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Scientific Research and Tropical Development.

IN the three previous reports on the Colonies for which he was either wholly or partly responsible, Mr. Ormsby-Gore had perforce to deal at length with constitutional and political issues, questions of land tenure and other land problems, and labour problems. But the constitution of British Malaya is not at present a subject of controversy ; the constitutional and political problems of Ceylon have been dealt with specifically by the Donoughmore Commission ; and the constitution of Java, a Dutch Colony, is obviously not a matter upon which a British Minister should be expected to express opinions. Apparently there are no difficult land or labour problems in British Malaya and Ceylon. Consequently, in his report on British Malaya, Ceylon, and Java (Cmd. 3235, H.M. Stationery Office, 1928 ; 4*s.* 6*d.*), Mr. Ormsby-Gore is able to deal exhaustively with the subject nearest to his heart, the application of science to those public services upon which the physical health and the wealth and intellectual progress of communities depend.

It must be confessed that in this report he shows himself far more critical of the attitude of local governments and non-official Europeans towards their problems than in any previous report. This can be attributed to the fact that he brings to bear upon these problems the knowledge and experience he has gained by his visits to other colonies, and the contacts he has made with scientific workers, educationists, and technicians throughout the whole Empire. During the past five years he has served on every government committee set up in Great Britain for the furtherance of education, public health, and scientific research in the Empire, and he has thrown himself whole-heartedly into the work. Probably no public man, certainly no Minister of the Crown, has ever had such opportunities for making himself personally acquainted with the tasks confronting workers in these three important fields of endeavour, and the workers themselves. Small wonder that his grasp of the essentials of tropical development has developed or that his critical faculty has been sharpened.

There is evidence that the white community, in Malaya at least, is not altogether satisfied with the results of Mr. Ormsby-Gore's visit. He has discovered too much and been too outspoken a critic to earn popularity. Business men in Malaya are probably like business men everywhere, inclined to attribute their successes to their own brains and

initiative and all their failures to the government; at one moment to cry aloud to the government for protection, at the next to curse the government for its interference; to beg for government assistance in their various enterprises, and then to criticise the government for its increased expenditure in satisfying their demands. We are only too familiar with these moods of 'business' men and farmers in post-War England. We know, too, how bitterly they resent being shaken from their complacent belief in their own super-efficiency by well-informed criticism, with what Micawberish optimistic obstinacy they wait upon events, trusting to luck, instead of courageous reorganisation to meet changing conditions, to bring back prosperity. But heirs to prosperity are notoriously blind to the facts of history. The European planters in British Malaya are no exception to rule. They have acquiesced in the starvation of the research and technical services. In consequence they have lost several of the best officers of the Agricultural Department. They disregarded for fifteen years the advice of the Agricultural Department on the subject of soil erosion on rubber estates. They have disregarded the work being done by the Dutch in Java. The big rubber plantation companies are now seriously threatened by the native small-holder. Naturally, it must be galling to them to be told by Mr. Ormsby-Gore that

"The only justification for the present complicated and expensive mechanism of directors, agent firms, visiting agents, managers, and shareholders is the application of greater intelligence and skill than the native can reasonably be expected to acquire."

Lest this were not sufficient blow to their self-esteem, they are informed also:

"It is to the individual enterprise, industry, and thrift of the Chinese merchant and petty trader, the Chinese craftsman, the Chinese coolie, and above all the small Chinese contractor with his 'Kongsi' or guild, that the great wealth and development of British Malaya are mainly due."

It will be remembered that, when Great Britain was suffering from acute trade depression in 1921–22, the government appointed a commission under the chairmanship of Sir Eric Geddes to inquire into government expenditure with the view of effecting economies therein. Had that commission's recommendations been put into effect, practically the whole of the government's research and technical services would have been crippled, and a severe blow been administered to the education services of the country. British Malaya is now faced with trade depression owing to the fall in price of rubber and tin, its two chief economic commodities. If his opinion reflects that of the present government, Mr. Ormsby-Gore's comments on the situation indicate the distance and the direction in which his colleagues have travelled since 1922. He says:

". . . economies in the public services will no doubt have to be considered. On the other hand, there can be little doubt that further development and expansion depend very largely on an active and progressive policy on the part of the technical departments, such as agriculture, public health, education, forestry, veterinary, railways, and public works. The higher staffs of these services are recruited by the Secretary of State for the Colonies, and Malaya cannot afford other than the best men available."

He states further that

". . . the scientific services have not hitherto always received that recognition which can alone ensure an adequate supply of up-to-date technical officers possessed of that training and leadership which are required for modern development."

We are informed that the Malayan Agricultural Department at Kuala Lumpur has not been properly supported. At the present time, in spite of the signal proofs its officers have given of their capacity to improve the crops of the country, "its present accommodation in the way of offices is overcrowded and inadequate." The large field station initiated at Serdang in 1921 has no laboratories, the nearest being the Kuala Lumpur laboratory, seventeen miles away, which makes it difficult to maintain any close or continuous touch with it. Again, since there is no agricultural school in Malaya — in marked contrast to Java, which has an admirably co-ordinated system of agricultural education—"the liaison between the work of the Department and European or native agriculturists is still very imperfect. The Department has in fact worked in isolation under grave disadvantages and often neglect." There is now a Rubber Research Institute at Kuala Lumpur, but this was started only in 1925. Mr. Ormsby-Gore says he is convinced that "on research rather than restriction depends the prosperity of the rubber industry," but there are still many plantation companies which look to the government to fix prices on the basis of what the least efficient estates consider a reasonable level, and ignore scientific research. Animal industries in Malaya, due to the fact that there is no real veterinary department, are not being developed.

