICK SODDY.

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Oxford.

Change of Density of Ethyl Ether with Temperature.

IN connexion with my former studies on ethyl ether, made in the Physical Laboratory of the Technical Institute at Warsaw, I have made a study of the dependence of the density of ethyl ether upon temperature in the interval between − 120° C. and + 35° C., using the method described by H. Kamerlingh Onnes and J. D. A. Boks (*Comm.*, Leyden, No. 170 b).

The dilatometer and the control tube were made of fused quartz, carefully calibrated and provided each with a closely fitting quartz stopper. The dilatometer was placed in a deep glass Dewar vessel, so as to permit the observation of the level of liquid in the dilatometer. The temperature was determined by two platinum resistance thermometers placed at different depths.

There was great difficulty in selecting the cooling liquid. The specially purified petrol ether which is commonly used for this purpose permits of lowering the temperature to − 150° C., but even at − 70° C. it becomes so markedly disturbed as to make the observation of the levels of the liquid both in the dilatometer and the control tube quite impossible. After several attempts I found that a mixture of chemically pure ethyl ether and ethyl alcohol remains clear down to − 120° C. Probably this is due to the fact that ethyl alcohol absorbs the last traces of moisture in the cooling liquid, which would otherwise cause it to become disturbed at low temperatures.

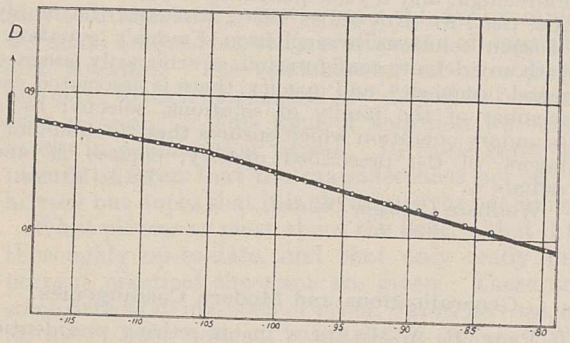

FIG. 1.

The density of ethyl ether as a function of temperature in the neighbourhood of the point − 105·4° C. is represented on the accompanying graph (Fig. 1). The shape of the curve shows that the density of very carefully purified ethyl ether increases with the lowering of temperature from the value 0·6964 at 35° up to 0·8595 at − 105·4° C. With further lowering of temperature the density of ethyl ether still increases, but the rate of increase is markedly lower. According to former studies made in this laboratory, there appears also at this temperature a change of the value of the dielectric constant and of the specific heat of ethyl ether (J. Mazur, NATURE, **126**, 649; 1930: M. Wolfke and J. Mazur, NATURE, **126**, 684; 1930). Thus at the previously found transition point − 105·4° C. the density curve shows also a distinct change of character. At − 117·2° C. (freezing-point) the density has the value 0·8654.

J. MAZUR.

Technical Institute, Warsaw,
Jan. 6.

Crystal Structure of Martensite.

IT was first shown by W. L. Fink and E. D. Campbell (*Trans. Am. Soc. Steel Treat.*, **9**, 717; 1926), and independently by N. Seljakow, J. Kurdumoff, and N. Goodtzow (NATURE, **119**, 494; 1927), that quenched carbon steels contain a phase with a tetragonal crystal structure, which might be considered as a deformation of the body-centred cubic structure of α-iron. This has been confirmed by other investigators, and our present knowledge of the tetragonal martensite may be briefly summarised as follows. The axial ratio increases from about 1·03 at 0·8 per cent carbon to 1·06 at 1·4 per cent carbon. At lower contents of carbon the interference doublets corresponding to the tetragonal lattice are not resolved, but in photograms of very rapidly cooled specimens the α-Fe-lines are slightly displaced in such a way as to indicate a tetragonal deformation. The higher the carbon content and the higher the axial ratio, the larger is also the volume of the unit cell.

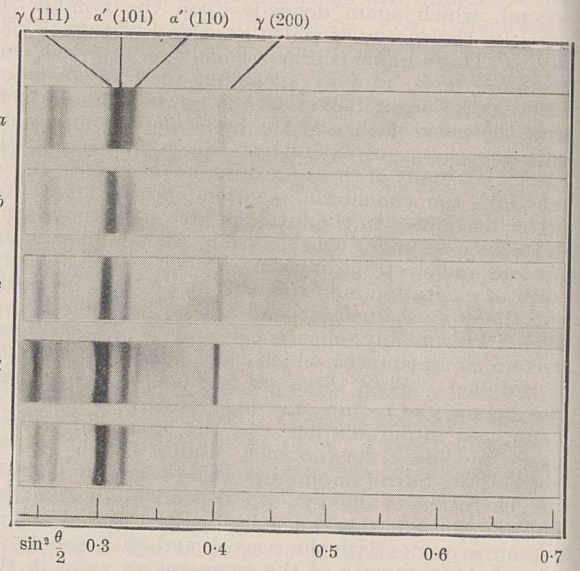

FIG. 1.—X-ray photograms of quenched carbon steels. The two lines γ (111) and α′ (101) are separated in the original films. *a*, 0·80 per cent carbon; *b*, 1·04 per cent carbon; *c*, 1·20 per cent carbon; *d*, 1·35 per cent carbon; *e*, 1·35 per cent carbon, after forty-eight hours in liquid air.

It is thus evident that there is a correlation between carbon content and lattice dimensions, and it must be considered as an established fact that the tetragonal martensite has a homogeneity range of considerable

extent. Recent investigations by means of thermal (Ed. Maurer and G. Riedrich, *Archiv f. d. Eisenhüttenwesen*, **4**, 95; 1930) and microscopic (F. Wever and N. Engel, *Mitt. a. d. Kaiser-Wilhelm-Inst. f. Eisenforschung*, **12**, 93; 1930) analysis have shown that the austenite-martensite change takes place also in steels with a very low content of carbon. This is in favour of the assumption that the tetragonal martensite is a supersaturated solution of carbon in α-iron. An X-ray investigation by G. Kurdumoff and E. Kaminsky (NATURE, **122**, 475; 1928) points very strongly in the same direction. They find the dimensions of the axes c and a of the tetragonal phase to be linear functions of the carbon content, and the lines to intersect at a point corresponding to the elementary cube edge of pure α-iron. On the other hand, Wever and Engel refrain from stating the axial dimensions obtained in their X-ray work, and emphasise the difficulties of exact determination, due to the diffuse interference lines and to the fact that the strongest lines of the tetragonal phase are covered by either γ- or α-iron lines.

By using focusing cameras constructed by G. Phragmén, which give a much higher dispersion than the ordinary Debye cameras, and by employing chromium K-radiation, which has a comparatively long wave-length, I was able to obtain photograms of quenched steel specimens of which the line (101) of the tetragonal phase is separated from the γ-Fe line (111). It was thus possible to determine the lattice dimensions of the tetragonal structure from the strong and comparatively sharp lines (101) and (110). Some of the photograms are reproduced in Fig. 1. The results obtained are given in the following table.

Per cent Carbon.	Tetragonal Phase.				γ-iron.	
	a.	c.	$c:a$.	Volume per lattice point.	a.	Volume per lattice point.
0·71	2·853 A.	2·941 A.	1·031	11·97 A³.	3·581 A.	11·48 A³.
0·80	2·852	2·956	1·036	12·06	3·584	11·51
1·04	2·848	2·979	1·046	12·08	3·592	11·59
1·20	2·846	2·999	1·054	12·15	3·600	11·66
1·35	2·843	3·014	1·060	12·18	3·609	11·76
1·40	2·840	3·034	1·068	12·23	3·616	11·82

The results are reproduced graphically in Figs. 2 and 3. The correlation of the points belonging to the tetragonal phase is very satisfactory. The two curves of Fig. 2, giving the axial dimensions as

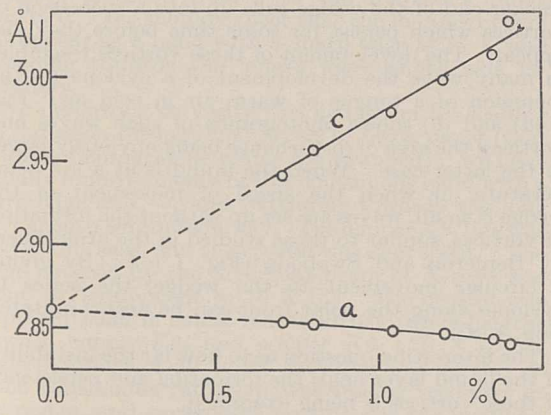

FIG. 2.—Lattice dimensions of the α′-phase as function of the carbon content.

function of the carbon content, converge to a point corresponding to the edge of the elementary cube of pure α-iron in complete agreement with the result of Kurdumoff and Kaminsky. The present investigation has thus completely confirmed the assumption that the tetragonal martensite is a supersaturated solution of carbon in α-iron. Ferrite and tetragonal martensite are thus one and the same phase, but as they are often present in one and the same specimen as separate micrographic structure elements, it seems convenient to denote the tetragonal phase as α′.

As shown by A. Westgren and G. Phragmén (*Jour. Iron and Steel Inst.*, **109**, 159; 1924), the carbon atoms, when dissolved in γ-iron, do not occupy any points of the face-centred lattice, but are statistically distributed in the interstices between the iron atoms. Seljakow, Kurdumoff, and Goodtzow (*Zeit. f. Physik*,

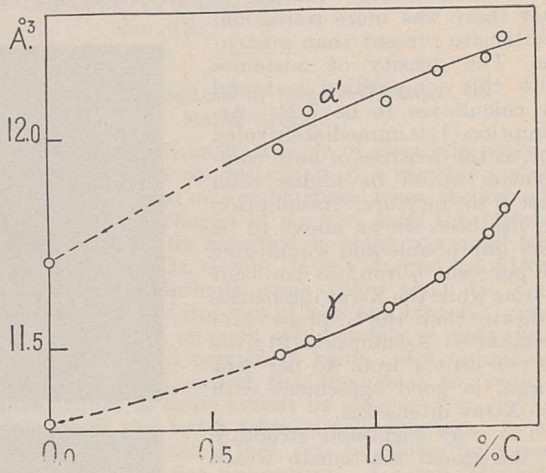

FIG. 3.—Volume per lattice point for the α′- and the γ-phases as function of the carbon content.

45, 384; 1927) suggested that the same might be the case in the α′-phase, and even proposed definite positions for the carbon atoms which would explain the tetragonal deformation, namely, at the centre of those faces which are perpendicular to the tetragonal axis. This atomic arrangement is, however, very improbable, as the space available for the carbon atoms would be extremely small. But even if a carbon atom were situated in one of those points, where the distances to the surrounding iron atoms are the greatest ($\frac{1}{2}$ 0 $\frac{1}{4}$), the space available for the carbon atoms would be considerably smaller than in the face-centred structure. One would therefore expect the volume of the body-centred lattice to increase much more rapidly with the carbon content than that of the face-centred, while, as seen from Fig. 3, the opposite is in fact the case. On the other hand, a simple substitution of carbon atoms for iron atoms in the lattice would cause a decrease in the lattice dimensions, as the carbon atoms are much smaller than the iron atoms.

I am indebted to Dr. G. Hägg for the suggestion of still another possibility, namely, a complex substitution in such a way that a group of two carbon atoms is substituted for one iron atom in the lattice. Such groups of carbon atoms have, in fact, been found by M. v. Stackelberg (*Zeit. phys. Ch.* (B), **9**, 437; 1930) in several carbides of the composition MC_2 and a similar arrangement of hydrogen atoms by Hägg (*Zeit. phys. Ch.*, in press) in ZrH_2. These compounds all have a tetragonal structure, and in most cases the axial ratio is higher than one, which is contrary to what is generally the case in deformed cubic structures. This is explained by the assumption that the C_2 group is in these cases orientated parallel to the tetragonal axis, an explanation which holds equally well for the tetragonal martensite.

An attempt was made to find the positions of the carbon atoms by means of density determinations. The density of the α'-phase when containing 1·35 per cent carbon was calculated on the following three assumptions :

(1) Addition of carbon atoms	7·65
(2) Complex substitution of carbon atoms . .	7·42
(3) Simple substitution of carbon atoms . .	7·19

A steel specimen with this content of carbon was quenched and afterwards placed in liquid air for 48 hours in order to increase the percentage of the α'-phase. The density was found to be 7·62. As shown by an X-ray photogram (Fig. 1, *e*), the specimen consisted of α'- and γ-iron, and the intensities indicate that there was more tetragonal martensite present than austenite. The density of austenite with this composition is found by calculation to be 7·94. Assumption (1) is immediately ruled out, as the densities of both components would be higher than that of the mixture. Assumption (3) has been shown above to be very improbable and would give 57 per cent γ-iron, 43 per cent α'-iron, while the X-ray intensities indicate that the α'-phase predominates. Assumption (2) gives 60 per cent α'-iron, 40 per cent γ-iron, in good agreement with the X-ray intensities.

The only suggested structure of tetragonal martensite which explains the observed density, the increase of volume with the carbon content, and the elongation of one of the crystallographic axes may be described as follows. In the body-centred lattice, groups of two carbon atoms, statistically distributed, replace some of the iron atoms. The carbon atoms are most probably orientated in such a way that the axes of the C_2 groups are parallel to the tetragonal axis of the lattice.

The decomposition of the α'-phase on tempering, as well as the reactions occurring on ineffective quenching, have also been studied, and the results obtained will be published elsewhere, with a more detailed account of the results reported here.

EINAR ÖHMAN.
Institute of General and Inorganic Chemistry of the University,
Institute of Metallography,
Stockholm, Jan. 5.

A Laboratory Method of demonstrating the Formation of Fronts and Vortices when there is discontinuous Movement in a Fluid.

ACCORDING to views now generally accepted, extra-tropical cyclones are formed along surfaces of kinematical discontinuity between air-masses having different temperatures and moisture-contents, and during their growth they possess an asymmetrical structure. Recent studies [1] of tropical cyclones show that they also have often a similar origin and structure.

It is well known that vortices can easily be formed in a fluid by producing a sufficiently sharp discontinuity of velocity—as by suddenly moving a half-immersed spoon across the surface of water. A common method of studying stream-lines in water is by strewing aluminium powder on its surface. With water, however, the movement is so rapid that it is often difficult to follow its details. Melted spermaceti, in which aluminium powder is suspended, is a very convenient medium for the demonstration and study of fronts and vortices similar to those which occur on a much larger scale in Nature.

If a shallow layer of spermaceti is heated in a flat enamel dish over a plate of copper or brass, then, as is well known, the liquid layer is divided up into a series of small polygonal cells with liquid rising at the centres of the cells and falling at their peripheries. If, now, a cylindrical rod is moved across the liquid with its axis vertical, the formation of the Kármán double row of vortices can be distinctly seen. By substituting a thin small-angled wedge of wood with its narrow end dipping in the liquid, and moving it across the surface with its axis inclined, a wave motion is set up, and the stream which flows past the thicker end of the wedge rolls up into a succession of vortices which persist for some time before they disappear. The development of these vortices resembles in many ways the development of a cyclone by the incursion of a tongue of warm air in cold air. Fig. 1 (*a*) and (*b*) shows photographs of such waves and vortices, the area of disturbance being obviously larger in the latter case. When the liquid is at a low temperature, or when the speed of movement of the wedge is small, waves are set up without the formation of vortices, similar to those studied in the atmosphere by Bergeron and Swoboda (Fig. 1 (*c*)). By giving a circular movement to the wedge, the series of cyclones along the polar front can be neatly imitated (Fig. 1 (*d*)).

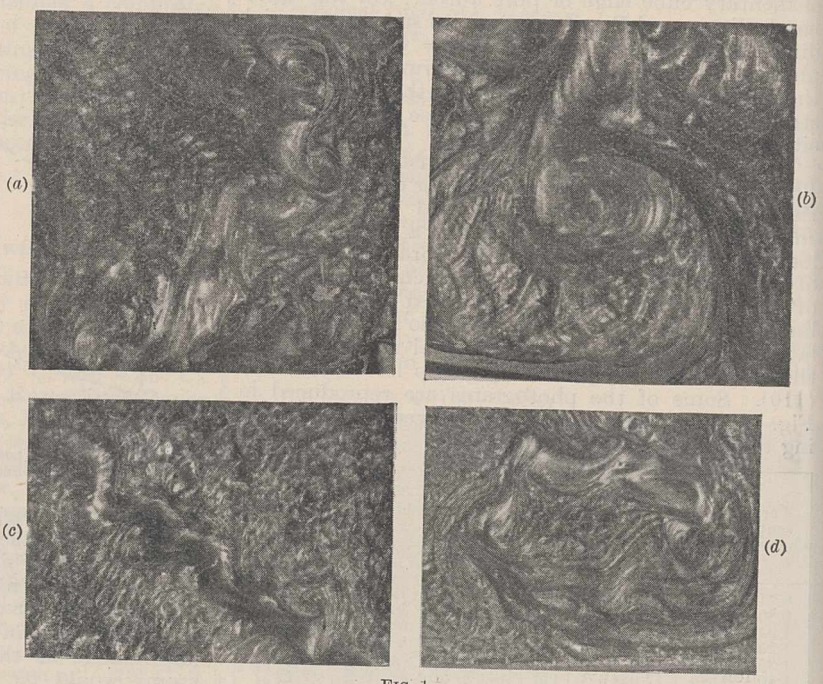

FIG 1.

The interesting question as to how far the instability of the liquid layer helps the formation and persistence of these vortices is being examined.

K. R. RAMANATHAN.
SOBHAG MAL.
Meteorological Office, Poona,
Dec. 23.

[1] K. R. Ramanathan and A. A. Narayan Iyer: "The Structure and Movement of a Storm in the Bay of Bengal during January 1929".

Modification of Quanta by Photo-ionisation.

In the course of further experiments on the phenomenon described by Dr. B. B. Ray (NATURE, May 17, p. 746, and June 7, 1930, p. 856), which was explained by Dr. Ray and one of us (NATURE, Sept. 13, 1930, p. 398) as a case of partial absorption of the quantum leading to photo-ionisation, we came across an interesting experimental result. On using the copper $K\alpha_1, \alpha_2$ radiation and passing it through paraffin 1 mm. thick, we obtained a modified line on the long wave-length side, separated from the parent line by the approximate frequency distance $\Delta\nu = R$ (R = Rydberg constant). We are inclined to interpret it as a case of photo-ionisation of hydrogen contained in paraffin in the combined state.

In these experiments, a Uhler and Cooksey type of X-ray spectrometer supplied by Messrs. A. Hilger, Ltd., was used. The crystal of calcite was kept fixed. The photographic plate was firmly clamped in the plate-holder, which is itself a heavy metallic one and is firmly clamped to the body of the spectrograph, leaving no chance of the plate being displaced during an exposure. The modified line was obtained on three plates only when a layer of paraffin was used as an absorber.

The other alternative was to ascribe this line to partial absorption of the quantum by an electron in the aluminium (used as window) L_1-shell, but this explanation fails, as the energy of ionisation of aluminium in the L_1-shell is found to be equivalent to about $5{\cdot}3\,R$, that is, about 72 volts, according to a recent paper by Söderman (*Phil. Mag.*, 616, Sept. 1930).

