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Broadcasting in Great Britain.

THE Report of the Broadcasting Committee (H.M.S.O., Cmd. 2599, 6*d*. net), to which a brief reference was made in our issue of March 13, is commendably concise and at the same time practical; the recommendations made therein are likely to meet with general approval. The problem which the Committee had to consider, that of advising the Postmaster-General as to the scope of the broadcasting service in Great Britain and as to the management, control, and finance thereof after the expiry of the licence of the British Broadcasting Co. on December 31 next, is one which possesses several features containing special difficulties, not merely in relation to the scientific and technical aspects of the service, but yet more so in relation to various influences, still latent, which it may be capable of exerting on practically the whole range of human activities, political, commercial, educational, recreative, and social.

The Committee appreciates the great value of the work accomplished by the British Broadcasting Co., and properly places its admiration thereof on record; however, it recognises that the progress made in broadcasting since its inception in 1922 has already been so rapid and noteworthy that the organisation laid down for that Company no longer corresponds to national requirements or responsibility.

Having considered the various methods which seem available for the conduct of the service, the Committee, it is evident, felt that the prejudice on the part of a large section of the public against the continuance of a monopoly, sanctioned, supported, and protected by the State, is to-day so marked that, in spite of certain obvious advantages that the existing arrangement possesses, a great outcry would instantly have been raised against any proposal to allow broadcasting to remain in the hands of a body constituted on trade lines for the profit of those composing it. On the other hand, there was no getting away from the fact that, although the control by the State of a service with such far-reaching possibilities as those of broadcasting was absolutely essential, yet in view of the impression which widely prevails that the management of the wireless service already in the hands of the Post Office is inefficient, and the circumstance that it has proved unprofitable, it was certain very considerable opposition would be offered to any proposal which contemplated the transfer to a Government department of the undertaking of the British Broadcasting Co., with the exceptionally complicated features existing in its commercial as well as its scientific and technical side. In these circumstances, the Committee had to find a way out of the dilemma, and it has done so by definitely

recommending that the broadcasting service should be conducted by a public corporation—the "British Broadcasting Commission" is suggested as a suitable title for it—acting as trustee for the national interest, and that its status and duties should correspond with those of a public service. It further proposes that the management of the corporation should be vested in paid Commissioners, who should be "persons of judgment and independence, free of commitments, with business acumen and experienced in affairs," in order that they may inspire confidence by having no other interests to promote than those of the public.

It is suggested that the Commissioners—to be not more than seven or less than five in number—should all be nominated by the Crown and hold office for five years, subject to an extension of this term on its expiry. The appointment of a considerable number of advisory committees is also contemplated; it is expected that on them, to a great extent, the duty will rest of ensuring due consideration for particular phases of broadcasting, in relation both to programmes and to scientific progress and research, although ultimately it is the Commissioners upon whom will devolve the task of laying down the general line of policy and initiating experiment and research. The appointment of these advisory committees will be in the hands of the Commissioners, who would, the Committee assumes, gladly consult societies and organisations which are qualified to advise on questions of personnel.

The finance of the Commission receives careful consideration; the view is definitely expressed that "the Commission must be self-supporting and can expect no grant from public funds." The Committee fully anticipates that (i) increasing outlay on plant will be necessary, (ii) the overhead and administrative charges of the new authority will rise, and (iii) the control of programmes will be more onerous than hitherto. It further lays down that outlay on bold experiment should not be meagre, and research, both official and unofficial, should be constant. The Committee is therefore of opinion that the expenditure of the Commission, which, it is recommended, should be empowered to raise capital on the security of its income from licence-fees, may be calculated on the assumption that the present licence-fee of 10*s*. per annum will be maintained in the future. The Postmaster-General, it is recommended, should remain the licensing authority, and continue to collect the licence-fees and be responsible for the detection and prosecution of those who conceal their equipment. He should be completely indemnified against all expenditure incurred by him in relation to the broadcasting service; subject thereto, the duty is imposed upon him of paying to the Commissioners from the licence-fees "an income thoroughly adequate to enable them to ensure the full and efficient maintenance and development of the service." Any surplus after the condition last mentioned shall have been met should, it is suggested, be retained by the State.

The Committee recommends that the Commission should be granted a licence by the Postmaster-General; in the first instance, this should be for a term of not less than ten years. The general framework of this licence should be similar to the existing one of the British Broadcasting Co., and would contain a variety of technical provisions, together with the general powers entrusted to the Commission and specific restrictions imposed in the interests of the State. This arrangement would admit of a complete review of the situation at a later date, and any changes, either in the method of control or in the organisation now proposed, which might be rendered necessary by the development of broadcasting, could then be readily introduced.

The Committee recognises that the British Broadcasting Co. has enjoyed certain advantages owing to the permission it had to use, without royalty, certain transmission patents, the property of the constituent members of the Company, advantages which may not appertain to its successor. However, it does not anticipate that any difficulty will arise in respect of these patents should their continued use be essential to broadcasting, and hints that if, at any time, the owners of patents attempt to impose unnecessarily burdensome conditions in relation to the use thereof by the Commission, Section 29 of the Patents and Designs Act, 1907, may not be without its relevance.

Among other matters not touched upon above, the report contains recommendations proposing that: (*a*) All existing contracts and the staff of the British Broadcasting Co. should be taken over by the new Commissioners; (*b*) the Commissioners should be entitled to all ordinary rights as regards copyright material, but it is considered unnecessary to invest them with any special privilege or preference in the matter; (*c*) the claims of listeners desiring a larger proportion of educational matter should, if possible, be met; (*d*) a moderate amount of controversial matter should be broadcast, provided the material is of high quality and distributed with scrupulous fairness; and (*e*) the prestige and status of the Commissioners should be fully acknowledged and their sense of responsibility emphasised.

A historical summary of the broadcasting service in Great Britain is contained in an appendix to the report, the concluding paragraph of which appropriately shows the growth, quarter by quarter, in the number of wireless receiving licences: at March 31, 1922, the number of licences current was 7690, and had by January 31, 1926, increased to 1,840,268.

Work and Needs of the Smithsonian Institution.

THE Smithsonian Institution is appealing to the American public for an addition of ten million dollars towards its endowment. The grounds of this appeal were put in a very forcible and interesting way by Mr. Austin Hobart Clark, in an address to the American Association for the Advancement of Science, at Kansas City, on January 1. Readers of NATURE know something of the Smithsonian and what it has done. Its general policy has been to encourage research along all lines that do not receive adequate support from other sources, but never to interfere with work done under other auspices. In this way it has led to the establishment of ten technical bureaux, which now proceed as Government establishments, though in close touch with, and sometimes under the supervision of, the Smithsonian. The fields in which the Institution is desirous of expanding are mainly those of astrophysics, oceanography, entomology, palæontology, anthropology and archæology, animal diseases, botany, zoology, intensive exploration, and publications. While far from unmindful of the economic importance of these varied activities, the Smithsonian recognises that the vast extension of applied science and its superior rewards are attracting the best of the younger generation, so that the stream of those to whom we should otherwise look for the elaboration of new ideas and theories is being deflected elsewhere. It will therefore be the aim of the Smithsonian in the future, even more than in the past, to promote research in pure science.

The most detailed part of Mr. Clark's interesting address on the work of the Smithsonian Institution was, as might be expected from his own studies, that dealing with the investigation of the sea. He showed in how many points our knowledge is either lacking or too vague for present-day requirements. In the course of his illustrations of economic entomology, he urged the necessity for exact specific identification by comparison with the types in museums, and incidentally mentioned that new kinds are being described at the rate of about six thousand a year, at which rate he estimates that it will take five hundred years to complete the task. Under "Animal Diseases" he announced that it is proposed to establish a laboratory for their study in the National Zoological Park. The botanical programme includes exploration and study of the plants in Colombia, Ecuador, and Venezuela, where the flora is less known than in any other section of the western hemisphere. The need for bringing all this knowledge, not merely to professional workers, but also to the general public, was strongly emphasised.

Mr. Clark claims that the leadership in science which he is pleased to assign to England is intimately connected with the widespread interest as manifested in the large number of amateur scientific societies. Newspapers and magazines show that the interest exists; on men of science falls the responsibility of providing accurate material and plenty of it. Where stimulus is needed is in the presentation of the results of pure science, and here it is sad to note that increased costs have forced the Smithsonian to suspend its "Contributions to Knowledge" and to reduce the "Miscellaneous Collections" by two-thirds. The Smithsonian Institution is appealing for increased endowment. Founded by an Englishman nearly a century ago, it has greatly assisted the workers of Great Britain as well as those of other countries. Would it not be fitting and gracious that Great Britain too, though from a straitened purse, should make some response to this appeal?

Science and Religion.

Science, Religion and Reality. By the Earl of Balfour, Dr. Bronislaw Malinowski, Dr. Charles Singer, Dr. Antonio Aliotta, Prof. Arthur S. Eddington, Joseph Needham, Rev. Dr. John W. Oman, Dr. William Brown, Prof. Clement C. J. Webb, Rev. Dean Inge. Edited by Joseph Needham. Pp. v+396. (London: The Sheldon Press; New York and Toronto: The Macmillan Co., 1925.) 12*s.* 6*d.* net.

THERE has been of late a recrudescence of interest in the relations between science and religion, and the present book is a solid and important contribution to the study of this question, so fundamental for every thinking man. The book is remarkable also as showing how great a change has taken place in the attitude both of the theologian and of the scientific man towards this ever-present problem. The hearty days are gone when Huxley gave battle to the bishops, and fierce controversy raged through the pages of the serious reviews. In this book the spirit of antagonism is gone, and there is an earnest seeking after not compromise, but reconciliation. The pages breathe a sweet reasonableness, and one almost longs—in unregenerate moments—for a little clashing of swords.

In all seriousness, however, this change of attitude is to be welcomed, for every man must make his peace both with science and with religion if his life is to be complete and harmonious. The change is no one-sided one; the theologian realises more and more that he must frankly accept all the well-established facts of science and jettison ruthlessly outmoded cosmologies and fables of creation; the man of science on his part is beginning to recognise that the principles he finds serviceable in the investigation of the material world cannot safely be erected into a comprehensive

philosophy of existence. So both sides abate somewhat of their pretensions, and a working reconciliation becomes possible.

It is very difficult to summarise a book of this kind—the work of many hands, approaching the problem from many different viewpoints—the more so because it is not a symposium, but a collection of papers written independently of one another. There is a short introduction by the Earl of Balfour, and a long concluding article by Dean Inge, which in some measure sums up and appraises the work of the contributors, while remaining a brilliant and individual presentation of the Dean's own views, written from an avowedly Christian point of view with all that skill, competence, and originality which we have learnt to expect from him.

About half the book is historical in treatment, the rest a presentation in different ways of both the religious and the scientific points of view.

Dr. Malinowski, in a well-thought-out and interesting article on "Magic, Science and Religion," based largely upon his own personal researches in Melanesia, succeeds in distinguishing clearly between the spheres in savage life of practical—not theoretical—science, magic, and religion. In his dealings with the world around him, in his activities as hunter or tiller of the ground, the savage is necessarily a practical man of science, depending upon the uniformity of Nature for the return of seed time and harvest time and for success in the chase. Magic is defined as "a practical art consisting of acts which are . . . means to an end expected to follow later on." It is akin to science in that "it always has a definite aim intimately associated with human instincts, needs, and pursuits." It is often an attempt to influence favourably a chancy or inimical environment. Religion has a different function and is pre-eminently social.

"Religious faith establishes, fixes, and enhances all valuable mental attitudes, such as reverence for tradition, harmony with environment, courage and confidence in the struggle with difficulties and at the prospect of death. This belief, embodied and maintained by cult and ceremonial, has an immense biological value, and so reveals to primitive man truth in the wider, pragmatic sense of the word" (p. 82).

There is naturally at this stage of development no struggle between science and religion, for science is quite undeveloped.

In the next essay, Dr. Singer gives us a scholarly account of the "Historical Relations of Religion and Science," treating antiquity and the Middle Ages in some detail and in a most interesting way, and concluding with the final establishment by Newton of the modern cosmology. This historical survey raises many difficult and important problems into which it is impossible to enter fully here. Why, for example, did science suffer a long eclipse from about A.D. 200 to 1500? Was it the influence of the Church, the authority of Aristotle, or were the causes many and complex? From the Stoics onwards, many forms of religion were definitely hostile to science, and the spirit of free inquiry was—from whatever causes—effectively stifled. Active conflict with religion scarcely arises before the birth of modern science, which Dr. Singer dates about 1600.

Early in the seventeenth century, the work of Galileo and Kepler, following on that of Copernicus, began to bear fruit, and presented men with a picture of the universe differing irreconcilably from the geocentric cosmology of the Scriptures and of Aristotle. Here was a clear-cut issue on which no compromise was possible, and in which right was entirely on the side of science. Astronomy inflicted a serious blow upon the Christian conception of the universe, far more serious than that later delivered by the theory of evolution, for evolution can be regarded by the theologian as merely the means of creation, and the conception of gradual development is not incompatible with the Christian theology. Dean Inge goes so far as to say that to this day the Churches have not really faced the problem of reconciling Scriptural doctrine with the incontrovertible teachings of astronomy:

"The task has been put off from generation to generation, and to this day little has been done to relieve the strain upon the intellect and conscience of the Christian world. Those Churchmen who airily declare that there is no longer any conflict between Christianity and science are either very thoughtless or are wilfully shutting their eyes. There is a very serious conflict, and the challenge was presented not in the age of Darwin, but in the age of Copernicus and Galileo" (p. 357).

Dean Inge advises the Churches to adopt the honest and sensible policy of recognising that "all theological doctrines which rest upon the geocentric theory must be recast, inasmuch as the results of science are, within their own sphere, unassailable" (p. 360).

The paper by Prof. Antonio Aliotta, which follows, is entitled "Science and Religion in the Nineteenth Century," and brings the story up to modern times. Here we are introduced to questions of philosophy, and the recent revolt against Intellectualism is treated ably and sympathetically. Perhaps we can best sum up Prof. Aliotta's point of view by the following quotation:

"Science and philosophy strive to order the world of our symbols and concepts into the unity of an idea. But the idea does not exhaust the reality; the articulation of concepts will never bring about the attainment of the fullness of life, in which, therefore, our spirit does not find itself understood. Harmony of thought is not sufficient; we wish to feel ourselves to be truly living souls. We do not wish merely to conceive, we wish

also to realise in sentiment and action the concrete unity of life. That is exactly the meaning of religion. The love of our neighbour and the love of God are at the bottom the same aspiration towards this harmony of the lived experiences" (p. 182).

Philosophical questions are brought into prominence also in the next two papers, "The Domain of Physical Science," by Prof. Eddington, "Mechanistic Biology and the Religious Consciousness," by Mr. Needham, and with the latter may be linked up the acute criticism of Naturalism to be found in the concluding paper.

Prof. Eddington discusses in a lively and vivid way the scope and significance of theoretical physics, especially as affected by the doctrine of relativity, and comes to the conclusion

"that the external world of physics is in the first place approached by way of consciousness, that it derives actuality and value from consciousness, and that it relates only to certain aspects of the common basis of material and spiritual things. The dance of electrons in the brain is only a partial aspect of the mental states and resolutions occurring, and there is no reason why it should claim to reveal the whole inner constitution by which one mental state leads to another" (p. 214).

We do not know quite what to make of the position taken up by Mr. Needham with respect to biological method. In the first part of his article his enthusiasm for biochemistry rather carries him away. He contends that in these days zoology must give place to, or rather has already become, comparative biochemistry and physiology biophysics.

"The causes for the change lie deep, but the effect has been a profound infiltration of physico-chemical ideas and terminology into the whole biological field, and this implies a corresponding peaceful penetration of the mechanistic theory of life. This change from comparative morphology to comparative biochemistry is indeed one of the most important factors in the scientific history of the last few decades. It will never again be equalled in importance until comparative biochemistry passes over into electronic biophysics" (p. 224).

Mr. Needham assures us that the mechanistic method has triumphed finally over vitalism and neo-vitalism, confounding under this term such diverse views as those of Driesch and Haldane. His attack on vitalism has much weight when directed against theories that rely on 'vital forces' or entelechies, and it must be conceded also that no vitalistic theory as yet has been developed into a coherent body of biological doctrine anything like so imposing as the mechanistic scheme; but has the problem not moved a little further nowadays than the mere opposition of materialism to vitalism? No one denies the great value of biochemical research, or the validity of its findings of fact, but some of us feel constrained to question whether physics and chemistry alone are sufficient to give us a real biology. Can biology get on satisfactorily as a mere annexe of the physical sciences, or does it not require concepts and methods of interpretation which shall be peculiarly its own? Biology in this sense could coexist comfortably with biochemistry—the two points of view would be complementary, not antagonistic.

Later on in his paper Mr. Needham seems almost to admit this. He recognises that "although mechanism in biology is perfectly justified and indeed essential, it cannot be applied to psychology," and he outlines a form of animism according to which

"it is the physical functions of life that physics and chemistry are competent to explain, for such questions as the distribution of animals and the general theory of evolution, which obviously involve the consideration of conscious striving, do not come under their entire dominion. MacBride in a recent essay has spoken of evolution as a vital phenomenon, but, from his actual words, this means no more than that evolution is in part a mental or psychological phenomenon, and in this respect we may fully agree with him" (p. 254).

Just how far down in the scale Mr. Needham is prepared to admit the existence and efficacy of 'mind' is not very clear, nor whether with McDougall he regards blind purposive striving as an indication of 'mind' or restricts the term to the conscious manifestations of purpose.

One has the impression that Mr. Needham, having broken with Descartes, has gone some little way towards modifying his fervent belief in mechanism, and may yet go further.

There should be read in connexion with Mr. Needham's paper the able presentation in Dean Inge's article of the anti-mechanistic point of view. He is of opinion that the attempt to explain life and evolution on mechanistic principles has failed and that nothing remains but to explain Nature spiritually. He sees signs of this change of attitude in the interest which is being shown in panpsychism, and directs attention to the remarkable philosophy of Fechner, which is known to English readers mainly through a sketch of it contained in William James's book, "A Pluralistic Universe."

Of the three remaining articles in the volume, two, by Dr. Oman and Prof. Webb, deal respectively with "The Sphere of Religion" and "Science, Christianity and Modern Civilisation" from the point of view of the Christian theology; the other, by Dr. W. Brown, treats in an extraordinarily sympathetic spirit the psychology of religious experience. He finds that there is a distinctively religious experience, a distinctive attitude to, or feeling of dependence upon, the Universe, which can be but partially analysed by

psychology, and the content of which cannot be completely exhausted by such analysis.

To sum up our impressions of this notable book—it seems to us clear that science and religion have each their own sphere and function in human life. Science is primarily an intellectual reconstruction of experience; religion is a man's whole relation, mental, moral, and spiritual, to the totality of existence. Religion is not primarily an intellectual effort, an imperfect philosophy, but an attitude of the spirit as a whole. If, on one hand, the man of science recognises the philosophical limitations of his methods, and on the other hand, the man of religion honestly faces and accepts the proved results of scientific research, there seems no reason why they should be in conflict. Danger comes on either side from dogmatism and respect for authority.

E. S. R.

The Phylogeny of Flowering Plants.

The Families of Flowering Plants. 1. Dicotyledons. Arranged according to a new System based on their Probable Phylogeny. By J. Hutchinson. Pp. xiv + 328. (London: Macmillan and Co., Ltd., 1926.) 20*s.* net.

IT is an interesting coincidence that two books dealing systematically with the Dicotyledons should appear about the same time. The much-delayed second volume of Dr. Rendle's "The Classification of Flowering Plants" was issued at the close of 1925, and Mr. Hutchinson's work, herein reviewed, at the opening of the present year. The manner of their appearance suggests a prediction to the effect that one marks the close of a chapter and the other the opening of a new one in British systematic botany. The classification of Engler upon which Rendle's useful and informative text-book is based has, we venture to say, run its course, and botanists generally, at any rate the younger school, will welcome this refreshing and originally conceived handbook of Mr. Hutchinson's, with its new classification professedly framed on phylogenetic lines and actually at any rate on sound and stimulating ones.

At present Mr. Hutchinson is publishing in the *Kew Bulletin* a series of papers on the phylogenetic classification of flowering plants, the end in view being, we believe, the production of a *magnum opus* in the shape of a new "genera Plantarum." The present volume is a foretaste—a *parvum opus*—dealing only with the families. It is a means of addressing a larger botanical public than he could hope to reach through the pages of the *Kew Bulletin*.