The agricultural situation in Ceylon is much more hopeful. "Public opinion in Ceylon is now very much alive to the need for furthering research in agriculture." At Peradeniya, there are the headquarters

of the Agricultural Department, the Botanic Gardens, a central experimental station, central laboratories and library, a farm school, and the head office of the Ceylon Rubber Research Institute. Agriculture now forms part of the curriculum of two of the voluntary secondary schools, each of which has its own farm, namely, Trinity College, Kandy, and Richmond College, Galle. 748 Government and 100 assisted schools have school gardens. There is a separate Tea Research Institute, financed by a cess on all tea exports, at present located in temporary quarters at Nuwara Eliya. There is also a separate Veterinary Department with a Central Laboratory at Colombo at which "some excellent research work has been done." The Government Dairy Farm in Colombo and the branch farm at Ambepusa, under the control of the Veterinary Department, provide facilities for breeding and feeding experiments.

"Ceylon," Mr. Ormsby-Gore reminds us, "is, after India, the largest tea-producing country in the world. It is the chief exporter of coconuts and coconut products in the Empire. It ranks third in the world as a producer of rubber. It is the principal producer in the world of cinnamon and citronella. It produces the highest grade and highest priced cocoa." Coffee was once an important crop, but this industry was practically wiped out by disease, particularly *Himeleia vastatrix*. In the opinion of experts, however, modern Java *robusta* coffees, highly resistant to disease, would do well in Ceylon and prove commercially profitable. The rice area could also be extended with advantage, particularly if more research were directed towards increased yields per acre. Mr. Ormsby-Gore also suggests that sisal might profitably be introduced into the dry zone and the natives be encouraged to grow tobacco as a rotation crop to sesame (locally known as 'gingelly').

While the Ceylon Agricultural Department is ahead of the corresponding service in British Malaya, the reverse aspect is presented by the respective forestry services. The Malayan Forestry Department is well staffed, it has achieved a uniform policy throughout the peninsula, and its research, experimental planting, conservation and commercial development sections, are all doing admirable work in accordance with a properly co-ordinated plan. It is true that British Malaya, in spite of the fact that four-fifths of the territory is under forest, still imports large quantities of timber from the neighbouring Dutch colonies, but it is hoped that it will not be long before it is entirely self-supporting in this respect. The need for a well-defined forestry policy with regulations directly enforced by the administration is emphasised by the fact that the Conservator of Forests estimates that 75,000,000 tons of timber in the most accessible areas have been wasted by the ruthless burning out of forests to make room for rubber plantations or to mine for tin.

As regards Ceylon, we are informed that there was no effective forestry control or policy until 1907. For generations before that the best and most valuable trees had been cut out indiscriminately. "The export of satinwood from Ceylon was very extensive in the early years of the nineteenth century, and little or nothing was done until quite recently in the way of conservation, regeneration, and improvement of forests by scientific clearing or planting. Even when the Forestry Department was first established (in 1907), the policy then adopted was wrong, uneconomic, and unscientific." Not until 1921 was any attempt made to rectify matters. In that year a report was made by a visiting forestry officer, after which a Commission was appointed to make an exhaustive inquiry. This Commission took five years to complete its work, and "*the putting into force of its many proposals is still under consideration.*" (Italics ours.)

The sections of Mr. Ormsby-Gore's report dealing with the public health services of the two British Colonies are informative, illuminating, and suggestive. In attaching the greatest importance to preventive as compared with curative medicine, he is following the best precepts of our time. "There is no part of the Empire where the progress of medical and sanitary science can be studied with greater advantage than in British Malaya," he informs us. For climatic and ecological reasons Malaya is naturally highly malarious, and "malaria is still the disease responsible for the highest mortality in both the Straits Settlements and those Federated Malay States where vital statistics of sufficient scientific value are obtainable." In addition to high mortality, "malaria is the main indirect cause of debility, suffering, and death from other causes." Again, the tropical peoples of Malaya, like those in other parts of the tropics, possess very little resistance to pneumonia and tuberculosis. As in other tropical countries also, helminthic and venereal diseases cause much debility and loss of efficiency among the peoples of Malaya. The venereal disease problem of Singapore is aggravated by the fact that Singapore city "is one of the main ports of the world visited by vessels of every flag from every country."

Mr. Ormsby-Gore pays tribute to the public

health authorities in British Malaya for the work which has been and is being done to cope with these many difficult problems. He also commends the public health work which has been undertaken by private enterprise on the part of rubber and mining companies, and the pioneer work of such private practitioners as Sir David Galloway and Sir Malcolm Watson. In particular, he says the anti-malarial work of the Malay States is rightly held up as an example among the countries of the world. Again, he states that the medical research services and the provision made for medical education are alike excellently conceived and efficiently carried on. It is in no spirit of carping criticism that he suggests the existing dichotomy in the public health services in Malaya should be ended, that every medical practitioner in a tropical climate should be a sanitarian, that the financial rewards available to the public health worker as compared with those obtainable in ordinary medical private practice should be reconsidered, and that more liberal leave should be given to the officers of the public health services of Malaya to enable them to take refresher courses at the London School of Hygiene and Tropical Medicine.