In a previous letter (NATURE, Sept. 13, 1930), it was pointed out that the phenomenon is analogous to the ejection of electrons from the K-shell of radioactive atoms by γ-ray quanta coming from the nucleus, as found by L. Meitner, Ellis, and others. But there is one important difference. The γ-ray is supposed to impart the whole of its energy to the K-electron, which is therefore ejected with the energy $h(\nu - \nu_k)$. But in the present case, the X-ray quantum is supposed to impart only a fraction $h\nu_k$ ($h\nu_k$ stands for energy of ionisation in the K-shell) and then continues its journey with the energy $h(\nu - \nu_k)$. The two cases are therefore two extremes of the same phenomenon.

It therefore seems probable that the quantum, whether internal (coming from the nucleus) or external (coming from an outside source as an X-ray quantum), may on its passage through atomic shells impart any part of its energy to the electron from $h\nu_k$ to $h\nu$, and be therefore modified from ν to the frequency range $\nu - \nu_k$ to 0. We should expect that the modified beam will appear as a band with a sharp edge at $\nu - \nu_k$ and extending towards the longer wave-length side indefinitely.

We undertook to verify this deduction by sending the radiation through four layers of black paper (that in which photographic plates are wrapped); we have actually found evidence of this continuous band with a sharp edge at $\nu - \nu_k$ and extending towards the long wave-length side indefinitely. The copper $K\beta_1$ line was used in this case, and the crystal was kept fixed. The range covered by the divergent beam of X-rays was about 45′ (equivalent to 70 X.U.). The crystal was so placed that it could reflect all the wave-lengths between copper-$K\beta_1$ and copper $K\beta_1 + 70$ X.U. A single exposure of 50 hours' duration was given. A feeble continuous radiation was indeed recorded in this region, and superposed on this was the modified line with a sharp edge on the short wave-length side and extending towards the long wave-length side as stated in the previous paragraph. The separation between the edge of this line and the parent line was about 20 in ν/R units—20·4 being the C level in ν/R units as found by Söderman (*Zeit. f. Phy.*, 52; 1929). A separate exposure was given for 10 minutes to record the copper $K\alpha_1, \alpha_2$ lines for reference and measurement. No continuous radiation was recorded in the neighbourhood of copper $K\alpha_1, \alpha_2$, as the former is too feeble to be photographed in an exposure of 10 minutes.

These experiments seem therefore to prove that the phenomenon is general, and the quantum can impart to the bound electron energy varying from $h\nu$ to $h\nu_k$, and be modified to any frequency less than $\nu - \nu_k$. Further experiments are proceeding.

S. BHARGAVA.
J. B. MUKERJIE.

Physical Laboratory,
University of Allahabad,
Nov. 13.

Simple Deposition of Reactive Metals on Noble Metals.

According to Nernst's theory of electrode potentials, a very small concentration of a reactive metal should be deposited on a noble metal when the ions of the former are brought in contact with the latter. The effect is usually regarded as being too small for demonstration. Dr. G. von Hevesy showed the effect by radioactive methods some years ago. He deposited radioactive isotopes of lead and bismuth, presumably as metal, on such noble metals as platinum, gold, mercury, and copper, in some cases quantitatively; he showed, indeed, that the ions of any radio-element could to some extent be deposited on noble metals when the latter were merely immersed in a solution. The effect, I find, can be shown by some metals which are not radioactive. I have obtained it with reactive metals like uranium, titanium, tungsten, and molybdenum on such noble metals as mercury, copper, and tin.

It is obtained simply. A liquid amalgam is shaken vigorously with a solution of a uranium, titanium, tungsten, or molybdenum compound in acid for a few minutes or less, removed from the solution, and well washed. To the amalgam 0·1 gram of pure zinc is added, and the minimum concentration of sulphuric acid at which hydrogen is found to be evolved determined. Whereas with an amalgam employed as a blank no hydrogen is visible with $2N$-sulphuric acid, the amalgams which have been shaken with uranium, titanium, tungsten, and molybdenum solutions are found to evolve hydrogen down to concentrations of 0·012, 0·0025, 0·002, and 0·002 N-sulphuric acid respectively. This catalytic effect cannot be due to the mere act of shaking, since it is not given when acidified solutions of manganese, chromium, and vanadium, which are metals similar to those given above, are shaken with amalgams to which zinc is afterwards added. Nor can it be ascribed to oxides or other compounds of these metals, since these have never been shown to catalyse the formation of hydrogen when zinc is brought in contact with a dilute acid. In the well-known experiment of adding copper sulphate or platinic sulphate to zinc immersed in acid in order to catalyse the evolution of hydrogen, it is difficult to think that the catalyst is not metallic copper or platinum. These catalysts, uranium, titanium, tungsten, and molybdenum, behave as though they were deposited platinum, and are therefore presumably in the metallic state.

This view is supported by the fact that any of these metals when deposited by a current on a mercury cathode behaves catalytically towards the evolution of hydrogen exactly as does the amalgam which has been shaken with a solution. Such amalgams appear entirely metallic. Uranium and titanium have

hitherto not been deposited electrolytically from aqueous solutions on a cathode, but this has been effected by Mr. R. Groves in this laboratory.

Mercury is the noblest metal on which we have succeeded in depositing these four metals by mere shaking. Amalgams of copper, bismuth, lead, tin, cadmium, and zinc show the effect in increasing amount, but only with molybdenum have we shown the presence of the catalytic metal by chemical means. The amount deposited must in all cases be very small. The electrode potentials of the four metals I have mentioned have never been accurately determined, but published work places uranium with manganese, titanium with zinc, and tungsten and molybdenum with cobalt and nickel in the list of electrode potentials of metals. These similarities are supported by the behaviour of the metals towards acids, the difficulty of reduction of their ions in aqueous solution to the metallic state, and such evidence. It is quite certain, in any case, that all four are more electro-positive than tin, and therefore than lead, copper, and mercury.

It is fortunate that each of the catalytic metals, as appears from measurements we are making, is quite insoluble in mercury. The very small concentration deposited on the amalgam by shaking thus forms a separate phase with practically no loss through solution in the mercury. It is this separate phase which is the catalyst for the hydrogen evolution which enables the small concentration to be detected.

A. S. RUSSELL.

Dr. Lee's Laboratory, Christ Church,
Oxford, Jan. 26.

Development of Golgi Apparatus in Water- and Soil-grown Roots of *Vicia faba* Seedlings.

WHILE *Vicia faba* is generally quoted as the type seed for successful germination in water under laboratory conditions, it is, nevertheless, noted that germination in sand is more rapid and much more reliable.

The rate of growth of a seedling root under normal conditions depends on the activity of the meristem, and of the region of elongation. This is directly related to the supply of available food material, which in turn is a function of metabolic rate, and consequently of respiration. The respiration of a non-hydrophyte, such as *Vicia faba*, might conceivably be adversely affected by growth in water. Two series of seedlings were therefore grown, one in water and one in sand, to determine whether the difference in growth rate was linked up with any constant cytological variation.

As has been already observed,[1] part of the food material visible in the cells of *Vicia faba* consists of Golgi apparatus, either in a reticular or granular form. The examination of fifty seedlings, varying in length from one to sixteen centimetres, showed that such a Golgi apparatus is commonly present in dermatogen and periblem in both water- and soil-grown roots. It may be temporarily absent in the primary root during the early stage of development of the secondaries. In the latter, as in the tertiary rootlets, it is also observed to occur. The fixation method used is described in detail in the paper referred to above. The sections were cut four to six microns thick.

FLORA MURRAY SCOTT.

University of California at Los Angeles,
California.

[1] Scott, F. M., "Occurrence of Golgi Apparatus in the Seedling of Vicia faba", *Amer. Jour. Bot.*, **16**, No. 8, pp. 598-605; October 1929.

Swelling Pressure of Rubber.

MEASUREMENTS of the swelling pressure of rubber (Stamberger and Blow, *Koll. Zeitschr.*, **53**, 90; 1930) lead to the conclusion that the swelling pressure results from the attraction of solvent molecules by the molecules of gel. A simple formula expressing the variation of molecular force of attraction with dilution, $P = K/V^2$, has been applied and gives satisfactory results. In the present case P is the swelling pressure (MLT^{-2}), V is the volume of solvent bound to unit weight of jelly (L^3), K is a constant the meaning of which is obtained by substituting $P = K/V^2$ in the maximum work term $dA = P\,dV$.

K is characteristic for all solvents and jellies, and expresses the potential energy when unit volume of solvent is bound to unit weight of the gel. (The dimension of K is ML^5T^{-2}.)

The formula has been tested with all the data available and the constancy of PV^2 is fulfilled in a satisfactory manner.

Full details will be published shortly.

PAUL STAMBERGER.

The Netherland Government Rubber Institute,
Poortlandlaan, Delft,
Jan. 3.

The Black-necked Grebe.

I OWE thanks to the Writer of the Note on the black-necked grebe for correcting my error in naming Linnæus instead of Latham as responsible for the generic title of the grebes (NATURE, Feb. 7, p. 201); but when he goes on to say that the "name is a label and need have no meaning in itself", I must ask how a label can be justified that conveys a false meaning, as *Podiceps* does. Are misprints in scientific nomenclature to be reckoned indelible? That has not been the opinion of such ornithologists as Seebohm, A. H. Evans in the "Cambridge Natural History", and Prof. Alfred Newton, who all write *Podicipes*. In his "Dictionary of Birds", Newton notes about *Podicipedidæ*—"often, but erroneously, written *Podicipidæ*. The word *Podiceps*, as commonly spelt, being a contracted form of the original *Podicipes* (*cf.* Gloger, *Journal für Ornithologie*, 1854, p. 430, note), a combination of *podex*, *podicis*, and *pes*, *pedis*, its further compounds must be in accordance with its derivation".

HERBERT MAXWELL.

Monreith.

Embryology and Evolution.

IN NATURE of Jan. 10, Prof. MacBride appears to deny that a cross between two types of *Cavia* to which I referred, and which leads to Mendelian segregation, was an interspecific cross. Not only did Detlefsen,[1] who carried it out, regard it as such, but, also, the male hybrids were wholly sterile. In view of the latter fact, I did not suppose that Prof. MacBride would question its interspecific nature.

In spite of Prof. MacBride's disbelief in autocatalysis, I hope to demonstrate this phenomenon to students of the Natural Sciences Tripos next week, as I have done annually for some years.

J. B. S. HALDANE.

University of Cambridge,
School of Biochemistry,
Sir William Dunn Institute,
Tennis Court Road, Cambridge,
Jan. 31.

[1] Detlefsen, *Pub.* 205, Carn. Inst. Wash.

New Aspects of Radioactivity.*

By Dr. C. D. ELLIS, F.R.S.

γ-RAYS AND NUCLEAR STRUCTURE.

UNTIL a few years ago, the fundamental problems of physics were those concerned with the structure of the atom. The nucleus was necessarily often referred to, but only in relation to its effect on the behaviour of the electrons in the atom. It was found that for most purposes the net charge, Ze, was a sufficient description of the nucleus. Within, however, the last three years, the whole attitude of physicists to this problem has changed; on one hand, our knowledge of those phenomena which depend on the intimate structure of the nucleus has been greatly increased; on the other hand, wave mechanics has proved to be eminently suitable for a theoretical attack on this problem, and has already provided a solution of some of the outstanding problems.

Of the many lines of investigation which have been developed, not the least interesting is that of the characteristic electromagnetic radiation that can be emitted by radioactive nuclei. These radiations are termed the γ-rays and are in general of considerably shorter wave-length than the X-rays. They bear the same relation to the structure of the nucleus as do the ordinary optical and X-ray spectra to the structure of the electronic system of the atom, but there is this one point of difference. The optical and X-ray spectra can conveniently be studied for a series of elements because the process of excitation is under control, but it is only in a few isolated cases that it has yet been possible to excite a nucleus by external agencies to emit characteristic radiation. Some of the radioactive bodies, however, emit these radiations spontaneously, since the process of disintegration leaves the newly formed nucleus in an excited state and able to emit its characteristic radiation. The nuclear spectra have therefore only been examined in detail for those radioactive bodies which happen to emit them, and it has been impossible as yet to find any general laws governing the arrangement of these spectra by noting the similarities in the spectra from a succession of different nuclei.

The result of this was that, until a few years ago, while there was a great deal of information about the nuclear spectra of several radioactive bodies, it was still impossible to associate this with any definite feature of the structure. Recently the position has changed greatly, and it now seems possible to view in the nuclear level systems which can be deduced from the γ-ray measurements the characteristic stationary states of α-particles or protons in the nucleus, and to associate such level systems directly with the ground states deducible from other evidence.

METHODS OF INVESTIGATING THE γ-RAYS.

A simple method that was of great importance in the early days of radioactivity was to investigate the absorption of the radiation emitted by a particular body by placing a radioactive source at some distance from an electroscope and observing how the ionisation decreased when successive sheets of some material such as aluminium or lead were interposed. It was frequently possible to analyse the resulting absorption curve into a series of simple exponential curves, and thus to obtain a general idea of the different components of the complex radiation. Methods such as this could never yield very precise information, and they have now been superseded by more accurate methods.

The crystal method, in the forms used for X-rays, has been applied with considerable success to γ-rays.[1] In one respect the technique is simpler, since in place of the X-ray tube with all the apparatus necessary to run it, it is only necessary to use a fine tube containing the radioactive material, but in other respects the experiments are far more difficult. Owing to the very short wave-length, of the order of 40 X.U. to 4 X.U., the glancing angles are extremely small, and not only is the adjustment of the apparatus considerably more difficult but it is also impossible to measure the wave-length with much accuracy. Further, in comparison with an X-ray tube, the normal amount of radioactive material constitutes an extremely weak source of radiation. As a result it has not yet been possible to push this method when using photographic registration beyond 16 X.U. Recently Steadman [2] has devised an arrangement, using an electrical counter in place of a photographic plate, which may overcome some of these difficulties.

The method which has given us most of our information is based on the photoelectric effect. The general principle is very simple and is as follows.[3] A tube containing the radioactive body, the γ-rays of which are under investigation, is placed inside a small tube of some material of high atomic weight, such as platinum. In their passage through the platinum, the γ-rays eject groups of photoelectrons the energies of which are connected with the frequency of the γ-rays by the Einstein law. Thus the γ-ray of frequency ν will lead to the ejection of a series of groups of electrons of energies $h\nu$-K_{Pt}, $h\nu$-L_{Pt}, etc., according to whether the conversion occurs in the K, L, etc., state of the platinum atoms. This electronic emission can be separated out into a corpuscular spectrum by the usual method of semicircular magnetic focusing. It is usual to register these spectra photographically, and there is not a great deal of difficulty in analysing them and deducing the corresponding γ-rays, since in most cases it is only the electronic group from the K level which is sufficiently intense to give a detectable effect. The general application of the method is greatly limited by the fact that the photographic impression of the groups of electrons always shows as a broad, rather diffuse band. The reason is that, although the photoelectrons are ejected from the platinum atoms with sharply defined energies, only those from the surface

* Substance of two lectures delivered at the Royal Institution on Nov. 4 and 11.

of the tube actually emerge with their full velocity. Those from the lower layers are retarded in their passage out, and cause the diffuse character of the band.

Fortunately, the radioactive atoms themselves provide us with much more favourable opportunities for observing this photoelectric conversion, by what is termed internal conversion. This is by itself an extremely interesting phenomenon, and will be referred to in detail later. For the present purpose it is convenient to describe it as follows. When a radioactive nucleus emits a quantum $h\nu$ of radiation, this does not always escape as such from the atom but may be absorbed by the electronic structure of the atom in its passage out. This internal conversion follows the usual photoelectric laws, and thus a radioactive body which emits γ-rays will also emit a corpuscular spectrum similar in every respect to that coming from the platinum tube already mentioned, except that the energies are now $h\nu$-K_{rad}, $h\nu$-L_{rad}, . . . The result is in principle in no way different from the previous case where the γ-rays were converted in the platinum, but the importance of this phenomenon for determining the wave-length of the γ-rays depends on the following facts. If a normal amount of radioactive material is deposited on the surface of a fine wire, the actual number of atoms is so small that the layer is in general less than one atom deep. The electrons liberated by this internal photoelectric effect therefore all escape with their full energy and give extremely sharp lines on a photographic plate, in striking contrast to the broad bands obtained by the normal external photoelectric effect. There is the further advantage that the probability of this internal conversion is so great that measurable lines can be obtained with far shorter exposures than by the other method, and the effects of γ-rays are detectable which are so weak as to be quite unattackable by the other method.

The γ-rays of many radioactive bodies have been analysed by this method, and the main features of the characteristic nuclear spectra are known. The accuracy with which the frequencies can be determined is, however, considerably lower than that realised with X-ray spectra. Even in the case of the bodies radium B and radium C, which have been extensively investigated, the relative frequencies are probably not known to much better than one part in five hundred, and the absolute error may be greater. The chief cause for this lies in the difficulty of obtaining a homogeneous magnetic field over a large area.

Intensities of the γ-Rays.

An important method[4] of investigating the intensities has been developed by Skobeltzyn, based on the Compton effect of the γ-rays. A narrow pencil of γ-rays is allowed to pass through an expansion chamber and the recoil electrons liberated by the Compton effect of the γ-rays are observed in the usual manner. In addition, a magnetic field parallel to the axis of the chamber is applied at the moment of expansion, so that the tracks of the recoil electrons are curved by an amount depending on their velocity. By observing both the curvature and the direction of emission of the recoil electrons, it is possible to associate each electron with a γ-ray of definite frequency. A statistical study is made of the relative number of the recoil electron tracks, and from a knowledge of the general laws of scattering it is possible to deduce the relative intensities of the γ-rays.

Owing to a variety of experimental causes, the resolution of the method is not very high, and the effect of two neighbouring γ-rays cannot always be clearly separated. This disadvantage, however, is far outweighed by the definiteness of the results about the intensity distribution throughout the spectrum, and by the fact that the method detects weak γ-rays equally efficiently as strong γ-rays. The interpretation involves a knowledge of the laws of scattering, but there is both a reasonable theoretical foundation and internal evidence from these experiments which combine to render the uncertainties due to this cause of little importance at present.

The photoelectric method has been applied to determine the intensities of the γ-rays by Ellis and Aston.[5] The corpuscular spectra liberated from the radioactive atoms themselves by the internal conversion are clearly of no use in this connexion, since the relative intensities of the groups depend upon the unknown laws of internal conversion. If, however, the corpuscular spectrum ejected from platinum is observed, we are concerned only with the normal photoelectric effect. Supposing that the X-ray absorption results could be extrapolated to the γ-ray region, it would then be possible to deduce the intensities of the γ-rays from the intensities of the corresponding electronic groups. It is, however, precisely this point which is doubtful, and the accuracy of this method is at present limited by the accuracy of the empirical formula which it was necessary to assume for the photoelectric method. The method, however, has one extremely important advantage, which is, that if a γ-ray is sufficiently intense to give a measurable corpuscular group, then the intensity of this group can be determined independently of neighbouring weak γ-rays. It will be seen that these two methods are really complementary, one supplying the deficiencies of the other. The γ-rays of radium B and radium C are the only ones that have yet been intensively investigated, but the results seem consistent, and we know not only the general distribution throughout the spectrum but also the individual intensities of all the strong γ-rays.