Since an article appeared in NATURE only a year ago (vol. 115, pp. 340 and 385) on this subject, readers especially interested are referred to this, as space will not permit of the same ground being re-traversed. Hutchinson's principles of classification and his new arrangement of the Archichlamydeæ (Polypetalæ and Apetalæ combined) were there explained and comments made. In this book for the first time his scheme for the Metachlamydeæ (Sympetalæ)—the higher Dicotyledons with corolla in one piece—is outlined, and in his ingenious phylogenetic diagram facing p. 8, he shows how he proposes to derive them from the lower free-petalled orders. He is here still fertile in new ideas, continuing to employ what might be called his *leitmotiv*, namely, the derivation of the Dicotyledons in two branches, one from the Magnoliales with the tree-habit dominant and the other from the Ranales with the herbaceous habit prevailing. The former is considered to have given rise to the Ebenales (possibly straight from the Anonaceæ), the Ericales, Apocynales, and Rubiales; the latter to the primroses, gentians, scrophs, labiates, etc. The Compositæ are regarded as of mixed origin and are no longer given pride of place among dicotyledonous plants. This is now awarded to the Labiatæ.

The book begins with a short, well-balanced foreword by the Director of the Royal Botanic Gardens, Kew. The author's preface follows. Here stress is laid on the distinction to be drawn between a phylogenetic classification and a key. One should emphasise rather the *resemblances* and the other the *differences* between plants. One aims at a truly natural system by striving to discover relationships. The other is purely artificial and constructed solely for the easy identification of plants. Taxonomists in the past, by trying to compromise, have failed on one hand to stimulate inquiry, and on the other to give the most readily worked keys. Hutchinson sets out to keep these two ends in view quite distinct.

The introduction is largely a reprint of his general remarks on classification which appeared in the *Kew Bulletin* about three years ago. A useful table is added contrasting his new system with those of Bentham & Hooker and Engler & Prantl. Then follows the phylogenetic system itself. After this comes the artificial key to the families of the Dicotyledons, 264 in all. This is an ambitious effort, and if workable, as apparently it is, should prove of considerable practical value, especially to botanists and foresters stationed in the tropics.

The descriptions of the families which naturally occupy the greater part of the book are concise and clear. The numerous illustrations, one, in fact, to each family, form a noteworthy and attractive feature. These are from the pen of Mr. Trevithick and the author. Some are original and few are hackneyed. In each figure a flowering shoot of the plant selected to illustrate the family is shown along with enlarged

details. No scale, however, is given. One cannot refrain at this point from mentioning the frontispiece. This is from the author's own designing and charmingly represents in floral form the ideas of affinity expressed in this work. It surrounds the appropriate dedication, namely, to the memory of George Bentham and Joseph Dalton Hooker. A strong point is made of geographical distribution, and several maps are given showing family or generic distributions of a restricted or otherwise interesting character. An appeal is made to the economic botanist and horticulturist by enumerating, at the end of each family, plants useful to man. Some reference to the mode of pollination might have increased the value of these descriptions. The book ends with a glossary and index.

Manuals of this kind published in England usually lay stress on the families which are especially exemplified in the British flora. This, though quite understandable, is apt to give the student a restricted and wrongly balanced conception of the flowering plants of the world as a whole. Hutchinson avoids this by treating all families alike. Hence the book is suitable for any part of the world. A companion volume dealing with the Monocotyledons is promised. Eventually we hope that both Dicotyledons and Monocotyledons may be included within the pages of a single book and issued at a cost not exceeding that of the present volume.

This work might have benefited from more detailed inspection when in proof. The mistakes and omissions are chiefly noticeable in the explanations to the illustrations. These are, however, not likely to be misleading.

In conclusion, we should like to congratulate the author in particular and Kew in general on this forward move in taxonomy and the study of the flower. The views expressed as to the inter-relationships of the Dicotyledons should arouse research in this department of botany. Several lines of inquiry will, one imagines, suggest themselves to interested and critical readers.

J. PARKIN.

Principles and Practice of Electrochemistry.

(1) *Principles and Applications of Electrochemistry*. In 2 vols. Vol. 1: Principles. By Prof. H. Jermain Creighton. Pp. ix+446. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1924.) 20*s*. net.

(2) *Theoretical and Applied Electrochemistry*. By Prof. Maurice de Kay Thompson. Revised edition. Pp. xix+551. (New York: The Macmillan Co., 1925.) 20*s*. net.

(1) PROF. CREIGHTON'S book on electrochemistry deals exclusively with "Principles," but is to be followed by a second volume on "Applications of Electrochemistry" by Prof. Colin G. Fink. The theoretical volume is a well-balanced treatise, which covers in a satisfactory manner the principal methods of measuring conductivities, ionic mobilities, and electromotive forces, as well as the deductions that can be drawn from these measurements. It is, however, not a very easy matter to write a text-book on theoretical electrochemistry at a time when physicists have declared that, even in the solid state, there is no such thing as a molecule of common salt, but only an aggregate of ions, and when physical chemists are beginning to explore the possibility of applying the same drastic conclusion to salt solutions. What, for example, is to be done in these circumstances with the old hypothesis of Arrhenius, which has formed the basis of all such treatises during the past thirty years, but must now apparently be regarded as obsolete?

As a provisional solution of the problem, the author has adopted the worldly-wise policy of writing his book in terms of the old hypothesis, instead of rewriting it in terms of modern physical conceptions; and he justifies his retention of this hypothesis by quoting with approval a statement of Kendall that "no case has yet been made out for its abandonment." Nevertheless, it is clear from the reservations that he makes, and from the explanations that he gives, that the foundations have already crumbled and must speedily be replaced, even if this involves only an underpinning and not a rebuilding of the old superstructure.

One fascinating application of the newer point of view is made in connexion with amphoteric electrolytes. According to the traditional method of formulation, the un-ionised portion of an amino-acid was regarded as made up of electrically neutral molecules of the type $NH_2 . CHX . COOH$. In the newer system it is natural to regard it as having a similar structure to ammonium chloride, $\overset{+}{N}H_4\overset{-}{Cl}$, and therefore to write it in the form of a bipolar molecule or *zwitterion*, $\overset{+}{N}H_3 . CHX . CO . \overset{-}{O}$. The effects of this simple change have been worked out by Bjerrum, who has thus deduced an entirely new set of dissociation constants for these compounds. In particular, he finds that the acid dissociation constants of the amino-acids are larger than those of the carboxylic acids from which they are derived, instead of being very much smaller; and their basic dissociation constants are also found to be much larger than was formerly supposed. Thus, in the case of asparagine, the acid dissociation constant is of the order of 10^{-2} instead of 10^{-9}, and the basic dissociation constant is of the order of 10^{-5} instead of 10^{-12}. The theoretical deductions from these altered numbers need not be discussed; but it is at least clear that grave risks are

involved in drawing deductions from data that have not been examined in the light of the modern physical theory of atomic structure.

In accordance with a practice which is becoming increasingly common, a series of problems has been added to each of the principal chapters. Experience shows that problems such as these are of great value in fixing the subject matter of the text in the mind of the reader, if he is willing to make use of them, and their inclusion in the present volume is therefore to be welcomed.

(2) Prof. Thompson's "Theoretical and Applied Electrochemistry," based originally upon a course of lectures on applied electrochemistry at the Massachusetts Institute of Technology, appeared first in 1911. The principal change in the second edition arises from a decision to include in the volume a treatise on theoretical electrochemistry as well, in response to suggestions made by readers of the first edition. The sections on "Applied Electrochemistry of Aqueous Solutions" and on "Electric Furnaces and their Products" have, however, also been revised and largely rewritten. The author has received assistance from a large number of those engaged in the electrochemical industry of the United States, and there can be little doubt that his book gives a satisfactory account of the present position of the industry so far as this is available for publication.

The Spirit of Modern China.

From Peking to Lhasa: the Narrative of Journeys in the Chinese Empire made by the late Brig.-General George Pereira. Compiled by Sir Francis Younghusband from Notes and Diaries supplied by Major-General Sir Cecil Pereira. Pp. x+293+33 plates. (London: Constable and Co., Ltd., 1925.) 18*s.* net.

GENERAL PEREIRA'S notes, from which this volume has been compiled by Sir Francis Younghusband, cover three journeys. Of these, the first from Peking to Lhasa and India is the longest and the one of which the account is the most detailed. It is also the most interesting, for the author was the first European to succeed in reaching Lhasa from China since 1848, when Pères Huc and Gabet reached the Holy City from this direction. This journey was in itself a remarkable feat for a man nearly sixty years of age and physically weak; but almost immediately he started on his second journey from Burma to Shanghai, and then, in attempting to traverse China from south to north, he died in 1923 while on his way from Yunnan to Kansu.

Pereira was particularly well qualified for the task he had set himself. He had resided long in China and had visited every one of its provinces, either as a private individual or as an official. His notes of his journey are therefore valuable not merely as a geographical record; they also embody the acute observations on conditions in China in the years 1921–23 of one who was intimately acquainted with the people. In addition, three chapters written by Pereira himself, one in 1921 and two in 1923, summarise his views of the situation. He held that the evils of the imperial system had been multiplied under the Republican Government, while the checks on undue extortion and the influence of the students had been removed. The great dangers, as he saw them, were the facility with which popular opinion might be diverted into dangerous channels, as had happened in the Boxer movement; the student movement with its superficial acquirement of Western ideas; and generally, the lack of discipline in education, due to the weakness in the position of the foreign teacher, and the increase in the numbers of the soldiery, who at the least inducement were liable to become brigands. These factors were, of course, additional to and dependent on the lack of a strong central government. The proposal to abolish extra-territoriality he considered to be due to a misunderstanding of the position outside of the treaty ports, where Europeans lived in conditions which were practically Western.

Subsequent events have largely justified Pereira's views, even if to some little extent these are coloured by his training and mentality. The emphasis he lays on the importance of the student class as the future governors of the country, and his acute analysis of its weaknesses, lend support to the views of those who press the need for the inculcation of a new public spirit in Chinese affairs, and hope that it may be attained through co-operation between Britain and China in extending the facilities for university and secondary school education by means of the Boxer indemnity.

The Kiwai.

Among Papuan Headhunters: an Account of the Manners and Customs of the Old Fly River Headhunters; with a Description of the Secrets of the Initiation Ceremonies divulged by Those who have passed through All the Different Orders of the Craft, by one who has spent many Years in their Midst. By E. Baxter Riley. Pp. 316+16 plates. (London: Seeley, Service and Co., Ltd., 1925.) 21*s.* net.

IN this book we have the observations upon the natives of the region of the Fly estuary by a missionary who has been in the district for twenty-five years, and as he has taken a lively and sympathetic interest in the people under his care, we may accept his account with

confidence. Mr. Baxter Riley nowhere refers to missionary work as such; his aim evidently has been to give his readers a knowledge of native life and customs without obtruding the personal element.

The old order is rapidly changing, but the former conditions are not so far distant that they have become seriously obliterated. The author admits that he has omitted certain details which might be considered to be out-of-place in a book designed for the general public, and it is obvious that in a book of this kind a selection must be made. Nevertheless, ethnologists will find a great deal of information which has not previously been published. As a matter of fact, a good deal has been written in English in scattered publications about these people, but mainly from an external point of view, though Dr. G. Landtman has published intensive papers on such subjects as: Wanderings of the dead in the folk-lore of the Kiwai-speaking Papuans (*Festskrift*, E. Westermarck, 1912), the poetry of the Kiwai Papuans (*Folk-Lore*, 1913), Papuan magic in the building of houses (*Acta Acad. Aboensis Humaniora*, 1920), and especially his great work "The Folk-tales of the Kiwai Papuans" (*Acta Soc. Sci. Fennicae*, 47, 1917); but most of these are not readily accessible to the non-specialist reader. This book, therefore, fills a gap in our knowledge of the region, and the accounts of the various ceremonies are of considerable value.

A more detailed account of their ethical ideas, however, would have been welcome, for, after all, the ideas and ideals of a people are the most important phenomena, and it is these which are usually so lacking in ethnographical descriptions; but perhaps a missionary is not always in the best position to obtain these, as they are, as a rule, what he has come to replace, and the natives know this. The three-line paragraph on "The State after Death" is clearly inadequate; fortunately Dr. Landtman has given us full information on this matter. The book concludes with an interesting chapter on the "Psychology of Native Dancing." The book is well illustrated by photographs and native drawings, and there are two maps.

A. C. HADDON.

The Preservation of Food.

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1924. Pp. vi+80+6 plates. (London: H.M. Stationery Office, 1925.) 3*s*. 6*d*. net.

THE work of the Food Investigation Board ranges from laboratory experiments on the chemistry of foods or allied materials and on the physics of methods of preservation, to large scale investigations on the storage of various foods under commercial conditions, and on the engineering problems connected with this subject. The first section is devoted to the theory of freezing: it has been found that discs of gelatin frozen slowly show an outer shell of ice and an inner core of concentrated protein, while with very rapid freezing there is no external shell of ice, but the ice phase is distributed throughout the gel in the form of small discrete spheres of about 3μ in diameter. Intermediate rates of freezing give intermediate results. The displacement of water involves not only a permanent alteration of microscopic structure but also a permanent molecular change; but the actual separation of water on thawing, as in the 'dripping' of frozen beef when thawed, seems to occur only with a slow rate of cooling when ice separates on the surface of the colloidal material.

Further investigations have been carried out on the freezing of eggs and on the chemistry of muscle. The curious change in the yolk on freezing below $-6°$ C. for a sufficient length of time, whereby it passes into a stiff pasty condition on thawing, appears to be due to an irreversible precipitation of the lecitho-vitellin. It was found also that eggs retain their fertility longest at 8°-10° C., and die at $-7°$ C. Further work has been carried out on the production of lactic and succinic acids in muscle, and a new investigation commenced on the oxidation-reduction potential of the cell interior.

About half the report is taken up with the section on the preservation of fruit and vegetables, most of the work having been carried out on apples. The chemical changes occurring on storage and the conditions favouring or hindering the growth of fungi and the deterioration of the fruit on keeping have been investigated in great detail. The respiratory activity falls off *pari passu* with the acid concentration during the growth of the apple, whether on or off the tree, until senescence sets in, when an abrupt rise occurs. Alterations of respiratory metabolism occurring with 'internal breakdown' lead to the production of acetaldehyde and alcohol; this change is accelerated by a certain amount of carbon dioxide in the external atmosphere and is retarded by a smaller concentration in the presence of oxygen; an atmosphere of pure carbon dioxide is almost as favourable as air with a carbon dioxide content below the critical value. The optimum conditions of storage are difficult of attainment, since the following factors all affect the results: species of apple, nature of soil on which it is grown, season, temperature and atmosphere of storage chamber. Other work has been carried out on the chemistry of oils and fats, and of carbohydrates, including the chemistry of glycogen. The final section is devoted to some engineering problems in refrigeration, and closes an extremely interesting report.

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.*]

Rock-lead, Ore-lead, and the Age of the Earth.

IN 1921 Prof. H. N. Russell attempted to fix an upper limit to the age of the earth on the basis of an assumption that all the lead in igneous rocks was of radioactive origin (*Proc. Roy. Soc.*, A, vol. 99, p. 84). He took the proportion of lead as 22×10^{-6} (gr. per gm.) and obtained in consequence a very high maximum age. This proportion appears to be based largely on analyses of rocks from the neighbourhood of galena veins, and is therefore probably not a fair average for igneous rocks as a whole. An estimate more applicable to the problem is provided by an analysis for lead of 329 igneous rocks, made in 1914 by F. W. Clarke and G. Steiger (*Journ. Wash. Acad. Sci.*, vol. 4, p. 58). They found a proportion of only $7{\cdot}5 \times 10^{-6}$. The present proportions of uranium and thorium in average igneous rocks are respectively 6×10^{-6} and 15×10^{-6}, the lead-generating equivalent in terms of uranium alone (U + 0·37 Th) being $11{\cdot}5 \times 10^{-6}$.

If all rock-lead has been derived from the radioactive elements, then the equivalent amount of uranium must have been $8{\cdot}6 \times 10^{-6}$, giving an original total of equivalent uranium of $20{\cdot}1 \times 10^{-6}$. The time required for this original amount to disintegrate into $7{\cdot}5 \times 10^{-6}$ parts of lead and the corresponding quantity of helium, leaving the existing amounts of uranium and thorium, is approximately 3200 million years.

On the above figures, or on the data for any individual type of rock, granitic, basaltic, or peridotitic, the atomic weight of rock-lead should be a little less than 207. The lead of commerce, which is ore-lead derived almost entirely from the common vein mineral galena, is 207·2; and no significant deviation from this standard figure has been detected. Whatever the age or locality of galena may be, the atomic weight of its lead appears to be in all cases substantially higher than 207. It is therefore certain that ordinary lead cannot have been wholly derived from the radioactive elements during their terrestrial history, and this conclusion leads to two remarkable deductions.

Since an unknown amount of the lead in igneous rocks may be ordinary lead, it is clear that the earth —as a radioactive container—cannot have existed for so long as 3200 million years. This is in accordance with the evidence of radioactive minerals. Uraninites and other minerals from the Middle Pre-Cambrian rocks of Norway, Sweden, Ontario, Texas, Colorado, India, and Mozambique all give ages between 1000 and 1100 million years. The greatest age yet determined is that of a pitchblende from the Black Hills of South Dakota. I am indebted to Prof. A. C. Lane for an analysis of this mineral recently made by Mr. C. U. Davis, of the United States Bureau of Mines. It indicates an age of 1525 million years, and the atomic weight of the lead separated from it has been determined by Mr. L. P. Hall as 206·07. The frequently quoted figure for the age of the earth, 1600 million years, thus appears to be of the right order, provided that the method, as I believe it to be, is sound in principle.

Accepting this provisional estimate, it follows that roughly half the lead of igneous rocks is of radioactive origin. It also follows that the ore-lead of mineral veins cannot be a concentration of the lead of igneous rocks, as is usually supposed. At least the greater part of the lead of ore-deposits must have been already in existence when uranium and thorium began to generate lead in the crustal rocks. Consequently, unless one assumes that ordinary lead can have been formed within the earth by some other unknown process, it seems safe to conclude that ore-lead must have originated either in the ancestral sun or during the events that attended the birth of the solar system. In the former case it may have been of radioactive origin, but if so it must have been generated during a period over which the average ratio of uranium to thorium was 6 : 16·2, in order that the resulting mixture of isotopes should have an atomic weight of 207·2. The terrestrial ratio is not less than 6 : 15, and if this is a guide to the solar ratio, the latter must in former ages have been greater than 6 : 15 instead of less, because the half-period of uranium is much shorter than that of thorium. On the other hand, if ore-lead is not of radioactive origin, as the argument suggests, then uranium and thorium must either have originated or have become radioactive at about the time of the birth of the solar system.

From the point of view of ore-genesis, the distinction drawn between ore-lead and rock-lead is of fundamental importance. It implies that the ore-bodies in which galena occurs are not derivatives from the igneous rocks visibly associated with them in time and place. J. E. Spurr has already concluded from the distribution of ores that the "magmas" of the latter are not residual fluids expelled from igneous rocks during their crystallisation, but that they are magmas of a special type developed in a zone that is locally a rich storehouse of certain metals.

It is clear that if the atomic weight of rock-lead could be determined, the result, whatever it may be, would throw a searching light on many baffling problems. To separate sufficient lead for the purpose from a representative collection of the world's igneous rocks would be a herculean task, but the value of the result would justify the labour, and I have penned this letter partly in the hope that some great research association, such as those of the United States, may be persuaded to undertake it.

ARTHUR HOLMES.

The University, Durham,
March 10.

Miller's Ether Drift Experiment and Stellar Motions.

IN connexion with Dr. Miller's recent announcement (*Science*, 63, 105, 1926) of his results in measuring the 'ether drift,' the writer wishes to direct attention to a few points which may be worthy of interest.

If we suppose that Miller's results are real, and if we try to interpret them as a partial drag of the ether, it is difficult to avoid conflict with known facts about first order (v/c) effects. The constant of aberration and the Michelson-Gale experiment for determining the earth's rotation by optical means give, within the errors of measurement, the full effect expected from theory, whereas Miller's experiment seems to give a greatly reduced effect of an ether drift. But if we interpret his results in terms of what they really are, second order effects (v^2c^2), most of the difficulties disappear.

The displacements measured by Miller correspond to a change in the length of his interferometer of the order 10^{-9}, and his final errors are about 5 per cent. of this quantity. There are probably several explanations for this change in length of his interferometer or

in the velocity of light, but if a contraction in the Lorentz-Fitzgerald sense (that is, one due to 'absolute' motion in a stationary medium) exists, it is *only* by experiments of this type that we have as yet been able to determine whether the supposed change in the velocity of light in different directions is *exactly* compensated by the contraction within quantities of this order of magnitude. If this compensation is not exact, the expression for the Lorentz-Fitzgerald contraction, and the fundamental formulæ in the special theory of relativity, require a small but important modification of such a form that the 'absolute' motion enters explicitly into the final expressions. A corresponding modification must also be introduced into the space-time transformations of the general theory, but as these modifications are of the order of only 5 per cent., or more probably 3 per cent., no conflict need arise with the observed facts as regards the tests of the general theory of relativity. But in this case we are obliged to admit the existence of a fundamental reference frame which plays an active rôle in determining physical phenomena.