A different note is struck on the Ceylon public health services. Ceylon has the most extensive and expensive hospital system of any British possession, but " medical research, modern medical practice, public health services, and preventive medicine in Ceylon are not up to modern standards and are below the public need." It is Mr. Ormsby-Gore's impression " that in medical education and practice the community as well as a large section of the medical profession in Ceylon are still living in the nineteenth rather than the twentieth century." Accordingly, he throws out a series of important suggestions for consideration by the government and the public in Ceylon, in which he emphasises the need for a new central medical research institute, an overhaul of the medical education work, improved status and conditions of service for public health officers, and the teaching of personal and public hygiene in all schools.

We have dealt extensively but by no means exhaustively with this report by Mr. Ormsby-Gore. His views on other subjects connected with the economic development and intellectual progress of the peoples of the East Indies and Ceylon for whom Europeans have assumed responsiblity will repay the most careful study by all interested in the development of the British Empire, and in particular by those who wish to understand what science has done and still can do for our subject peoples. There is a certain unenviable forbidding notoriety attached to blue-books printed for the special edification of members of Parliament, which militates against their wide distribution among all classes of the population. This is unfortunate, because the reports of Mr. Ormsby-Gore are full of accurate information, presented in easily assimilable form, which would be invaluable to students in all our secondary schools. They are a liberal education in themselves, and free copies might with advantage be distributed by the Board of Education to all schools in the country. The expense would be negligible in comparison with the interest they would awaken. One thing is certain : all scientific workers with a regard for the profession to which they belong should take the first opportunity to make themselves acquainted with the contents of this last report on Malaya, Ceylon, and Java. They will not only find there a complete justification for themselves and their special studies, but also will be made more fully aware of their responsibilities to the world at large and their potentialities for good. In the Under-Secretary for the Colonies they have a firm friend and doughty and authoritative protagonist.

In congratulating Mr. Ormsby-Gore on his signal achievement, we are conscious of the debt of gratitude we owe to his labours on behalf of science.

British Folklore.

(1) *English Folklore.* By A. R. Wright. (Benn's Sixpenny Library, No. 33.) Pp. 80. (London : Ernest Benn, Ltd., 1928.) 6*d*.

(2) *Folklore of the British Isles.* By Eleanor Hull. (Methuen's Anthropological Series.) Pp. xii + 318. (London: Methuen and Co., Ltd., 1928.) 7*s*. 6*d*. net.

BOTH these books appeared opportunely. Their date of publication falling near the jubilee congress of the Folklore Society, they served to supplement the proceedings of that congress in demonstrating to the general public a broader conception of the aims and methods of the study of survivals. It is patent from incidental references and the occasional correspondence in the daily press that there is a widespread interest among the public in the vestiges of our popular custom and belief ; but there is little evidence of appreciation of the fact that these queer practices are worthy of serious study or that their collection or record has any object other than the satisfaction of a curiosity about the past. The collection of facts is indeed of paramount importance, especially

when the material is disappearing rapidly before the spread of education and the standardisation of culture which must ultimately obliterate local peculiarities; but it is not the exclusive end of the study, and unless the material acquired is surveyed periodically on broad lines in relation to the general problems of the science, there is a danger that it may cease to be regarded seriously and fail to attract the public interest and support without which in present conditions scientific research can scarcely maintain its full vigour and attract serious workers. At the recent Folklore Congress, conditions in England were contrasted with those on the Continent, where, it was pointed out, in various countries chairs in the study of the folk have been established, and it has been introduced into school curricula. But to secure even academic support a study must justify its existence.

Though this is not the occasion for a review of the methods of folklore studies during the last fifty years, it is necessary to emphasise the needs which Miss Hull and Mr. Wright have met in order that their work may be fully appreciated. To the achievements of their great predecessors, Frazer, Gomme, Hartland, Miss Burne, and all who assisted in the compilation of the "Handbook of Folklore," they would be the first to pay homage. But much that was implicit in the works of these writers has been made explicit and reviewed in the light of later knowledge; much that was intended for the needs of the student has been made accessible to a wider public. Though both Miss Hull and Mr. Wright confine themselves to a specific geographical area, the principles upon which their analysis proceeds are of general application.

(1) Mr. Wright's book will help to dispel any idea that few vestiges of popular belief and superstition, except on certain lines, remain in England. His little book is a remarkable feat of condensation, yet as it is, he has to express regret in a final chapter that he has been unable to deal with a number of subjects such as folk song and dance—the latter a fruitful subject—folk drama, proverbs and riddles, games, and folk art. Yet in seven chapters he has covered a multiplicity of subjects, such as birth, courtship, marriage, and death, business and work, calendar customs, ghosts and supernatural beings, divinations, charms, witchcraft, to name the most important; nor is his material obsolete or even mainly drawn from the records of the past. Nearly all his illustrative citations are of incidents which have occurred since the War. Of these, the cases of witchcraft may be familiar, as they receive more notice in the Press and tend to be remembered. One of the most remarkable was that at Newton Abbot in 1926 of a man who objected to his wife placing a ring of salt around his chair because she believed he had bewitched his son.

Mr. Wright is incorrect in placing the last ducking of a witch in Northamptonshire. The 'White Witch' who diagnosed the case came from Northamptonshire; the ducking took place in Hertfordshire. The victims lived at Tring. Although the panel of the Insurance Acts has done much to eradicate the popular pharmacopœia, the help of the white witch is still invoked. Mr. Wright records a charm for toothache which involves the insertion of human hair in a slit in the bark of an ash tree. It may be mentioned that American negroes also do this. The point is of interest, as much of the negro belief in the United States is European and not African in origin. Even the Voodoo cult is of European origin, in name certainly, and possibly to some extent in practice.