The results that have just been mentioned referred to the relative intensities of the γ-rays, and in the analogous case of X-rays or optical spectra this would be all that could be stated. However, in the case of the radioactive bodies it is possible to define and to deduce the absolute intensities. This depends upon the fact that the process of excitation is due to the disintegration of the atom. When a nucleus disintegrates, the departure of the disintegration particle, α or β, may leave the nucleus

in an excited state, and its subsequent return to its normal state is the cause of the emission of the γ-rays. The γ-rays are, therefore, emitted only after this disintegration, and it is possible to define the absolute intensity of a γ-ray as the average number of quanta emitted per disintegration. It follows that the absolute intensity of any γ-ray cannot be greater than unity. The simplest way of deducing these absolute intensities is to make use of the measurements of the total amount of energy emitted in the form of γ-rays. Knowing both the frequencies and the relative intensities of the γ-rays, it is easy to calculate the average number of quanta of each frequency emitted per disintegration. This further step has already been carried out for the γ-rays of radium B and radium C.

If we now review the information that we possess about the γ-rays of radium B and C and anticipate that which we shall no doubt in time possess about the rays of other bodies, it will be seen that on the whole it compares very favourably with that available about X-ray spectra. The accuracy of the wave-length determinations is certainly much lower, but we have this important information about the absolute intensities. For example, a prominent γ-ray of radium C has a wave-length of 20·2 X.U., which may be in error by one part in five hundred to even one part in three hundred, but on the other hand, we can say that a quantum of this radiation is emitted by the nucleus on the average twice in every three disintegrations.

Applications to the Structure of the Nucleus.

The preceding account will have shown the extent to which the spectroscopy of the γ-rays has advanced. Its application to the problem of nuclear structure is only at the beginning, but it is already possible to indicate the possible lines of advance.

It has been realised for some time that there were many examples of combination differences between the frequencies of the γ-rays from any one body, and that this indicated, what was otherwise probable, that the γ-rays could be associated with a nuclear level system. Little progress, however, was made with this idea for several years, due to the realisation of the difficulty of associating such a level system with any specific part of the nucleus. In the nucleus there are α-particles, protons, and electrons, and in general any of these particles might be the emitters of the γ-rays. This question is still open, but there is now sufficient evidence to make it reasonable to try the hypothesis that the γ-rays are emitted by transitions of α-particles between stationary states in the nucleus.

The theories of Gamow and of Gurney and Condon [6] have shown that we may regard the process of emissions of an α-particle as due to the gradual leak of the wave function through a potential barrier. An extremely important result of this view is that the energy of the α-particle outside the atom, which can of course be measured, is the same as the energy of the α-particle in the stationary state in the nucleus which it occupied before the disintegration. For example, the α-particle from radium C is found to be emitted with an energy of 7·68 million volts. We therefore deduce that in the radium C nucleus there is an α-particle level with a positive energy of this amount. Such a level gives a natural basis on which to build the level system deducible from the γ-rays. We imagine that as a result of some internal nuclear arrangement an α-particle is excited to one of certain higher states, and that from these states it arrives at the ground state by emitting γ-rays of frequencies corresponding to the energy differences. It now follows, however, that if an α-particle can leak out through the potential barrier from the ground level, it can do so still more easily from the excited levels. We should therefore expect to find a certain number of high-speed α-particles corresponding to these modes of disintegration.

The existence of such long-range α-particles has of course been known for a long time, and in fact many tentative suggestions have been put forward associating the energy differences of the groups of α-particles with the frequencies of the γ-rays. The present-day point of view, however, goes much further than this, since it predicts definite relations between the intensities of the γ-rays and the number of long-range particles. That such a relation must exist can be easily seen in the following way. Suppose that on the average out of every thousand disintegrations there are n cases where an α-particle is excited to a certain state, the rate of leak through the potential barrier is given to a fair approximation by theory, and the probability of the nuclear transition can at least be estimated. We are therefore able in terms involving only the unknown quantity n to write down the number of long-range α-particles we should expect and the number of quanta of radiation. Both these quantities can also be measured, perhaps not with a very high accuracy, but yet sufficient to see whether there is an agreement with theory or not.

This is really a stringent test for the theory, because although the theories of the probabilities of nuclear transitions are necessarily tentative, any adjustment which proved necessary for one γ-ray must also apply to all the others. By arguments of this type Fowler [7] has been led to associate one excited α-particle level of the radium C nucleus with the corresponding nuclear transition formed from the β-ray spectrum. It seems likely that this line of investigation will lead to definite and valuable results. It is of course quite probable that several nuclear transitions will not be able to be associated with long-range α-particles, but it would then be possible to draw the important conclusion that these transitions were due to protons or α-particles of small positive or of negative energy.

Internal Conversion.

Reference was made above to internal conversion and it was pointed out that groups of electrons are ejected from the K, L, M states of radioactive atoms with just those energies that they would have if radiation were emitted from the nucleus but was absorbed photoelectrically before it escaped.

It has been frequently pointed out that there was no need and, in fact, no justification to assume that in this case the radiation was ever actually emitted at all.[8] All that could be truly inferred from the experimental results was that an excited nucleus could either emit its excess energy as radiation or had some means of transferring this energy to the electronic structure of the atom.

On the old quantum mechanics, it was difficult to imagine any method other than that of radiation transfer, but the wave mechanics suggests that there is a far more intimate connexion between the nuclear particles and the electronic structure. The wave functions of the particles in the nucleus will extend out to a certain extent into the electronic region of the atom, and conversely the electronic wave functions will exist throughout the nucleus. As a model, we may think that every electron in the atom occasionally passes right through the nucleus, and that a nuclear particle might sometimes for a very short time be found to be actually outside the nucleus.

We have thus no difficulty in seeing, in a general way, how the nuclear energy might be transferred to the electronic system by a direct collision process. Which process, radiation or collision, is predominant can only be settled by experiment, and the answer given by experiment in this case is fortunately unambiguous. The measurements of Ellis and Aston [5] of the extent of this internal conversion and of the way in which it depends on the frequency of the associated radiation show clearly that the behaviour is incompatible with the radiation hypothesis, and we are thus led to conclude that the collision process is the most important. It will be seen that this process is really a collision of the second kind, between an electron and an excited nucleus.

The peculiar interest of this phenomenon lies in the fact that it represents an easily measurable example of direct interaction between the nucleus and the electronic system. There are several other cases where the interaction between the nucleus and the electronic system must be taken into account, but only in order to give the finer details. The importance of the phenomenon of internal conversion is that the entire phenomenon, even to its first approximation, depends upon interaction, and that no approach can be made to it with a simple point nucleus.

However, quite apart from the intrinsic interest of this interaction, the phenomenon of internal conversion seems likely to provide valuable information about the stationary states in the nucleus. The quantity that can actually be measured, the internal conversion coefficient, is the ratio of the probabilities of occurrence of this collision of the second kind and of the nuclear radiation transition. The latter is determined mainly by the energy difference of the initial and final states, whilst the absolute energies are involved in the former. In a general way it can be seen that the internal conversion should lead to a classification of the levels responsible for the γ-rays, or, in other words, should enable the γ-rays to be associated with a definite part of the nucleus.

While but little has yet been accomplished along these various lines of investigation of the nuclear levels, it is certainly true that the most difficult step has already been made. The problem can now be clearly envisaged, and definite lines of work proposed which seem likely to lead to results. The way appears open to an experimental investigation of certain radioactive nuclei, and to an interpretation of the experimental results in terms of nuclear phenomena.

[1] Rutherford and Andrade, *Phil. Mag.*, **27**, 854; **28**, 262; 1924. Thibaud, Thèse, Paris, 1925. Frilly, Thèse, Paris, 1928. Meitner, *Zeit. f. Physik*, **52**, 645; 1928.
[2] Steadman, *Phys. Rev.*, **36**, 460; 1930.
[3] Ellis, *Proc. Roy. Soc.*, A, **101**, 1; 1922. Thibaud, Thèse, Paris, 1925.
[4] Skobeltzyn, *Zeit. f. Physik.*, **43**, 354; 1927: **58**, 595; 1929.
[5] Ellis and Aston, *Proc. Roy. Soc.*, A, **129**, 180; 1930.
[6] Gamow, *Zeit. f. Physik*, **51**, 204; 1928. Gurney and Condon, NATURE, **122**, 439; 1928.
[7] Fowler, *Proc. Roy. Soc.*, A, **129**, 1; 1930.
[8] Smekal, *Zeit. f. Physik*, **10**, 275; 1922. *Ann. d. Phys.*, **81**, 399; 1926. Rosseland, *Zeit. f. Physik*, **14**, 173; 1923.

An Institute for Experimental Research in Surgery.

THANKS to the munificence of Mr. George Buckston Browne, the Council of the Royal College of Surgeons of England will be able to build, equip, and maintain an Institute for Experimental Research in Surgery, to be known by the donor's name. For the building and maintenance of such an Institute, and for the endowment of experimental research, Mr. Buckston Browne has given £50,000, with a promise to make further additions until a total of £100,000 is reached.

This munificent gift will give England what she now lacks—an institute where surgeons can carry out experimental research bearing on their art. The Institute is part of a scheme which was initiated by the Council of the College of Surgeons some years ago, when it equipped laboratories for surgical research in connexion with the Museum in Lincoln's Inn Fields. The workers now engaged in these laboratories have found that their investigations are crippled by the lack of a biological station or farm in the country where experimental animals can be maintained and observed under the best conditions. Mr. Buckston Browne's generosity makes the completion of the Council's scheme now possible.

It will be remembered that three years ago Mr. Buckston Browne acquired Down House, Kent, from Prof. C. G. Darwin, F.R.S., and after restoring and endowing it, presented it to the British Association to be preserved as a memorial to Darwin, and for such scientific purposes as the Council of the Association might determine. It was Mr. Buckston Browne's original intention to establish the Institute which is to bear his name on the grounds attached to Down House; but certain circumstances compelled an alteration of this plan. The chief of these was that the land lying to the west of the Down property and flanking

Darwin's 'sand-walk' was to be opened up for building purposes. To save the adjacent fields from being built over, Mr. Buckston Browne stepped in and obtained the freehold of the property —13 acres in extent. It is this land which is to be the site of the Institute. It is possible that arrangements may be made whereby the new Institute and Down House may be linked so as to work together for the advancement of knowledge.

Mr. Buckston Browne has recalled the fact that John Hunter, the founder of the Museum of the Royal College of Surgeons, maintained a farm at Earl's Court for experimental purposes. He hopes that his Institute will be to modern surgeons what Earl's Court farm was to John Hunter.

Mr. George Buckston Browne, the donor, was born in Manchester in 1850, the only son of a well-known medical man—Dr. Henry Browne, physician to the Manchester Royal Infirmary and lecturer in medicine to the Manchester Medical School. Dr. Henry Browne represented the fourth generation of a medical dynasty where son had succeeded father, the founder of the family having been Dr. Theophilus Browne, of Derby, who was townsman and contemporary of Dr. Erasmus Darwin, grandfather of Charles Darwin. Mr. Buckston Browne continued the family tradition, representing the fifth medical generation. In 1866, at the age of sixteen, he matriculated as a student of the University of London, entered University College, was awarded medals in anatomy, chemistry, and midwifery, and gained the gold medal for practical chemistry and the Liston gold medal in surgery. He became a member of the Royal College of Surgeons in 1874, and gained in open competition the house-surgeoncy to his hospital (University College Hospital), where he served under Sir John Erichsen. He also taught anatomy under Prof. George Viner Ellis. No one ever trained himself more thoroughly for his profession. He is justly proud of the fact that the fortune which he now gives for the endowment of research in surgery has been gained in the zealous pursuit of his chosen profession.

Obituary.

Sir Andrew Balfour, C.B., K.C.M.G.

THE death of Sir Andrew Balfour on Jan. 30 at the early age of fifty-seven years has deprived the world of one it can ill afford to lose. His remarkable knowledge of tropical medicine and hygiene, the result of years of practical experience in the field, research in the laboratory, and intensive study of the literature of the subject, had fitted him more than any other to be a leader and adviser in any movement concerned with the health of our great empire. Physically he was a powerfully built man of striking appearance, with open, clean-shaven face, searching blue eyes, and determined jaw; and these attributes, combined with a remarkable personality embodying unbounded energy, enthusiastic devotion to duty, absolute honesty of purpose, and an irresistible appeal, brought him not only to the high position he held in his profession, but also at the same time into the hearts of everyone who knew him. His solicitude for the welfare of all, both high and low, who worked with him, and the personal interest he took in the aspirations or difficulties, whether great or small, of anyone who came to consult him, endeared him to a host of friends and admirers. From his early days he threw himself with fiery zeal into all he undertook to do or say.

As first director of the Wellcome Tropical Research Laboratories in Khartoum and medical officer of health of that city, and later, sanitary adviser to the Sudan Government, Balfour placed the medical and health services of the Sudan on a sound scientific basis. Later, he established the Wellcome Bureau of Scientific Research in London, and commenced a graphic museum of tropical medicine which has developed into the Wellcome Museum of Medical Science. Finally, he directed the building and organisation of the London School of Hygiene and Tropical Medicine, a most difficult task, which brought him to the end of his career. The Great War found him with the Medical Advisory Committee, before and after which he made various tours of inspection in tropical lands.

Outside the particular sphere of his life's work, Balfour was an omnivorous reader, but biography, travel, and adventure pleased him most. He was a life-member of the Stevenson Club in London and Edinburgh, and took an active part in its proceedings. What appears to be only a few months ago, he gave one of his characteristic lectures, which in his modesty he entitled a "Gossip about Robert Louis Stevenson". He even found time to write books himself—books of adventure in his early day, such as "Cashiered, and other War Stories", "By Stroke of Sword", "The Golden Kingdom", and later, books and articles on public health and preventive medicine. Some of his articles, such as those collected in book form as "War Against Tropical Disease", were of a semi-popular nature and appealed to a wide public.

Balfour was an inspiring lecturer. He never failed to hold an audience by the charm of his language, the graphic pictures he would draw of what he had seen in his travels abroad, his earnest condemnation of what was bad and praise of what was good, and the sudden outbursts of wit and humour. To prepare his lectures he took endless trouble, which was often not apparent to those who listened to the easy flow of speech, always tinged with an accent indicative of his Scottish descent, of which he was supremely proud. In conversation, with his remarkable knowledge of many subjects, he had no equal, and, when in the mood, would recount his experiences or tell stories in a manner to fascinate his listeners for hours.

No account of his life would be complete without a reference to his passion for Rugby football. A former Scottish international, he remained

throughout an enthusiastic supporter of the game which gave him his most inspiring relaxation. He championed the Scottish teams in all their contests, which he frequently attended, and at the time of his death was president of the Scottish Rugby Union. He loved to ride a horse, a form of exercise too seldom available; while shooting and fishing found their place in his general keenness for sport when opportunity occurred. His was a life crowded to the full. He did not know how to spare himself, though at times he felt the burdens which his devotion to tropical medicine and hygiene and his good nature prevented him from refusing. No wonder that a few days before his death he wrote to a friend: "My own life has been such a rush".

Andrew Balfour, or simply Andrew, as he was to many of his friends, was born in Edinburgh on Mar. 21, 1873. His father was a practitioner who brought up his family strictly according to the old Scottish tradition, and sowed the seeds of character which remained ever rooted in his son. That such upbringing was not unnecessary to curb the spirit of adventure in the young is well illustrated by the behaviour at family prayers, where one or other, during the father's pleadings, would, at the risk of severest chastisement, make a silent circuit of the room from chair to chair. From George Watson's College, Andrew passed to the University of Edinburgh, where he graduated M.B., C.M., in 1894. For a short time he joined his father in medical practice, but, as he said himself, this was not his "line of country". Accordingly he went to Cambridge in the following year with the intention of devoting himself to public health. He took his D.P.H. in 1897, and in 1898 his M.D. with a gold medal at Edinburgh with a thesis on the pollution of water by toxic dye-stuffs. Finally, in 1900 he obtained the B.Sc. in public health. During the South African War, 1900-1901, he served as civil surgeon, gaining the medal with three clasps. A severe attack of typhoid fever brought him back to England more firmly convinced than ever that public health was to be his life's work.

The establishment by Mr. Henry S. Wellcome in 1902 of the Tropical Research Laboratories at Khartoum and Balfour's appointment as director gave him his first great opportunity. Not content with developing the laboratories, which would have been sufficient for a less energetic man, he undertook also the work of medical officer of health, and in a few years converted Khartoum, a former death-trap, into a healthy city. At the same time, from his laboratories at the Gordon College, he showed not only those around him but also the whole of Africa, and, indeed, the whole world, through his well-known reports, what organised research could do to improve the health of the tropics. His sanitary rounds were made on horseback in the early morning, while the rest of the day was spent at research in the laboratories, and this routine continued in spite of the terrible heat and periodic sand storms which smothered all in dust. As a correspondent, closely associated with him in his Sudan days, wrote: "All this he accomplished in virtue of his combative, virile, truth-loving, honest personality". Occasional trips up the Nile and its tributaries gave him opportunities for observation on the diseases of the native tribes and their domestic animals. This convinced him of the utility of a floating laboratory which could take the facilities of modern research into the heart of the country, and again through the munificence of Mr. Wellcome such a laboratory came into being. It was ever Balfour's hope that similar floating laboratories would be established on other great tropical rivers of the world. On one occasion his research laboratories were almost completely destroyed by fire, during which he displayed the greatest daring in saving his records from the flames.

In research, Balfour devoted himself chiefly to the blood and its parasites, describing a number of new forms. The greater part of his time during several years was spent in investigating spirochætosis of fowls, and he became a convinced adherent to the view that spirochætes have a granular stage in their life-history. He spent many hours studying these organisms by dark field illumination, and actually saw, or thought he saw, granules thrown off "like drops of water from a dog's tail". One of his best papers was on fallacies and puzzles in blood examination.

In 1913, leaving behind many who had learned to respect and love him, Balfour came to London to establish the Wellcome Bureau of Scientific Research. Here he exhibited the same qualities which brought him fame in the Sudan. The laboratories soon became recognised as one of the centres of medical research in London and—with Balfour, with his world-wide reputation, as their head—as a bureau of information where all and sundry were sure of a welcome and of obtaining the latest views and facts regarding diseases and health problems in the tropics. In the year of the foundation of the Bureau he extended his experience by a tour of the northern States of South America and the West Indies.

The outbreak of the Great War made him restless to be doing something for his country, and to prepare himself for any emergency he entered into training with the Old Boys' Corps. In 1915 he was in France, and later in the same year, with the rank of Lieutenant-Colonel, a member of the Medical Advisory Committee in the Near East. In 1916, as president, he went with the Committee to India and Mesopotamia. During a few months' leave in England in 1917, which might well have been spent in rest, having realised from personal experience the want of a concise account of tropical diseases for medical officers, he undertook the task of writing for the War Office a small book entitled "Memoranda on Medical Diseases in Tropical and Sub-Tropical War Areas". He was able to see the book through a second and third edition, and its success is proved by the recent appearance of the fifth edition. The value of this book to medical officers in the War, most of them untrained in tropical medicine, cannot be over-estimated.

In 1917 Balfour was appointed adviser to the

Inspecting Surgeon-General, East Africa. In 1918 he arrived in Egypt to undertake the presidency of a Public Health Commission to reorganise the public health service of that country. Later in the same year, at General Allenby's request, he visited Palestine to report on the anti-malaria measures adopted there.

In 1919 Balfour was again established at the Wellcome Bureau of Scientific Research, picking up the threads of work which had been interrupted by his war service. Though settled in London from 1919, he was not at rest for long, for in 1921, at the request of the Colonial Office, he visited Mauritius and in 1923 Bermuda to advise on the health conditions in those islands. On his return he took up the directorship of the London School of Hygiene and Tropical Medicine, and threw himself with his accustomed energy into every detail of construction and organisation of this great enterprise. For seven years, broken only by short visits to the Sudan, Warsaw, and the United States and all too short holidays, he laboured unceasingly to make his School justify by its teaching and research the generosity of the Rockefeller Foundation, which had made its building possible.