If the 'absolute' motion does not completely vanish in the case of contraction of matter, it is likely that the expression for the change of mass of an electron requires a corresponding modification, so that the absolute motion enters explicitly. Our ordinary conception of electro-magnetic mass is connected with the way in which the 'field' reacts on the motion of a charged body, and if the mass of an electron is a function of its absolute motion, we may expect a resultant momentum opposing the absolute motion of an atom, but noticeable only when the electron connected with the atom has a velocity approaching the velocity of light. Inside the atoms of the heavier elements, and even more in radioactive processes, electronic velocities occur which approach the velocity of light. As this reaction presumably is exceedingly small, it is difficult to detect. The most promising objects to study are the stars, for which the impulses have opportunity to accumulate for a very long time without being modified by collisions. For a system of stars like our local star system, for which we can assume a community of origin, that is, small initial relative velocities, we may thus expect an asymmetry in the distribution of stellar motions. The motions of the stars in our local system actually show such an asymmetrical distribution and of just such a type as is to be expected from a velocity restriction in a fundamental reference frame in which the globular star clusters and the spiral nebulæ are statistically at rest (*Astrophysical Journal*, 61, 363, 1925). The sun's velocity relative to this 'world-frame' is about 300 km/sec. in the direction $\alpha = 307°$, $\delta = +56°$. Miller claims that his observations indicate a translation of the sun of at least 200 km./sec. in the direction $\alpha = 255°$, $\delta = +65°$, which point is about 23° from the apex as derived from the asymmetrical distribution and from the globular clusters. As the earth's orbital motion is too small to be detected, there is no way, however, of deciding between two opposite directions.

Even apart from a possible positive effect in the Michelson-Morley experiment, there is another reason for suspecting the existence of a fundamental stationary reference frame. The velocities of the stars are in general less than 500 km./sec., and this is ordinarily explained as a result of the fact that the stars have formerly been more intimately connected than they are now, and that objects of excessive velocities have escaped. But astronomers during the last decade have gone far outside our local star-system, and still we find velocities in general less than 1500 km./sec. The assumption of a selective effect or of an exchange of momenta between *all* cosmical systems may be unnecessary; distant systems may even, in a sense, have an independent origin and still have comparatively small initial velocities, if they are 'born' out of a fundamental medium, the metrical properties of which are the same everywhere. Such a medium and a velocity-restriction would also account for the rigidity of the inertial frame and its coincidence, so far as rotation is concerned, with the stellar frame even for the most distant objects observable. The uniformity in Nature is then due to the uniformity of this medium.

There are, however, several difficulties with regard to the possible interpretations of Miller's experiment. Among these difficulties is the predominant westerly deflexion of the 'ether-drift.' Unless unknown disturbing effects are present, the algebraic sum of the east-west components of the drift during a sidereal day must be zero. Among disturbing effects, besides those due to temperature changes, the effect of a magneto-striction ought to be carefully investigated.

GUSTAF STRÖMBERG.

Mount Wilson Observatory,
January 22.

Nitrogen in the Sun and Stars.

IN a letter in NATURE of February 20, p. 268, under the title "Nitrogen in the Sun," Prof. Saha, in his discussion, refers to the occurrence of nitrogen lines in stellar spectra. He says: "The only nitrogen line which can be identified without ambiguity in the stellar sequence is λ3995. This, however, does not occur in the sun; it occurs, according to [Miss] Payne, first in the Ao class, and Fowler assigns it to N^+." The correction of inaccuracies in these statements may prove of assistance to Prof. Saha in his valuable theoretical deductions appertaining to spectra.

In 1910 the present writer gave ("Researches on the Chemical Origins of various lines in Solar and Stellar Spectra." Publication of the Solar Physics Committee) a list of twenty-nine lines of nitrogen which had been traced in spectra of various subdivisions of the B class. Five of these were, in the stellar spectra, probably blended with lines of other elements, but the remainder were quite free from ambiguity, though a few were weak lines which could not be traced through so long a range in the stellar sequence as the stronger nitrogen lines. Such well-known lines as λλ3995·3, 4447·2, 4630·7 and its four companions on the more refrangible side, are all quite free from blending, the first and third being traced through almost the whole of the B group (B8 to Bo) and in ι Orionis of the Oe type, while the remainder were detected only in the shorter range B2 to Bo. In addition to occurring in the ordinary stellar sequence, they were observed as absorption lines at certain stages of the spectra of Nova Geminorum by Mr. Stratton, and of Nova Aquilæ by the writer, but in each of these spectra they were enormously displaced to the violet of their normal positions. All the nitrogen lines just mentioned belong to the singly-ionised group designated by Fowler as N^+.

Of the doubly-ionised lines of Fowler's N^{++} class, there is no ambiguity in stellar spectra with such lines as λλ4097·5, 4379·3, 4634·3, and 4640·8. Of these 4097·5 occurs as a weak line at B2 (γ Orionis), is much stronger at Bo (ε Orionis), and apparently attains its maximum intensity in a star of Oe type (29 Canis Majoris), where it is almost as strong as H_δ. This is, however, probably a 'freak' intensity in a star placed, from other considerations, in the Oe class. In other stars of the same named type the line is much less intense. Line 4379·3 is never very

strong in stellar spectra, but has been recorded in B2 and Bo types in Kensington publications, and by H. H. Plaskett in O9 and O7 of his suggested classification of O-type stars. It is slightly weaker in 10 Lacertæ (O9) than in 9 Sagittæ (O7), but it is not easy to say where it attains its maximum intensity. Lines 4634·3 and 4640·8 have a different range from the other N^{++} lines discussed here. They have not been traced in any sub-division of the B group. Plaskett records them as absorption lines in O9, and as emission lines in O8 and O7.

All these N^{++} lines occur as emission lines at certain stages of the spectrum of Nova Aquilæ, and probably also in other Novæ. All except 4379·3 have also been recorded in various nebular spectra by Wright. It would seem that the N^{++} class might be further subdivided in the light of their rather different behaviour in stellar spectra.

With regard to Prof. Saha's assertion that, according to Miss Payne, the N line 3995 occurs 'first' in the Ao class, he rather misrepresents her. What she said is: "3995 . . . appears at Bo or earlier, reaches maximum at B5, and is last seen at Ao." She was discussing the changes in the line-intensity from B types towards A and later types. This may seem a detail, but in mentioning where a line 'first' or 'last' appears, as Prof. Saha did, it is as well to specify which direction along the stellar sequence an argument is being taken.

It is not here a question, however, of whether the N^{+} lines (3995, for example) are first or last seen at Ao, but whether they occur in that type at all. The Harvard type-star for Ao is α Canis Majoris, and in the Harvard tables of stellar lines 3995 does not occur for that spectrum. It was not recorded in the Kensington list of lines for α Canis Majoris, and further search for it in the best spectra available here has not revealed it. It occurs as a weak line in β Tauri (B8), and in β Orionis (B8 Pec.), but that is the latest type in which I have been able to detect it. There is no spectrum of the B9 type in the Cambridge or Kensington collections, but one would rather expect this type to show it as a very weak line. I have always associated these nitrogen lines with the B class of spectra, but never with any subdivision of the A class, and no spectrum has been found here containing the 3995 line which has not the helium lines well-developed. This latter characteristic is not generally associated with A stars, although a few of them (*e.g.* α Cygni) show one or two of the helium lines faintly.

In the light of the table given in the "Harvard Annals," of "Lines in Classes B to B9A" in which the 3995 line is indicated as 'not' occurring in B5, B8, and B9 types (the type-stars for which are respectively φ Velorum, γ Gruis, and λ Centauri), it seems curious that Miss Payne describes it as having its maximum at B5, and as being last seen at Ao. It would be interesting to know in which particular spectra of B5 and Ao types respectively the 3995 line fits her statement. Any worker amongst stellar spectra knows that those attributed to a particular type do not always show exactly identical spectra, but it seems almost incredible that two spectra could be allocated to the same sub-division of a group, one showing a certain line at its maximum for the range throughout which it occurs in the stellar sequence, and the other showing no trace of the line at all, without either of them being denoted as 'peculiar.'

Of the spectra available here, 3995 is certainly strongest in γ Orionis, the Harvard type-star for B2.

F. E. BAXANDALL.

Solar Physics Observatory,
Cambridge University, March 7.

The "Gas Laws" in Surface Solutions.

M. ANDRÉ MARCELIN, in a recent paper (*Annales de Physique*, vol. 4, p. 459, 1925) referred to in NATURE of February 13, p. 247, states that the relation between the surface pressure F and area A is, with certain films, of the form of Boyle's law, $FA = kT$; but he states that k is much smaller than the universal gas constant.

Both kinetic and thermodynamic theory predict that at extreme dilution of the films, when the molecules are so far apart that their size and mutual cohesion become negligible, the product FA should be equal to RT, R having the same value of $1{\cdot}372 \times 10^{-16}$ (in c.g.s. units per *molecule*) as in a gas or a perfect solution. If k is much smaller for surface solutions than R, either there must be a great degree of association among the film molecules, or the thermodynamic theory is wrong. M. Marcelin's figures would require an association factor of about 18 for oleic acid on distilled water, and of about 60 for benzyl benzoate. He rejects this as improbable, but suggests an alternative explanation which seems quite impossible; he suggests that owing to movements of the film molecules perpendicular to the surface, a large proportion of them are so far out of the plane of the confining barrier that they do not exert pressure on it. But if they do not exert pressure on the barrier, they must be quite free to pass this barrier; if this is so the number of molecules in the film will be unknown, and the experimental method breaks down altogether.

We find, however, that in the region of pressures and areas covered by M. Marcelin's experiments, the relation between pressure and area is quite different from that reported by him. Our own recently published work (*Proc. Roy. Soc.* A, vol. 110, p. 423, 1926) shows that at low pressures the product FA approaches the theoretical value of $1{\cdot}372\ T$ (areas measured in sq. Å.U. per molecule). At higher pressures the course of the F-A isothermals followed very closely the isothermals for carbon dioxide in the region of the critical point, and indicated the presence in two dimensions of phenomena analogous to evaporation from a liquid film to a gaseous film. There was not, with any one of the compounds, which belonged to four different homologous series, any evidence of considerable association of the molecules before condensation set in. There was a general resemblance between the results on the different series, which indicated that the results are typical of all films. It was possible, however, that the two films on which M. Marcelin worked were exceptions to what we thought was a general law.

We have therefore examined the films of oleic acid on distilled water, and of benzyl benzoate. Benzyl benzoate gave such an unstable film that the surface pressures were evanescent and very small, vanishing almost entirely in about 4 minutes. We think the low pressures in this case are due simply to the molecules not remaining in the film.

With oleic acid, we find the film to be 'expanded' above about 0·2 dynes per cm., when it has an area of 49·7 sq. Å.U. per molecule. There is a fairly abrupt transition from this state into one at which the pressure is constant at about 0·08 dynes per cm., the 'vapour pressure' region. The substance thus behaves very much like the other fatty acids described in our recent paper. Recalculating the results given by M. Marcelin to sq. Å.U. per molecule as unit of area, there is little correspondence; the angle between the vapour pressure region in the F-A curves, and the much steeper 'expanded' curve is obliterated in M. Marcelin's results.

In the following table the results are compared:

Surface Pressure (dynes per cm.).	Areas per Molecule (sq. Å.U.).	
	Marcelin.	Adam and Jessop.
0·5	45	49·5
0·2	112	49·7
0·1	about 230	51·4
0·08	about 300	55 to 660, and probably upwards

The discrepancy is difficult to explain. We feel confident of our results, as the oleic acid was a particularly pure specimen given us by Prof. Lapworth, and the experimental results correspond so well with those of the other acids in our paper; moreover, our results are in accordance with a reasonable theory, which has been recently shown by Schofield and Rideal to include the slightly soluble fatty acids of the saturated series. It is exceedingly difficult to obtain oleic acid absolutely pure; we do not claim that our specimen was perfectly pure, as it probably contained a little palmitic acid. But it may be that M. Marcelin's oleic acid contained some impurity which would obscure the true course of the *F-A* curve just in this region. If this is so, it is a pure accident that he found the relation FA = constant.

We would also criticise M. Marcelin's experimental method, for his methods of cleaning the surface and handling the films do not seem adequate for quantitative work, with the very sensitive pressure-recording instrument which he describes. In the sensitive apparatus, he describes the float, which bounds one end of the film, as separated from the fixed side boundaries by channels about 1 mm. wide. In our experience even much smaller leaks would be fatal to accuracy, and we close this gap completely, with flexible metal ribbon. Leaks and accidental contamination are serious sources of error in this work, and too great care cannot be taken to discover and avoid these complications.

N. K. ADAM.
G. JESSOP.

The University, Sheffield,
March 6.

Origin of the Fresh-water Fishes of New Zealand.

IN the *Journal of the Linnean Society*, Zoology, 47, No. 313, pp. 99-140, 1925, Oliver has outlined what is virtually a new theory to account for the distribution of South Pacific plants and animals. It is of interest to note that the fresh-water fishes of New Zealand, not included in the above paper, appear all to conform with the suggestions: (1) Their present habits and nature are such that they may easily have crossed small areas of ocean and independent species originated in the separate land masses; or (2) marine species of a restricted habitat have taken to a life in fresh water, changing in form to meet the new conditions. Almost simultaneously Oliver (p. 109) and Skottsberg (*Bishop Museum Bull.* 16, p. 22, 1925) have independently suggested the modification of species and increase in number of forms after arriving at a new region.

Before the introduction of salmon and trout, New Zealand rivers swarmed with species of Galaxias, Anguilla, and other comparatively small fishes, of which the following is a complete list: *Geotria sacci-fera* Regan, *Geotria australis* Gray, *Anguilla auck-landii* Richardson, *Anguilla australis* Richardson, *Anguilla schmidtii* Phillipps, *Anguilla waitei* Phillipps, *Cheimarrichthys forsteri* Haast, *Gobiomorphus gobioides* (Cuv. and Val.), *Rhombosolea retiaria* Hutton, *Galaxias attenuatus* (Jenyns), *Galaxias fasciatus* Gray, *Galaxias brevipinnis* Günther, *Galaxias huttoni* Regan, *Galaxias kokopu* Clarke, *Galaxias lynx* Hutton, *Galaxias post-vectis* Clarke, *Galaxias alepidotus* (Block and Schn.), *Galaxias burrowsius* Phillipps, *Neochanna apoda* Günther, *Prototroctes oxyrhynchus* Günther, and *Retropinna retropinna* (Richardson).

Oliver suggests that among fish the Galaxiidæ and Geotridæ with headquarters in New Zealand owe their development and distribution to the New Zealand continent, which in former times stretched towards Antarctica. While it is by no means a proved fact that the headquarters of these families were in New Zealand in the Cretaceous period, present conditions would appear to indicate that such may have been the case. Much further investigation of the Geotridæ is required, but in the meantime it seems advisable, from facts I have gathered in regard to growth changes in the life-history, to admit only two species in New Zealand. These species, *australis* and *saccifera*, are also known from Australia and Chile; but, as the Geotridæ in our rivers are essentially sea-going forms, they may be discarded, together with the Anguillidæ, as offering evidence either in favour of or against former land connexions.

The Galaxiidæ as a family are worthy of mention in that in New Zealand the highest development and the lowest degeneration of the family have taken place. Eleven members of the family are known in New Zealand fresh waters, the young of *Galaxias attenuatus* running from the estuaries of rivers in the spring months and forming the chief constituent of the southern white-bait. Though this species is found both in Australia and South America, it appears to be not nearly so prolific in those countries. Thus, it is quite possible that, in the Cretaceous period, when the New Zealand area was much greater, the Galaxiidæ, which had originated here, then spread to adjoining land masses. The degenerate members of the family are *Galaxias burrowsius* and *Neochanna apoda*, the former having almost lost the use of the ventral fin, while in the latter it has quite disappeared. These fish both hibernate during dry weather and are peculiar to New Zealand.

Gobiomorphus, represented by one species common in all New Zealand fresh waters, has numerous allies among the small Gobiidæ in rock pools on the sea-coast. It is almost certainly a descendant of a coastal goby which has taken to a life in fresh water. Turning to Cheirmarrichthys, we note a relative in *Parapercis colias*, the common blue cod of New Zealand; so we may conclude that this species also has arisen independently in the New Zealand area. *Rhombosolea retiaria*, the river flounder, is common in estuaries of large rivers, and on one occasion I have examined an example taken by a trawler in Hawke Bay, New Zealand. There are three common marine species of Rhombosolea around our coasts.

Two species remain to be noted. These are *Prototroctes oxyrhynchus* (the New Zealand grayling) and *Retropinna retropinna* (the New Zealand smelt), each of which is allied to the Salmonidæ of the northern hemisphere, being the only fishes indigenous to New Zealand having an adipose dorsal fin. It is not necessary to erect a continent to explain either of these species; but, as a species of Prototroctes and a species of Retropinna are known in Australian fresh water and not in the sea, it is important that the representatives of Prototroctes and Retropinna in New Zealand rivers enter brackish water, as noted by me in the *New Zealand Journal of Science and Technology* (vol. 6, pp. 115 and 166, 1923). It has never been proved that either of these species has entered the sea. Possibly both Prototroctes and Retropinna

originated in the New Zealand area and spread from here to outlying lands. Both species appear to spawn in brackish water, and it is quite possible that the young were formerly capable of crossing short oceanic areas.

W. J. PHILLIPPS.

Dominion Museum,
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The Nomenclature of the Banded Constituents of Coal.

IN view of the wide acceptance in Great Britain of the terms vitrain, clarain, durain, and fusain devised by Dr. Stopes to describe the banded constituents of British bituminous coal, and the introduction of the further terms anthraxylon and attritus by Dr. R. Thiessen, it may be of interest to define the relation between them. At a recent symposium of the Coal Research Club, at which both Dr. Stopes and Dr. Thiessen were present, it appeared to be agreed that the two systems have entirely different bases and that each has its validity and use. It was the important service of Dr. Stopes (*Proc. Roy. Soc.*, 1919) to replace the vague terms bright and dull coal by others capable of exact definition. The basis of her system is a lithological one. There are two kinds of bright coal. Vitrain is not in itself banded, and has a glassy lustre and conchoidal fracture. Clarain is inherently banded or striated, and consequently scatters light, and has a silky lustre, and does not break with a conchoidal fracture. These purely lithological characters are sufficient to define the terms, without resort to the microscope, a feature essential for practical purposes to retain. Dr. Stopes correlated them with the microscopic and chemical characters, but these are under further investigation.

Clarain, whether derived from a single plant fragment or from general debris, always shows marked structure in thin sections. In vitrain the structure, even if not entirely absent, is relatively obscured or obliterated, so that it produces no striation or scattering of light at the surface. Dr. Thiessen's terms, on the other hand, have a botanical, not a lithological basis. It is the contenion, first advanced by White and Thiessen in 1913, that the bright laminæ of coal (which from their description must have been vitrain) are always derived from parts of stems and roots. This material Thiessen calls *anthraxylon*. The term suggests 'coal derived from wood.'

Dr. Thiessen perhaps underestimated the contribution of cortical tissues to coal. Miss M. Evans, at the University of Sheffield, has found much vitrain to consist of periderm, and I have under investigation a thick band of clarain consisting wholly of the periderm of a Sigillaria or Lepidodendron. Nevertheless, it is clear that Dr. Thiessen includes in anthraxylon all the associated tissues of stems and roots. His generalisation may be expressed in the statement 'all vitrain is anthraxylon.' The converse is not true: all anthraxylon is not vitrain; it may be clarain or even fusain, which Dr. Thiessen describes as 'carbonised anthraxylon.' Nothing could better illustrate the difference between the two systems of nomenclature.

In striking contrast to anthraxylon is the general plant debris, called by Dr. Thiessen attritus. The essential point is that whereas anthraxylon is of homogeneous botanical origin in stems and roots, attritus is of heterogeneous origin in plant debris of all kinds. It is a sort of concrete in which larger fragments (anthraxylon, spore-exines, cuticles, etc.) are embedded in a cement of finely comminuted debris. If the brighter components preponderate, it will be clarain; if the duller ones, it will be durain.