(2) Miss Hull's book differs from that of Mr. Wright in both scope and method. The latter lays down principles which are illustrated by examples of English folklore. Miss Hull aims at giving an account, as complete as her space allows, of the various phases and aspects of belief and custom in the whole of Britain from the earliest times of which there is any record susceptible of interpretation. For by inference we may probe even so far as the Stone Age, and legend and story take us back with certainty to the Iron Age. Both Mr. Wright and Miss Hull point out that Britain, having been overrun by people after people, its folklore is a series of superpositions of different racial beliefs. Yet it is remarkable how little can be identified as distinctively Saxon, while legendary lore is almost exclusively Celtic. Was this due to the fact that, while the Saxon conquerors were able to establish their institutions, their beliefs had no opportunity to become ingrained in the general mass of the population before they were overwhelmed or transformed by Christianity? Or was the general run of folk belief, apart from the pantheon, so closely akin as to escape subsequent discrimination? And when the Normans came, was a feudal practice imposed upon a ritual which had continued through Saxon from British times? Such, for example, would be the origin of the popular court held annually in some localities under an ash or other tree by the roadside and the 'gospel oak' as a boundary mark. So also the feudal due of a buck and doe offered at St. Paul's in London at the two feasts of St. Paul, for which

Miss Hull offers an explanation, which, by the way, was also suggested in our Calendar of Customs and Festivals (see NATURE, Jan. 21, 1928, p. 121).

So far as Britain is concerned, the cult of the horse may be peculiarly associated with the Saxons. There are references to it in the chronicles additional to the evidence of archæological relics. Miss Hull does not deal with the horse under 'animal cults,' but in connexion with one Irish practice, allows herself to accept, though apparently without strong conviction, the hard-worked explanation of totemism. The kings of Cenel Conaill, Western Ulster, were consecrated by the ceremonial slaying of a white mare, in the broth of which the chieftain bathed, while his people solemnly partook of its flesh in a feast. This certainly has all the appearance of an admission to a clan totem group and a ritual feast. If it is so, this takes us back to a very primitive phase of Nordic belief, possibly before the cult of the horse had become even tribal. But in India, where the horse is sacrificed by Aryan peoples, the rani must perform a certain rite with the sacrificed animal, which indicates either that it is identified with the rajah or is regarded as possessing marital rights over the women of the social group, that is, the act is an assertion of the divine individuality of the group, analogous to the assimilation of the Irish king to the divine identity of the group over which he is to rule.

Miss Hull has dealt fully with most sides of British belief—well worship, tree worship, stone worship, worship of the sun and moon, animal cults, sacrifice, and so forth. Her chapters on calendar customs are selective but illuminating. Most of all, however, we are indebted to her for her systematic handling of the Irish material, of which her profound knowledge has enabled her to introduce order where it was badly needed, and at the same time to make known to a wider public in assimilable form much that is of profound interest in the history of the British Isles.

The Properties of Silica.

The Properties of Silica: an Introduction to the Properties of Substances in the Solid Non-conducting State. By Dr. Robert B. Sosman. (American Chemical Society Monograph Series, No. 37.) Pp. 856. (New York: The Chemical Catalog Co., Inc., 1927.) 12.50 dollars net.

IT is unusual to write a whole volume about a single oxide of one of the elements; but if any oxide deserves this place of honour, it is certainly silica, since no other compound possesses such an array of interesting physical properties, even if we leave out of account all its chemical reactions. A precedent for monographs of this type has been set by Le Chatelier's books on "Le Carbone" and "La Silice," and it is not a mere coincidence that the *doyen* of French chemistry should have selected silica as the subject of his second series of published lectures. Le Chatelier's book, however, is of quite a different character, since it preserves the narrative form of the lectures, and tells a simple story in simple words. Dr. Sosman's book, on the other hand, is essentially a reference-book, in which *all* the information about the physical properties of the various forms of silica is catalogued and reviewed.

The book is made more formidable by the author's anxiety to use a logical method of classifying data, since he threatens in his introductory chapter to write a book of fifty-seven chapters, in order to deal with all possible combinations of the six fundamental concepts of length, time, mass, electric charge, entropy, and energy; and in discussing the micro-forms of quartz he insists that they may be 'micro' in one, two, or three dimensions '(flaky, fibrous, or granular), and that these micro-forms may be crystalline, amorphous, or aphanitic, so that nine classes are possible. In these circumstances it is perhaps fortunate that the number of fundamental concepts is six and not twelve, and that the micro-forms are not classified into triple groups according to a third or fourth property, so as to increase the nine classes to eighty-one. In the opinion of the reviewer, schemes of classification such as this should be concealed, like the working-parts of a British locomotive, instead of being displayed ostentatiously like the working-parts of some American and Continental engines. In the present instance the author's determination to make his treatise complete, by including definitions of entropy, crushing strength, index of refraction and optical rotatory power, as well as tables showing the nomenclature of the thirty-two classes of crystal symmetry and the classification of radiation over the range from γ-rays to Hertzian waves, has led to the production of a volume of 856 pages, which is priced at 50s., and will therefore be purchased for the most part only by specialists and by reference libraries.