Balfour was a member of numerous committees, and from 1925 until 1927 was president of the Royal Society of Tropical Medicine and Hygiene, delivering as his presidential address an inspiring lecture on "Some British and American Pioneers of Tropical Medicine and Hygiene", which well illustrated the amount of research involved in the preparation of one of his discourses. Writing of this lecture, a reviewer remarked that "this does something more than impart instruction. It admonishes us of one of the serious deficiencies of the ordinary medical curriculum; namely, neglect of the History of Medicine. Without a good knowledge of this history of hard work and self-sacrifice under difficulties, how shall the old spirit remain alive and the ancient traditions of our profession be handed on unbroken?" It would seem that Andrew Balfour himself had imbibed much of the spirit of these old warriors and had carried on successfully the ancient traditions.

In the midst of his great activities, Balfour was in constant demand as a lecturer and writer, and he rarely refused a request. His knowledge of his own subject was profound, the result of a system of annotating current literature which he commenced in his Sudan days and continued to the end, though frequently this involved working far into the night. Exhausted and overworked, a nervous breakdown brought his labours to a close in 1929. Though he fought his indisposition with indomitable courage, the enforced inactivity became, as he said himself, a vicious circle which prevented his recovery.

Balfour received the C.M.G. in 1912, the C.B. in 1918, and, in recognition of the great work he had done for our overseas possessions, the K.C.M.G. in 1930. The University of Edinburgh conferred on him the honorary degrees of D.Sc. and LL.D., the latter of which was also given him by the Johns Hopkins and Rochester Universities of the United States of America. He was a fellow of the Royal College of Physicians of London and Edinburgh. He married in 1902, and leaves a widow and two sons, the elder of whom is completing his medical studies. C. M. W.

WE regret to announce the following deaths:

Prof. J. S. Dunkerly, Beyer professor of zoology in the University of Manchester, known specially for his researches on the Protozoa, on Feb. 11, aged forty-nine years.

The Hon. Sir Charles Parsons, O.M., K.C.B., F.R.S., whose name is associated particularly with the development of the steam turbine, on Feb. 12, aged seventy-seven years.

Mr. W. G. Robson, lecturer in natural philosophy in the University of St. Andrews, on Feb. 16.

News and Views.

THE British Industries Fair, 1931, was opened on Feb. 16, the London Section at Olympia and at the White City, the Birmingham Section at Castle Bromwich. This year, for the first time, the catalogues of the two sections are in the same form, each having a classified index in nine languages—English, French, Spanish, Portuguese, Italian, German, Dutch, Swedish, and Danish. This feature is an innovation in the Birmingham volume. Advance overseas editions of the catalogues were issued on New Year's Day, and were despatched to 10,000 business men and potential buyers in Europe, Africa, parts of Asia, North America, and the east coast of South America, in time for the copies to be received before the recipients departed for the Fair. The buyer from abroad can thus look first at the classified index in his own language, from which he can obtain a list of firms exhibiting the particular goods in which he is interested. If he desires further information about particular firms, the alphabetical list of exhibitors gives him a description of everything shown by them. The Fair continues to show remarkable growth. This year both the London and Birmingham Sections have more exhibitors and cover a greater area than in 1930. Moreover, the total area of the Fair is still further increased by the holding of the cotton textile section at the White City, London, for which a separate catalogue is issued. The London catalogue, it may be noted, contains descriptions of the exhibits of about 1200 manufacturers, and the Birmingham entries bring the total of exhibitors to more than 2000.

SINCE it is a British Industries Fair, only British manufacturing firms are permitted to exhibit, and no exhibitor may exhibit articles other than those of his own manufacture. The Fair, it may be remembered, is organised by the Department of Overseas Trade and has been held annually since 1915 with the object of attracting important oversea buyers and bringing them into touch with the British producer. The Birmingham section was established in 1920 as the

British Industries Fair (Birmingham), and for its organisation the Birmingham Chamber of Commerce is entirely responsible; but the two sections constitute in effect an annual integrated demonstration that Great Britain is still in the forefront of the industrial and manufacturing countries of the world. At Birmingham, the exhibits are those of the heavy industries, chiefly hardware and machinery, including electrical equipment. There is also a gas industries section organised under the auspices of a national committee fully representative of the various organisations in the industry. The London exhibits at Olympia range over a wide and diversified field of the 'light' industries, including, for example, cutlery, jewelry, glassware and china, furniture, toys, leather, scientific instruments, chemicals, foodstuffs, and tobacco. The Empire Marketing Board has an exhibit of Imperial food products and raw materials, cotton textiles being shown separately at the White City. There is also a British artificial silk goods exhibition at the Royal Albert Hall, South Kensington. The stands alone at the four exhibitions occupy no less than 610,000 square feet of space. We hope to give a further account of the Fair, with particular regard to the scientific exhibits, at a later date.

THE interest of the Rubber Industry Bill, which passed its second reading in the House of Commons on Jan. 30, is at least as much in the principle involved of a compulsory levy for research purposes as in its intrinsic importance to the rubber industry. The question can scarcely be dissociated from that of the position of other research associations. In its last report the Advisory Council for Industrial and Scientific Research alluded to the financial instability associated with the voluntary contribution system, and expressed the belief that the associations would benefit greatly if some equitable form of levy could be substituted. In the same report, the Advisory Council expressed its disappointment that the results achieved by the various research associations are not being applied and utilised by the industries to a greater extent. In spite of the technical nature of the investigations carried out, there is often a gap between the completion of the investigation and the application of its results in practice. The more progressive firms, organised on scientific lines, admittedly profit most through their ability to utilise a potentially valuable discovery. Every investigation, however, that has important industrial applications tends to raise the general efficiency of the industry. Under modern conditions 'trade secrets' are of minor importance, and an important advance speedily becomes part of the general knowledge and technique in which all units share. To this extent the small manufacturer may derive sufficient benefit to enable him to meet external competition to which he would otherwise succumb.

ON the broad issue it is probably true that, in view of the fundamental scientific work which most of the research associations have had to carry out, it is early yet to judge of their utility. We may admit that co-operative research of this kind is under definite disadvantages as compared with that carried out by the large industrial units. That such research associations are doing most valuable work is, however, not disputed by those who are in a position to know, and not the least service they render is in encouraging habits of co-operation and of a scientific outlook in certain sections of industry which, compared with those of other countries, are notoriously backward. Whether a compulsory levy can expedite what is partly educational work has yet to be demonstrated. It should, in the case of the rubber industry at any rate, secure the Research Association from a recurrence of its financial crisis, occasioned by the gradual decrease both of the voluntary contributions and the grants from the Department of Scientific and Industrial Research. The proposed contribution of the manufacturers is limited to one twenty-fifth of one penny per pound of raw rubber purchased, and will provide an average sum of £15,000 per annum for five years. On last year's rubber consumption this would be provided by a contribution of not more than one forty-fifth of a penny.

ON Feb. 28 occurs the centenary of the birth of the astronomer Edward James Stone, who, for ten years, was first assistant to Airy at Greenwich, and was afterwards successively Her Majesty's Astronomer at the Cape of Good Hope and Radcliffe Observer at Oxford. Stone also served as secretary of the Royal Astronomical Society, in 1868 was awarded its gold medal, and during 1882–84 served as president. During his ten years at the Cape, he observed the total solar eclipse of April 16, 1874, and the transit of Venus of Dec. 8, 1874; and eight years later was entrusted with the superintendence of the work of the Government expedition to observe the transit of 1882. He also reduced and published the observations made at the Cape by his predecessor, Maclear, and completed a systematic survey of the southern heavens from the south pole to 115° N.P.D. His final catalogue contained 12,441 stars, and it was for this work that he was awarded the Lalande Medal of the Paris Academy of Sciences. Stone died at the Radcliffe Observatory on May 9, 1897.

IN the *Quarterly Review* for January is an article by J. M. Hone on "The Royal Dublin Society and its Bicentenary". A Dublin Philosophical Society, with aims similar to those of the Royal Society of London, was founded by William Molyneux, and Sir William Petty had been president, but it had ceased to exist owing to the Irish Civil War which followed the deposition of James II. From its ashes, however, may be said to have sprung the Dublin Society, of which, on its formation in 1731, the public-spirited Thomas Prior was the first secretary. Its interests, the promotion of agriculture, manufactures, arts, and sciences, quickly made the Society of importance. "It attracted to itself", said Lecky, "a considerable number of able and public-spirited members, and it was resolved that each member, on his admission, should select some particular branch, either of natural history, husbandry, gardening, or manufacture; should endeavour as far as possible to make himself a complete master of all that was known concerning it, and should

draw up a report on the subject." Granted a charter in 1750, the 'Royal' title was assumed in 1820. For many years the Society had as its house the Dublin mansion of the Duke of Leinster, but this was taken over in 1923 by the Free State and converted into Parliament buildings, and the activities of the Society are now all concentrated at the fine premises at Ballsbridge. With a variety of interests to serve, "the main work of the Society has been, and is still, the promotion of the agricultural interests of the country".

To choose a popular, though maybe difficult subject, to invite contributions thereon from well-qualified experts, then to stage a discussion in the inspiring setting of an 'exposition', congress, or the like, is a truly American custom and one which, though by no means contrary to academic or technical policy in Great Britain, is perhaps not quite so frequently in evidence here as it might be. The Institution of Petroleum Technologists sponsored such an event on Jan. 13, and thereby added what has long been wanted to complete the already detailed American picture of salt technology in its relationship to petroleum—the Eurasian evidence. Not that European scientific workers have been backward either in their study of salt bodies, in their presentation of theories of more universal application, or in their published views; but to some extent the Gulf Coast occurrences have tended in the past to sway opinion (largely by the volume and detail of publication devoted to the subject, also influenced by the magnitude of modern geophysical explorations in that region), and it was time that the even balance should be restored.

THAT we yet have much to learn of this fascinating subject, and that North Germany, Rumania, Persia, and even lesser-known regions in the remoter parts of Asia have much to teach us, especially in connexion with salt-oil association, is generally conceded, so that the papers presented in London were timely. J. Romanes discussed the salt domes of North Germany; Dr. G. M. Lees dealt with some depositional and deformational problems of salt; F. G. Clapp contributed what we may perhaps term the 'liaison' paper on the Gulf Coast, without which no discussion of natural salt bodies would seem complete; J. V. Harrison described the salt domes of Persia, probably the classic region of visible saline achievements; Dr. A. Wade dealt with intrusive salt bodies in coastal Asia, South-West Arabia; E. de Golyer directed attention anew to the origin of Gulf Coast salt domes; L. Owen brought forward some 'moot points' in current theories; Dr. C. Schmidt wrote on the salt dome area of Celle, Germany; while C. Sundberg gave an account of recent geo-electrical methods.

THE centenary of the death of Henry Maudslay, the eminent mechanician and engineer, which was noted in NATURE, Feb. 14, p. 245, was commemorated on Sunday, Feb. 15, by a special service in St. Mary's Church, Woolwich, in which Maudslay was married and in the churchyard of which he is buried. The service was conducted by the Rector of Woolwich, Canon A. M. Pickering, and was attended by the Mayor of Woolwich, Councillor Miss G. E. Walters, members of the Borough Council and various societies, and by representatives of the Maudslay family. During the service, Mr. F. Carnegie, Superintendent of Woolwich Arsenal, in which Maudslay began work at twelve years of age, gave an address on the work and character of Maudslay, making especial reference to his improvements in the lathe and their great influence on the development of machine tools. Though Maudslay's life was mainly spent in London, he always retained a great affection for his native borough, and it was therefore only fit that Woolwich should honour his memory. After the service, the mayor, on behalf of the Newcomen Society, laid a wreath on Maudslay's tomb. In works of reference the date of Maudslay's death is given as Feb. 14; but the date on the monument is Feb. 15. In view of the fact that the monument commemorates other members of the family and that it was erected soon after Maudslay's death, it may be taken that Feb. 15 is the correct date.

THE short-wave broadcasting and wireless telephone and telegraph duplex station which has been supplied by Marconi's Wireless Telegraph Company to the Vatican City, and was formally inaugurated with a Latin speech by His Holiness the Pope on Feb. 12, has a world-wide range. In its main features, the transmitter follows the design of the Marconi short-wave high-speed beam transmitters, which are used in the British Imperial beam stations, and it was manufactured at the Marconi Works at Chelmsford. The complete installation consists of four main panels, designed for telephony and high-speed telegraphy on either 19·84 or 50·36 metres. On telephony the transmitter is rated to deliver from 8 to 10 kilowatts of unmodulated carrier wave energy to the aerial feeder system, the output depending slightly on the wave-length used. On continuous wave telegraphy the rating is from 13 to 15 kilowatts to the aerial feeder. A special Marconi type of vertical short-wave aerial is used for transmitting, there being a separate aerial for each wave-length. The transmitting room is situated in a part of the grounds in the Vatican which is surrounded by a Roman wall 45 ft. high, while the masts, 200 feet in height, are placed outside this wall. In order not to destroy the amenities of the Vatican gardens, a tunnel 141 feet long has been constructed under the Roman wall to accommodate the feeders connecting the transmitter with the aerial. A special receiver secures good telephone and telegraph duplex communication between the Vatican City and any part of the world, telephony being possible from any telephone installation in the Vatican City. This receiver is situated in one of the rooms of the transmitting station and utilises a vertical aerial placed at a distance of only a few yards from the sending aerial and suspended from the same triatic.

IN *World Power* for February an interesting account is given of the South Scotland Electricity Scheme (1930). The area covered by the scheme is 4308 square miles and the population is nearly 256,000. The stations selected by the Central Electricity

Board for operation are a thermal station at Galashiels and five water-power stations in Galloway. Little of this district has been developed electrically, but much of it consists of forest and moorland. It is hoped that by 1935 the water-power stations will develop 102,000 kilowatts. It is anticipated that much of this power will be absorbed in the Central Scotland and North-West England areas. The construction of the water-power stations may be postponed, however, unless the iron and steel, coal, and shipbuilding industries in Central Scotland and the cotton industry in North-West England improve. The operation of the water-power stations is primarily intended to help the supply at times of 'peak' load. The commissioners have planned an extension of this system so as to connect it with the North-East England Scheme at Newcastle. It is very desirable that such a line should be constructed as soon as possible, owing to possible future requirements of the London and North-Eastern Railway. The northern district of Northumberland, which is without an electricity supply, could also be served. Although this is desirable, it does not seem attractive at present from the financial point of view. The capital charges of the water-power stations are heavy. It is estimated that the cost to the Board will vary from 0·38*d.* per unit in 1934 to 0·34*d.* per unit in 1943. The average price to the consumer will be less than 0·5*d.* per unit.

ON Feb. 11, Mr. E. L. Gardiner gave a lecture to the Television Society on "The Stenode Radiostat and its Application to Television". This type of transmission has not yet been tried experimentally, but from a mathematical consideration of the problem it appears possible to generate a signal to which only the stenode will respond, and which, even when superimposed on ordinary transmissions, will cause no interference. In its simplest form the stenode radiostat is a very sharply tuned receiver. A wireless receiver with a very peaky resonance curve, however, gives a reproduction which is woolly, due to the attenuation of the higher frequencies consequent on the sharp tuning. To correct this, the low frequency amplifier in the stenode is designed to emphasise the higher frequencies, so that the final output is fairly even throughout the audible range. Sharp tuning in a straightforward circuit causes, among other difficulties, instability, and to overcome this the superheterodyne principle is used. With this circuit selectivity can be made as keen as is necessary, simply by reducing the frequency of the intermediate amplifier; and this without altering the form of the resonance curve. By using the superheterodyne circuit with six valves and comparatively simple tuning arrangements, a satisfactory separation of stations only two kilocycles apart can be secured. For a similar result with a band-pass-filter circuit at least six ganged circuits are necessary. A better method of employing the stenode principle is to insert a quartz crystal, cut to resonate at the required frequency, in the circuit of the intermediate amplifier. This, due to the fact that the crystal acts as a very high resistance to all frequencies but its resonant frequency, gives a much sharper tuning, and makes it possible to get almost any degree of selectivity.

IN his Friday evening discourse delivered at the Royal Institution on Feb. 13, Prof. F. L. Hopwood discussed ultra-sonics or inaudible sound. Sound is, of course, produced whenever a vibrating body is placed in a material medium, whether the latter is a solid, a liquid, or a gas. For sounds to be audible, the vibrations must not only be of sufficient amplitude, but also their frequencies must lie within the range 20–20,000. Disturbances of the same type as sound-waves but having frequencies exceeding 20,000 vibrations per second are termed ultra-sonic. Remarkable effects are obtained when sound-waves of great intensity, and frequency of about half a million, are generated in an oil bath by means of a quartz crystal set into resonant vibration by a thermionic valve oscillator. Acoustic radiation pressure exerted on the free surface of the oil may raise in it a mound several centimetres or even inches in height, and cause it to erupt droplets like a miniature fountain. On plunging vessels of appropriate form into this mound of oil, vibrations of great intensity may be communicated to the walls of the vessels, or, through the walls, to liquids contained in them. Following the methods of Langevin, Boyle, and Wood and Loomis, demonstrations were given of reflection, refraction, and interference of sound waves of short wave-length; the production of bubbles and expulsion of dissolved gases from liquids; acoustic distillation; transverse vibrations in solids accompanied by anomalous movements of dust particles; flocculation of suspended matter and production of emulsions; acceleration of chemical action; pronounced thermal effects; remarkable effects produced on plants, bacteria, muscle-nerve preparations, and on living organisms such as planaria and fish.

IN view of the pessimistic opinions often expressed regarding some of our industries, the figures relating to steel production recently given by Mr. W. B. Jones, at the first annual general meeting of Steel Industries of Great Britain, Ltd., are of considerable interest. One aspect of the steel industry is reflected in the total amounts of steel produced in Great Britain, Western Europe, and the whole world respectively. Taking the three years 1913, 1925, and 1929, the figures for Great Britain were 7,660,000, 7,390,000, and 9,640,000 tons; for Western Europe 25,670,000, 25,440,000, and 34,990,000 tons, and for the world 75,150,000, 88,930,000, and 118,300,000 tons. After referring to the disadvantages steel-makers suffer from, Mr. Jones said, "it is surprising to find how well the British steel industry has stood up against these handicaps". "In 1929, a year in which Western Europe was able to take full advantage of the handicaps in its favour, production of British steel not only reached its highest figure, but the relation of its production to that of itself and Western Europe added together, which in 1913 was 23 per cent, in 1929 was only reduced to 21·6 per cent." Though not referred to by Mr. Jones, it may be remarked that Great Britain has to import

a considerable proportion of the iron ore used; in 1928, 11,261,000 tons of ore were produced in the country and 4,439,000 tons imported.

THE Pharmaceutical Society's second conversazione was held in the Society's house in Bloomsbury Square on Feb. 10. The whole of the premises, including the School of Pharmacy, the library and museum, the pharmacological laboratories, and the research laboratories, were thrown open. The council chamber contained an exhibition of portraits of pharmaceutical interest and old pharmaceutical apparatus and equipment. Among the exhibits in the laboratories were the following: diagrams showing the method of estimating the absorption of calcium through the intestine; growth charts of animals suffering from a deficiency of vitamins; methods of distinguishing between vitamins B_1 and B_2; a demonstration of recent work showing that carotene is changed to vitamin A in the animal body; the latest forms of pharmaceutical apparatus under working conditions; army and navy pharmaceutical equipment; samples of crude drugs about to be added to the British Pharmacopœia and the British Pharmaceutical Codex; the use of the quartz lamp for detecting adulterants in drugs; the syntheses of various organic chemical drugs, including camphor, salvarsan, and anæsthesine.