The relation between the two systems may be tabulated as follows:

A. ANTHRAXYLON (of homogeneous botanical origin from stems or roots).	A_1 Structure absent, obscured or faint.	Lustre glassy, fracture conchoidal or semi-conchoidal, not laminated.	VITRAIN.
	A_2 Structure well preserved.	A_2, I. Dull, friable.	FUSAIN.
		A_2, II. Lustre silky, minutely laminated.	CLARAIN.
B. ATTRITUS (of heterogeneous botanical origin, general plant debris).	B_1 Much anthraxylon present.	Lustre silky, minutely laminated.	CLARAIN.
	B_2 Little anthraxylon present.	Dull, compact.	DURAIN.

Should it prove that there is a vitrain not derived immediately from portions of stems or roots, this will simply mean that there is a kind of vitrain not contemplated by Dr. Thiessen. The two kinds of clarain could be distinguished as anthraxylous and attrital clarain respectively. Dr. Thiessen uses the adjective 'attritious,' but I do not think it happily formed, and consider 'attrital,' on the model of detrital, to be better.

CLARENCE A. SEYLER.

Nelson Terrace, Swansea.

The Action of Strychnine on the Cerebellar Cortex.

THAT strychnine has a stimulating action on the cerebellar cortex was shown by me a few years ago—(*Science*, 51, 413, 1920). On the application of strychnine to the surface of the *lobulus ansiformis* or cerebellar hemisphere the motor manifestations consist in increased tonus, together with clonus, affecting particularly the ipsilateral hindleg, though affecting also, to some extent, the forelegs and the contralateral hindleg. My positive results obtained with strychnine in the cat agree with those of Shimazono (*Arch. f. mik. Anat.*, 80, 397, 1912), who observed an ipsilateral increase of tonus after applying strychnine to the cerebellar cortex in the pigeon.

It becomes a matter of interest to determine the action of strychnine when applied to the surface of the *lobus anterior*, from which, as Sherrington showed, faradisation yields inhibition of decerebrate rigidity. I have observed that the application of strychnine to this surface results at times in remarkable phenomena: in one instance, the animal (cat) having been decerebrated under ether with the Sherrington decerebrator, 1 per cent. strychnine was applied to the surface of the *lobus anterior*. This quickly resulted in two motor pictures, which alternated regularly: (1) Head and neck dorsiflexed, movements of progression in shoulders, the forelegs being stiffly extended, movements of progression in hindlegs; (2) head, neck, and body flexed ventrally, the hindlegs in violent extension and the forelegs in extension of somewhat less degree. At other times the action of the strychnine on the *lobus anterior* is manifested simply by a heightened intensity of the decerebrate tonus.

A question which obviously demands an answer is whether the application of strychnine to the *lobus anterior* changes in any way the inhibition of decerebrate rigidity elicitable by faradisation of this surface. Bremer (*Arch. int. de Physiol.*, 25, 131, 1925) has already shown that the intravenous injection of strychnine does not modify the inhibitory response.

In my experiments the cat was decerebrated under ether with the decerebrator, and faradisation with bipolar electrodes was applied to the *lobus anterior*. There resulted the typical inhibition of the tonus in the forelegs; 1 per cent. strychnine nitrate was then

applied; this resulted in some increase in the tonus of the forelegs. On repeating the faradisation, inhibition of the tonus was again evoked, the effect being, however, slightly less pronounced than before the application of the strychnine; then followed an augmented tonus (rebound), which was greater than before the application of the strychnine. These observations were repeated a number of times after several applications of strychnine and always with the same result.

Clearly we must conclude that strychnine applied to the cortex of the *lobus anterior* does not reverse, though it reduces slightly, the inhibitory response which can be elicited therefrom; the subsequent rebound is somewhat enhanced, a modification of the same kind as that noted by Bremer after intravenous injection of strychnine. The question as to why strychnine, though apparently exciting the cortex of the *lobus anterior*, should evoke an augmented instead of a diminished tonus, as does faradisation, remains for the present undecided.

FREDERICK R. MILLER.

Medical School,
University of Western Ontario,
London, Canada, February 20.

The Relationship between Viscosity of the Blood and Shock.

IN a series of experiments in which solutions of peptone or histamine were injected intravenously into rabbits I have observed that, accompanying the fall in blood-pressure and other anaphylactoid phenomena, there is a marked reduction in the viscosity of the blood. I consider that this lessened viscosity is the primary cause of the fall in blood-pressure and the accompanying symptoms of shock. That a fall in blood-pressure can be produced by a reduction in the viscosity of the blood was proved by Bayliss (*Proc. Roy. Soc.*, 89, 380, 1917), who proved that on bleeding an animal and afterwards injecting a corresponding amount of saline, both blood-pressure and viscosity show parallel reductions.

In my experiments, rabbits were anæsthetised with ether and urethane. Blood-pressure was recorded from the carotid artery and samples of blood were drawn from the femoral artery before injection of the peptone or histamine, and at intervals following the injection. The viscosity of these samples was determined by a viscosimeter of the Oswald type, the temperature being kept constant during the observations. The peptone or histamine, dissolved in physiological saline, was injected into the external jugular vein.

Following the injections, an immediate fall in blood-pressure was observed and the animal showed symptoms of shock. Examination of the blood showed that the viscosity was diminished. As a control, the experiments were repeated, with the difference that the peptone or histamine was dissolved in saline gum acacia solution of the same viscosity as blood; while the decrease in viscosity following these injections was not quite so great as in the former experiments, it was nevertheless very marked.

It seems plausible, then, to conclude that the fall in viscosity is produced by the peptone or histamine *per se* and not by the small amount of solvent in which it is dissolved. In conclusion, I wish to express the view that the anaphylactoid phenomena observed following the injection of peptone or histamine owe their origin primarily to the lessened viscosity of the blood and the resultant diminution in blood-pressure which are induced by the injections of these substances.

Viscosity determinations of the blood of sensitised guinea-pigs before and after injections of the provocative dose are now being carried out. The results indicate a definite decrease in viscosity following the injections.

RUSSELL A. WAUD.

Department of Physiology,
University of Western Ontario,
London, Canada, February 25.

Domestic Heating.

IN her letter in NATURE of March 6, p. 343, Dr. Stopes affords no evidence that the beneficial effects which she says she derived from the glowing coal fire were due to coal. She might have got equally good effects from a *glowing* coke fire, gas fire, or electric heater. She compares the effect of lying naked in front of a glowing coal fire with stripping in a warm room. Advantage lies in the use of a visible source of radiation.

This winter's experience has shown us that the close-up use of electric lamps in the Zoo has made a great difference to the marmosets, iguanas, etc. Dark heat does not suffice to keep such animals alive. We, and they, need visible rays which penetrate to, and are absorbed in, the blood beneath the epidermis, the red rays penetrating still deeper, and ultra-violet rays, which are absorbed in the epidermis, the energy of all these rays being converted in living cells. Dark heat is absorbed by the water in the surface layer of the body—quite another thing. While there is no evidence of any mysterious health-giving property in a coal fire, such as Dr. Stopes imagines, by polluting the atmosphere it causes great economic loss, and by screening off sunshine lessens health and happiness. We should therefore take to smokeless fuels, keeping to visible sources of radiation which are not only healthy but also adaptable to our changeable climate.

LEONARD HILL.

Osborne House, Loughton,
March 12.

Chemical Society Publications Fund.

IT is a welcome sign that research work in chemistry emanating from our universities continues steadily to increase. Pessimists told us that the increase which followed the War was due to abnormal conditions and that the apex of the curve would soon be reached. Fortunately for our chemical well-being, this is not the case and the curve continues to rise. Unfortunately, the costs of printing do not diminish and the financial burden on publishing societies continues to grow.

In order to ease the burden, the Chemical Society has raised a Publications Fund which, through the generosity of fellows of the Society and chemical manufacturers, now approaches 5000*l.*; but the income from this is still too small to be really effective.

The Society acts as a publishing body for the universities, and does so freely in the interests of chemical science. Nevertheless, it is gratifying to record that one university, namely, that of Birmingham, by subscribing 100*l.* from its research fund to the Publications Fund, has recognised the work the Society is doing for it and for academic institutions in general. *Venienti occurrite morbo.*

JOCELYN THORPE.
(Treasurer.)

Chemical Society,
Burlington House, London, W.1,
March 13.

The Modern Boiler-House.

By Eng.-Capt. EDGAR C. SMITH, O.B.E., R.N.

FEW departments of engineering practice have seen more radical changes than that of steam raising. Stokeholds of ships and power stations have been transformed. Where dirt, confusion, and inefficiency often reigned there is now order and method, and brawn and muscle have made room for skill and trained intelligence. Science has come into its own, and the modern boiler-room reflects the progress of the time. Installed in well-lighted and spacious buildings, the boilers and all their accessories are the objects of the care of the engineer-in-charge as much as the main machinery itself. Water-tube boilers, superheaters, economisers, air heaters, mechanical stokers, pulverised fuel systems, forced and induced draught fans of many types have taken the place of tank boilers fired by hand, while new forms of gauges and indicators keep continuous records of the fuel consumed, the analyses of the gases, the temperatures of gases, steam, and water, and, in some instances, steam-flow meters are fitted which make the approximate test of a boiler a comparatively simple matter.

The most advanced boiler practice is to be found in the electric power stations. Of such stations there are in Great Britain nearly six hundred concerned with the public supply of electric current, but the majority of them are small. Those at Barking, Manchester, Birmingham, Glasgow, Newcastle, and a few others are of considerable size; but it is in the United States we see the rise of the so-called super-power station—a super-power station being essentially a very large plant comprising a part of a regional system wherein the more efficient plants are linked up. Electricity is used in America to a far greater extent than in the old world, and as much current is generated in the United States as in all the countries of Europe combined. Some striking figures and diagrams regarding the electrical industry is given in the January issue of the *Electrical World*, where it is stated that the power distributed in the United States last year amounted to 54,413,000,000 kilowatt hours, the corresponding figure for Great Britain being 6,681,000,000 kilowatt hours. Other interesting details regarding the super-power stations were also recently given by Mr. W. H. Patchell in his honorary members' lecture to the Junior Institution of Engineers. Mr. Patchell has himself been connected with power station work for the last forty years, and he was the pioneer of the very large boiler.

Modern power station boilers are invariably of the water-tube type, among the most popular being the Babcock and Wilcox and the Stirling. Pressures in such boilers have gradually advanced until to-day 300 lb. and 400 lb. per square inch is common, while there are stations using steam at 500 lb., 600 lb., 800 lb., and even 1200 lb. pressure. Boilers are also made in very large units. Copper, brass, wrought iron and steel have all been used for boiler tubes, which formerly were made from sheets rolled and welded; but thanks to the invention of the German metallurgist, Mannesmann, boiler tubes now are of solid drawn steel, and with such tubes failures are infrequent.

The stoking of the boilers is done by one of two types of mechanical stokers known as chain-grate stokers and under-feed stokers, or the coal is pulverised and blown into the furnace by jets of air. In chain-grate stokers the coal is fed from a hopper on to an endless chain of short fire-bars linked together, the grate travelling slowly into the furnace at about 2 to 6 inches per minute. With such stokers, firebrick arches are employed to reflect the heat from the fire and assist the combustion of the gases. The ash falls off the chain grate at the back of the furnace and is conveyed away by various means. The size of a large chain grate may exceed 20 feet square. In an under-feed stoker the coal is fed into the furnace by retorts and is thrust up under the already burning coal, the fuel being agitated by reciprocating fire-bars. Thick fires are the practice with under-feed stokers. Many types of mechanical stokers are in the market, and the choice is determined largely by the class of coal to be burned.

The most interesting development in boiler firing is the comparatively new system of using coal dust. In this case the coal is crushed, then passed through a magnetic separator to remove pieces of stray iron, and, after being dried in steam or hot-gas driers, is pulverised in mills to such a fineness that most of it will pass through a sieve with a mesh of $\frac{1}{100}$ of an inch. From the mill it is conveyed to bunkers, from which it is delivered to the burners. In a plant using pulverised fuel the lower drum of the boiler may be some 20 feet or more above the ground floor, the walled-in space beneath the boiler constituting the furnace or combustion chamber. So large are some of these combustion chambers that it would be possible to place a two-storeyed double-fronted villa in one of them. The coal dust is injected into the chamber through nozzles pointing downwards from a position corresponding to the cornice of a ceiling. The very high temperatures reached have called for improvements in refractory materials for the walls of the combustion chambers, but a promising experiment has been made by forming the walls of water-tubes with longitudinal fins welded on them. With pulverised fuel the ash falls as minute drops of liquid slag. A screen of water-pipes placed about a foot apart across the bottom of the combustion chamber cools these drops, and the ash reaches the floor as fine dust, which is easily dealt with.

An integral part of every modern boiler is the superheater through which the steam passes on its way to the engine. Super-heating is now in use in ships and locomotives as well as in power stations, and there is a rough rule that 10° F. super-heat leads to an economy of 1 per cent. in the fuel.

After the gases have passed among the boiler and super-heater tubes they are still at a moderately high temperature, and are therefore caused to flow through an economiser for heating the feed water and through a pre-heater for heating the air for the furnaces. Finally, at the top of the boiler-house, they are drawn into the induced draught fan and ejected into the chimney-stack.

A modern boiler-house is a steel-framed structure of

three or four storeys, perhaps 100 feet in height. Platforms at intervals support the various sections of the plant, and gratings and ladders give access to the stop-valves, gauges, burners, and other fittings. Roomy and well lighted inside, the buildings are designed by architects especially qualified in such work, and the exteriors are both pleasing and appropriate.

Super-power stations each designed for an ultimate capacity of over 300,000 kilowatts, have already been erected at St. Louis, Chicago, Pittsburg, New York, Brooklyn, Detroit, Boston, Cincinatti, and one or two other places, and a few particulars of some of their boiler plants may be of interest.

What will probably be the largest station is the Crawford Avenue station of the Commonwealth Edison Co., Chicago, and it was for this station Messrs. C. A. Parsons and Co. constructed the fine 50,000 kilowatt turbo-generator, the model of which was shown at the British Empire Exhibition at Wembley, from whence it was removed to the Science Museum, South Kensington. A full description of this set is in *Engineering* for March 5. The ultimate capacity of Crawford Avenue will probably reach 800,000 kilowatts. Very large Babcock and Wilcox boilers are installed, the tubes being 15 feet long, while the steam drums are 4 feet in diameter and 32 feet long. The drums are of steel plates $1\frac{7}{8}$ inch thick, and the riveting is of an exceptional character. Forced draught chain grates are used, the grates being 24 feet wide and $20\frac{1}{2}$ feet long. Steam is generated at 600 lb. pressure and delivered to the turbines at 550 lb. pressure at a temperature of 725°. About 190 tons of steam per hour is required for the single 50,000 kilowatt Parsons set. The boiler-house also contains a reheat boiler through which the steam is caused to pass on its way from the H.P. turbine to the I.P. turbine. The steam leaves the H.P. turbine at 100 lb. pressure and at a temperature of 425° F., and enters the I.P. turbine at about the same pressure but with its temperature increased to 700° F. Economisers are used, but the feed water, before entering the economiser, has already passed through five steam heaters, with the result that it enters the economiser at 315° F. and leaves at 380° F. At Crawford Avenue full advantage is made of the modern system of 'bleeding' the turbine.

Another large plant is that of the Detroit Edison Co., which supplies electricity over a very large area and sells it to the farmer 50 miles away at the same price as to the town dweller. The company has stations at Delray, Connor's Creek, and Marysville, and a new station has recently been erected at Trenton Channel. The Stirling boilers here work at 410 lb. pressure and the steam is super-heated to 700° F. Pulverised fuel is used entirely. A section of the boiler-house shows the ash-shoot at the ground level, the boiler floor 45 feet above this, and the roof 130 feet from the ground. Standing in the huge combustion chambers, the ash-shoots are at one's feet while the boiler tubes are some 50 feet overhead. The volume of such a combustion chamber is about 25,000 cubic feet, and one boiler will supply sufficient steam for a 25,000 kilowatt machine. At present there are three 50,000 kilowatt turbo-generators installed. Electricity is generated at 12,000 volts and distributed by overhead mains at 120,000 volts.

With the reputation of having established a record in economy, the Philo Station at Zanesville, Ohio, is a station possessing many remarkable features. It forms one of the plants of the American Gas and Electric Co., and was designed "to produce a marketable commodity at the lowest possible price." The thermal efficiency of the plant worked out at 23·81 per cent. The boiler pressure is 650 lb. and the steam temperature 750° F. In addition to the main boilers there are super-heaters, economisers, air heaters, forced and induced draught fans, and a reheat boiler as at Crawford Avenue. This station is unique in that it is able to draw its circulating water for the condensers from a reservoir at a higher level than the machinery, and for ten months in the year, therefore, no circulating pumps are required. Philo is but a link in a great system supplying electricity to parts of Ohio, Indiana, Pennsylvania, and West Virginia.

All records of boiler pressures in actual use are surpassed by the 1200 lb. pressure generated in the remarkable Babcock and Wilcox boilers at Calumet and at the Edgar station, Boston. At Boston three large boilers provide the main steam supply at 350 lb. pressure, but there is a separate boiler working at 1200 lb. pressure. This very high pressure steam is first used in a 2500 kilowatt turbo-generator, from which it exhausts to a reheater and then finds its way into the 350 lb. main of the station. The steam drum of the 1200 lb. boiler is an exceptionally fine piece of work. It was made from a steel ingot weighing about 100 tons. The ingot was 'upset' until about 8 feet in diameter, a core of 23 inches was then removed from it, and by subsequent operations the ingot was drawn out into a drum 34 feet long and 4 feet in diameter, the walls of which were 4 inches thick. Such work is within the capacity of only a few firms, but it well illustrates the demands made on the manufacturer by the designer of modern boilers.

Trends in American Geology.

IN an address delivered to Section E (Geology and Geography) at the recent meeting of the American Association for the Advancement of Science, Dr. W. C. Mendenhall dealt with "Some Recent Trends in American Geology," indicating the lines along which, according to his view of the matter, effective progress in the science of geology is being made. Modern science, said Dr. Mendenhall in his opening remarks, is too broad and too complex to be comprehended by any individual, and any one of the sciences is beyond the grasp of one man. "Progress is made by the specialist or group of specialists who devote themselves to a limited field. Presently there comes out of their endeavours a generalisation which can be used by other groups. Thus the advances in different fields are linked together and a united front is maintained."

Study of Sediments.

A promising development of the last few years is the revival of interest in the petrology of sediments and the organised attack that is being made on the problems connected therewith. The United States National

Research Council has appointed a Committee on Sedimentation under the chairmanship of Drs. Vaughan and Twenhofel. Under the guidance of this committee it is proposed to issue a treatise on sedimentation for the purpose of directing attention to the research problems involved. Laboratories for the study of sediments are being installed in various institutions, and new courses are being organised in several of the universities. Already, scientific papers are being published on this subject, and petrographers are ceasing to find their sole interest in igneous problems. It is expected that the influx of new data arising from these investigations will have much influence on the study of palæogeography by throwing new light on the climatic and other conditions under which sedimentary rocks have been formed.

Glacial History.

Two conspicuous tendencies are displayed in this branch of study; one towards the establishment of a more definite chronology in glacial events, the other towards linking up these glacial events more closely with pre-glacial history. In this connexion perhaps the most striking and best-known quantitative attack is that of Dr. Antevs, who, with the assistance of the Canadian Survey, Harvard University, and the Carnegie Institution of Washington, is applying the methods of Baron de Geer to North American problems.

Stratigraphy and Palæontology.

In these departments there has been a large increase in the amount of available data, which has been collected by more refined and exact methods, and on that account has made possible more definite correlations and more exact interpretations of the physical environment in which strata have been formed. In the light of this newer data, old problems like that of the Laramie problem are vanishing, and strata, the ages of which have long been considered doubtful, are taking their places in the normal sequence. Ulrich has recognised in America two large and extensively developed assemblages of Lower Palæozoic rocks which he thinks deserve to rank as systems, although they are but meagrely represented in the classical localities of north-western Europe. Much progress is being made in the study of the smaller fossils, especially in oilfield stratigraphy, and the research now being carried on in this connexion is expected to lead to interesting results and useful developments in the near future.

Petroleum Geology.

The last decade has witnessed a large absorption of geological talent by various oil interests, consequent upon recognition by the latter of the fact that the science of geology is an essential weapon in the attack on problems of oilfield exploration and development. This has led to a rapid development of the more obviously favourable areas. The exploration of less favourable areas requires more refined methods, in the application of which the more alert organisations are engaging physicists, chemists, palæontologists, and more geologists in order to cope with the difficulties involved in the maintenance of supplies of oil.