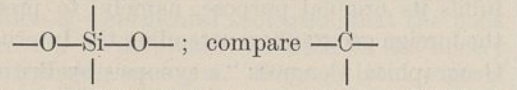
As a reference book, however, this monograph is admirable, since it covers all the physical properties of silica in all its various forms. Since quartz, tridymite, and crystobalite exist in two, two, and three forms respectively, there are eight distinct crystalline forms to be considered in addition to the

amorphous varieties. The interconversion of these eight forms gives scope for the author's fondness for classification, although nothing at all is known about some of the possible transformations. The 'high-low' transformations of quartz, tridymite, and crystobalite are, however, totally different from those of the three main forms, since they do not proceed from nuclei or centres, but take place completely, reversibly, and almost instantaneously throughout the crystal when the inversion temperature is reached, so that it has actually been proposed to use one of them as a secondary standard in thermometry. The same type of transformation is seen in the $\alpha\,\beta$ change in iron, but we have not yet reached a stage at which the two kinds of polymorphism can be discussed conveniently in elementary books on physical chemistry, since the underlying changes of structure are still open to discussion.

From this point of view, X-ray analysis is proving to be of fundamental importance; but in the case of quartz the progress hitherto made has not been sufficient to establish once for all an undisputed orientation of the atoms of silicon and oxygen, and the story which the author has to tell is therefore a long one instead of a short one. Thus the chapter on "The Ultimate Structure of Silica" is followed by a chapter on "The Hypothetical Structure of Low-Quartz," in which the views of McKeehan, W. H. and W. L. Bragg, Gibbs, Beckenkamp, Sohncke, Huggins, and Ichikawa are cited. In the opinion of the reviewer, the key to the problem of the structure of crystalline silica is to be found in a recent paper by Prof. F. S. Kipping on "The Carbon-silicon Binding" (*Trans. Chem. Soc.*, p. 104; 1927) in which he writes:

"Fresh evidence is continually being obtained by the author that an ethylenic binding between carbon and silica is either impossible or can only be produced under exceptional conditions. Those reactions which lead to the formation of an olefine seem to be quite inapplicable to the production of the group >Si : C<."

This observation provides an excellent illustration of G. N. Lewis's view, that the formation of double bonds is different or impossible except between elements of the first short period. If, then, we admit that silicon is unable to form a double bond, it follows at once that a molecule of silica must have an unsaturated structure, and in particular that each molecule of silica has four spare bonds just like an atom of carbon, thus:



The rise of boiling-point from $-80°$ to $+2600°$ on passing from CO_2 to SiO_2 can then be attributed to the same cause as the rise of boiling-point from $-196°$ to (say) $+3800°$, on passing from nitrogen to carbon, namely, the transition from a saturated molecule, O=C=O or N≡N to an unsaturated system, as formulated above.

The discussions of the structure of the various forms of quartz are followed by sections dealing with the thermal and mechanical properties, the piezo-electric and pyro-electric properties, and finally the optical properties under the heading "Silica in the Periodic Electromagnetic Field." The data collected in these sections are so numerous that one can only assume that the collection is complete; and the reviewer is certainly not in a position to point to any gaps, apart from the lag that is inevitable when dealing with a subject that still plays an active part in current literature.

The final section of the book deals with applications, and includes seven chapters, describing silica minerals and rocks, vitreous silica and silica refractories, the geological and industrial applications, and the chemical and physical uses of silica. The whole volume is a monumental work which may be consulted with advantage by all those who want to know anything about silica but may not have access to the original literature; and even those who are seeking first-hand information will find in it a trustworthy guide to the papers which they ought to read, and an excellent summary of their contents. The only complaint that can be made is in reference to the possibility of having 'too much of a good thing,' since the elementary student might well be frightened if there were any prospect that all the chemical compounds of all the elements might be monographed in the same efficient way.

T. M. LOWRY.

Regional Geography of Great Britain.

Great Britain: Essays in Regional Geography. By Twenty-six Authors. Edited by Alan G. Ogilvie. Published on the Occasion of the Twelfth International Geographical Congress at Cambridge. Pp. xxx+486. (Cambridge: At the University Press, 1928.) 21*s.* net.

THE origin of this book is probably to be found in a conversation which the editor, Mr. A. G. Ogilvie, had with a well-known French geographer some two or three years ago. Mr. Ogilvie in his preface points out that there is a certain lack of modern authoritative geographical works dealing with Great Britain, and remarks that, although there are now twenty-one departments of geography

in universities and university colleges in Great Britain, no attempt had been made, until this book was planned, to gather together the accumulated experience of the heads of these departments and the results of their studies in their own regions. He therefore made the suggestion to the British National Committee for Geography, a body which was formed on the initiative of the Royal Society, and is one of the constituent members of the International Geographical Union, that a composite volume should be published, to be written in the main by the heads of departments of geography, and that this volume should contain accounts of the geography of the various regions of the country by those who had specially studied them.

This suggestion was approved by the National Committee, especially as it was accompanied by the proposal that the volume should be presented free to the foreign geographers attending the International Geographical Congress of July 1928. The National Committee formed a special committee to arrange for the production of the book.