THE Council of the National Museum of Wales, in spite of the financial stringency of the times, continues to pursue a strong policy in regard to the erection of the museum buildings. Bearing in mind that the Government grant of £50,000 promised in 1928 was conditional on the full building programme of approximately £150,000 being proceeded with, the Council has proceeded with the second portion of the scheme. The estimated cost is £81,987. The sums in the hands of the Council are insufficient, but the councillors go forward believing that their countrymen will support them in their endeavours. The past financial year brought excellent contributions, amounting in all to £26,767, and Cardiff City Council voted the munificent sum of £21,000, to be spread over a period of seven years. A considerable sum still remains to be collected, and during the course of the present year every effort will be made to secure the balance. We trust that the effort will be abundantly successful; the Welsh National Museum has set a new standard for museum construction in Great Britain, and the energy, foresight, and faith of the members of its council deserve every encouragement.

THE scheme for the award of the "Beit Railway Trust Fellowships for the Two Rhodesias" has now been completed. This scheme has been made possible by the provisions of the will of the late Sir Otto Beit and offers facilities for two years' post-graduate work for three candidates. The fellowships will be tenable at any university or institution, approved by the trustees, in South Africa, Great Britain, the Oversea Dominions, Europe, or the United States of America. Each fellowship is valued at £250 per annum if held in South Africa and £375 per annum if held overseas. Preference will be given to South Africa, if the suggested course permits. The chairman of the advisory board for the administration of these fellowships is the Governor of Southern Rhodesia. Applications for information of conditions, etc., with reference to the fellowships (one of which is that the applicant shall have resided in Northern or Southern Rhodesia for three full years prior to application) should be made to the Secretary, Advisory Board, Beit Railway Trust Fellowships for the Two Rhodesias, P.O. Box No. 4, Bulawayo, Southern Rhodesia.

THE after-shocks of the New Zealand earthquake are becoming less frequent and less violent, though strong earthquakes on Feb. 8, 12, and 13 brought down some already damaged houses at Napier. A harbour official reports that although the bed of Napier harbour rose during the earthquake it has since subsided gradually. It appears to be still about 7 feet above its former level; but coastal steamers will be able to use the harbour, though additional dredging will be necessary. The latest reports show that 133 persons were killed at Napier, 71 at Hastings, and 36 elsewhere.

MADAME CURIE has been awarded the Cameron Prize of the University of Edinburgh for 1931, in recognition of the important therapeutic advances that have been made in recent years as a result of her discovery of radium.

THE Council of the Iron and Steel Institute has awarded the Bessemer Gold Medal this year to Sir Harold Carpenter, professor of metallurgy in the Royal School of Mines, Imperial College of Science and Technology, London. The award is made in recognition of distinguished services rendered by Sir Harold Carpenter in the advancement of metallurgical science, and of the valuable research work performed by him in relation thereto.

AT the annual general meeting of the Quekett Microscopical Club, held at 11 Chandos Street, Cavendish Square, W.1, on Feb. 10, the following officers and new members of committee were elected: *President:* Mr. J. Ramsbottom; *Hon. Treasurer:* Mr. C. H. Bestow; *Hon. Secretary:* Mr. W. S. Warton; *Hon. Reporter:* Mr. A. Morley Jones; *Hon. Librarian:* Mr. C. H. Caffyn; *Hon. Asst. Librarian:* W. P. Sollas; *Hon. Curator:* Mr. C. J. Sidwell; *Hon. Asst. Curator:* Mr. R. G. Evans; *Hon. Editor:* Mr. W. S. Warton; *New Members of Committee:* Mr. R. G. Evans, Mr. W. J. Lloyd, Mr. J. M. Offord, Mr. D. J. Scourfield.

WITH reference to the review of his book on "Fourier's Series and Integrals" (Ed. 3) which appeared in NATURE, Oct. 25, 1930, Prof. H. S. Carslaw has written pointing out that the reviewer wrongly gives him credit for noticing that a certain Wilbraham in 1848 anticipated Gibbs's discovery in 1899 of the property now generally known as "The Gibbs Phenomenon". Wilbraham's paper was cited by Burkhardt in his article on "Trigonometrische Reihen und Integrale" in the "Enc. d. math. Wiss." (Bd. 2,

Teil 1, 2 Hälfte, p. 1049; 1914), and there is also a reference to the matter in the article by Hilb and Riesz in Bd. 2, Teil 3, p. 1203 (1924). Prof. Carslaw's attention was directed to Wilbraham's paper by Prof. G. N. Watson.

A USEFUL statistical summary entitled the "Mineral Industry of the British Empire and Foreign Countries" has been compiled by the Imperial Institute (H.M. Stationery Office, 5*s*. 6*d*.). The volume includes statistics for 1927, 1928, and 1929, where available, for some fifty minerals. Under each heading are given the total production for each producing country, and the imports and exports for all countries. Minerals are arranged alphabetically. Quantities are given in tons, hundredweights, or pounds. The uniformity with which the statistics are given much facilitates use and comparison, and the volume should meet with wide acceptance. An appendix gives lists of statistical publications for each State.

A CATALOGUE (New Series, No. 24) of some 1400 second-hand works on natural history, classified under the headings of periodicals and publications of learned societies, zoology, botany, geology, mineralogy, mining, etc., astronomy, chemistry, etc., and Linnæana, has just been published by Messrs. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in the Department of Mathematics and Physics of the Polytechnic, Regent Street—The Director of Education, The Polytechnic, Regent Street, W.1 (Feb. 27). A forestry inspector under the Department of Agriculture of the Irish Free State—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (Feb. 27). A lecturer in pathology in the Department of Pathology and Bacteriology of the University of Leeds—The Registrar, The University, Leeds (Mar. 2). A male senior lecturer in the Department of Education of King's College, London—The Secretary, King's College, Strand, W.C.2 (Mar. 6). A chief designer in the Design Office of the Department of Technical Education of the Egyptian Ministry of Education—The Under-Secretary of State, Ministry of Education, Cairo, Egypt (Mar. 9). A full-time teacher in the Department of Chemistry of the West Ham Municipal College—The Principal, West Ham Municipal College, Stratford, E.15 (Mar. 14). A temporary hydrologist and a temporary biologist under the Ministry of Agriculture and Fisheries, for research work in connexion with the survey of new fishing grounds by H.M.S. *Challenger*—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (June 1).

ERRATUM.—NATURE, Feb. 14, p. 237, col. 2, line 3, for "raise the temperature" read "lower the melting-point".

Our Astronomical Column.

Bright Meteor Photographed.—The *Journal* of the B.A.A. for January contains a reproduction of an interesting photograph of a bright meteor, obtained on Sept. 19, 1930, by E. H. Collinson at Ipswich. The meteor was observed visually by Mr. J. P. M. Prentice at Stowmarket. From a combination of the two, Mr. A. King has deduced the path of the meteor; the speed came out 24 m.p.s., which is 3 m.p.s. less than the parabolic speed. The luminous flight began at a height of 79 miles, and ended at one of 54 miles. The photograph indicates three explosions; after each of them the track on the plate suddenly widened, and then gradually grew narrow again; the calculated heights at the explosions are 68½, 61, and 58 miles respectively. The path produced ended in the sea, 16 miles south-east of Brightlingsea. The inclination of the path was 52°, and the perihelion distance 0·34 unit. The motion was inward. Most meteor photographs have been obtained accidentally on plates exposed for other purposes; but Mr. Collinson uses a specially constructed automatic camera for the purpose of securing them; he is to be congratulated on this fine result.

Pluto.—M. Mineur, assistant at the Paris Observatory, contributes an article on Pluto to *L'Astronomie* for December, in which he directs attention to the two remarkable relations between the orbits of Pluto and Neptune:

(1) Their periods are almost exactly in the ratio 3 to 2. This relation may be rendered quite exact when the period of Pluto is known with great accuracy.

(2) They have very nearly a common line of apsides, the perihelion of Pluto being in longitude 223° 14·6′, and the aphelion of Neptune 224° 1·1′, both for the equinox of 1930·0.

If they were simultaneously on the apse-line, there would be a type of regular periodic motion, but this is not actually the case. It is interesting to note that in the two other pairs of interlocking orbits with which we are acquainted, satellites VI. and VII. of Jupiter, and satellites VIII. and IX. of Jupiter, the apojoves of each pair are roughly opposite to each other. It is difficult to think that the relationship can be permanent in the case of Neptune and Pluto, as the perturbations that they undergo from the other planets must be decidedly different.

Nakamura's Comet.—*Bulletin* No. 183 of the Kwasan Observatory, Kyoto, gives some more particulars about this comet. It was discovered photographically on Nov. 13 on plates taken with the 11 cm. triplet lens, and was then of magnitude 13·5. Mr. Nakamura observed it visually on Nov. 16, noting that it appeared fairly sharp and somewhat elongated. The following photographic positions are given, presumably for the equinox of 1930·0:

		R.A.	N. Decl.
1930 Nov. 13.	57635 U.T.	$3^h\ 40^m\ 41{\cdot}44^s$	18° 53′ 25·4″
14.	51980	3 37 52·69	18 41 1·0
15.	56116	3 34 51·86	18 28 12·5

The parabolic elements deduced from these by Mr. Y. Sibata were telegraphed to Europe, and have already been published in NATURE.

The seconds of R.A. on Nov. 13 were printed as 14 in the circular, but it is fairly evident, both by comparison with the telegraphed position and by differencing from the ephemeris, that 41 is correct.

This comet must have faded very rapidly, as Prof. G. van Biesbroeck made a careful search at Yerkes Observatory after receiving the telegram, but could not find it.

Kwasan Circ., 181, notes that a 25 cm. photographic reflector, focal length 95 cm., has been installed at Kwasan for photographing comets and asteroids.

Research Items.

The Eskimo.—Dr. Aleš Hrdlička reports, in the *Forty-sixth Report of the Bureau of American Ethnology* (1928–29), on a journey among the Eskimo of Alaska which lasted from May to September 1926. His object was to make an anthropological survey of the Eskimo, in the hope of filling in some of the gaps in our knowledge of this people which, up to the present, vitiate the conclusions which have been drawn as to their origin and affinities. The conclusions at which it has been possible to arrive are as follows: The Eskimo throughout their territory are one and the same people. The strain is fundamentally related to that (or those) of the American Indian. It is also undoubtedly related to the yellow-brown strains of Asia. In many respects the Eskimo are remarkably alike over their whole territory—in such characters as pigmentation, build of body, physiognomy, large brain, fullness of forehead, largeness of face and lower jaw, etc. They differ in details such as stature, form of head, and breadth of nose. The distribution of these is of some significance; but between east and west, where the extremes are found, there is a regular gradation without significant interruption. This is due not to admixture but to adaptation and differentiation. They suggest a moderate stream of people, rooted in Asia, of fairly broad but moderately high head, of good medium stature with a mesorhine nose, and other characteristics in common, reaching America from north-easternmost Asia after the related Indians, spreading along the coast until blocked by the preceding Indian tribes, and gradually modifying physically in adaptation to the environment and conditions. The evidence shows that, with the exception of some irregularities, the more highly differentiated and divergent the Eskimo becomes, the greater the gap between him and his Indian neighbour. The facts point, therefore, to the original identity of the source from which the Indian, more particularly the latest branches, and the Eskimo were derived, and to the identification of this source with the palæo-Asiatic, yellow-brown peoples of lower northern Asia. The differentiation of the Eskimo from this source must have proceeded over a fairly long time, and probably began on the northern coasts of Asia.

Supervision and Morale.—The *Journal of Industrial Psychology* (vol. 5, No. 8) gives an account of an experiment in supervision and morale by Mr. Elton Mayo, the object being to study the effect on employées of controlled changes in conditions of work. Six girl operatives doing standardised mechanical routine work for forty-eight hours a week were selected at random, and placed under test conditions for three years. A supervisor was installed to observe non-experimental influences. Then various changes were introduced, for example, segregation in test room, payment at special gang-rate, rest pauses, five-day week, and so forth. The result showed a steady improvement, measured in terms of output, which was continued even after resuming original conditions. Contrary to anticipation, it appeared that none of the controlled conditions was significantly responsible for the improvement, which appeared to be attributable to the mental attitude of the workers towards the supervisor. Periodic examinations of blood pressure and pulse rates revealed that a state of equilibrium, not one of constant effort, was that in which the best work was produced: this was equally true in the mental sphere, where the supervisor's tact and capacity for listening sympathetically were important. The details of the investigation, and relevant graphs given, are illustrative of the investigator's thorough work; but the experiment would have been of more scientific value had adequate control-groups been described to the same extent.

The Creeper Fowl.—Further genetic experiments by Landauer and Dunn (*Jour. Genetics*, vol. 23, No. 3) confirm their hypothesis that the condition is lethal when homozygous. They have obtained creeper fowls from America, Scotland, Germany, and the Marquesas Islands. Crosses were made between these four strains, which indicated that the same mutation is present in each. All the bones of the legs and wings are shortened in this type, the tibia is strikingly bent, and the fibula much enlarged. This condition is inherited as a simple dominant to normal. Breeding tests show that all creeper fowls are heterozygous; when mated together they give about 2 creepers: 1 normal, and about 25 per cent more embryos die during the first six days of incubation than in the case of outcrosses. These homozygous lethal embryos were identified. They show a great retardation in development on the third day of incubation, and a photograph is given for comparison with a normal three-day chick. A small number of these embryos, especially from crosses between different creeper strains or from outcrosses with normals, may develop nearly to the hatching time; but they show a condition of phocomelia similar to that known in man and other mammals. This is apparently the first time phocomelia has been observed in birds.

Scottish Tunicates.—Dr. H. Thompson, in his paper "The Tunicates of the Scottish Area, I." (*Fishery Board for Scotland, Scientific Investigations*, No. 3, 1930), has begun a systematic survey of the tunicates found in the area worked by the research vessels of the Fishery Board for Scotland, with special reference to the distribution and ecology of the species. He fully realises that a knowledge of the live animal with its eggs, larval and post-larval stages is of the greatest importance in classification, and the fact that he has been able in most cases to study each species in this way makes his work specially valuable. He also lays great stress on the proper preservation of the animal, a precaution often much neglected. Certain ascidians are important as fish food. For example, haddock in some districts, such as the Moray Firth, may feed on half a dozen species and at times almost exclusively on *Ascidia scabra*. An exact mapping of the distribution of all animals preyed upon by fish is very desirable. Natural barriers, such as a definite change of temperature where two waters meet, must affect both the fishes and their food. Indeed, the food is probably one of the most important factors in the distribution of fish. It is shown that there is such a natural barrier at or near a region to the south-east of Iceland where within a few miles the temperature of the water undergoes a sudden change from boreal to arctic conditions. The haddock on each side of this barrier grow at quite different rates, and the change, at any rate in the ascidian fauna, is complete. The chief object of the work is to show which species are found under typical conditions. These 'critical' species, or 'test' species, are specially studied, whilst others which are able to exist under more varied conditions are of secondary importance. The species are divided into boreal and arctic, and subdivided into boreo-arctic, north, south, east, and west boreal. The systematic part classifies the tunicates into orders, further classifies the sedentary forms, and describes the first order, Ptychobranchia, with the two families, Molgulidæ and Pyuridæ.

Culture of Sponges and Oysters.—Two recent parts of Abderhalden's comprehensive "Handbuch der biologisches Arbeitsmethoden" (Abt. 9, Teil 5, Heft 4, Lief. 326; Heft 5, Lief. 333) continue the volume describing the culture and methods of rearing of marine plants and animals. Lief. 326 deals with sponges, cœlenterates, mollusca, and crustacea, whilst the oyster alone occupies Lief. 333. Only a few sponges have so far been reared from the egg, and it is very difficult to find suitable food for them. This is the main problem in the rearing of all marine animals, successfully solved for many forms by the diatom cultures of Allen and Nelson; but there still remain many invertebrates which in their first stages are too small to use these diatoms. In such cases minute flagellates and the active spermatozoa of *Fucus* are recommended. Unfortunately, however, the latter live scarcely longer than a day and so have to be frequently renewed, and cultures of flagellates are not so easy to maintain as cultures of diatoms. Much work is still needed on these points, although it is very interesting to see how much has already been done and how many invertebrates have been reared. Here, echinoderms come first and several species have been brought through all the larval stages on the diatom *Nitzschia*. These have already been described in a former part (Lief. 278). In the present sections both Dr. Hagmeier and Dr. Kandler say much about the rearing of molluscs, most of which must have very minute food in their early stages. Cœlenterates usually require animal food such as Copepod and Cirripede nauplii and other small planktonic forms. Crustacea, such as crab zoeæ, seem to prefer very young larval molluscs and may eat the planulæ of worms and echinoderms. Oyster larvæ form an ideal food for crab zoeæ, the older larvæ eating small crustacea or pieces of shrimp, prawn, or mussel. Vessels and aquaria of all kinds for rearing are fully discussed, and apparatus for collecting the various animals. Commercial rearing is also described, especially with regard to sponges and oysters.

A Natural Species-Hybrid in the Genus *Geum*.—A careful study of the well-known hybrid between *Geum urbanum* and *G. rivale*, which goes under the name of *G. intermedium* and has long been recognised as a natural species-hybrid, has been made by E. M. Marsden-Jones (*Jour. Genetics*, vol. 23, No. 3). By crossing the two species experimentally the F_1 generation was found to be practically uniform but not intermediate between them except in three characters. Six of the *rivale* characters were dominant, including the presence of plumose hairs on the styles, anthocyanin in the flowers, and the flowers pendulous, while two *urbanum* characters appeared in the majority of plants. The back-crosses of *intermedium* to both species have been studied, as well as the F_2 generation from the original and the back-crosses. The evidence of segregation in many characters is clear; but simple Mendelian ratios were not obtained. The reciprocal crosses between *intermedium* and *urbanum* gave identical results: 4 plants were *intermedium*, 2 *urbanum*, and 88 very like *urbanum*. These hybrids also exhibited a new type of short plumose hair. When a plant of this back-cross is selfed, segregation takes place in number of glands, colour of petals, and type of flowers. The back-cross *intermedium* × *rivale*, on the contrary, when selfed, shows very little segregation. A colony of such plants was studied at Bradfield, Berkshire, on the River Pang, where this hybrid appears to have established itself and largely replaced *rivale*.

Exploration in East Greenland.—A small expedition aided by the Norwegian Government visited East Greenland in the *Veslekari* under the leadership of A. K. Orvin during the summer of 1929. The objects were largely scientific, and a certain amount of correction of the charts was accomplished between Sabine Island and Davy Sound. The results are outlined, in Norwegian, in *Norges Svalbard- og Ishavs-undersökelser, Meddelelse*, No. 11, which also contains a map. One of the important aims of the expedition was to obtain a number of musk-ox calves, which were to be sent to Spitsbergen, where the musk-ox does not exist at present. In the absence of wolves in Spitsbergen the musk-ox should thrive well in places where grasses are fairly abundant in the vegetation.