The solution of the problem of the distribution of petroleum in the earth is one involving many hindrances and difficulties. In spite of the excellent forum offered by the American Association of Petroleum Geologists and its journal, there is not complete freedom in the interchange of ideas, owing to the fact that some companies hesitate to give the world the full benefit of results which they have been able to obtain only at much expense. There is, moreover, the further difficulty that any particular company or group is often hindered by commercial considerations from taking a large view of the research aspects of the problems it has to deal with. It is hoped, however, that oil companies will soon come to realise more fully how much might be done for the advancement of knowledge by exploiting more fully the opportunities that already exist. Leaders among petroleum geologists are fully aware of these opportunities, and their co-operation, on one hand with the oil-company executives, and on the other with various non-commercial scientific organisations, is expected to have fruitful results. The American Petroleum Institute recently announced that John D. Rockefeller had provided a fund for petroleum research. It seems likely, therefore, that the next decade will see large advances in knowledge concerning the origin of petroleum and the extent of the United States petroleum resources.

Origin of Coal.

The results of a combined attack by geological, chemical, and physical methods upon the problems of the origin and classification of coal has tended in recent years to confirm the old belief that coals of different kinds have a common origin, and that they represent different stages in the metamorphism of peat, material differences among coals being due to differences in the nature and relative amounts of the various original plant-debris constituents. A notable outcome of these researches into progressive carbonisation has been its use by Dr. D. White as an indicator of the extent to which the beginnings of metamorphism in rocks has gone, and the practical application of this indicator in determining areas in which the survival of liquid and gaseous hydrocarbons may be expected. Research is now being undertaken to ascertain whether a study of carbonaceous sediments other than coal can be turned to similar account, so that in the absence of coals it may still be possible to predict whether any petroleum that formerly may have been present in a region has survived.

Seismology.

In this field of work, a co-ordinated effort is being made by the Seismological Society, the Carnegie Institution of Washington, the Research Council, the Coast Survey, the Geological Survey, and many universities and individuals, to collect facts from which it may be possible to define seismic and non-seismic areas, and to classify the former according to their degree of seismicity. The aim of this work is to ascertain how far it may be possible to predict the immanence and locus of earthquake shocks, so as to be prepared in some measure for their occurrence. This work will derive stimulus and support from business interests. Already it is a broad business problem, the approach being mainly from the point of view of insurance.

ORE DEPOSITS.

For a generation or so, according to Dr. Mendenhall, this branch of geology has brought forth no such universally accepted generalisation as appeared in the preceding period. A large amount of data has been accumulated, however, and the possibility of interpreting these data by scientific principles has been actively tested for the purpose of solving the important economic problems of ore-finding and mine development. A growing consciousness of the prospective shortage in supply of the precious metals, as well as some of the base metals, has led to attempts to survey broadly the whole field of mineral supplies, to see whether, from the detailed studies that have been made already, any general laws can be deduced that will prove helpful as a guide to means of increased production. In this connexion there has been in recent years a growing appreciation of the international aspect of the problem of mineral supplies.

As Dr. Mendenhall fully realises, however, this, and other of the topics he deals with, relate to applied rather than to pure geology; and, unless one is satisfied that geology is a perfected science, it seems needful that the fundamental principles of the science should receive attention; for science has to be established before it can be applied. Is sufficient being done for the principles of geology by the present generation, and is adequate progress being made towards the unity and co-ordination of the various specialised branches of geology? Dr. Mendenhall assures us that the trends in American geology show that sound and substantial progress, impressive in the aggregate, is being made. His rather optimistic view of this matter is defined in his opening remarks, as already mentioned, to the effect that progress in the science as a whole is made by the maintenance of a united front by bands of specialists, each ploughing its rather lonely furrow. We may, however, reasonably doubt whether bands of specialists are capable of moving forward on a united front without some generalship in the way of fundamental scientific principles to guide them.

Looking at the subject from a less appreciative point of view, and presumably more as a student of principles than of details, President Lowell of Harvard said not long ago that for many years geology had taken no forward step. In his address last year as president of the Institution of Mining and Metallurgy, Sir Thomas Holland voiced a similar view. These differences of opinion as to whether geology is making progress clearly depend upon the viewpoint we take. Looking at the matter from a specialistic point of view, Dr. Mendenhall is no doubt right in claiming that there has been movement. Viewing it more generally, President Lowell is no doubt equally right in claiming that such movement as has taken place does not constitute progress. Anyhow, it seems desirable enough that geologists should keep well in mind the need that exists for the cultivation of scientific principles as well as specialistic details, for only by so doing will it ever become possible either to raise the status of geology as a science, or to cope with the many difficult problems, both scientific and economic, that await solution. T. C.

British Association at Oxford.

PRELIMINARY PROGRAMME.

THE preliminary programme of the British Association meeting in Oxford on August 4-11 has been issued from the office of the Association at Burlington House. It indicates that the presidential address by the Prince of Wales is expected to deal, among other matters, with relations between scientific research, the community, and the State, both at home and in the overseas Dominions. The address will be delivered, at 8.30 P.M. on August 4, in the Sheldonian Theatre, but as the accommodation there is not expected to suffice for so large a meeting, the proceedings will be relayed to the Town Hall, and, if necessary, to the Union Society's Hall or elsewhere.

The subjects of a number of the addresses by sectional presidents are announced. In the mathematical and physical section, Prof. A. Fowler will deal with the production and analysis of spectra; and spectroscopy is likely to be an important subject of discussion in this section. Prof. J. F. Thorpe will address the chemical section on the scope of organic chemistry, and Prof. S. H. Reynolds the geological section on progress in the study of the British Lower Carboniferous rocks. In the zoological section, Prof. J. Graham Kerr will speak on biology and the training of the citizen. The Hon. W. Ormsby-Gore will bring the first-hand experiences of his African tours to bear in discussing the economic development of British tropical Africa, in the geographical section. Sir Josiah Stamp will address the section of economics on inheritance as an economic factor. In the engineering section, Sir John Snell will deal with the recent and probable future development of the electricity supply. Prof. H. J. Fleure, in the chair of the anthropological section, will review the modern position in regard to knowledge of the evolution of human races; and Prof. J. B. Leathes, addressing the physiological section, will deal with function and design. Announcements received since the programme went to press include that of Sir Daniel Hall's address to the agricultural section; his subject will be the area of cultivation required to feed the population. Prof. F. O. Bower, who succeeds the late Dr. W. Bateson as president of the botanical section, will review the state of botanical science at the present time in comparison with that at the Oxford meetings in 1894 and 1860. One of the evening discourses will be given by Prof. A. S. Eddington, and a large number of discussions on leading scientific subjects have already been arranged. On Thursday, August 5, there will be two on important Imperial topics—educational training for life overseas, and the effect of contact with European civilisation upon African native races.

The Vice-Chancellor of the University of Oxford and the Mayor of Oxford will hold receptions, and the local executive committee will give a conversazione, with the co-operation of the Junior Scientific Club. A number of excursions to places of interest are also being

arranged. Among preachers at the cathedral and principal churches on the Sunday during the meeting will be the Bishops of Oxford and Winchester, the Dean of St. Paul's, and the Master of the Temple, and at Mansfield College, Dr. Selbie, the principal. Assistance is offered by the local committee to members desirous of obtaining accommodation, during the meeting, in colleges, hostels, lodgings, and private hotels, and there should be no lack of room for visitors, provided (but the proviso is important) that early application be made on the form sent out with the programme.

News and Views.

WE note with pleasure the appointment of an engineer officer of the Royal Navy as a Naval A.D.C. to the King. This is the first time this honour has been bestowed upon a naval engineer. The officer selected is Engineer Captain E. P. St. John Benn, who is at present in command of the Royal Naval Engineering College, Keyham. The College, it will be remembered, was opened in 1880, but owing to the changes due to the Selborne scheme of training the direct entry of engineer cadets ceased and for some years the College was closed. It was reorganised in 1920 and midshipmen from Dartmouth and special entry cadets for the Engineering Branch now enter it for a four years' course of training in mechanical and electrical engineering. Captain Benn's appointment is the direct outcome of the representations made by the Engineering Institutions to which we have already referred, and to which the Duke of Northumberland alluded in his presidential address last week to the Institution of Naval Architects. In the course of his remarks the Duke of Northumberland said that in the opinion of the Institution it was an anachronism to emphasise the difference between the executive officer and his engineering colleague, and that it was felt that if a place could be found in the Board of Admiralty for direct representation of the engineering branch it would certainly tend to make engineers confident that their views would be fully considered. With these views we are in entire agreement.

THE Hon. Robert Boyle remarked that "it may much assist us to take notice of the multitude of Effluvia, and make us expect great matters from them," and the chief conclusion reached in the course of some investigations recently undertaken for the *Forum*, and described by Mr. E. E. Free in the March issue of that journal, is: "that a conscious effort to train our national noses might have a distinctly worth-while effect on the comfort of living." A similar conclusion has been arrived at by quite a number of investigators; reference may be made to various papers on the subject listed in "Osmics" (Oliver and Boyd, Edinburgh, 1922, 1924). The conclusion is strengthened by finding that the percentage of correct identification of the odours used in these tests is only 21·2, and in a group of students at Dartmouth College, 27·4, whereas a trained pharmacist identified correctly eleven out of twelve odours submitted. The conclusion that people do not differ greatly in their olfactory acuity is somewhat vitiated by the circumstance that the paper does not reveal the employment of exact olfactometric methods, the odours being merely referred to as very weak, weak, moderately strong, and strong. While Henning's method of classifying odours is criticised, there is no mention of Zwaardemaker or Heyninx. "We found a complete absence of indication that any primary list exists at all. So far as we can determine from our tests each odour is smelled individually and all of them unlike each other." This conclusion may be due to the small number of odours employed, as well as to the circumstance that association by similarity involves more elaborate neuron patterns than association by contiguity. Various instances are given of affects and associations due to odours, and Mr. Free concludes that smells are largely recognised by their associations. The value of the paper would seem to lie in the plea for training the sense of smell, and perhaps, too, in emphasising the value of previous work on the subject, for example by Titchener, Vortriede, Harris, and others, not to mention Dr. Dan McKenzie's "Aromatics and the Soul," which Mr. Free would find to be an excellent introduction to the subject he has written about.

IF it can be shown that those who launch a new scientific journal are justified in their claim that it can indeed contribute to the welfare of the science that it is meant to serve, then even those who bemoan the increase of publications will welcome it. In the foreword to the first number of the *Quarterly Review of Biology*, Prof. Raymond Pearl, the editor, gives adequate reasons for adding yet another to the 25,000 already existing reputable scientific journals of the world. The new journal is addressed primarily to all men of science who wish to keep soundly orientated as to the general progress of biology, but it is intended further to be an effective answer to the menace of Fundamentalism, which is best met by the diffusion of scientific knowledge among intelligent men and women who are not professionally scientific workers but are genuinely interested in the advances that are being made. The journal, which costs 5·50 dollars a year, is published by the Williams and Wilkins Company, Baltimore; the associate editor is Prof. R. W. Hegner, and the advisory board includes fifteen of the best-known American biologists, most 'specialisms' being represented. The first number includes the following papers: "The Biology of the Mammalian Testis and Scrotum," by C. R. Moore; "Symbiosis among Animals," by L. R. Cleveland; "Experimental Studies on Morphogenesis in the Nervous System," by S. R. Detweiler; "A Review of the Discovery of Photoperiodism," by K. F. Kellerman; "Recent Discoveries in the Biology of Amœba," by A. A. Schaeffer; reviews of seventy-seven new biological books, including a long critical

one, by J. H. Gerould, of Cuénot's "L'adaptation." The articles are written by acknowledged authorities capable of presenting accurate, balanced, and critical summaries of the present position of their own particular fields. The list of papers to appear in future numbers is such as would seem to indicate that the success of this new journal is assured. It is but fitting that Prof. Raymond Pearl, who by his outstanding ability and almost superhuman energy has, in the past, set such a pace in biological research that few of us could keep up with him, should, by producing the *Quarterly Review of Biology*, enable us 'to get our second wind.'

THE Report for 1925 of the Marine Biological Station at Port Erin, Isle of Man, drawn up by Prof. Jas. Johnstone, shows a very satisfactory state of affairs and a large amount of work has been accomplished both by the resident staff and by occasional workers. The fish hatchery has yielded more than three million plaice larvæ which have been set free into the sea, and of the parent stock not one died, all being in good condition. More larval lobsters were reared than in any previous year. From fifteen lobsters 526 lobsterlings, fed on fresh plankton, were reared in jars, 500 of these being set free into the sea besides many thousand younger larvæ. The naturalist of the Laboratory, Mr. J. Ronald Bruce, has published an interesting paper on the "Salinity and Carbon Assimilations in Amphidinium" in the *British Journal of Experimental Biology*, and proposes further instalments of this important work on the metabolism of the shore-living dinoflagellates, which on the Port Erin sands offer special facilities for such studies. He is also investigating the seasonal variations of the gaseous metabolism in the common mussel. From the oceanographical department of the University of Liverpool, Mr. R. A. Fleming publishes "Notes on some Fish landed from the South-Western Hake Grounds," the fish, chiefly sharks, having been sent to the Laboratory for researches into their liver-oils, and Mr. R. J. Daniel describes a large and perfect Stenoteuthis measuring six feet including the tentacles, taken in the trawl off St. Kilda. Dr. Margery Knight, from the botany department of the University, reports on the investigations on Algæ undertaken by herself and pupils—research covering a wide area which promises to yield important results only obtainable by methodical team-work and keen workers both in the laboratory and on the sea-shore. The absence of a research boat at Port Erin is certainly to be deplored, and it is hoped that this gap will be filled at the earliest opportunity.

IN 1923 the Government of Finland issued invitations for a conference of delegates from the States which border the Baltic in order to discuss the desirability of common action whereby a chain of first order triangulation round the Baltic shores might be carried out. The conference met at Helsingfors at the end of June 1924, and was attended by representatives of Esthonia, Finland, Germany, Lettonia, Lithuania, Poland and Sweden. A report has now been issued (*Comptes Rendus des Séances de la Conférence Géodésique réunie à Helsingfors*, Helsinki, 1925). The discussions which took place were essentially of a technical character, and a number of resolutions were adopted with the view of ensuring the work being homogeneous, and of a uniformly high standard of accuracy in all portions of its circuit. A considerable portion of the chain is already in existence in various countries, but the additional extensions and connexions which will be required were discussed and agreed upon. In such new work the mean length of a side of a triangle is to be about 30 km. and no angle is to be less than 30°; heliotropes or lamps are to be used as signals except where the sides are short. The instrument recommended was a theodolite having divided circles of 20 cm. diameter and reading to 2″. Six additional bases are to be measured at various points of the chain with Jäderin wires which are to be verified by measurements made on a selected control base. Astronomical determinations of latitude, longitude, and azimuth are to be made as often as practicable, and it was agreed that Laplace stations should in any case be not more than 200 km. apart. Considerable emphasis was laid on the importance of gravity determinations, which are to be made as frequently as possible. Von Sterneck's pendulum apparatus is to be employed, and those used will be standardised at Potsdam. The publication not only summarises briefly the plans which have been made for carrying out this important piece of European geodesy, but it also furnishes a convenient abstract of the operations which have to be carried out in a piece of modern geodetic triangulation, and of the accuracy which is required at the various stages of the work.

WE have received three volumes of the final report on the Japanese earthquake of 1923. They belong to the series of Reports of the Imperial Earthquake Investigation Committee printed in Japanese, and it is much to be hoped that before long they will appear in English in the corresponding series of Reports in Foreign Languages. If we may judge from the tables of contents and the numerous and admirable plates, the complete report on the earthquake will assuredly take its place as one of the finest accounts that we possess of any natural phenomenon. The first volume (No. 100, A) is mainly concerned with the earthquake in general and its after-shocks, and with the distribution of intensity in various districts; the second (No. 100, B) with the geology and physiography of the central area, the changes in the level of the land and of the floor of Sagami Bay, and the sea-waves following the earthquake; and the third (No. 100, E) with the great fires in Tokyo and other places. Among the plates may be specially mentioned the detailed chart showing the changes in the bed of Sagami Bay, the seismograms from Tokyo and elsewhere, the mareograms from many Japanese ports, and the map showing the isoseismal lines bounding places in which the percentage of collapsed houses reached 30 and 5, respectively. Yokohama lies

within the former curve, and the greater part of Tokyo outside the latter.

THE Weather Bureau of the U.S. Department of Agriculture has issued "Instructions to Marine Meteorological Observers" (W.B. No. 866). For ocean meteorology the Weather Bureau asks for one regular observation a day at noon, G.M.T. In certain designated areas from which observations are transmitted by radio-telegraphy, an additional regular observation is asked for at midnight, G.M.T. The reason for making observations at the same moment of time is for the construction of synoptic weather charts of large areas. For the transmission of observations by radio a separate publication, "Radiographic Weather Code for Vessel Weather Observers," is issued. Instructions for taking observations are printed in English, French, German, Italian, and Spanish. The requirements for observations are much the same as those of the Marine Branch of the British Meteorological Office, and the observations obtained are similarly used. Good explanations and illustrations are provided of the various instruments as well as of clouds and other weather observations, together with maps showing the use of synoptic observations over the Atlantic. A glossary is given of a number of meteorological terms of special interest to mariners and tables for the correction and reduction of observations.

THE report of the Botanical Survey of India for 1924–1925, issued by the Director, Mr. C. C. Calder, is melancholy reading in one sense in that it states that owing to reduction in staff, effected "to secure the object of retrenchment," the Survey, "so far as field exploration is concerned," became "a Department in name only." On the other hand, much good systematic botanical work is chronicled by students of Indian botany both in India and abroad. An interesting report is also given of a further year's experimental work with cinchona in Burma. The Director concludes his account of the Burma plantations with the forecast that, if labour conditions are favourable, he sees no reason "why a large quinine producing belt extending from the Tenasserim River eastwards to the borders of Siam should not result and production on a scale sufficient to affect controlled prices and bring the drug within the reach of India's malarial millions."

THE address given by M. Daniel Berthelot at the formal meeting of the Society of Civil Engineers of France, with the President of the Republic in the chair, held in celebration of the centenary of the publication of Carnot's tract "sur la puissance motrice du feu," is given in full in the issue of the *Revue Scientifique* for February 13. Born in 1798, Nicolas-Leonard-Sadi Carnot was only twenty-eight years of age when his brochure of 118 pages was published by Bachelier of 55 quai des Augustins, and eight years later he was carried off by an epidemic of cholera. In conformity with the sanitary regulations his effects were burnt, a small exercise book with scientific notes, now in the archives of the Paris Academy of Sciences, alone being saved. The tract excited little attention, and when Lord Kelvin in 1845 found a reference to it in a memoir of Clapeyron, he only succeeded in finding a copy after three years' search. Clausius in 1870 stated that he had not up to then succeeded in finding a copy, and at the present time it is almost unprocurable.

THE after-Easter Lectures at the Royal Institution will begin on Tuesday, April 13, at 5.15 P.M., when Prof. J. Barcroft will deliver the first of four lectures on organs of multiple function, (i.) "The Salivary Glands." These will be followed by three lectures by Dr. G. W. C. Kaye on the acoustics of public buildings (Tyndall Lectures); and two by Sir Percy Sykes on (i.) Shah Abbas of Persia, the contemporary of Queen Elizabeth, (ii.) Chinese Turkestan and the Pamirs. Thursday afternoon lectures include three by Sir William Bragg on the imperfect crystallisation of common things; two by Mr. U. R. Evans on corrosion, tarnishing and tinting of metals; and two by Dr. J. Newton Friend on (i.) iron in antiquity, (ii.) science in antiquity. Saturday afternoon lectures include two by Dr. W. T. Calman on the shipworm, beginning on April 17; two by Dr. G. C. Simpson on atmospheric electricity; and one by Prof. Alexandre Moret on "Une Revolution sociale en Egypte vers 2000 Av. J-C." (in French). The Friday evening discourses will be resumed on April 16, when Dr. A. W. Hill will deliver a discourse on the quest for economic plants. Succeeding discourses will probably be given by Prof. R. Whiddington, Dr. W. H. Eccles, Sir Frederic Kenyon, Mr. Seton Gordon, Sir Almroth Wright, Prof. J. Garstang, Prof. J. C. M'Lennan of Toronto, and others.

SUMMER time will come into force in Great Britain and Northern Ireland, as well as in France and Belgium, at 2 o'clock, Greenwich Mean Time, on the morning of Sunday, April 18.

SIR HENRY MIERS, who is retiring this year from the Vice-Chancellorship of the University of Manchester, has been elected a trustee of the British Museum in succession to the late Dr. W. Bateson. Sir Henry was a member of the staff of the British Museum in the Department of Mineralogy from 1882 until 1895.

THE summer meeting of the Institution of Electrical Engineers will be held at the North-Eastern Centre, Newcastle-on-Tyne, on June 8-11. The meeting will then be in the centre of an industrial district, and numerous visits to important works in the neighbourhood, as well as to places of more general interest, have been arranged.