A general introduction is written by Sir John Russell, who, in the opening sentence, defines regional geography as the description of the regions of a country as they are and the discovery of the causes that have made them what they are; such a description would, no doubt, be taken to include the effect of the study of environment on the human generations that inhabit, or used to inhabit, the region. Sir John Russell speaks authoritatively of the agriculture and soils of the country. At the end of his introduction he mentions a fact of much interest to the student of population questions, namely, the curious change that is coming over the Clyde area, in which "a large foreign population, chiefly Irish, is taking possession, ousting the Scotsmen, and doing by peaceful penetration what no previous invaders were able to do by force." The same process is commented upon by Mr. Ogilvie at the end of his excellent account of central Scotland. He remarks that there is evidence that the Irish in Scotland will increase while the Scottish race decreases, and that, unfortunately, many of the cream of the Scottish people are emigrating every year. This "penetration of Protestant Scotland is viewed with alarm by many of her people, not so much on account of religious prejudice, as because of the social implications. Scotsmen value above all their nationality and traditions." The movement of population thus indicated deserves the attention of all geographers.

Dr. H. R. Mill contributes an admirably clear article on the climate of Great Britain, and following this article of eighteen pages we come to the series of twenty-three regional studies written by such authorities as Prof. Fleure, who describes Wales; Prof. Rishbeth, who deals with central south England; Mr. Jervis, the Severn Basin; Dr. Fawcett, the Pennines; Mr. Fagg, the south-east of England; Prof. Roxby, East Anglia; Mr. Debenham, the Fenlands; Dr. Rudmose Brown, the South Yorkshire Coalfield; Mr. A. Stevens, the Highlands and Hebrides; and a dozen other authorities, each writing with knowledge of the region dealt with.

The writers were given a very free hand in describing the various areas, but there is, as a fact, a kind of general similarity of treatment. In almost every case the regional study begins with an account, necessarily very brief, of the geology; then we usually find some description of the land forms and drainage system, followed by a note as to the climate, and, in some cases, an account of the vegetation. Then we arrive at the human side of geography, early settlement, changes in population, the character of the existing people, and agriculture and industry. Added to these, which we may perhaps describe as the orthodox mixture, we shall find miscellaneous comments on such subjects as the future of certain of the great centres of population; the significance of certain town sites; regional planning; the distribution of population, and, of course, the study of human geography; the effect of place conditions on the human race is, indeed, the principal reason for the existence of the subject of geography at all, apart from the necessary work of exploring and mapping the earth's surface.

The book is, from the nature of the case, condensed and 'facty.' It must be taken in small doses; but so taken, the reader will find in it much of interest, and much that he probably did not know before. One can obtain from it a good idea of the main conditions of human existence in the various characteristic divisions of Great Britain. It is a book that everyone either learning or teaching the geography of Great Britain should possess. It is well illustrated by figures and diagrams in black; but it will probably be found useful to study it with the additional aid of a quarter-inch map of the region which is being studied at the time. It should also be said that the book admirably fulfils its original purpose, namely, to present to the foreign geographers attending the International Geographical Congress "a synopsis by British geographers of the regional geography of Great Britain."

Our Bookshelf.

Fever, Heat Regulation, Climate and the Thyroid-Adrenal Apparatus. By Dr. W. Cramer. Pp. ix + 153 + 40 plates. (London: Longmans, Green and Co., Ltd., 1928.) 15*s*. net.

IN this interesting little volume the author adduces evidence in favour of his view that heat regulation in warm-blooded animals is mainly under the control of the sympathetic nervous system, and that since the adrenal and thyroid glands are controlled by this system, the mechanism involved is both nervous and humoral. The activities of the two glands have been followed by the histological method: in the adrenal, fixation by means of osmic acid vapour discloses the presence in the resting medullary cell of fine black granules, which, from their absence from other cells and from their disappearance under conditions known to result in a secretion of adrenalin, are considered to indicate the presence of the base. In the case of the thyroid, conclusions are drawn from the appearance of the colloid and cells lining the alveoli. The numerous illustrations of drawings of actual microscopic sections show clearly the marked differences observable in the gland picture following exposure of the animal to heat or cold or injection of various compounds.

An essential part of the author's thesis is the consideration of the glycogen in the liver as a secretion rather than as a simple store of surplus carbohydrate; the presence or absence of glycogen is not a measure of the activity of the glycogenic function, since the amount present depends solely on the balance between production and secretion from the cell; increased glycogen means hyperactivity of the liver on the storage, inactivity on the secretory conception.

In general, the author throws a new light on, or gives a new interpretation of, established facts, and thereby clarifies several problems; in one or two cases, however, the foundations of the thesis appear insecure, owing to the experiments on which he relies being unconfirmed or not generally accepted; as an example may be mentioned the question of the influence of the sympathetic nervous system upon the metabolism of skeletal muscle. In his concluding chapters the author considers the relationships of climate and various pathological conditions to the heat-regulating mechanism. This is a most stimulating book, and should be read by all physicians, pathologists, and psychologists.

Allgemeine Biologie: eine Einführung in die Lehre vom Leben. Von Dr. Max Hartmann. Zweiter Teil: *Formwechsel und Reizerscheinungen.* Pp. v + 263-756 + ix. (Jena: Gustav Fischer, 1927.) 25 gold marks.