Geology of Uganda.—The Annual Report of the Geological Survey of Uganda for 1929 contains many features of unusual interest, one of the most notable being a geological account of a journey from Lake Tanganyika to Entebbe, undertaken by A. D. Combe. A general description of the spectacular volcano Nyamlagira is given, with details of its behaviour during the visit made to its crater. Bombs of olivine-leucitite are recorded from a late Pleistocene volcanic area near Kichwamba, south of the Kazinga Channel. At the other end of the geological column, in the "green-grey rocks" of North Kavirondo, W. C. Simmons finds phonolites with andesites and rhyolites. These ancient lavas are pre-Karagwe-Ankolian in age and may correspond with the Ventersdorp of South Africa. Not far away there are phonolites of later Tertiary age. Simmons also adds to his previous contributions some further notes on the petrology of the Bufumbiro volcanic rocks, and points out that the total area over which leucitic lavas predominate is nearly 1500 square miles. A general paper on this important volcanic field and on the nature of its rocks appears in the *Geol. Mag.*, Nov. 1930. Detailed work is in progress, the results of which will be published in a forthcoming memoir. Other research notes in the report record seismic tremors connected with an epicentre near Ruwenzori; the occurrence of nepheline- and melilite-bearing rocks from near Mount Elgon; heavy mineral suites of Uganda granites; and archæological discoveries of three ages on a site near Port Bell. The report is enriched by a clearly designed and well printed provisional geological map of the Protectorate. The Director, Mr. E. J. Wayland, is to be congratulated on the solid record of achievement that is summarised in this very welcome map.

Carboniferous Rocks of Hook Head.—L. B. Smyth (*Proc. R. Irish Acad.*, **39** B, p. 523; 1930) describes the zonal characters of the Lower Carboniferous (Tournaisian) of the promontory ending in Hook Head, co. Wexford. The Carboniferous rests conformably on the Old Red Sandstone and includes the Cleistopora zone (*K*1, *K*2), the Zaphrentis zone (*Z*1, *Z*2, γ), and the Caninia zone (*C*1, *C*2). The succession closely resembles that found in Pembrokeshire. The echinoids, of which beautifully preserved specimens were obtained by collectors in the last century, appear to have come from the zones *C*1 and *C*2. In the section on palæontology some new species of corals and brachiopods are described.

Artificial Production of γ-Rays.—W. Bothe and H. Becker report in the *Zeitschrift für Physik* for Dec. 3 that a number of light elements—lithium, beryllium, boron, fluorine, magnesium, and aluminium—emit γ-rays when bombarded by α-particles. The effect is apparently similar to artificial disintegration with liberation of protons, since the efficiency of production of the γ-rays is about the same as that of protons, and the absorption coefficient of the radiation

from boron and beryllium—the latter being the most efficient radiator—about that of the hardest γ-rays from the common radioactive bodies. Liberation of protons and emission of γ-rays do not, however, run parallel; nitrogen, for example, gives relatively large yields of protons, but no γ-rays, whilst beryllium gives strong γ-radiation, but is otherwise very stable. The hardness of the radiation does not appear to be much affected by the speed of the α-particles by which it is excited, and the radiation from boron, at least, is emitted about equally well in forward and backward directions. The existence of a hard γ-radiation from polonium, the source of α-rays for these experiments, is also reported.

A Possible New Spectrum of Helium.—In the issue of *Die Naturwissenschaften* for Jan. 9, Dr. W. Grotrian has given a critical summary of Rosenthal's theory of the lines of the solar corona, the principal remaining spectrum of uncertain origin. Rosenthal has suggested that these come from neutral helium atoms, in which both electrons have been displaced from their most tightly bound positions, with one always in the orbit next to the innermost. On general grounds it would be expected that this system should give rise to a spectrum closely similar to the ordinary arc spectrum of this element, with corresponding lines displaced to the violet. This is in fact what is observed with the coronal spectrum, the lines of which can be associated, with little forcing, with strong arc lines which are well known from laboratory work. The objections raised by Dr. Grotrian to this are serious, but not insuperable, as he recognises by characterising the theory as the first meriting really careful consideration; that the energy of the excited atoms is far in excess of that required for ionisation is only an extreme instance of what has been already established in several spectra obtained from laboratory sources, whilst the absence of the normal helium arc lines and the apparent occurrence of a state of the atom forbidden by the Pauli principle may possibly be attributable to the special conditions of excitation and to a flaw in the theory of the helium atom. Dr. Grotrian mentions that Rosenthal is attempting to obtain these lines from a discharge through pure helium, but whether this proves practicable or not, it should be possible to test his hypothesis by calculation of the energy of the helium atom in doubly excited states.

Thermodynamic Properties of Fused Salts.—Three papers in the December number of the *Journal of the American Chemical Society*, by J. H. Hildebrand, E. J. Salstrom, and A. Wachter, describe experiments on the electromotive forces of concentration cells with fused salts. Solutions of lead chloride in lead bromide, lithium bromide in silver bromide, and lead chloride in zinc chloride were used, with suitable electrodes. The results show that the variations of electromotive force cannot be explained on the assumption of complete ionisation of the salts, although the authors prefer to consider them from the point of view of the change of interionic forces due to the substitution of one ion by another. In the case of lead bromide and lead chloride, for example, a change in the interionic forces due to the replacement of the bromide ion by the smaller chloride ion is assumed. The data so far obtained do not allow of a quantitative treatment on these lines, which will be attempted later.

Lipase in Olives.—It has been known from ancient times that olives, after being gathered or allowed to fall from the tree, are subject to a fermentative process which exercises a deteriorating influence on the oil afterwards obtained. Experimental results published by Pantanelli and Verdesca in the *Rendiconti* of the Naples Academy of Physical and Mathematical Science for January-June 1930 show that this process consists in acidification of the fatty matter owing to the action of a lipolytic enzyme which accelerates the scission of the glycerides into free fatty acid and glycerol with absorption of water. The activity of this lipase increases rapidly as the cellulose structure of the fruit is destroyed by the pressing. During the treatment of the olives, the enzyme is transferred from the aqueous magma to the oil, and the more highly acid the oil at the time of crushing, the richer is it in lipase and the more prone to become more acid. The hydrolysis of the fat is related to the presence of moisture, which remains emulsified during the operations, and, apart from this, is proportional to the amount of glycerol already formed. Hence, the factor determining the course and the intensity of the acidification is the glycerol, as it is the means of introducing water and lipase into the oil.

Egg Albumin.—The December number of the *Journal of the American Chemical Society* contains two papers on egg albumin. The first of these, by J. B. Nichols, gives the results of ultra-centrifuge experiments on crystallised, electro-dialysed egg albumin. The diffusion constant is abnormal, being six-tenths of the value calculated from the sedimentation constant ($4{\cdot}06 \times 10^{-13}$ cm. per sec. at 30°) and the molecular weight (34,500). The molecule is spherical and of radius 2·17 mμ; it is practically identical in size and mass with that of Bence-Jones protein, although entirely different in chemical composition. At a *p*H value of 1·16 in 0·1 *N* hydrochloric acid egg albumin is completely denatured and forms a gel, the mean size of the gel clumps corresponding with about seven molecules per particle after three hours. The second paper, by Sjögren and Svedberg, is on the *p*H stability region of egg albumin. Crystallised electro-dialysed material was used, about three months old. In the *p*H range the protein is stable and the ultracentrifuge gave a homogeneous molecular weight of 34,200. Below *p*H 4 and above *p*H 9 some of the molecules split into a non-centrifugible substance. At *p*H lower than 3 the sedimentation increases, indicating aggregation; above *p*H 9 it decreases, indicating the breaking up of the whole material.

Atomic Weights of Uranium Lead.—Baxter and Bliss, in the December number of the *Journal of the American Chemical Society*, report the value 206·01 for the atomic weight of lead from Swedish kolm (a shale-like material said to be an upper Cambrian sedimentary with trilobites). This is the lowest value ever formed, the next being 206·046 obtained by Hönigschmid and Horowitz for lead from Morogoro pitchblende. No theorium was found in the kolm ash. If Pb^{207} is the end product of the actinium series, on the basis of Aston's results, an atomic weight not less than 206·1 is to be expected for uranium lead. In a second paper the same authors report the value 206·195 for lead from a specimen of uraninite from Ontario. On the assumption that this is essentially free from ordinary lead, that the relation of Pb^{206} to Pb^{207} found by Aston in bröggerite material, 86·8 to 9·6, is that in which these isotopes are produced from uranium, and that the uranium equivalent of thorium in lead-producing power is 0·38, the average atomic weight of lead in the specimen of uraninite used is calculated as 206·23. The difference between this value and that found experimentally, 206·195, is far larger than the experimental uncertainty. The possibility that Aston's bröggerite lead was badly contaminated with ordinary lead is raised.

Problems of High Tension Overhead Electric Supply Systems.

THE setting up of high tension overhead electric supply systems all over Great Britain has brought to the foreground many engineering and scientific problems, the solutions of which are urgently wanted. One is the best design for insulators so as to avoid flashover, and another is the best way of preventing the vibrations of overhead transmission conductors. In a paper read by Mr. P. J. Ryle to the Institution of Electrical Engineers on Feb. 5, both these problems were discussed and partial solutions given.

Seven years ago, the Newcastle Electric Supply Co. put into operation a 66-kilovolt line which is now nearly a hundred miles long. It was soon found out that flashovers occurred in the strings of suspended insulators in industrial areas. It was also discovered that they occurred oftener when the line was near a rocky coast than when it was in the neighbourhood of a sandy beach. Probably the salt spray was the cause. The number of insulators in the supports was increased from five to six; but this had little effect. The main cause was traced to the deposits on the insulators. Similar troubles have occurred in Germany near lignite (brown coal) power stations, and mention was made of a complete 110-kilovolt system which had to be roofed over owing to the dust from an adjacent lignite station. Deposition on the porcelain surfaces is favoured by hollows in the insulator which are protected from the wind and rain. Several firms in Great Britain have installed fog and dirt chambers for the purpose of carrying out full voltage tests on these insulators, under the most severe conditions. The solution favoured is that facilities should always be available for shutting down main transmission lines once a year for a thorough inspection and for the cleaning of the insulators. This could be done at a period of light load.

Vibration probably occurs on every transmission line in the world; but breakdowns due to it do not often occur. In Mr. Ryle's paper the swaying of the conductor as a whole, which is evident in a strong wind, was not discussed, nor was the 'dancing' of conductors which sometimes occurs when rapid changes in the load or the temperature occur. He dealt with phenomena analogous to the humming of telephone and telegraph wires, the transverse vibration of aeroplane stay-wires which caused difficulty in the early days of flying, the regular swaying of tall factory chimneys across the wind, and the vibration of underwater towing cables. The 'speed-wobble' on motor cycles, which is due to the front and rear halves of the front wheel tending to vibrate in opposite directions, is probably due to a similar cause.

The cause of the vibration, which is, at least initially, in the plane perpendicular to the direction of the wind, is attributed to the instability of a type of air flow in the wake of a cylindrical body. The eddies seem to set up alternating forces transverse to the wind, which tend to initiate and maintain vibration, especially when their period coincides with a natural period for transverse vibration. Little is known at present of the various types of damping forces due to the air, elastic hysteresis in the wires and in the lattice towers. Luckily, there is, in general, little probability of vibrations ever building up to large amplitudes, as a very slight change in the wind velocity alters the resonant harmonic. Experience has shown that the vibrations increase the larger the conductor and the more tightly it is strung. Wind velocities of between two and twenty miles per hour are the most effective in producing these vibrations. Some guiding principles were given for the design of damping devices.

Indian Lac Research.

THE Annual Report (to Mar. 31, 1930) of the Indian Lac Association for Research gives evidence that the important work carried on at this Institute is making steady progress. The Institute and its connecting buildings are almost completed, and the staff, which now numbers 24, has had added to it Dr. R. W. Aldis, in charge of the physico-chemical section. As the director and bio-chemist, Mrs. Dorothy Norris, states, "it will now be possible to examine closely each stage of the ordinary process of lac manufacture, with a view to checking waste and devising improvements".

For those interested in lac and its development and economics this report will well repay a study. Briefly, the work at the Institute resolves itself into the following main features: The formation of plantations of species of trees which are considered likely to produce the largest amount of lac. The chief factors under study are (*a*) the sylviculture and requirements in soils, etc., of the different species and their success under varying climatic conditions; (*b*) the success attainable by employing manures in the plantations; (*c*) the chemical factors affecting or encouraging the growth of the trees on different soils; (*d*) the chemical differences in the sap of the twigs and their influence on the lac insect itself; (*e*) the seasonal variations in host plants of the lac insect, also under investigation in the laboratories of the bio-chemist and assistants, together with analysis work of lac obtained from different host plants.

The other important section of the Institute is that on entomology, under Mr. P. M. Glover, helped by a staff of nine. Mr. Glover divides the work of his branch into two groups—first, the bionomics of the lac insect, *Laccifer* (*Tachardia*) *lacca*, and secondly, the investigation of the insect enemies and friends of the lac insect, the latter including the enemies of lac host trees. It is impossible to follow Mr. Glover in the interesting account of the problems with which he is faced. As an example it will be sufficient to state that one well-known lepidopterous (Noctuidæ) pest, *Eublemma amabilis*, passes through six life-cycles in a year and eight days, to indicate the complications which insect depredators add to the study of this valuable lac insect and its habits, and to the best methods of propagation and so forth. The theory that ants preyed upon the lac insect and consequently diminished the crop is now officially disproved in the majority of cases investigated.

That the work of the entomological branch, however, is of the greatest importance is supported by Mr. Glover's statement on the damage done by pests: "The annual stick lac production of India, including Burma and Assam, is in the neighbourhood of 1,700,000 of maunds [1 maund = 80 lb.] valued at about Rs.6,80,00,000. The average percentage damage by insects to lac crops is 60 per cent; this means that the annual lac crop is roughly one-third of the hypothetical undamaged crop, giving an annual loss due to insect damage of Rs.13,60,00,000." It will be apparent that the study of the pests of lac and methods of combating them should well repay the sums expended on the research undertaken with this object in view.

Fossil Wood from the Bituminous Sands of Alberta.

SINCE 1913 the Mines Branch of the Department of Mines of Canada has been carrying out, under the direction of Mr. S. C. Ells, an extensive investigation of the bituminous sands (McMurray Tar Sands) of Northern Alberta. In a long communication to the Editor, dated Jan. 12, Mr. Ells directs attention to the presence of fossil wood in these sands. The discovery of fossil wood on the Ells River was first recorded by him in 1914, and later similar wood was obtained in shaft-sinking operations near McMurray (*Report* 632, Mines Branch, Dept. of Mines, Canada, p. 55, 1925). Many of these specimens and others found later were sent to Prof. I. W. Bailey at Harvard University, who reported that one of the fossil woods belongs to some gymnosperm, not found growing in North America at the present day, which closely resembles in its wood-structure *Sciadopitys*, the parasol pine of Japan. Another he refers to the conifer *Keteleeria*, which is found in China and Formosa at the present day; while a third appears to belong to the type of wood called *Xenoxylon*, which has been found in Jurassic rocks. These three types, which may be referred to the three form-genera of fossil woods, *Phyllocladoxylon*, *Protopiceoxylon*, and *Xenoxylon*, from other records appear to have a stratigraphical range from the Jurassic onwards.

The fossil wood, which is found in the McMurray Tar Sands in various-sized fragments, up to trunks at least 40 ft. in length, must have been transported, according to Mr. Ells, by water, and afterwards embedded in sand. The sands at a later date became saturated with asphaltic base petroleum, which impregnated and preserved the cellular structure of the wood.

Other samples of these fossil woods were examined at the University of Alberta by Prof. F. J. Lewis, who, in a letter to the Editor, dated Dec. 23, 1930, states that some of the fragments of wood belong to the form-genus *Cupressinoxylon*, a type of wood found in the cypress and several other conifers, living and extinct. He also mentions that some of the wood is "Cordaitean in character with centripetal xylem". Without fuller details and photographs, it is impossible to express more than a guess as to the significance of these discoveries and identifications. Wood of Cordaitean type with centripetal xylem is what one might have expected to find in Palæozoic rocks. On the other hand, *Cupressinoxylon*, *Phyllocladoxylon*, *Protopiceoxylon*, and *Xenoxylon* would suggest a Mesozoic age for the beds. This is consistent with the fact that the beds immediately below are found to contain a Jurassic flora. It is to be noted that all the woods apparently belong to coniferous trees and there are no Angiosperms represented in the collection. This negative evidence is in favour of a Jurassic or very early Cretaceous age, before the advent of the Angiosperms. According to Mr. Ells, the discovery in the beds of two shells, of a *Campeloma* and a Melanoid belonging to the genus *Pachymelania* on Hangingstone River gives an additional clue to the age, for *Campeloma* has hitherto not been found in beds older than the basal part of the Cretaceous in America.

These various pieces of evidence, though not of much weight taken separately, point, on the whole, to an early Cretaceous age (or perhaps late Jurassic age) for the bituminous sands in which the fossil woods are found. However, until these fossil woods have been identified specifically and compared carefully with similar woods of known geological age, they are of little value as stratigraphical indices. One looks forward to the appearance of an adequately illustrated memoir on these interesting finds. The specimen of "Cordaitean wood" may be of considerable botanical interest.

Cancroid Crabs of America.

MISS MARY J. RATHBUN has completed a third part of her series of handbooks on American crabs in a work entitled "The Cancroid Crabs of America of the Families Euryalidæ, Portunidæ, Atelecyclidæ, Cancridæ, and Xanthidæ" (Smithsonian Institution, United States National Museum, *Bulletin* 152, 1930). This monograph is on the same lines as those previously published, namely, "The Grapsoid Crabs of America" and "The Spider Crabs of America", and is equally valuable and well got up. Not only does it enable one to identify the American crabs, but also it helps all carcinologists with its detailed and carefully prepared classification, synonymy, and tables of distribution.

The Smithsonian Museum has recently been much enriched by large collections of crabs from South America obtained by Dr. Waldo L. Schmitt during his two series of explorations under the auspices of the Walter Rathbone Bacon scholarship. These, together with several exchanges from various museums, make the South American collections very valuable. Further investigations at the Tortugas and neighbourhood for the Carnegie Institution by Dr. Schmitt and Mr. Clarence R. Shoemaker in co-operation with Dr. William H. Longley, in charge of the Laboratory, have contributed much that is of interest; and collections have been added from the University of Southern California and the California Academy of Sciences.

A specially valuable find was a specimen of the extremely rare little crab *Metopocarcinus truncatus* Stimpson, of which the type is not extant, and this is the only one known to exist in any collection. It is recorded from Cape St. Lucas, Lower California, Mexico, and Valparaiso, Chile.

It is with some reluctance that we call the common green crab *Carcinides* instead of *Carcinus*, but this alteration and the substitution of Euryalidæ for Corystidæ, to quote only one of many changes, are sound from the point of view of the International Rules of Nomenclature, as is also the restriction of the genus *Portunus* to those forms with nine lateral teeth each side of the carapace. Mr. Richard Palmer in his paper, "A Revision of the Genus *Portunus* (A. Milne Edwards, Bell, etc.)", in the *Journal of the Marine Biological Association*, N.S., vol. 14, No. 4, 1927, discusses the subject with much fairness, and one cannot help hoping that the general opinion will be in favour of keeping our British forms with five teeth each side of the carapace in the genus *Portunus*.

Nothing at all is said of the larval forms of any of the crabs, although now a good deal is known which is helpful in classification. This is, of course, in keeping with the other volumes, but it is to be hoped that the time is not far distant when larval characters will be as important as any of those of the adult, and that the structure of larvæ and adults together will form the basis of all systematic work.