MR. A. RODGER, President of the Forest Research Institute and College at Dehra Dun, will succeed Sir Peter Clutterbuck as Inspector-General of Forests when the latter goes on leave preparatory to retirement, and will combine his new duties with the presidential duties already in his charge. According to the Delhi correspondent of the *Times*, this will

mean the creation of a new appointment of professor of forestry at the Research Institute and College.

THE committee of the Manchester Museum, in its report for the year 1924–25, notes that the construction of the new building provided by the late Dr. Jesse Haworth, though delayed by labour troubles, is now progressing, and it adds that if this building is to be adequately maintained, an increase in the Museum's income is imperative. One step towards that end has been taken by the committee, on the lines of the American Museum of Natural History, in enrolling all annual contributors of five shillings or more as "Members of the Manchester Museum." The committee has also widened its basis by co-opting representatives of the chief scientific societies in Manchester. We cannot but feel that the Corporation of this wealthy city might increase its grant to this excellent Museum, which took the lead in the education of school-children.

THE report of the meeting in London in April 1924 of the International Commission for the Exploration of the Upper Air has recently been issued by the Meteorological Office of the Air Ministry. The report is in English but the French text of the nineteen resolutions is also given in an appendix. The most important of these resolutions are: (1) Nos. (iii.) and (iv.), which register the decision of the Commission to publish in collected form the full results of the International Investigation of the Upper Air in 1923 and 1924, thus renewing an international effort which had been in abeyance since the War; (2) No. (xv.), which expresses clearly the two main purposes of international exploration of the upper air, namely, the study of the general circulation and the more detailed study of the structure of the atmosphere in different regions for different types of weather; and initiates a system of deputy presidents charged with the supervision of the investigation in different regions of the world; and (3) a resolution on p. 32 of the report affirming that barometric pressure should be expressed in millibars, and that geopotential expressed in dynamic metres should be used in place of geometric heights. Among the appendices one notes a number of memoranda presented by the Russian delegate. Until records of *ballons-sondes* for Russia and Siberia are available for the same time as those made in the rest of Europe, the solution of many of the problems connected with the stratosphere cannot be achieved. The Commission indeed affirmed this by passing a special resolution (No. viii.) "that intensive observations of *ballons-sondes* in Russia and Siberia from 3-5 stations are of great importance in the investigation of the upper atmosphere."

THE American Geophysical Union now meets annually, and the transactions of the sixth annual meeting (1925) have been issued as a *Bulletin of the National Research Council*, vol. 10, part 3, No. 53, July 1925. The major part of the bulletin is, however, devoted to abstracts of reports and papers, covering a very wide field. W. J. Humphreys reports that a rocket is being developed with the aid of which it is hoped to obtain determinations of the temperature of the upper air at various heights, and also samples of gas from these heights, for chemical analysis; direct information on both these disputed questions is much to be hoped for. The bulletin also includes a series of reports, by the American delegates, of the meetings at Madrid (1924) of the International Geodetic and Geophysical Union and its various sections. The official report of the Madrid meeting, in October 1924, of the Section of Terrestrial Magnetism and Electricity of the International Geodetic and Geophysical Union, has been issued as Bulletin No. 5 of the Section's publications. It supersedes an earlier report issued in December 1924. The contents are too varied to be detailed here, but, besides collecting opinions on many important points of organisation and observation important for the progress of the science, the bulletin affords a valuable medium for publishing reports at regular intervals of work proposed or accomplished in the different countries. The resolutions passed at the meeting, urging the necessity of establishing more magnetic observatories in high latitudes, or improving the equipment of existing observatories, have already borne fruit in one or two important cases.

WITH reference to the article on the Report of the Coal Commission which appeared in NATURE of March 20, p. 405, and to the statement therein that concealed coal could only be discovered as the result of the labours of the Geological Survey, Messrs. S. and J. Bailey, Princes Chambers, 6 Corporation Street, Birmingham, write to point out that the knowledge of the existence of much of this coal has been derived from boreholes put down by individuals at their own expense, which has often been very heavy, and in many cases has brought them in no return. The knowledge of geological structure thus obtained has often been of value to the Geological Survey. These statements are perfectly correct, but it is obvious that had there never been a Geological Survey of Great Britain, individuals would have had little or no incentive for boring and would not have known where to bore. It is precisely because the labours of geologists have in the first instance made clear the structure of the hidden portions of the earth's crust in Great Britain that boring for a concealed coalfield was rendered conceivable, let alone feasible.

THE Chemical Society of Japan has commenced the issue of a monthly Bulletin, of which we have received No. 1, vol. 1, January 1926. This development has been made possible by the presentation to the Society of a gift of money made to Prof. Ikeda to celebrate his sixtieth birthday. The publication contains short chemical papers and abstracts.

FOUR more sets of charming coloured illustrations on postcards, each set containing six cards with descriptive folder, have been issued by the Royal

Botanic Gardens, Kew (1s. per set). The set with rhododendrons and azaleas are very seasonable, as also two delightful series of illustrations of hardy trees and shrubs; the coloured reproduction of Japanese cherries flowering at Kew is particularly successful, but all these are extremely effective. The fourth set deals with stove and greenhouse plants.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A biochemist for the study of the nitrogen compounds in barley and their relation to malting—The Secretary, Institute of Brewing, Brewers' Hall, Addle Street, E.C.2 (April 14). A director of experiments at the Experimental Station of the Chemical Warfare Research Department, Porton—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S.W.1 (May 1). An investigator in the Metallurgical Department of the Royal Aircraft Establishment for work on the electrodeposition of metals—The Superintendent, R.A.E., South Farnborough, Hants (quoting A. 92). An analyst under the Air Ministry for duty in Irak—The Secretary, Air Ministry (W.B. 5), Kingsway, W.C.2.

Our Astronomical Column.

TWO FIREBALLS.—Mr. W. F. Denning writes: "On Saturday, March 20, at 6.45 P.M., when twilight was still strong and but few stars visible, a fine meteor passed from E. to W. over the south of England. It was observed by many persons, for the weather was generally clear and the flight of the object extended over about 290 miles. Reports of its appearance have come from Bampton near Oxford, Neath (Glam.), Bristol, Dartmoor, Stratton, Fowey (Cornwall), and Watford (Herts). The descriptions are not in good agreement, but they indicate a radiant point near the E.N.E. horizon. The luminous path of the object apparently extended from Kent to a region of the sea about 35 miles N. of Land's End. The height is not exactly determinable, but appears to have been lower than usual. The meteor traversed its lengthy course at a velocity of about 29 miles per second.

"On Sunday, March 21, at 8.13 P.M., a very large meteor was noticed from Bristol and other places in the west of England. It was a ball of fire which moved slowly amongst the stars of Taurus and Orion. At the end point it crumbled into pieces and died away amid thin white clouds in the S.W. sky. The radiant point was at 12° + 40° in Andromeda, and its height 65 to 29 miles; path, 90 miles; velocity, 23 miles per second. This meteor appears to have been noticed by very few persons who have troubled to describe its appearance."

COMETS.—There are at last some definite post-perihelion observations of Ensor's comet; they were obtained at Bergedorf observatory by A. Schwassmann and J. Stobbe. They gave exposures of 2½ hours with the Lippmann astrograph, and obtained images showing a tail half a degree long in position angle 250°, which is nearly at right angles to the line from sun to comet. The tail was forked at 20′ from what was taken to be the head, but as there was no trace of a nucleus it is difficult to know what point to select for measurement. The positions they give are:

	U.T.	R.A.	N. Decl.	Obs. *minus* Tab.		Mag.
March	16d 1h 12m	21h 47·9m	49° 6′	+0·2m	−3′	12
	20 19 5	22 23·0	59 20	+0·4	−3	13

The tail was fan-shaped, its angular opening being 10°. The rapid decline in light after perihelion was quite unexpected.

Comets Borrelly, Brooks, Tuttle, Orkisz, and Van Biesbroeck have also been photographed recently at Bergedorf observatory, which makes a speciality of observing faint comets. Comets Borrelly and Brooks have now been under observation for six months, so there is ample material for improving their orbits. Van Biesbroeck's comet continues to be an easy object though nearly six months from perihelion.

THE ECLIPSE OF ODYSSEUS.—Herr C. Schoch has written further about this eclipse, noting the corroborative facts that Homer's narrative states that the day in question was the day of new moon, and that the time of the darkness was somewhere in the neighbourhood of noon, agreeing with calculation, which gives 11h 41m A.M. local time. The prophet's words, "The sun is lost from the heaven, and evil darkness has come," certainly accord well with totality. Moreover, his tables, which were based on many ancient eclipses and occultations, place the northern part of Ithaca inside the track of totality. There was no other totality at Ithaca within 200 years.

Herr Schoch agrees with Dr. Fotheringham in the value used for the sun's acceleration, 2·64″ per century, but his other data are not quite the same; his centennial motion of the moon is 1″ greater than Fotheringham's. He claims that his values represent the occultations of the Almagest considerably better than Fotheringham's. He supposes that the Odyssey was written three or four centuries after the events described, but considers that the eclipse results make it probable that some trustworthy traditions of those events had come down.

A REMOTE STELLAR SYSTEM.—A study of that most interesting object N.G.C. 6822 is given by Hubble in the *Astrophysical Journal*, vol. 62, p. 409. This system is a very faint cluster, closely resembling in many ways the Magellanic Clouds, both in its constituent objects as well as in general appearance, though of course it is apparently much fainter and smaller than those Clouds. Throughout the two seasons of 1923 and 1924 it was carefully observed by the author, who has obtained some fifty negatives, as well as several spectrograms, with the great reflectors of the Mount Wilson Observatory. He has found fifteen variable stars in the cluster, eleven of which are Cepheids, and five diffuse nebulæ similar to those found in other systems. The period-luminosity law for the Cepheid variables is well shown, and a comparison with Shapley's curve indicates a distance for the cluster of 214,000 parsecs (about 700,000 light-years). This enormous distance shows that the cluster must lie far beyond the limits of the galactic system; but it is corroborated to some extent by a comparison of the cluster with the Magellanic Clouds, as regards angular dimensions, luminosities of the nebulæ and of the brightest stars. Shapley had previously made such comparison, and judged the distance of the cluster to be of the order of 1,000,000 light-years. The brightest stars present appear to be of absolute magnitude about −5·9, which is in satisfactory accordance with other isolated systems such as our own local cluster and the Magellanic Clouds.

Research Items.

ARCHÆOLOGY IN KENYA COLONY.—In the January number of the *Journal of the East Africa and Uganda Natural Historical Society*, Mr. G. W. B. Huntingford points out that while the antiquities of Kenya Colony provide a considerable amount of material for investigation, although it is confined to certain areas, very little attention has been paid to local archæology. The greater number of the antiquities occur in the districts of Uasin-Gishu and Nandi, with, it is believed, some in the Tanganyika territory. There are several classes of these antiquities, of which the more important are: (*a*) enclosures of stone or earth with double or single walls confined to Uasin-Gishu and not occurring in Nandi; (*b*) hut-circles occurring throughout the Eldoret area and with still more frequency in Nandi; and (*c*) pit-villages, groups of hut-circles usually earthen, some of which are even double or treble. In addition there are artificial mounds—at least two have been observed—a menhir on the summit of a hill on the western Nandi escarpment, and remains of 'roads' and irrigation canals and rows or low ridges which suggest graves. A number of 'finds' include pottery differing in character from the Nandi pottery, and a number of stone implements of various types. As regards the builders of the ruins, in the absence of excavation, no very convincing suggestion can be made, although it is clear that they were the predecessors of the present inhabitants of the area and possibly came from the north. The Sirikwa branch of the Uasin-Gishu Masai have been suggested, though certain considerations militate against this and point to these people having found the circles built when they came, while the Keyu (Elgeyo) tradition says the builders were a 'red' race, which may indicate a people of Libyan origin. There appears to be no connexion with the Zimbabwe culture, though the ruins may represent the early work of the Zimbabwe race.

ARCHÆOLOGICAL INVESTIGATIONS AT CHICHEN ITZA, YUCATAN.—Dr. Sylvanus G. Morley's report on Middle American archæological research in Year Book 24 of the Carnegie Institution, Washington, covers the operations of the year 1924, when the activities of the Institution were concentrated at Chichen Itza. The most extensive piece of work undertaken was the complete clearance of the Temple of the Warriors and its partial repair. This work was under the care of Mr. R. H. Morris, who furnishes a detailed report. This building, it now appears, was one of the most important in the whole city. It is second only to the Castello in size and exceeds it in wealth of sculptured decoration. The pyramid supporting the temple covers two-thirds of an acre and rises in four terraces or steps to a height of 37 feet above the paved level of the Group of the Thousand Columns. The three lower terraces have their cornices elaborately sculptured with men, eagles, jaguars, and another as yet unidentified animal with a woolly covering. These were originally painted in brilliant colours. The interior and exterior walls of the temple were also once brilliantly painted, but the collapse of the roof has wrought irreparable damage to the frescoes. Originally there were twenty-two painted and sculptured columns, of which two—feathered serpents—stood in the doorway. Against the back wall was a sculptured and painted altar supported by nineteen painted Atlantean figures. During the repair of the Astronomical Tower, which was undertaken to preserve from shifting the passage ways formerly serving as astronomical lines of sight, a hieroglyphic band was discovered. This gives a date now deciphered as 3 Imix 9 Yax, Tun 1, which is interpreted as A.D. 1280. Six lintels discovered, four at Chichen Itza and two from Yula, apparently coincide in their day of dedication—a Tun 13 ending on a day 1 Ahau—for which a probable date is A.D.1155.

CLIMATE AND PLANT DISTRIBUTION.—In a lecture delivered before the Royal Geographical Society on February 15, Dr. E. J. Salisbury discussed very fully the relation between the geographical distribution of plants and climatic factors. Although the effect of the various climatic factors upon plant growth is primarily one for investigation by the physiologist, yet the application of the results of these investigations must continue to remain the province of the ecologist or plant geographer, whose particular outlook must be much more influenced by the conception of competition as a factor of vital importance. Climate may delimit three zones in the distribution of a given plant, namely: a zone in which both abundant vegetative growth and reproduction are possible; a second zone, in which normal vegetative growth ensues but reproduction is possible only in exceptional seasons; a last zone, in which the plant may be cultivated but will not reproduce. To be of real use, plant distribution maps should, therefore, also indicate the relative abundance in different areas of the species under consideration. Dr. Salisbury also pleads for detailed maps showing the actual rainfall not corrected to mean sea-level, and for maps showing the seasonal distribution of rainfall.

INSECT PESTS IN AMERICAN AGRICULTURE.—The report for 1925 of the U.S. Bureau of Entomology, by Dr. L. O. Howard, the chief of that organisation, has recently come to hand. It forms a record of an enormous range of activities distributed over the whole of the United States. While the progress achieved in the control of the cotton boll weevil and gipsy moth, for example, is encouraging, there are certain other major pests that seem to defy all efforts to restrain them within bounds. The European corn borer is reported to have added nearly 9000 square miles to its area of infested territory during the year. It is hoped that the enactment of compulsory legislation providing for the cleaning up of infested fields will facilitate the repression of this pest. The discovery of the alfalfa weevil in eastern Wyoming marks the entry of that insect into the extensive alfalfa region of the Mississippi basin. The Mexican bean beetle is also continuing to spread rapidly in a northern direction, it having reached the shores of Lake Erie and extended its range in other States. The report is a striking testimony to the severity of the warfare between man and insects, and how the resources of an army of investigators are being employed to attack big problems from all points of view.

PLACENTATION IN LIZARDS.—Prof. Harrison and Miss Weekes (*Proc. Linn. Soc., N.S.W.*, vol. 1, pt. 4, 1925) give a preliminary account of their discovery of a true placenta in an Australian lizard, *Lygosoma entrecasteauxi*. Both omphaloplacenta and allantoplacenta are present. The former is in a state of regression but shows evidence of having been more actively functional at an earlier stage. The allantoplacenta comprises a uterine part, of vascular villous ridges with modified epithelium, and a fœtal part, with greatly modified chorionic ectoderm and a complex allantochorion. True placentation has already been recorded in other lizards, and the authors suggest that the occurrence of this condition in two not very closely allied genera such as Lygosoma in Australia and Chalcides in Europe indicates that the

allantoplacenta is a functional adaptation which may have arisen independently many times in evolution, and upon the mere occurrence of which phylogenetic statements cannot justifiably be based. A consideration of reptilian placentation as a whole leads the authors to suggest three stages of placentation, chorioplacenta, omphaloplacenta, and allantoplacenta, arising in that serial order both in ontogeny and phylogeny.

A FOSSIL BRANCHIOPOD.—Mr. D. J. Scourfield publishes in the *Philosophical Transactions of the Royal Society*, B, 415, 1926, an account of an extremely interesting branchiopod crustacean from the Rhynie chert bed of the Old Red Sandstone. The species, which he names *Lepidocaris rhyniensis*, is minute, not exceeding 3 mm. in length, and probably lived in water which was hot and strongly charged with silica, by which the specimens have been beautifully preserved. It has no carapace, and in many features resembles the Anostraca, but differs from them in certain important respects. On this account a new order, the Hipostraca, is created. There are apparently no paired eyes. The antennules are three jointed and the antennæ biramous swimming organs. The mouth parts resemble those of the Anostraca, save that to the maxillules (probably) there is attached, in the male, a large clasping organ. The first three pairs of trunk limbs are phyllopodia, resembling those of the Anostraca, but having the first endite replaced by two, of which the proximal resembles the gnathobase of the Conchostraca. The remainder of the trunk limbs are of a peculiar biramous type. Curious movable scales lie above the origin of the trunk limbs. The last three segments are limbless and are succeeded by a long telson which retains the primary furca of the larva together with the secondary furca.

FOSSIL FOOTPRINTS FROM THE GRAND CANYON.—An account has recently been published by Dr. Gilmore (*Smithsonian Miscellaneous Reports*, vol. 77, No. 9) of fossil footprints from the Grand Canyon. These occur in the Coconino sandstone of Permian age, and the 'fauna' is represented by eight genera and ten species of vertebrates and two of invertebrates. No other trace of the animals that made these footprints has as yet been discovered, and for the majority of them no attempt is made to connect them with any actual animals known from elsewhere. In two cases, however, the impressions suggest forms strongly suggestive of, in one case the light lizard-like Aræoscelis, and in the other the heavier Stegocephalian Cacops. In the absence of other criteria, these tracks have some value in the geological correlation of these deposits with similar track-bearing deposits elsewhere. Dr. Gilmore is returning to the Grand Canyon to continue his investigations.

SURVEY WORK IN THE UNITED STATES.—In his annual report for 1924–25, the Director of the United States Coast and Geodetic Survey records a great increase in the amount of hydrographical work accomplished, owing largely to the acquisition of several large modern and well-equipped vessels. In Alaskan waters, surveys have made great progress, both in the west and on the south-east coast. Other important surveys were made on the Oregon and Californian coasts, and revision work has been done on the Georgia and Florida coasts. The survey of the Virgin Island waters is nearly completed, and good progress has been made in the Hawaiian and Philippine coastal waters. Of the geodetic work of the survey, probably the most important was that carried out along the boundary between Canada and the United States to the west of Lake Superior, but a great deal of other work was successfully undertaken. The report is fully illustrated with large-scale maps showing the progress of all surveys.

POLAR FORM OF ETHYLENE LINKAGE.—Attempts to determine experimentally whether compounds containing the ethylene linkage exist in a polar form have been made by a quantitative study of the reaction with the Grignard reagent. The experiments by H. Gilman and J. M. Peterson are fully described in the *Journal of the American Chemical Society* for February. Under the conditions of the experiments, no active or polar forms appear to exist, or the active forms are present only in extremely small concentrations or are not sufficiently active to react with the Grignard reagent.

MELTING POINTS OF CALCIUM, BARIUM, AND STRONTIUM OXIDES.—Some trustworthy values for the melting points of barium, calcium, and strontium oxides are given in the *Journal of the American Chemical Society* for February by E. E. Schumacher. Samples from several different sources were heated electrically in a tungsten boat supported on molybdenum rods in pure hydrogen at 0·2 atmosphere pressure. A carefully standardised optical pyrometer was employed to read the temperatures. The results are: calcium oxide 2576° C., barium oxide 1923° C., and strontium oxide 2430° C.

EKA-IODINE AND EKA-CÆSIUM.—The possibility of the 'missing' elements of atomic numbers 85 and 87, eka-iodine and eka-cæsium respectively, occurring in a subsidiary disintegration series of one of the radioactive elements, is discussed in an interesting article by Prof. O. Hahn in *Die Naturwissenschaften* for February 26. The nature of the surrounding elements makes this very probable, although it is pointed out that since eka-iodine and eka-cæsium have odd atomic numbers, one would expect to find only very small quantities as compared with the proximate radioactive elements of even atomic numbers. Attempts to isolate an active cæsium from a highly active mesothorium preparation containing radium are described, but the results obtained were completely negative.