WHILE some of the material in this book is years out-of-date, there are so many beautiful figures and descriptions from the works of the last generation of Continental zoologists, that the book will prove a very valuable addition to the library of the teaching zoologist. Some of the work of Bělař especially, which is incorporated, is extremely fine. The protozoological and cytological treatment is naturally very well done, if, as the reviewer has mentioned, a little behind the times. It is possibly somewhat tiresome to have served up to one the descriptive cytology and protozoology of the Bouin's fluid and Schaudinn's fluid epoch. The author would have done well if before finishing he could have read Wilson's "The Cell," but it would be cavalier to expect in a book of this size a treatment of various cytological subjects on the masterly lines of Wilson. There is a quite fine chapter on developmental physiology, written, as indeed is the rest of the book, concisely and clearly. The reviewer recommends teachers of zoology to obtain a copy of this work, because, in the absence of a good library, it will provide something from the work of the Continental protozoologists and cytologists. The author is to be congratulated on the manner in which he has brought forward a great mass of material, and condensed it into a splendid work of seven hundred pages.

J. BRONTË GATENBY.

Man a Machine: in Answer to a Romantical and Unscientific Treatise written by Sig. Eugenio Rignano and entitled "Man not a Machine." By Joseph Needham. (Psyche Miniatures, General Series, No. 12.) Pp. 111. (London: Kegan Paul and Co., Ltd., 1927.) 2*s*. 6*d*. net.

THE author has revived the title of a discourse which appeared in 1748 under the authorship of M. de la Mettrie, a Paris physician, who interpreted the nature of life on a basis of experiment and scientific observation. So materialistic a view was bound to call forth many replies—for example, "Man More than a Machine," of unknown authorship, in 1750—most of which were based on anti-materialistic ideas, more especially relating to the soul.

The controversy between the materialism of natural philosophy and the vitalism of the metaphysicians continues to experience periodic waves of revival; and again, in 1926, there appeared in this series of miniatures a philosophic presentation of Rignano's interpretation of life under the resuscitated title of "Man not a Machine." The booklet now under review is a reply to Rignano, in which the author presents scientific data, chiefly of a physico-chemical and embryological character, as being more directly related to his own work. Readers interested in a rational interpretation of living processes will find here some of the points at which the gradual encroachment of scientific method is continuously making inroads into the sacred preserves of vitalism.

The Earth: its Nature and History. By Dr. Edward Greenly. (The Forum Series.) Pp. ix + 54. (London: Watts and Co., 1927.) 1*s*. net.

THE publishers of the Forum Series are gradually building up a library of cheap books of which they may well be proud. Prof. Julian Huxley and Sir Arthur Keith are among the earlier contributors, and now comes Dr. Edward Greenly with a fascinating

little volume on geology. In so far as it is possible profitably to discuss the make-up of the earth and its long history of changing landscape, climate, and life in 54 pages, Dr. Greenly has succeeded where most of his competitors have failed. His reputation as a brilliant but cautious geologist is so high that no one need doubt his authority to act as a guide to the beginner in a subject which is notoriously difficult to condense effectively. The book is beautifully written—obviously it was a pleasure to write it—and is everywhere clear and concise. It is imbued throughout with a mellow spirit of philosophy which will give pleasure to the professional geologist as well as to the general reader for whom it is intended. No better school introduction to geology could be wished for. So many small books of this kind are written by earnest amateurs who are generally ill-equipped for the difficult task of writing simplified geology, that it is a pleasure to find one by a master of his subject that can be cordially recommended.

Geology and Natural Resources of Colorado. By Prof. Russell D. George. (University of Colorado Semicentennial Series, 1877–1927, Vol. 1.) Pp. xv+228. (Boulder, Colo.: University of Colorado, 1927.) 2 dollars.

THE professor of geology in the University of Colorado has attempted to summarise a vast subject in a small volume with results that are likely to be of greater value to the geographer than the geologist. Beginning with an elementary but well-illustrated introduction to geology and mineralogy, the succeeding chapters deal with the geological history of Colorado; the metallic ores; fuels; structural materials; water supplies; soils and agriculture; climate and scenery. The treatment is generally too sketchy to have any detailed value. We learn, for example, that "the region is one of profound folding and faulting, and intrusion of igneous rocks. In many places it is evident that there were at least two periods of folding and two or more periods of faulting. The igneous intrusions are also of different ages." This information cannot be said to be helpful.

The addition of a bibliography would have made the book really useful to geologists, and it is no excuse to say, as the author does in his preface, that "a worth-while bibliography . . . would be too voluminous." As it is, the book is likely to be appreciated only by teachers of geography in North America as a source-book. For that purpose it is well arranged and illustrated.

Leçons sur quelques équations fonctionnelles avec des applications à divers problèmes d'analyse et de physique mathématique. Par Prof. Émile Picard. Rédigées par Eugène Blanc. (Cahiers scientifiques, publiés sous la direction de Gaston Julia, Fascicule 3.) Pp. v+187. (Paris: Gauthier-Villars et Cie, 1928.) 40 francs.

THE book under notice constitutes a valuable addition to the scanty literature of the calculus of functions, so called by de Morgan. Chap. i. deals with the functional equations forming the basis of proofs of the parallelogram of forces, with extensions to non-Euclidean statics, trigonometry and geometry. Chap. ii. treats of the functional equations expressing rational addition and multiplication theorems of uniform functions, with applications to elliptic functions and to Poincaré's transcendents. Chap. iii. deals with the canonical difference equation of the first order, with applications to doubly periodic functions of the first and second kinds and to Picard's transcendents. The last chapter brings a discussion of the functional equations of Abel and of Schröder, and concludes with an application of Fredholm's equation to the problem of Dirichlet for the potential of C. Neumann. As might be expected from such a master of his craft, M. Picard has treated a variety of difficult problems in a most elegant and stimulating manner, thus demonstrating the great power of methods based on functional equations, and his book can be highly recommended to all interested in this subject.