The volume consists of 593 pages, containing many excellent figures, besides 229 beautiful photographic plates.

The Atlantic Cod and its Races.*

DR. JOHS. SCHMIDT'S happy intuition as to the choice of successful investigations is again exemplified by his latest memoir. Here he has examined samples of cod from all over its north Atlantic region of distribution. In each fish (about 20,000 in all) the numbers of vertebræ and the numbers of rays in the second dorsal fin have been counted. The results are fully displayed in a series of tables and charts. They are very remarkable and unexpected.

The highest numbers of vertebrae (54 to 55·46) are found in the cod taken from the sea off the coasts of Newfoundland and Labrador, and the lowest numbers are those found in Irish Sea fish; we may summarise these results:

Newfoundland, Labrador	54-55·46	Vert.	Temperature	0°-5°
Greenland, Iceland, East Baltic	52·41-53·99	,,	,,	5°-10°
North from Scotland, North Sea	52-52·4	,,	,,	5° to >10°
Rockall, West from Scotland Irish Sea	51·47-51·99	,,	,,	10°-15°

Thus there is an undoubted correlation between the values of a certain morphological character and the general sea temperatures throughout the whole region inhabited by the cod. Dr. Schmidt gives other examples of similar correlations: (1) in respect of the number of rays in the second dorsal fin of the cod; (2) the numbers of vertebræ in both winter and summer spawning herrings; and (3) the numbers of vertebræ in the fish *Zoarces*. The latter investigation was the subject of a previously published memoir and it is very interesting: in a single fiord, for example, the numbers of vertebræ in the fish diminished regularly from the shore regions immediately outside the fiord to those at its inner extremity.

Returning to the cod results, it is clear that there are local races with relatively restricted regions of distribution, and that there cannot be much intermigration between these localised regions. This probably applies also to the distribution of the herring. The conditions responsible for these segregations require investigation, and Dr. Schmidt only touches this question. Probably there is 'direct impression', or action, upon the developmental factors of the fish, during some 'critical period', by the external physical factors. Certain experimental results actually suggest this; but, obviously, much more investigation is required. Such a conclusion does not rule out the hypothesis that differences between the races are of a "hereditary, genotypical nature". It is, on the whole, improbable that the differences are due to selection of the variates. Dr. Schmidt's memoir is a model of clear and accurate exposition, and the results themselves are of unusual interest. J. J.

* *Comptes-rendus des travaux du Laboratoire Carlsberg*, vol. 18, No. 6. 'Racial Investigations, 10: The Atlantic Cod (*Gadus callarias*, L.) and Local Races of the same." By Johs. Schmidt. Pp. 722+10 plates.

University and Educational Intelligence.

CAMBRIDGE.—The Appointments Committee of the Faculty of Biology "B" has reappointed Dr. W. E. Dixon to be University lecturer in biochemistry, and has appointed Mr. E. T. C. Spooner, of Clare College, and Mr. A. A. Miles, of King's College, to be University demonstrators in pathology.

The following Grace has passed the Senate: "That the Degree of Master of Arts, *honoris causa*, be conferred upon Ebenezer Everett, for many years assistant to Professor Sir J. J. Thomson at the Cavendish Laboratory."

THE Cecil Peace Prize of £100, which is offered yearly for an essay on some subject connected with the maintenance of international peace, to any undergraduate of any university or university college in Great Britain or Northern Ireland who has not attained the age of twenty-five years, has been awarded to Mr. G. G. Thomson (University of Edinburgh) for 1930, with Freda Marrison (University College of Swansea) as *proxime accessit*.

THE annual meeting of the Association of Technical Institutions will be held in the Merchant Taylors' Hall, Threadneedle Street, London, E.C.2, on Friday and Saturday, Feb. 27 and 28. The proceedings will commence at 11 A.M. on Feb. 27, when the chair will be taken by the president, the Right Hon. Lord Eustace Percy, M.P., who will introduce the president-elect, Major-General Sir Philip Nash. Following this, an address will be given by Principal B. Mouat Jones, on "Technical Education in Russia". Members and guests of the Association will afterwards be received by the Master and Wardens of the Merchant Taylors' Company, and luncheon will be served in the Company's Hall. Friday afternoon and Saturday morning will be devoted to the reading of papers by Mr. G. H. Gater, Chief Education Officer, London County Council, on "A Descriptive Account of Technical Education in London"; Mr. Comyns Carr, on "Industrial Administration"; Principal J. A. Todd, of the City School of Commerce, Liverpool, on "National Certificates in Commerce"; Mr. J. W. Ramsbottom, Director, City of London College, on "Commercial Education in America".

THE report of a consultative committee, under the chairmanship of Sir W. H. Hadow, which was appointed by the Board of Education to inquire into the courses of study suitable for children (other than children in infants' departments) up to the age of eleven years, with special reference to the needs of children in rural areas, has just been published under the title of "The Primary School" (London: H.M. Stationery Office, 1931. 2*s*. 6*d*. net). The report may be regarded as the logical complement to the consultative committee's report on the "Education of the Adolescent" (1926) (Hadow Report), dealing as it does with the upper stage of primary education. This important period in the development of children has, up to the present, been comparatively neglected by physiologists and psychologists. Recognising this fact, the Consultative Committee obtained memoranda on the physical growth and mental development of children up to the age of eleven years from Prof. H. A. Harris and Prof. Cyril Burt. The data contained in these memoranda (Appendices 2 and 3) and in other evidence obtained from various specialists are discussed in Chaps. 2 and 3. Chap. 4 deals with administrative problems, while Chap. 5 discusses questions of the internal organisation of primary schools. Chap. 6, on the problem of retarded children at the primary stage of education, dealing especially with the chief causes of retardation, should be of considerable interest to teachers and administrators. Chap. 7 gives the views of the Committee on the general problem of the curriculum for children up to the age of eleven. The sections on the "Study of Nature", and the memorandum on the anatomical and physiological characteristics and development of children between the ages of seven and eleven, by Prof. H. A. Harris, and that on the mental characteristics of such children, by Prof. Cyril Burt, are of special interest.

Societies and Academies.

LONDON.

Royal Society, Feb. 12.—J. Cohen, K. Cooper, and P. G. Marshall: Some aliphatic and aromatic amino derivatives of α-quinoline methodide. Many of the amino and acylamino compounds obtained by the condensation of derivatives of α-methyl quinoline with nitrosoarylamines possess active antiseptic and in some cases mild trypanocidal properties. Substances obtained by attaching a basic aliphatic or aromatic side-chain directly to the α-carbon of the quinoline nucleus exhibited no marked antiseptic or trypanocidal character. Diamino compounds of aliphatic and aromatic series with basic groups at both ends of the chain did not exhibit the expected antimalarial action.—C. H. Browning, J. B. Cohen, S. Ellingworth, and R. Gulbransen: The antiseptic and trypanoidal action of certain styryl and anil benzthiazole derivatives. The anil benzthiazole derivatives are relatively weakly antiseptic for *Staphylococcus* and *B. coli*, as compared with the quinoline analogues, which are highly active in this respect. Several benzthiazole styryl compounds have produced cure of mice infected with *Trypanosoma brucei*, and the same relationships between chemical constitution and trypanocidal action have been found to hold as in the styryl quinoline series. Thus the maximum effect is produced when one nucleus contains a basic group and the other an acetylamino group. The anil benzthiazole series, in general, possesses some trypanocidal action, but cure has only exceptionally been produced.

Physical Society, Jan 16.—L. C. Martin: The theory of the microscope. The paper examines the diffraction-effects produced by (*a*) two adjacent apertures, and (*b*) a series of apertures in an opaque screen situated in the focal plane of a lens system, when the illuminating system is projecting the elementary image of a point-source of light into this object plane. The diffraction effects and geometrical resolving power of the grating are shown to be independent of the concentration of the light in the object plane; they depend rather on the number of apertures free to transmit light. The theory is then extended to the case where the illumination of the object is produced by a source of finite area.—J. H. Vincent: Further experiments on magnetostriction oscillators at radio-frequencies. The coil surrounding the bar can be in either branch of a simple tuned anode circuit. When the bar-coil is in the inductive branch the circuit may be operated as a series or parallel arrangement; in the latter case the direct plate-current does not pass through the inductive branch of the fly-wheel circuit. The variation in either the anode- or the grid-current can be used to indicate resonance. Comparative experiments with corronil, nickel, and glowray suggest that glowray is the most suitable of these materials for high-frequency oscillators.—S. Butterworth and F. D. Smith: The equivalent circuit of the magnetostriction oscillator. The equivalent electric circuit is developed and expressions for its elements in terms of the fundamental constants of the material are given. The circle-diagram of impedances is deduced, and the modifying effects of eddy currents and hysteresis are investigated. Some simple geometrical relations between the vectors in the diagram are derived. An experimental investigation of the resonant radial vibrations of solid and laminated nickel rings verifies the theoretical deductions. For nickel in the annealed state, $\lambda = 1{\cdot}76 \times 10^4$ and $\kappa = 22{\cdot}1 \times 10^4$ at a point on the curve corresponding to $H_0 = 14{\cdot}5$ gauss.

Geological Society, Jan. 28.—J. F. N. Green: The South-West Highland sequence. The present succession near Ballachulish can be paralleled in detail with Islay. On attempting to apply the result to the neighbouring areas of Glencoe, Onich, and Cuil Bay, several amendments to current views are suggested. The evidence supporting these amendments is given. The three areas, Islay–Jura, Ballachulish–Appin, and Tayvallich – Loch Awe, are regarded as complex synclines of correlated rocks. Between these synclines appear grey calcareous phyllites. Between the phyllites and the flags or discontinuous quartzite occur shallow-water beds, composed essentially of quartzitic conglomerate and calcareous sandstone, accompanied usually, but not always, by black slate.

PARIS.

Academy of Sciences, Dec. 22.—P. Vincensini: A property relating to the deformation of surfaces.—Bertrand Gambier: Voss-Guichard surfaces.—J. Herbrand: A new demonstration and generalisation of a theorem of Minkowski.—Kourensky: The generalisation of the Poisson-Jacobi parentheses.—Henri Mineur: The K terms of the radial velocities. When the mean radial velocity of the stars is developed in a series of spherical functions, the development contains a constant, called the K term, which cannot be explained by the movement of the sun, or by the rotation of the whole of the stars. The K terms for stars of known radial velocities have been calculated, classifying by types of spectra, by the distances from the sun, and by galactic latitudes.—André Lallemand: The photometric study of the solar corona for radiations in the red and infra-red. The relation between the brightness (B) of an element of the corona and its distance from the sun (p) has been found to be

$$\log B = \alpha\rho + \log B_0.$$

For a given wave-length, α is constant and independent of the region explored.—G. C. Moisil: The systems of Dirac equations of elliptical type.—Marcel Chopin: An apparatus for measuring the surface tensions of liquids. The apparatus described and illustrated can be used for measuring surface tension in absolute values with quantities of liquid of the order of 0·15 c.c.—J. Basset and R. Dupinay: The compressibility of nitrogen and of hydrogen at ultra-pressures of 5000 atmospheres. 1 c.c. of hydrogen at 1000 kgm./cm.² becomes 0·456 c.c. at 5000 kgm./cm²: 1 c.c. of nitrogen at 1000 kgm./cm² becomes 0·610 c.c. at 5000 kgm./cm.². Apparatus is under construction for studying gases at pressures of 25,000 atmospheres.—P. de la Gorce: The realisation of a resistance for measurements at very high voltages. Description, with diagram, of an arrangement in use at the Laboratoire central d'électricité for a steady load at 150 kilovolts.—P. Girard and P. Abadie: The hypothetical existence in water of resonators of Hertzian frequency. Measurements of the dielectric constant of a solution of sodium silicate of concentration $1{\cdot}5 \times 10^{-4}N$ for wave-lengths between 50·18 cm. and 60·28 cm. have not proved the existence of dispersion bands, and the experiments of Weichmann and of Frankenberger cannot be confirmed.—Georges Fournier: The graphical calculation of the magnitudes connected with the electron in motion.—Z. Zajac: The fluorescence of excited mercury atoms.—Louis Goldstein: The introduction of the exchange in the statistics of a gas of electrons.—André Guilbert: The thermal phenomena produced along hysteresis cycles.—Marcel Dufour: The representation of the astigmatic pencil and the auxiliary straight line of Mannheim.—J. Dourgnon and G. Waguet: Theorems relating to the brilliancy of secondary sources.—Constantin

Salceanu: The magnetic rotatory polarisation of organic substances liquefied by fusion. Measurements are given of the magnetic rotation (field 36,000 gauss) of naphthalene and of β-methylnaphthalene for varying temperatures above the melting-points of these substances: the results are compared with those deduced from Mallemann's theory.—R. de Mallemann and P. Gabiano: The magnetic rotatory power of hydrocarbons in the gaseous state. Special attention has been paid to the purification of the gases examined, fractional distillation being used where possible. Data are given for the first six hydrocarbons of the paraffin series.—Charles Dufraisse and Léon Enderlin: Contribution to the study of the reversible oxidisability of organic substances: the thermochemistry of the oxidation of rubrene. The determination of the heats of combustion of rubrene and its oxides, proves that there is a loss of 23 calories when passing from rubrene to its dissociable oxide.—E. H. Buchner: The vapour pressure of jellies. The author has been unable to confirm the results obtained by Paul Bary on the vapour pressure of jellies, and hence thinks it unnecessary to discuss the theoretical explanation given by the latter.—Paul Bary: The vapour pressure of jellies. Reply to E. H. Buchner.—Marcel Godchot and Mlle. G. Cauquil: The dispersion of refraction of cyclanic hydrocarbons. The refractive indices (n, n') for two wave-lengths (λ, λ') have been determined for 23 hydrocarbons of the cyclo-pentane, cyclo-hexane, cyclo-heptane, and cyclo-octane series. The specific dispersion $(n - n')/d$, where d is the density taken at the same temperature as the optical observations, shows certain regularities.—G. Mahoux: The influence of high frequency oscillations on the treatment of metallurgical products. When a steel containing nickel, chromium, and molybdenum was heated to 500° C. for nine hours in a current of gaseous ammonia, its hardness and resilience are not appreciably changed. Under similar conditions, but with the test piece submitted to high frequency oscillations, the hardness is increased to about three times the original value. Other steels show similar changes.—Léon Guillet: Remarks on the preceding communication. The importance of these researches is emphasised and the necessity for further work indicated.—Augustin Boutaric: A method of following the variation of the number of particles in the course of the evolution of a colloidal solution. Application to blood serum. The change in the number of particles in suspension can be followed by the comparison of measurements of viscosity and the optical density.—P. Laffitte and M. Patry: The detonation of explosive solids.—M. Paić: The fusion diagram of the systems $HgBr_2 - HgSO_4$ and $HgCl_2 - HgSO_4$.—Edouard Urbain: The acid magnesium potassium carbonates and magnesium ammonium carbonates.—A. Travers and Franquin: The estimation of piperidine in a mixture of pyridine and its higher homologues.—J. Wyart: The dehydration of heulandite studied by means of X-rays.—L. Royer: The possible orientation of cubical crystals deposited on a sheet of mica.—F. Dupré la Tour: The polymorphism of the saturated dicarboxylic fatty acids as a function of the temperature.—R. Weil: The peculiarities of amethysts and quartz rich in solid inclusions.—Albert Michel-Lévy: Crushed granulite and ante-Stephanian mylonites at the north-east of the mountains of Espinouse.—Maurice Blumenthal: The transversal extension of the betic mass in the "Hoya de Malaga".—Henri Termier: The existence of Caledonian folds in central Morocco.—J. Devaux: The photometric study of the penetration of solar radiations in the interior of the Pyrenees glaciers—J. Thoulet: Aerial columns and submarine liquid columns.—R. G. Werner: The formation of lichens.—Maurice Hocquette: The evolution of the nucleus in the cells carrying bacteria of the nodules of *Ornithopus perpusillus* during the phenomena of infection and of intracellular digestion.—Marc Simonet: The cytological study of some hybrids of *Iris*.—Charles Pontillon: Variations in the unsaponifiable matter and lipoid phosphorus of *Sterigmatocystis nigra* as a function of the mineral composition of the culture fluid.—Paul Guérin: The development of the egg and polyembryony in *Erythronium dens canis*.—J. R. Denis and P. Paris: The influence of light on the free plankton of fresh water.—M. Bridel and C. Charaux: Frangularoside, a new rhamnoside of recently dried alder-buckthorn bark. It is the custom to store this bark for a year before sale, and Schwabe has stated that franguloside does not exist in the fresh bark. The authors confirm this view, since on applying the method which extracts 25 grams of franguloside from a kilogram of commercial bark, a different rhamnoside is obtained, to which the name frangularoside is given. Hydrolysis of this new compound gives 41 per cent of rhamnose.—G. Nicholas and Mlle. Aggéry: New observations on *Phyllosticta Daphniphylli* and the increase of its action by bacteria.—Mme. Lucie Randoin and Mlle. Andrée Michaux: Variations in the proportion of chlorine in the blood serum and the variations of the chloride elimination in the course of acute experimental scurvy.—H. Bierry: Protein, sugar and animal species.—L. Bugnard and C. Soula: Cholesterolic regulation.—C. N. Dawydoff: The post-embryonic development of the annamite *Cœloplana*. The organisation of the larva.—E. Roubaud: The existence of genetically distinct biological races in the common mosquito, *Culex pipiens*.—R. Fosse, A. Brunel, P. de Graeve, P. E. Thomas, and J. Sarazin: Application of the seed of *Soja hispida* deprived of uricase. The qualitative and quantitative analysis of allantoin.—Jean Loiseleur: The state of the biochemical constituents, especially the proteins, in anhydrous solutions. Proteins and other biochemical constituents are soluble in certain fatty acids, forming, in the absence of water, true solutions.—G. Ramon: The production of the tetanus antitoxin.—Georges Fontès and Lucien Thivolle: Tryptophane and histidine deficiency regarded as contributing to Biermer's disease (progressive pernicious anæmia).

MELBOURNE.

Royal Society of Victoria, Dec. 11.—J. H. Gatliff and C. J. Gabriel: Additions to, and alterations in, the Catalogue of Victorian Marine Mollusca. Of the new records, ten are chitons, three bivalves, and twenty-two univalves, of which nine are included in the family *Turridæ*.—F. Chapman and W. J. Parr: Notes on new and aberrant types of Foraminifera. A new genus, *Heronallenia*, is proposed for some previously described species of *Discorbina*. The genus is found fossil in the Oligocene of Muddy Creek, the Miocene of Batesford, and the Pliocene of England. The recent specimens are recorded off the Falkland Islands, the Antarctic, New South Wales, and Japan. The new genus, *Hofkerina*, has for genotype Howchin's *Pulvinulina semiornata*, and is a member of the family *Victoriellidæ*.—F. Chapman: Occurrence of a fossil *Hydractinia* in Australia. *Hydractinia thatcheri* is here newly described, from the Miocene of the Murray River Cliffs, South Australia. It is quite distinct in specific structure from any previously described, and is the first occurrence of the genus in Australian rocks. The perisarc is papillate and encrusts a once-existing gasteropod shell.—W. J. Parr: Victorian and South Australian shallow-water Foraminifera. One hundred and ninety-four species and varieties are

recorded, including sixteen described as new. Several usually warm-water species are found in Bass Strait, but not on the South Australian coast; while other species described from the Miocene of Victoria are now recognised for the first time as living in the same area.

Official Publications Received.

BRITISH.