ELECTRIC SALT BATH FURNACES.—The Allgemeine Elektricitätsgesellschaft of Berlin publishes every month a journal in English called *A.E.G. Progress*, of interest to engineers. The January number discusses such subjects as the life and operating trustworthiness of turbo-generators, self-regulating dynamos, wind-electric installations, benzol locomotives, etc. We were particularly interested by an article on electric salt bath furnaces. In the A.E.G. hardening furnace, a bath of molten salt is connected across the secondary of a transformer. The bath itself acts as the resistance and secures a uniform distribution of heat. The furnace is used for annealing, hardening, tempering and surface hardening (carbonising). For hardening tools of high-speed steel it generates temperatures up to 1300° C. The regulation of temperature is done by simply altering the voltage applied to the transformer. A protective hood placed over the furnace protects the operator from the heat radiated. Three-phase power is used to operate it. Special mixtures of salts are generally used. For hardening high-speed steel the best salt to use is barium chloride, but for carbon steel it is better to use a mixture of barium and potassium chloride. A claim is made that an important saving is effected by the improved quality of the work and the certainty of the action of the furnace. In a South African mine, the plant employed is capable of dealing with 6000 drills in eight hours at a cost of about two shillings per 100 drills. Asbestos gloves and coloured glasses are used by the operators.

Santal Medicine.[1]

THE Santals are one of numerous aboriginal tribes inhabiting those hilly tracts of western Bengal that extend southwards from the Ganges into Chutia Nagpur. They are—or were—distinguished for their bravery, independence, and love of sport. It was of the Santals that an English magistrate, coming among them with an official experience limited to the low-lying eastern districts of Bengal, complained that they confused him by their obstinate adhesion to the simple truth, or, as his Bengali clerk is said to have expressed it, by their ignorance of the value of a lie. More than other untutored races do Santals live in dread and constant appeasement of malignant spirits, or *bongas*. So much do these *bongas* exclude the supreme but impassive good spirit from men's minds that the earliest European missionaries, seeking among the people for some native concept of the supernatural upon which to ingraft the theology and message of Christianity, are said to have based their first unhappy attempts upon a misconception of the nature of a *bonga*.

Santal medicine, like that of the vast mass of humankind, consists of superstition tinctured with *materia medica*; but from the memoir under review, one gathers that among the Santals the superstitious element, though much preponderant, is strangely logical. The supreme excellent spirit, Cando, desires that all Santals shall live to a good old age. He may, though slow to anger, visit the whole congregation with an overwhelming punishment such as famine, but the idea of slitting the individual thread by disease is not a part of his plan. Sickness must needs occur during the allotted span; but Cando has provided a sufficiency of herbs of powerful grace, which restore health. This being the ordained plan, it is useless to try to get it changed by individual supplications. For the given disease the given remedy is already provided in Nature: it may be a household remedy known to all men, or it may be known only to persons who have acquired an extensive knowledge of diseases and their appropriate treatments. The author states that there are among the Santals persons professing such knowledge, who treat the sick solely and simply under Cando's good providence, without invoking supernatural aid. Such persons he calls 'medicine men'; but if only they had received—as they have not—a professional training, they would come nearer our idea of an orthodox physician.

The true signification of 'medicine man' belongs rather to the *ojha*, a more pretentious person, who, while professing a knowledge of diseases and of natural remedies, professes also to have acquired, by special training and formal initiation, a knowledge of the supernatural which explains why the sick man does not recover, or recovers only to relapse. Serious menacing disease is due mainly to *bongas* and ancillary witches, and can be treated only by the *ojha* with perhaps the co-operation of the *ján* or witch-finder. The *bongas* can only do damage; they have neither the will nor the power to heal. They act not directly, but through human errors and through ubiquitous *tejos*, which, like microbes, exist in great numbers in the body—*e.g.* scabies, ringworm, leprosy, rabies, etc., are due to the activity of *tejos*. The witches also act indirectly, by secretly obstructing the efforts of the *ojha* to discover and appease the appropriate *bonga*.

The *ojha* is on familiar terms with the *bongas*. If by proper divinations, incantations (*muntars*), and sacrificial vows (*sakets*), he can get in touch with the responsible *bonga*, he may be able to appease it and can then apply his pharmacology. His attempts at communication with the *bonga* may, however, be obstructed or diverted by a witch, and then the assistance of a *ján* may be necessary. Witches, of course, are not treated by propitiatory methods—*tout au contraire*.

It is notorious that the beliefs of most of the aboriginal races of India have been modified—sometimes absorbed—by the circumambient insinuating Hinduism, and the Santal theory of disease is a good example of the process. As the author points out, the *ojha* with his *muntars* (Hind. *mantra*) and *sakets* (Hind. *sakht*), and the *ján* are of Hindu origin—their names bewray them. Among the *bongas*, too, there is a special contingent with Hindi names. The conclusion therefore seems obvious—although the author makes no explicit statements—that the remaining and more rational parts of the theory are indigenous, and that the Santals, with their characteristic commonsense, have made a remarkably sagacious setting of the heavy exotic superstitions.

This interesting memoir in this first instalment deals in minute detail with all the paraphernalia of superstition. A second instalment, treating of *materia medica* and medical treatment, is stated to be in the press.

[1] *Memoirs of the Asiatic Society of Bengal*, vol. 10, No. 1. "Studies in Santal Medicine and connected Folklore." By the Rev. P. O. Bodding. Part I. The Santals and Disease. Pp. vii+132. (Calcutta.) Rs. 5.1.

Egyptian Fisheries.[1]

NEARLY all the fisheries of Egypt lie within the territorial boundaries and are State owned. In 1924 they brought in to the Government the substantial income of some 83,000*l*.

There are three main sources from which the fish supply is drawn: (1) The Nile and inland waters, including basins and irrigation canals; (2) the Mediterranean and, to a small extent, the Red Sea; and (3) the Delta lakes. Of these three fisheries, that of the Delta lakes is by far the most important, yielding a yearly catch equal to two-thirds of the total fisheries. In the Mediterranean, Egypt possesses, in addition, very fine sponge beds within her territorial waters along the north coast of Africa, west of Alexandria.

Little information of scientific interest about the fisheries was available to the public up to 1919, except for the interesting chapter on nets and gear in use on the lakes and inland waters by Loat in Boulenger's "Fishes of the Nile." In 1919, however, the Coastguards and Fisheries Service, under the disciplinary control of which the fisheries now lie, secured the services of a scientific and technical assistant, Mr. G. W. Paget. From that date we received annually reports of great interest. In April 1924 the Government closed down the Fisheries Research Section.

Between these dates the mere economic value of such an office became apparent to any one reading the reports. Of outstanding interest was a large stocking experiment that has proved an unbounded success. Of the four Delta lakes—Menzaleh, Brullos, Edku, and Maryût—the first three are either permanently, or temporarily during the year, connected to the sea by narrow straits. This allows of the population of these waters by immense numbers of grey mullet, chiefly *Mugil cephalus* and *M. capito*,

[1] Report on the Fisheries of Egypt for the Year 1924. By Kaimakam G. Jenkins Bey. Coastguards and Fisheries Service. Ministry of Finance, Egypt. (Government Press, Cairo.) P.T. 5.

These fish, which form a very large percentage of the lake catches, migrate to the sea from the lakes to spawn. Where exactly the eggs are laid is not known, none having yet been certainly identified. As a result of the spawning, countless fry, under an inch in length, make their way back through the straits to the lakes, there to renew the stock, being attracted thither by the outflow of comparatively fresh water into the sea.

Lake Maryût, however, is at no time directly connected with the sea, the water-level being kept down by the action of immense pumps. The mullet fry are attracted by the outflow of fresh water flowing down the canal from the pumps into the sea; they swim up this canal, but their way into the lake is barred by the pumping-station. Consequently, the mullet fishery in this lake was negligible up to 1920. In that year Paget inaugurated stocking operations, whereby these fry were captured at the pumps and taken in a specially designed transport boat far out into the lake, where they were released. The following figures speak for the success of the operation. The number of fry introduced varies from year to year, but is in the neighbourhood of 30 millions. The actual lake-side weight of grey mullet caught rose from practically nil in 1920 to 223 tons with a lake-side value of £17,500*l.* in 1923, and to 406 tons in 1924, and is still rising. The actual cost of transport of the fry remains at about 350*l.* per annum. As a direct result of this experiment, Paget was further enabled to study accurately the rate of growth, under natural conditions, of the fish through three years, and to correlate growth with scale markings, with the advantage of knowing the size at which they were put into the lake. The closing of the Research Office prevented this interesting problem from being carried through the later years of the fish's life.

It is at any rate gratifying to note in the 1924 report, compiled by Kaimakam Jenkins Bey of the administrative staff, that attempts are being made to continue stocking the lake and also that other schemes of a somewhat similar nature, designed to improve the fisheries of the lakes and inland waters generally, that Paget had planned, are now being put in action. Amongst these is a method of driving, by means of fine-meshed nets, thousands of young fish into the main waters of the Nile from flooded areas that dry up in the heat of the summer, thus causing much waste of fish life.

A further source of valuable information to the Government was a survey of the sponge beds along the north coast of Africa, made in 1919. These beds, up to 1915, had been exploited by nomadic Greeks, who took their catches home with them. From that date until 1920 the fishery lapsed on account of the War. The 1919 survey provided a basis for determining to what extent the beds will bear fishing without producing effects that may be harmful to the crops of future years. The fishery is now run on an economically sound basis and is put up to auction each season by the Government, the fishing fleet being licensed and their catches inspected at regular intervals.

It is surely false economy for a Government to dispense with an office, in no wise costly, that renders such signal service. It is, however, perhaps a promise of better things in the future to read the following passage in a covering letter to the 1924 report:

"For motives of economy the Fisheries Research Section was closed down in April 1924 and the service of the Staff dispensed with, consequently no improvement in the conditions of the industry can be expected in the future except through natural causes until such time as the situation allows for the re-establishment of the Research Section, to study local conditions, to make scientific observations and to conduct experiments with a view to increasing the fish supply and to recommend methods for preventing the destruction of immature fish." F. S. R.

Peat in the British Isles.

A PAPER not without importance in its application to one aspect of afforestation work in Great Britain and Ireland appears in the *Empire Forestry Journal* (vol. 4, No. 2, 1925). This paper bears the title "Types of Peat and their Connexion with Afforestation," and is by Mr. A. C. Forbes, Director of Forestry, Irish Free State. The problem of afforesting peat lands has been the subject of experiment for a considerable period of years in various parts of Europe, and in the British Isles two notable examples exist. The opinions of experts in this branch, based on experimental work, can scarcely be said to have been unanimous.

Mr. Forbes' paper is of value on one count, since he directs attention to the fact that the term 'peat' as used in the past has resulted in considerable confusion, and as a consequence the values of experiments undertaken have become either misleading or altogether useless for other regions or countries. The author roughly classifies what he terms 'peats proper' into five classes: (1) Turf peat, (2) heath peat, (3) mountain peat, (4) sphagnum peat, and (5) marsh peat. He shows that, so far as the bulk of the peat areas which may be of importance for afforestation purposes in the British Isles are concerned, the mountain peat is the most important. Forbes says that the confusion arising in the past, especially in connexion with German literature, has been occasioned by endeavouring to apply experiments which have proved satisfactory in the case of marsh peat to the other types of peat of his classification. "Mountain peat," he says, "is developed under humid conditions and usually at high elevations. Owing to the climatic conditions being favourable to sphagnum development, mountain peat accumulates faster and attains a greater thickness than heath peat, and may often terminate in pure sphagnum, the lower layers of which solidify, and cut off the connexion between the soil water and the surface." Mountain peat extends down to sea-level on the west coast of Ireland and Scotland and in Somerset and Devon not much below 1500 ft. The author hazards the statement that there may be no less than 10,000,000 acres covered with peat in Great Britain and Ireland. The two examples of attempts to plant mountain peat on any scale were at Knockboy, County Galway, which was a failure, and the classic work carried out by Sir John Stirling Maxwell at Corrour, a high-lying valley on the Moor of Rannoch, which is considered to be a partial success.

The author puts forward his term of 'mountain peat' with an apology, and states that 'tundra' might be a better term, though a word seldom used in the English language. The word 'tundra,' however, is essentially applied to the great marshy and peaty wastes in North Russia and elsewhere. These by the author's own showing fall under his (5) marsh peats. The term 'tundra' would therefore be misapplied to the mountain peat.

University and Educational Intelligence.

ABERDEEN.—The Senatus Academicus has appointed Dr. J. L. McIntyre, lecturer on comparative psychology, a member of the Faculty of Arts.

At the Spring Graduation the honorary degree of LL.D. was conferred on Dr. R. W. Reid, emeritus professor of anatomy in the University. The following doctorates were conferred: D.Sc. on Mr. J. M. Henderson for a thesis on "The Influence of Ultra-Violet Light on the Mineral Metabolism of Growth and Lactation"; Ph.D. on Mr. W. M. Dickie for a thesis entitled "The Scientific Method and Achievement of Aristotle and Bacon"; and on Mr. F. C. Kelly for a thesis entitled "The Role of Iodine in Nutrition."

The Vice-Chancellor announced bequests amounting to about 25,000*l.*, bringing the total addition to the endowments of the University since the War to more than 200,000*l.*

EDINBURGH.—Prof. P. S. Lelean has taken up duty as professor of public health.

Principal Ernest Shearer, of the Edinburgh and East of Scotland College of Agriculture, has been appointed professor of agriculture in the University in succession to Prof. J. A. S. Watson, now of Oxford. This appointment, which is the outcome of negotiations between the University and the College authorities, will lead to a more intimate relationship between the two Departments.

LONDON.—Prof. L. Dudley Stamp has been appointed as from August 1 to the Sir Ernest Cassel readership in economic geography tenable at the London School of Economics. During the latter part of the time Prof. Dudley Stamp was on war service, he carried out extensive research work on the ancient geography of north-west Europe, for which he was awarded the Gosselet Medal and Diploma by the Société des Sciences (University of Lille). From 1921 until 1922 he was geological adviser to oil companies in Burma, and since 1923 he has been professor of geography and geology in the University of Rangoon. His published work includes "An Introduction to Stratigraphy" (1923) and numerous papers in the geological periodicals.

Mr. R. B. Forrester has been appointed as from August 1 to the Sir Ernest Cassel readership in foreign trade tenable at the London School of Economics. Mr. Forrester was formerly a lecturer in commerce at the School. In 1925 he published a Report on "Large Scale Co-operative Marketing in the U.S.A." (Ministry of Agriculture Economic Reports, No. 4). He is recorder to Section F (Economics and Statistics) of the British Association.

It has been resolved to institute an Academic Diploma in Anthropology.

APPLICATIONS are invited for two Ramsay Memorial Fellowships for chemical research—one for candidates educated in Glasgow—each of the annual value of 250*l.*, plus a possible further sum of not more than 50*l.* a year for expenses. The tenure of the fellowships is normally two years, but an extension to a third year is permissible. The latest date for the receipt of applications, which should be sent to the Secretary of the Ramsay Memorial Fellowships Trust, University College, Gower Street, W.C.1, is June 5.

APPLICATIONS are invited by the Royal College of Physicians of Edinburgh for the Dr. Jessie Macgregor prize in medical science, value 63*l.* and open to medical women who are graduates in medicine of the University of Edinburgh, or who have taken the triple qualification, and who, before becoming qualified, have studied medicine for at least one year in Edinburgh. The latest date for the receipt of applications, by the Convener of Trustees, the Royal College of Physicians, Edinburgh, is June 30.

THE Rose Research Fellowship in lymphadenoma, at St. Bartholomew's Hospital, the annual value of which is 600*l.*, plus expenses, will shortly be awarded. The research will be carried out at the Hospital under the direction of the professor of pathology, and the fellowship may be tenable, under annual re-election, for a period of four years. Further information may be obtained personally from the professor of pathology, St. Bartholomew's Hospital, London, E.C.1, to whom applications should be sent by April 21.

SECONDARY education in the United States is developing along lines which point to its extension both upwards and downwards by undertaking, on one hand, the first two years' work of the hitherto normal four-years' college curriculum and, on the other hand, the seventh and eighth years' work of the elementary schools. California led the way in what is known as the 'junior college' movement, and has been followed by Illinois, Michigan, Minnesota, Missouri, Texas, and other States. Owing partly to these developments, but still more to the remarkable increase during the past five and twenty years in the number of their pupils (from 9·5 to 23 per thousand of population), the problems presented by the secondary schools in the United States to-day are many and complex. To stimulate, initiate, aid, and co-ordinate their investigation, a "National Committee on Research in Secondary Education" has recently been established in close relationship with the Bureau of Education. The chairman is J. B. Edmonson, professor of secondary education of the University of Michigan, and the secretary is E. E. Windes, a member of the staff of the United States Commissioner of Education.

THE Government has decided to offer the Bloomsbuy site, purchased five years ago for the University of London, to the vendor, the Duke of Bedford, on the ground that "no effective scheme for the utilization of the site" has matured. The Vice-Chancellor (Prof. E. A. Gardner) has issued a memorandum, the object of which is to show "how little the University can be blamed for being either dilatory or vacillating." The Vice-Chancellor states that "the movement of King's College from its existing site in the Strand to Bloomsbury was an absolute condition of the offer." On this question, it may be said, opinion is not unanimous, and it is significant that the establishment of King's College on the site was not made a condition in the agreement between the Duke of Bedford and the Government. It is true that Mr. Fisher's offer of April 7, 1920, was accepted by the Senate on October 20, 1920, but this acceptance was subject to onerous conditions. The existence of cross-currents is also indicated by the fact that so late as October 1925 the Senate informed the Government that the question of increased accommodation at the Imperial Institute was a matter of great urgency. It may be admitted, however, that if the removal of King's College was an absolute condition of the offer of the Bloomsbury site, the delay which has occurred can be readily understood. The Vice-Chancellor states at the end of his memorandum that "it is clear that the site can be effectively used for 'University and College buildings in connection with the University of London' within the much wider terms of the agreement between the Government and the Duke of Bedford. . . . If this area is now lost to education, it or more expensive land in the same neighbourhood or near by will have to be acquired again later, bit by bit, by the University or its Colleges." We may surmise that if the University in 1920 had spoken in these clear ringing tones the course of the negotiations with the Government might have taken a different turn.

Contemporary Birthdays.

April 1, 1874. The Rt. Rev. E. W. Barnes, F.R.S., Bishop of Birmingham.
April 2, 1853. Prof. P. Phillips Bedson.
April 3, 1846. Dr. B. Daydon Jackson.
April 4, 1852. Prof. Arthur P. Coleman, F.R.S.
April 5, 1849. Prof. George Forbes, F.R.S.
April 5, 1865. Sir John Bretland Farmer, F.R.S.
April 6, 1864. Sir William Bate Hardy, F.R.S.
April 8, 1859. Mr. George William Lamplugh, F.R.S.
April 8, 1861. Prof. J. R. Ainsworth-Davis.

Dr. Barnes, Bishop of Birmingham, was educated at King Edward's Grammar School, Birmingham, and Trinity College, Cambridge. Wrangler and second Smith's prizeman, he was ordained in 1902, becoming in the same year an assistant tutor at Trinity in mathematics; afterwards (1908–15) he was tutor. From 1915 until 1919 Dr. Barnes was Master of the Temple.

Dr. Bedson, emeritus professor of chemistry in Durham College of Science, was educated at Fairfield School, Manchester, at the Grammar School there, and at Owens College. He also studied at the University of Bonn.

Dr. Daydon Jackson is a Londoner. General Secretary of the Linnean Society since 1902, he is perhaps best known to botanists through his close association with the preparation and issue of the *Index Kewensis*. He is responsible for many useful works for botanical students, notably "A Guide to the Literature of Botany" (1881); and "A Glossary of Botanic Terms" (1916).

Dr. Coleman, emeritus professor of geology in the University of Toronto, was educated at the Victoria University, Cobourg, Canada, and at the University of Breslau. At the former he was (1881–90) professor of geology and natural history. He was geologist to the Bureau of Mines of Ontario, 1893–1909, accomplishing highly important work. Murchison medallist of the Geological Society of London, he has added largely to knowledge of the history of the stratified systems and of the igneous rocks of Canada. Dr. Coleman was president of Section C (Geology) of the British Association at the Sheffield meeting (1910).

Prof. George Forbes was educated at the Universities of St. Andrews and Cambridge. He is a Chevalier of the Legion of Honour of France. Sometime professor of natural philosophy in Anderson's College, Glasgow, he afterwards devoted himself to electrical projects. Prof. Forbes was electrical engineer for the first series of installations at Niagara Falls, 1891–95.

Sir John Farmer, professor of botany in the Imperial College of Science and Technology, graduated at Magdalen College, Oxford. He is a member of the Advisory Council of the Department of Scientific and Industrial Research. In 1919 he received a Royal medal from the Royal Society for his researches in the cytology and anatomy of plants.

Sir William Hardy was born at Erdington. He received his education at Framlingham College and Gonville and Caius College, Cambridge. After some years' service, he retired last year from office as one of the secretaries of the Royal Society.

Mr. Lamplugh was born at Driffield, East Yorkshire. He joined the Geological Survey of Great Britain in 1901, becoming Assistant Director, 1914–20. He is a past president of the Geological Society.

Societies and Academies.

London.

Royal Society, March 25.—E. B. **Verney**: The secretion of pituitrin in mammals, as shown by perfusion of the isolated kidney of the dog. When the head and neck of a dog are switched into perfusion-parallel with the isolated kidney, the blood picks up during its passage through the head and neck a substance or substances which inhibit the polyuria of the isolated kidney, augment the urinary chloride output percentually, or sometimes absolutely, and diminish the renal blood flow. This result is still obtained after previous exposure of the pituitary body. It does not occur as the result of perfusing the pelvis and lower limbs in parallel with the kidney. Previous removal of the pituitary body abolishes the reaction. An antidiuretic, chloride-augmenting, and vaso-constrictor principle or principles are contributed by the pituitary body to blood during its passage through the head of a dog.—H. W. **Florey** and H. M. **Carleton**: Rouget cells and their function. Capillaries in cat's mesentery have been studied by a method which enables blood-vessels to be selectively stained by intra-arterial injection of fixative and stain. Morphologically definable Rouget cells cannot be identified. *In vivo*, capillaries reacted to mechanical stimuli and particularly to the action of histamine and pituitrin. While capillaries are capable of actively expanding and contracting, their motor activities reside, not in Rouget cells, but in the endothelial elements.—R. M. **Sargent**: The relation between oxygen requirement and speed in running. A modification is described of the usual method of determining energy expenditure during running. The subject does not wear a mouthpiece, or carry a Douglas bag, and the exercise can take place under natural conditions. The results show actual energy expenditure and that involved in 'start' and in 'pull-up.' For the subject of these experiments to run 120 yards in 13 seconds necessitated an energy expenditure equivalent to an oxygen requirement of 29 litres per minute, or to 13·7 horse-power. There is extreme energy cost for rapid and vigorous exercise of short duration. An approximate means of allowing for energy utilised in 'start' and in 'pull-up' is adopted. Then the general relation between speed in running and oxygen requirement is: Oxygen requirement per 120 yards increases about as the 2·8th power of speed. Oxygen requirement per minute increases approximately as the 3·8th power of speed. The calculated optimum performances agree well with those actually recorded (or estimated) by the subject, over the range 300 yards to 2 miles.—Seana **King**: Oogenesis in *Oniscus Asellus*.—J. L. **Synge**: On the geometry of dynamics. The representation of configurations by points of multi-dimensional Riemannian space has been used hitherto to discuss certain aspects only of classical dynamical theory. In the present paper, tensor notation is used throughout, and to the advantages of this notation the novel results are due. Parallel discussions are given corresponding to two line-elements — the 'kinematical' line-element, $ds^2 = 2\mathrm{T}dt^2 = a_{mn}dq^m dq^n$, and the 'action' line-element, $ds^2 = 2(h-\mathrm{V})\,\mathrm{T}dt^2 = (h-\mathrm{V})\,a_{mn}dq^m dq^n$. The laws of motion are discussed, leading to a generalisation of Bonnet's theorem on particle orbits and a geometrical elucidation of the Principle of Least Curvature. A completely determinate form of the Lagrangian equations for non-holonomic systems is developed. Necessary and sufficient conditions are obtained for the admissibility of (N − 1) ignorable co-ordinates in a system with N degrees of freedom. From an invariant geometrical definition of stability

three special types of particular dynamical importance are selected. A new definition of steady motion is given. The system of normals to a curve, originally defined by Blaschke, plays a fundamental part.—P. E. **Shaw** and C. S. **Jex**: Tribo-electricity and friction.—H. G. de **Laszlo**: The absorption-spectra of some naphthalene derivatives in vapour and solution. The ultra-violet absorption spectra of mono-derivatives of naphthalene containing the groups CH_3, Cl, Br, OH, COOH, CN, and NH_2, were measured in vapour and in hexane solution. The β-isomer spectra are more like that of naphthalene than the α spectra. All were shifted towards the red when compared with naphthalene by an amount which is of the same order in the case of naphthalene and benzene derivatives containing the same group. The solution spectra are always shifted towards the red when compared with the vapour. This shift varies with the group, suggesting a modified "Stark effect" when the dipolar molecules are in the strong electric field of the solvent. The bands of most of the bodies examined have been ranged in simple series. These periodicities, representing the atomic oscillations, are all smaller than that of the parent body and appear again in the infra-red.—O. **Maass** and W. H. **Barnes**: Some thermal constants of solid and liquid carbon dioxide.—R. H. **Fowler** and D. R. **Hartree**: An interpretation of the spectrum of ionised oxygen (O II). The terms of the O II spectrum deduced from the observed lines by A. Fowler are correlated with theoretical terms expected on the theory of complex spectra developed by Heisenberg and Hund. The general agreement is satisfactory. No lines involving the deepest-lying terms have yet been identified, but from consideration of the O I spectrum it appears likely that the normal term of the O II spectrum is a quartet *S* term.—G. C. **Simpson**: On lightning. The conducting channel of a lightning flash originates in the region of maximum electric field and develops only in the direction of the seat of negative electricity. A negatively charged cloud can only be discharged by a discharge originating in a positively charged cloud, or in the induced positive charge on the earth's surface. A positively charged cloud may be discharged by discharges starting in the cloud and terminating either in the surrounding air or on the earth's surface. If a lightning flash is branched, the branches are always directed towards the seat of negative electricity. The application of these conclusions to 442 photographs of lightning discharges reveals the fact that the majority of lower clouds from which discharges proceed are positively charged.

Geological Society, February 19.—J. W. **Evans**: Regions of compression (Anniversary address). The characteristic structures of regions of compression—folding, thrust-faulting and slaty cleavage—are, as a rule, the result of horizontal forces ultimately to be attributed to the contraction of the earth's interior as it cools. It has been doubted whether, with the energy released by radioactive elements, the earth cools at all. The whole of that energy, however, is not converted into heat; much must be employed in effecting physical, chemical, or atomic changes in the surrounding rock. Jeffreys shows that the contraction on cooling of the crystallised rocks is more than enough to account for the folding of existing mountains. But there are many folds of ancient mountains, now worn down, which would require still more contraction. This may have occurred in the following ways: (1) the contraction of uncrystallised magma retaining the volatile constituents is greater than that of crystallised rocks; (2) the contraction on crystallisation is equal to that on a big fall of temperature; (3) contraction may take place on changes of crystal-structure, chemical composition, or even atomic nature; (4) it will result from the loss of volatile constituents; and (5) it must follow on the increase of pressure in the earth's interior due to the slowing down of its rotation. On the other hand, the extent of the crust may be locally increased in periods of tension by (1) infilling of rifts by igneous intrusions, and (2) slip-faulting; and also by hydration of rocks. Compression and folding may also result (1) from change in the earth's form on diminished rotation; (2) from change in the position of the crust relatively to (*a*) the poles and equator, (*b*) the maximum of gravitational force. In illustration of the process of folding, two examples are described: (1) the 'Hercynian,' or 'Armorican,' folding of the south-western peninsula of England and south Wales; and (2) the Wealden folding between the Thames Valley and the 'Massif Central' of France.

Physical Society, February 26.—J. E. **Calthrop**: The effects of torsion upon the thermal and electrical conductivities of aluminium, with special reference to single crystals. An attempt has been made to find the changes produced by torsion in the conductivities of single aluminium crystals, and of the annealed and hard aluminium wires from which the crystals are prepared. The hard wire gave a decrease of a few parts in a thousand in the thermal conductivity, but no change greater than one part in 1000 has been found in crystal wires. The decreases in the electrical conductivities, of the order of a few parts in 10,000, appear to be almost the same for all specimens.—T. H. **Harrison**: A study of the concurrent variations in the thermionic and photo-electric emission from platinum and tungsten with the state of the surfaces of these metals. The thermionic and photo-electric work functions for the same specimens of tungsten and platinum depend greatly on the previous heat treatment of the material. For platinum the curves showing the dependence of photo-electric sensibility on the wave-length of the irradiation are of four different types, while as regards thermionic properties the specimens can take up either a 'large-emission' or a 'small-emission' state, according to their treatment. The photo-electric work function of platinum appears to be greater than the thermionic, but no definite results were obtained for tungsten. The photo-electric curves obtained for both metals extended asymptotically towards zero emission in the direction of increasing wave-length. The irregularities in behaviour are attributed to the state of the surface of the specimens.

Royal Statistical Society, March 16.—Major P. G. **Edge**: The growth of mortality due to motor vehicles in England and Wales, 1904-23. In 1904 171 deaths caused by motor traffic were recorded in England and Wales; by 1923 this figure had grown to 2414. During the period 1904-23, while the mortality rate due to all causes had diminished by more than 11 per cent., the mortality caused by motor traffic had increased by approximately 1000 per cent. In London the figures for 1904 and 1925 were 24 and 595 respectively. The general mortality rate in London was 30 per cent. lower in 1923 than in 1904, while motor fatalities increased by more than 2000 per cent. Motor-vans are responsible for more than their share of fatal accidents. Driving licences should only be issued after a serious test of proficiency, and vehicles should be compulsorily insured. Lack of road sense and responsibility are more frequent factors of accidents among commercial vehicles than among owner-drivers.

Official Publications Received.

Dacca University Bulletins. No. 4: Eastern Humanism; an Address delivered in the University of Dacca. By Prof. Sylvain Levi. Pp. 9. (Dacca: The University; London: Oxford University Press.) 8 annas; 8*d*.

The Engineer Directory and Buyers' Guide, 1926. Pp. 260. (London: 33 Norfolk Street, W.C.2.)

Calendario della Basilica Pontificia del Santissimo Rosario in Valle di Pompei per l' anno 1926. Pp. 240. (Valle di Pompei.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 59 (Botanical Section): Hypertrophied Lenticels on the Roots of Cotton Plants. By James Templeton. Pp. 8+6 plates. (Cairo: Government Publications Office.) 5 P.T.

Air Ministry: Meteorological Office, London. Southport Auxiliary Observatory (The Fernley Observatory of the Corporation of Southport). Annual Report, and Results of Meteorological Observations, for the Year 1924; with an Appendix containing particulars of the principal Periodic Terms found in Southport Rainfall by the application of Harmonic Analysis. By Joseph Baxendell. Pp. 28. (Southport: Fernley Observatory; London: Meteorological Office.)

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 21: Health and Physique of School Children. By Dr. James Frederick Rogers. Pp. 16. 10 cents. Bulletin, 1925, No. 23: Statistics of Private High Schools and Academies, 1923–24. Pp. 37. 5 cents. Bulletin, 1925, No. 27: Some recent Movements in City School Systems. By W. S. Deffenbaugh. Pp. 22. 5 cents. Bulletin, 1925, No. 30: Parent-Teacher Associations at Work. By Ellen C. Lombard. Pp. 15. 5 cents. Bulletin, 1925, No. 32: Agricultural Education. By George A. Works. Pp. 11. 5 cents. School Health Studies, No. 10: Progress and Prospect in School Health Work. Pp. iv+54. 5 cents. (Washington, D.C.: Government Printing Office.)

Library of Congress. Report of the Librarian of Congress for the Fiscal Year ending June 30, 1925. Pp. xi+309+4 plates. (Washington, D.C.: Government Printing Office.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 309: Triangulation in Maryland. By Hugh C. Mitchell. (Special Publication No. 114.) Pp. vi+603+28 plates. (Washington, D.C.: Government Printing Office.) 1 dollar.

Department of the Interior: U.S. Geological Survey. Forty-sixth Annual Report of the Director of the Geological Survey to the Secretary of the Interior for the Fiscal Year ended June 30, 1925. Pp. ii+91. Bulletin 777: Pre-Cambrian Rocks of Gunnison River, Colorado. By J. Fred Hunter. Pp. vi+94+15 plates. Bulletin 778: Chemistry of Deposition of Native Copper from Ascending Solutions. By Roger C. Wells. Pp. ii+71. 15 cents. (Washington, D.C.: Government Printing Office.)

Classified List of Publications of the Carnegie Institution of Washington. Pp. 220. (Washington, D.C.: Carnegie Institution.)

Smithsonian Miscellaneous Collections. Vol. 77, No. 8: The Morphology of Insect Sense Organs and the Sensory Nervous System. By R. E. Snodgrass. (Publication 2831.) Pp. 80. (Washington, D.C.: Smithsonian Institution.)

United States Department of Agriculture. Separate from Yearbook 1924, No. 918: Weather and Agriculture. By A. J. Henry, J. B. Kincer, H. C. Frankenfield and W. R. Gregg, B. B. Smith and E. N. Munns. Pp. 457-558. (Washington, D.C.: Government Printing Office.) 20 cents.

Seale-Hayne Agricultural College, Newton Abbot, Devon: Department of Plant Pathology. Second Annual Report for the Year ending September 30th, 1925. (Pamphlet No. 19.) Pp. 32. (Newton Abbot.)

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 19: Statistics of Land-Grant Colleges, Year ended June 30, 1923. By Walter J. Greenleaf. Pp. v+51. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the Lake Superior Mining Institute, Twenty-fourth Annual Meeting (Marquette Range) held at Ishpeming and Sault Ste. Marie, August 13 and 14, 1925. Vol. 24. Pp. xxx+374. (Ishpeming, Mich.)

Transactions of the Geological Society of South Africa. Vol. 28, January to December 1925: Containing the Papers read during 1925. Pp. iv+178+15 plates. (Johannesburg: Geological Society of South Africa; London: Wheldon and Wesley, Ltd.) 42*s*.

Proceedings of the Geological Society of South Africa. Containing the Minutes of Meetings and the Discussions on Papers read during 1925. To accompany Vol. 28 of the Transactions, January–December 1925. Pp. iii+1. (Johannesburg: Geological Society of South Africa; London: Wheldon and Wesley, Ltd.)

Botanical Survey of South Africa. Memoir No. 8: Researches on the Vegetation of Natal. Series 2, including Accounts of Investigations on (i) The Water Relations of some Natal Plants, with special reference to the Leaves of *Ptaeroxylon utile* and *Portulacaria afra*; (ii) The Water-retaining Capacity of certain Woods in relation to their Microscopic Structure; (iii) The Water Requirement and Transpiration of a common Natal Weed, *Bidens pilosa* (L.). By Dr. J. W. Bews and Dr. R. D. Aitken. Pp. 65. (Pretoria: Government Printing and Stationery Office.)

Board of Education. Report of the Departmental Committee on the University of London. (Cmd. 2612.) Pp. 76. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

Irish Agricultural Organisation Society, Ltd.: Butter Control Scheme. A Creamery Survey. By James Cullen. Pp. 31. (Dublin: Plunkett House, Merrion Square.) 1*s*.

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 14, No. 1, March. Pp. 238. (Plymouth: Marine Biological Association; London: Dulau and Co., Ltd.) 7*s*. net.

Transactions and Proceedings of the Perthshire Society of Natural Science. Vol. 8, Part 2, 1924-25. Pp. 17-118+plates 5-17+xvii-xxviii. (Perth.)

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 55, July to December 1925. Pp. xii+199-490+20+37+plates 23-40. (London: Royal Anthropological Institute.) 15*s*. net.

Quarterly Journal of the Royal Meteorological Society. Vol. 52, No. 217, January. Pp. 126. (London: Edward Stanford, Ltd.) 7*s*. 6*d*.

Annual Report of the Meteorological Observatory of the Government-General of Tyôsen for the Year 1922. Pp. v+148. (Zinsen.)

Report of the Rugby School Natural History Society for the Year 1925. Pp. 54. (Rugby.)

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 2, No. 8: Scottish Drumlins. By Prof. J. W. Gregory. Pp. 433-440+1 plate. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1*s*. 6*d*.

Proceedings of the Royal Society of Edinburgh, Session 1925–1926. Vol. 46, Part 1, No. 11: The Intermittence of Electric Force. By Sir J. J. Thomson. Pp. 90-115. 2*s*. 6*d*. Vol. 46, Part 1, No. 12: On the Adjustment of Sir J. J. Thomson's Theory of Light to the Classical Electromagnetic Theory. By Prof. E. T. Whittaker. Pp. 116-125. 1*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Diary of Societies.

SATURDAY, APRIL 3.

SCOTTISH JUNIOR GAS ASSOCIATION (Annual Meeting) (at Royal Technical College, Glasgow), at 7.—Prof. T. Gray: Address.

TUESDAY, APRIL 6.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—W. J. Williams: Technical Education in relation to Industry.

WEDNESDAY, APRIL 7.

INSTITUTION OF AUTOMOBILE ENGINEERS (Derby Graduates' Meeting) (at Cavendish Café, Derby), at 7.30.—A. A. Rubbra: Problems of the High-speed Optical Indicator.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—H. Droop Richmond and J. A. Eggleston: The Analysis of Acetic Anhydride.—H. Droop Richmond and E. H. England: The Analysis of Glacial Acetic Acid.—Dr. J. F. Tocher: (*a*) Errors of Personal Judgment in Chemical Work; (*b*) Results of Further Work on Variations in the Composition of Milk.—E. R. Bolton and K. A. Williams: A Test for Tung Oil.

THURSDAY, APRIL 8.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—S. Mavor: The Applications of Machinery at the Coal Face.—L. Miller: The Design of Storage-Battery Locomotives for use in Coal Mines.—R. Nelson: Electricity in Mines: A Short Survey.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Marchesse De Pinedo: A 35,000 Miles Flight.

INSTITUTION OF STRUCTURAL ENGINEERS, at 7.30.—E. S. Andrews: The Production of Structural Steel Sections.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 8 St. Martin's Place, W.C.), at 8.—Dr. A. P. Laurie: The Optical Properties of Linseed Oil.

SOCIETY OF DYERS AND COLOURISTS (Bradford Junior Branch).—C. O. Clark: The Proofing of Textiles against Insect Pests by means of Eulan.

FRIDAY, APRIL 9.

ROYAL SANITARY INSTITUTE (in Town Hall, Weston-super-Mare), at 11 A.M.—The Rôle of Different Agencies in the Improvement of the Milk Supply:—Dr. W. G. Savage: The Bacteriological Laboratory.—W. S. Stevens: The Veterinary Surgeon.—H. R. Day: The Milk Inspector.—J. W. Dallas: The Agricultural Institute.—P. B. Tustin: The Large Scale Distributor and the Consumer.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.30.—W. A. Tookey: Industrial Tests on Internal Combustion Engines.

ROYAL ASTRONOMICAL SOCIETY, at 5.—J. M. Reesinck: Note on the Radiation of a Pulsating Star.—S. A. Mitchell and H. L. Alden: The Photometric Scale of the Leander McCormick Observatory.—(The late) E. E. Barnard: Visual Observations of the Brightness of Nova Persei No. 2 (Anderson 1901).—S. A. Mitchell and H. L. Alden: Observations of Nova Persei (1901) made with the 26-inch Refractor of the Leander McCormack Observatory.—Dr. J. K. Fotheringham: Precession, Galactic Rotation, and Equinox Correction.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Annual Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at St. Mary's Parsonage, Manchester), at 7.—Prof. R. V. Wheeler: The Constitution of Coal.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—S. Hazzledine Warren: The Preservation of Fragile Remains.—F. H. Worsfold: An Examination of the Contents of the Brick-Earths of Tankerton Bay, Kent.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—T. E. Dimbleby: Modern Methods of Cast Iron Pipe Manufacture.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 7.30.—W. S. Burn: High Powered Oil Engines.

INSTITUTE OF METALS (Sheffield Section) (at Sheffield University), at 7.30.—R. T. Rolfe: Bronze.

PHILOLOGICAL SOCIETY (at University College), at 8.—English Dialect Society and Dictionary.

SATURDAY, APRIL 10.

MINING INSTITUTE OF SCOTLAND (at Glasgow).

INTERNATIONAL MEETING.

APRIL 16 TO 20.

INTERNATIONAL SOCIETY OF MEDICAL HYDROLOGY (Annual Meeting will be held in Czecho-Slovakia). (Particulars from Dr. E. P. Poulton, at 36 Devonshire Place, W.1.)

CONGRESS.

APRIL 2 TO 23.

JERUSALEM AND BEIRUT, INTERNATIONAL ARCHÆOLOGICAL CONGRESS.