The South African Journal of Science. Vol. 27: Being the Report of the Twenty-eighth Annual Meeting of the South African Association for the Advancement of Science, Caledon, 1930, 7 July to 12 July. Pp. xlvi+620. (Johannesburg.) 30*s.* net.

Journal of the Manchester Geological Association. Vol. 1, Part 2, 1927–8. Edited by Laurance H. Tonks. Pp. 61-113. (Manchester.) 7*s.* 6*d.*

Annual Report of the Indian Central Cotton Committee, Bombay, for the Year ending 31st August 1930. Pp. ii+113. (Bombay.) 2 rupees.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1305 (E. 41): A Harmonic Analysis of the Torque Curves of a Single Cylinder Electric Ignition Engine when throttled to various Mean Indicated Pressures, with an Appendix on the Estimation of Forcing Torques in Multi-Cylinder Engines. By N. S. Muir and A. Terry. Pp. 14+11 plates. 1*s.* net. No. 1334 (Ae. 467): Wind Tunnel Experiments with Circular Discs. By L. F. G. Simmons and N. S. Dewey. (T. 2919.) Pp. 6+4 plates. 9*d.* net. No. 1337 (Ae. 468): The Stresses in a Radially Spoked Wire Wheel under Loads applied to the Rim. Part 2: Simplified Formulae and Curves. By Prof. A. J. Sutton Pippard and W. E. Francis. (T. 2978.) Pp. 10+9 plates. 9*d.* net. No. 1338 (Ae. 469): Stalled Flight Tests on a Bristol Fighter fitted with Auto Control Slots and Interceptors. By R. P. Alston and Pilots of Aerodynamics Flight, R.A.E. (T. 2979.) Pp. 3+1 plate. 4*d.* net. No. 1339 (Ae. 471): Full Scale Experiments on High Tip Speed Airscrews —The Effect of Thickness of Section on Airscrew Performance. By W. G. Jennings and A. Ormerod. (T. 3002.) Pp. 6+8 plates. 6*d.* net. No. 1340 (Ae. 472): Directional Stability of High Speed Aircraft. By W. G. Jennings. (T. 2991.) Pp. 4+17 plates. 6*d.* net. No. 1315 (Ae. 470): An Experimental Determination of the Intensity of Friction on the Surface of an Aerofoil. By A. Fage and V. M. Falkner. (T. 2936.) Pp. 24+13 plates. 1*s.* 3*d.* net. No. 1360: Technical Report by the Accidents Investigation Sub-Committee on the Accident to the Aeroplane G-AAZK at Meopham, Kent, on 21st July 1930. Pp. 92+27 plates. 5*s.* 6*d.* net. (London: H.M. Stationery Office.)

FOREIGN.

Mémoires de Musée Royal d'Histoire Naturelle de Belgique. Hors série. Résultats scientifiques du voyage aux Indes orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. Publiées par V. van Straelen. Vol. 2, Fascicule 2: Süsswasserschwämme von Neuguinea. Von Walther Arndt. Pp. 12. Vol. 2, Fascicule 3: Coelentérés hydropolypes. Par E. Leloup. Pp. 18+2 planches. Vol. 2, Fascicule 4: Scyphomedusen. Von G. Stiasny. Pp. 12. Vol. 2, Fascicule 5: Die Oligochaeten. Von W. Michaelsen. Pp. 26. Vol. 3, Fascicule 1: i. Isopoda (excl. Oniscoidea et Epicaridea), par H. F. Nierstrasz; ii. Isopoda Epicaridea, par H. F. Nierstrasz et G. A. Brender à Brandis. Pp. 17. Vol. 3, Fascicule 2: Parasitic Copepoda. By W. Harold Leigh-Sharpe. Pp. 11+5 plates. Vol. 3, Fascicule 3: Cirripedes. By Dr. C. A. Nilsson-Cantell. Pp. 24. Vol. 5, Fascicule 1: Batraciens. Par Gaston-Fr. de Witte. Pp. 8. (Bruxelles.)

University of California Publications in American Archaeology and Ethnology. Vol. 29, No. 2: A Crow Text, with Grammatical Notes. By Robert H. Lowie. Pp. 155-175. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.) 30 cents.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 97: Some Climatic Relations of the Date Palm in Egypt. By Ahmed K. M. Ghamrawy. Pp. ii+23. 5 P.T. Bulletin No. 100: Developments of the Existing System for Seed Supply of Cotton in Egypt. By Dr. W. Lawrence Balls. Pp. 11+3 plates. 5 P.T. (Cairo: Government Press.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 67: Reports of the Proceedings of a Special Hydrographic Meeting held on May 27th, 1930, in Copenhagen. Pp. 99. 4.00 kr. Vol. 68: Fluctuations in the Abundance of the various Year-Classes of Food Fishes. Reports prepared by Special Reporters nominated by the Council and indicating the Main Results brought out by the Papers read at the Biological Meeting of London in 1929. Pp. 115. 4.50 kr. Vol. 69: Statistiques biologiques et considérations sur la population harenguière de la Manche orientale et du sud de la Mer du Nord. Pp. 12. 0.75 kr. Journal du Conseil. Vol. 5, No. 3, Décembre. Rédigé par E. S. Russell. Pp. 285-454. (Copenhague: Andr. Fred. Høst et fils.)

Diary of Societies.

FRIDAY, FEBRUARY 20.

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual General Meeting) (in Botany Department Lecture Room, Imperial College of Science and Technology), at 11.30 A.M.—Discussion on Biological Races and their Significance in Evolution, to be opened by the President. Other speakers:— Dr. W. B. Brierley (Fungi); Dr. P. Bruce-White (Bacteria); Dr. T. Goodey (Nematodes); Dr. W. H. Thorpe (Insects); Dr. W. B. Turrill (Seed-Bearing Plants).

GEOLOGICAL SOCIETY OF LONDON (Annual General Meeting), at 3.—Prof. E. J. Garwood: Presidential Address.

LONDON SOCIETY (at Royal Society of Arts), at 5.—H. Robertson: Modern Architectural Possibilities.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5. —Discussion on Research on Physiological Effects of Baths.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.— G. G. Sherratt and J. H. Awbery: On the Velocity of Sound Waves in a Tube.—P. S. H. Henry: The Tube Effect in Sound-velocity Measurements.—W. A. Wood: Note on the Elimination of the β-wave-length from the Characteristic Radiation of Iron.

BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting) (at 32 Welbeck Street), at 5.—Dr. H. Cohen and Dr. P. H. Whitaker: Cinematograph of Ventriculography.—Dr. R. E. Roberts: (*a*) Lympho-sarcoma Involving the Stomach; (*b*) Carcinoma of Lung with Pathological Specimens.—Dr. J. H. Mather: X-Rays of a Case of Idiopathic Myositis Ossifican: 1896 and 1930.—Dr. H. K. Graham Hodgson: Demonstration of the Technique of Method of Sinus Investigation.— C. T. Holland: Radiographs of Unique Conditions.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (Annual Meeting) (at Liverpool University), at 6.—L. Wild: Modern Developments in Printing.

INSTITUTION OF MECHANICAL ENGINEERS (Annual General Meeting), at 6.—Capt. A. Swan, H. Sutton, and W. D. Douglas: An Investigation of Steels for Aircraft Engine Valve Springs.—R. G. C. Batson and J. Bradley: The Fatigue Strength of Carbon- and Alloy-Steel Plates as Used for Laminated Springs.

SOCIETY OF DYERS AND COLOURISTS (at Manchester Literary and Philosophical Society), at 7.—J. S. Wilson: Solazol Dyestuffs.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—Discussion on the Work of M. Puys.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (jointly with Northern Coke Oven Managers' Association) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. S. R. Illingworth: Some Aspects of the Carbonisation of Coal.

ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7.30.—T. I. Bernard: Electrical Methods: Ventilation and Air Conditioning.

JUNIOR INSTITUTION OF ENGINEERS (at Royal United Services Institution), at 7.30.—A. J. Grant: The Construction of the Variable Density Tunnel for the National Physical Laboratory at Teddington.

SHIPLEY TEXTILE SOCIETY (at Shipley Technical School), at 7.30.—A. B. Shearer: Rayon: its Uses in Woven Fabrics.

INSTITUTION OF STRUCTURAL ENGINEERS (at Merchant Venturers' Technical College, Bristol), at 7.30.—R. T. Morgan: Thames House.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Dr. A. A. Osman and Dr. H. G. Close: Observations on the Plasma Bicarbonate, and the Value of Alkalies in the Treatment of some of the Renal Complications of Pregnancy.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.— Discussion on the Future Policy of the Section.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. J. B. S. Haldane: Prehistory in the Light of Genetics.

GEOLOGISTS' ASSOCIATION (North-East Lancashire Group) (at Technical College, Blackburn).—W. L. Turner: With the Geologists' Association in Czechoslovakia (Lecture).

ROCHDALE TEXTILE SOCIETY (at Technical Schools, Rochdale).—Gregg: Modern Weaving Methods.

SATURDAY, FEBRUARY 21.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.—T. V. Simpson: Old Mining Records and Plans.—*Paper open for further discussion*:—W. H. Connell: Some Recent Improvements in Surveying Instruments.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—J. Stephens: On the Reading and Speaking of Verse (2): Difficult Poets.

MONDAY, FEBRUARY 23.

INSTITUTE OF ACTUARIES, at 5.—D. Houseman: Suggestions on the Legal Aspects of Life Office Practice.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 6.45.—D. G. Sopwith: Fatigue in Metals.

INSTITUTION OF ELECTRICAL ENGINEERING (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—E. T. Norris and F. W. Taylor: High-Voltage Testing Equipments.—B. L. Goodlet, F. S. Edwards, and F. R. Perry: Dielectric Phenomena at High Voltages.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—A. Hopewell Smith: (*a*) Evidence against the Theory of Metabolic Properties of Human Enamel; (*b*) The Head of an Egyptian Mummy.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—P. C. Visser: The Karakoram and Turkistan Expedition of 1920–30.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Botany School, Cambridge), at 8.45.—Prof. E. V. Appleton: Wireless Exploration of the Upper Atmosphere.

INSTITUTION OF ELECTRICAL ENGINEERING (Western Centre) (at Cardiff). —Prof. W. Cramp: The Birth of Electrical Engineering (Faraday Lecture).

TUESDAY, FEBRUARY 24.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4.30.— A. Wigglesworth: The Hard Fibre Industry, with special reference t the British Empire.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science), at 5.10.—Prof. G. T. Morgan: The High Pressure Plant at the Chemical Research Laboratory, Teddington (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: Recent Experimental Physics (3): Adhesion (1).

INSTITUTION OF CIVIL ENGINEERS, at 6.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Western District) (in Geological Department, University, Manchester), at 6.30.— E. Morton: The Properties, Selection, and Specification of Sandstones for Use as Kerbstones on Main Thoroughfares.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—E. Fawsset and G. E. Moore: Apparatus and Methods for Accurate Maintenance of Large A.C. Energy Meters.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—E. T. Norris and F. W. Taylor: High-Voltage Testing Equipments.—B. L. Goodlet, F. S. Edwards, and F. R. Perry: Dielecric Phenomena at High Voltages.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—E. R. Davies: The Electrical Measurement of Reflection Densities, and a New Photoelectric Reflection Density Meter.—M. Games: Demonstration of the Taxiphote.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Prof. G. W. O. Howe: Wireless Telegraphy and the Upper Atmosphere.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—G. J. Lugt: Supercharging, with special reference to Werkspoor Engines.

NELSON TEXTILE SOCIETY (at Nelson Technical College), at 7.30.—J. Yates: Manufacturing Efficiency.

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—Gossip Meeting.

BRITISH KINEMATOGRAPH SOCIETY (at Film House, Wardour Street), at 7.45.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Miss Winifred Lamb: Excavations at Thermi in Lesbos.

ROYAL AERONAUTICAL SOCIETY (Manchester Branch).—Alfred Herbert, Ltd.: Machine Tools.

WEDNESDAY, FEBRUARY 25.

SOCIETY OF GLASS TECHNOLOGY (in Applied Science Department, University, Sheffield), at 2.—The Use of Ammonium Sulphate in Accelerating the Melting of Glass:—M. Parkin, Prof. W. E. S. Turner, and W. J. A. Warren: Part I. Experimental Small Scale Meltings.—The Research Staff of Imperial Chemical Industries, Ltd.: Part II. Experimental Meltings in a Tank Furnace.—Dr. J. T. Howarth and Prof. W. E. S. Turner: The Temperature of Incipient Glass Formation.

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College), at 5.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. W. J. Arkell: The Upper Great Oolite, Bradford Beds, and Forest Marble of South Oxfordshire, and the Succession of the Gastropod Faunas in the Great Oolite.—Dr. A. Heard and J. F. Jones: A New Plant (*Thallomia*), showing Structure, from the Lower Downtonian Rocks of Llandovery, Carmarthenshire.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch—Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.—H. McIvor: Some Aspects of Mechanical Design.

INSTITUTE OF CHEMISTRY (Belfast Section) (at Royal Belfast Academical Institution), at 7.30.—J. A. Matthew: Effects of Air Humidity on Cellulose.

ROYAL SOCIETY OF ARTS, at 8.—W. G. W. Mitchell: Developments in Television.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.30.—Dr. Marie Stopes: The Lambeth Resolutions and the Papal Encyclical—Some Contrasts and Comments.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at 1 Wimpole Street), at 8.30.—Dr. Adrian Stephen: On Defining Psycho-analysis.

THURSDAY, FEBRUARY 26.

ROYAL SOCIETY, at 4.30.—J. C. Eccles and Sir Charles Sherrington: Studies on the Flexor Reflex, I-V.—Prof. A. V. Hill and J. L. Parkinson: Heat and Osmotic Change in Muscular Contraction without Lactic Acid Formation.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Surgeon-Comdr. S. F. Dudley: Some Lessons of the Distribution of Infectious Disease in the Royal Navy (Milroy Lectures) (1).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. B. S. Haldane: Respiration (2).

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Sir Philip Hartog: English Composition for Children of Twelve and Upwards.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Prof. W. Cramp: The Birth of Electrical Engineering (Faraday Lecture).

INSTITUTION OF LOCOMOTIVE ENGINEERS (at Institution of Mechanical Engineers), at 6.—R. G. E. Vallantin: Compound Locomotives on the Paris-Lyons-Mediterranean Railway.

ROYAL AERONAUTICAL SOCIETY (jointly with British Gliding Association) (at Royal Society of Arts), at 6.30.—Capt. F. Entwistle: Meteorological Aspects of Gliding and Soaring.

INSTITUTE OF METALS (Birmingham Section) (in Chamber of Commerce, Birmingham), at 7.—J. L. Williams: Press Tools for Sheet Metal Working.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. M. Cross: When Scouting Won.

EUGENICS SOCIETY (at 20 Grosvener Gardens, S.W.1), at 8.15.—Study Circle.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—Dr. W. R. Reynell: Sexual Neurosis.

ROYAL AERONAUTICAL SOCIETY (Gloucester and Cheltenham Branch).—Anglo-American Oil Co., Ltd.: Motor Fuels and Modern Methods of Testing.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch).—Major C. J. Stewart: Latest Aircraft Instrument Developments.

FRIDAY, FEBRUARY 27.

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre) (at Electricity Offices, Swansea), at 6.—B. Leggett: The Medical and Surgical Applications of Electricity.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. J. Montgomerie: Some Notes on Motor Engine Seatings.

OIL AND COLOUR CHEMISTS' ASSOCIATION (jointly with Institute of the Rubber Industry) (at Milton Hall, Manchester), at 7.—G. F. Thompson and E. V. Bratby: Colours used in the Rubber Industry.

BLACKBURN TEXTILE SOCIETY (at Blackburn Technical College), at 7.30.—J. H. Strong: Some Modern Tendencies in Cotton Manufacturing.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon-Tyne Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. B. Moore: Fused Silica in Industry.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff Technical College), at 7.30.—A. Watson: Building Research.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. A. Tookey: Oil Engines for the Maritime Fishing Industry.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.—Dr. P. Manson-Bahr: The Epidemiology of Human Trypanosomiasis.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Francis Younghusband: The Re-Birth of India.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas' Café, Swansea).—Dr. A. J. Amor: The Pathology of some Industrial Poisons.

ROYAL AERONAUTICAL SOCIETY (Hull and Leeds Branch).—H. Sutton: Aircraft Light Alloys.

SATURDAY, FEBRUARY 28.

MATHEMATICAL ASSOCIATION (at Bedford College), at 3.—W. J. Dobbs: The Correlation of Trigonometry and Geometry in Elementary School Mathematics.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—J. Stephens: A Poetry Recital.

PUBLIC LECTURES.

SATURDAY, FEBRUARY 21.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—R. W. Sloley: Water-Clocks and Sun-Dials.

MONDAY, FEBRUARY 23.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—T. D. Young: Meat Inspection.

KING'S COLLEGE, LONDON, at 5.30.—A. A. Pallis: The Exchange of Populations in the Near East (1913–1923).

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 6.—Prof. E. P. Cathcart: The National Diet. (Succeeding Lecture on Feb. 24.

TUESDAY, FEBRUARY 24.

LONDON SCHOOL OF ECONOMICS, at 5.—W. P. Yetts: The Cult of Ancestors in Ancient China.

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. H. R. Ing and Dr. Winifred M. Wright: Physical Properties and Chemical Structure of Drugs in relation to Pharmacological Action. (Succeeding Lectures on Feb. 26, Mar. 3, 5, 10, and 12.)

GRESHAM COLLEGE, at 6.—Sir George Newman: Physic. (Succeeding Lectures on Feb. 25, 26, and 27.)

ROYAL SANITARY INSTITUTE, at 8.—E. A. Elsby: Silicosis Prevention Methods (Chadwick Lecture).

WEDNESDAY, FEBRUARY 25.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—T. D. Young: Meat Inspection.

KING'S COLLEGE, LONDON, at 5.30.—Dr. J. A. Williamson: The Great Age of Discovery: The First Circumnavigation.

BIRKBECK COLLEGE, at 6.—Dr. G. Shearer: The X-Ray Microscope.

BELFAST MUSEUM AND ART GALLERY, at 8.—J. F. Hunter: The Making of Prints from Wood and Linoleum Blocks.

THURSDAY, FEBRUARY 26.

UNIVERSITY COLLEGE, LONDON, at 5.30.—M. M. Tod: The Light thrown by Greek Inscriptions on the Life and Thought of the Ancient World. (Succeeding Lectures on Mar. 5 and 12.)

SATURDAY, FEBRUARY 28.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—A. M. Hocart: Spirit-Worshippers of the South Seas.

EXHIBITION.

WEDNESDAY, FEBRUARY 25.

BIRKBECK COLLEGE, at 8.—Exhibition of Recent Films of Natural History Subjects produced by Visual Education, Ltd.

CONFERENCE.

FEBRUARY 27 AND 28.

ASSOCIATION OF TECHNICAL INSTITUTIONS (at Merchant Taylors' Hall, E.C.2).

Friday, Feb. 27, at 11 A.M.—Lord Eustace Percy: Introduction of Major-Gen. Sir Philip Nash as President Elect.
Principal B. Mouat Jones: Technical Education in Russia.

Friday, Feb. 27 (*afternoon*), and *Saturday, Feb.* 28 (*morning*)—
G. H. Gater: A Descriptive Account of Technical Education in London.
Comyns Carr: Industrial Administration.
Principal J. A. Todd: National Certificates in Commerce.
J. W. Ramsbottom: Commercial Education in America.