Calculations in Physical Chemistry. By Prof. J. R. Partington and S. K. Tweedy. Pp. viii+152. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1928.) 7*s.* 6*d.* net.

THE problems selected by the authors are of the standard required for a degree in honours, and are based from the beginning on the use of the calculus. The six sections of the book deal with thermodynamics, characteristic equations, liquids and solutions, equilibrium, electrochemistry, and the heat theorem. Explanatory introductions are supplied to each section, and the answers to the problems are given at the end of the book. There is also a series of 100 miscellaneous exercises to which no answers are given. The book should prove of real value to those who wish to acquire a mastery of physical chemistry in its numerical aspects, and, in spite of its small size, the price is not excessive in view of the compact character of the contents.

Soil Management. By Prof. Firman E. Bear. (The Wiley Agricultural Series.) Second edition, thoroughly revised and enlarged. Pp. v+412. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 17*s.* 6*d.* net.

THIS volume is primarily intended as a book for students, not only for those in college, but also for others who desire to gain an insight into modern methods of dealing with the various problems of soil management. Its general usefulness is testified to by the fact that a second edition is called for after three years. The requirements of crops and the characteristics of soils are outlined at the start, but the bulk of the work is devoted to a consideration of soil resources from the aspect of utilisation and conservation, together with the best methods of supplementing the natural supplies by fertilisers. Selected references bearing closely on the text are provided, together with a certain number of illustrations and diagrams.

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.*]

Fluorescence of Mercury Vapour under Low Excitation.

IN earlier letters to NATURE (Aug. 18 and Nov. 10, 1928), I have described mercury fluorescence with exciting wave-length as long as λ3125. Since then even longer waves have been used. The source was a nickel arc, with a filter of natural (ortho) salicylic acid, which cuts off completely all waves shorter than 3360. The mercury vapour was at high density. The spectrum observed consists of the two well-known broad continuous maxima, one in the visual region (green fluorescence), and the other in the ultra-violet, from about 3130 to 3650. The latter has never, so to speak, been dissected. If it has appeared at all in any spectrum it has appeared complete, and it has never shown any signs of resolution into a fine structure.

It was of interest to see what would happen in the present case when excitation is applied near the middle of this band. The result is that it still apparently resists dismemberment, even in these trying circumstances: the whole of it is excited with a striking violation of Stokes's law. The continuous fluorescent spectrum extends as much as 300 A. beyond the limit of the exciting spectrum, as set by the sharp cut of the filter. Owing to stray light from the source, the fluorescent spectrum is only seen quite detached beyond this limit, and it is hard to say whether any discontinuity of intensity sets in at the beginning of the 'anti-Stokes' region.

RAYLEIGH.

Terling Place,
Chelmsford, Jan. 10.

Light-scattering and the Hydrogen Spectrum.

IN an important paper in the *Proceedings of the Royal Society* for January, Raman and Krishnan give an account of their researches on the production of new radiations by light-scattering. In 1928 they announced the discovery that when a transparent medium is irradiated by monochromatic light the radiations scattered by the molecules contain spectral lines of modified frequencies. The *difference* between the incident and the scattered frequencies corresponds to a characteristic infra-red frequency of the molecule. Such new lines are clearly shown in the beautiful spectrograms which illustrate their paper. The authors direct attention to the usefulness of this phenomenon as a substitute for infra-red spectroscopy.

The secondary spectrum of hydrogen contains many thousands of lines, of which only a small proportion has been classified. I wish to suggest the view that many of these lines arise in the way described by Raman and Krishnan, in conformity with the theoretical work of Smekal and others. When hydrogen gas is subjected to an electric discharge, the lines of the Balmer series are emitted by atoms of hydrogen, and the neighbouring molecules of gas must be subjected to bombardment by light quanta of corresponding frequency. Hence we should expect *each* Balmer line to be accompanied by a system of fainter lines, corresponding to molecular frequencies in the infra-red. The accompanying table shows some of the first results of an examination of the secondary spectrum in the neighbourhood of the five Balmer lines $H\alpha$ to $H\epsilon$. The wave-numbers of these lines are given at the top of the table. In the lower part of the table are the wave-numbers and intensities of certain lines recorded by Gale, Monk, and Lee. The numbers in bold type are differences between such wave-numbers and the wave-number of the nearest Balmer line.

H_α	H_β	H_γ	H_δ	H_ϵ
15233·22	20564·79	23032·54	24373·06	25181·34
15102·10 (1)	20436 09 (1)	22903·51 (0)	24242 95 (1)	..
131·12	**128·70**	**129·03**	**130·11**	..
14970·53 (2)	20302·96 (3)	22770·26 (0)	24111·46 (2)	24919·57 (0)
262·69	**261·83**	**262·28**	**261·60**	**261·74**
14842·77 (oa)	20174·02 (1)	22643·75 (3)	23982·31 (2)	24790·49 (0)
390·45	**390·77**	**388·79**	**390·75**	**390·85**
14709·75 (oo)	..	22509·10 (2)	..	24657·74 (0)
523·47	..	**523·44**	..	**523·60**

It will be seen that these differences are approximately constant in each horizontal row, and are not far from the series of numbers 130, 260, 390, 520. In pure rotation spectra in the far infra-red the bands consist of a series of equidistant lines at intervals of $h/4\pi^2Ic$, where I is the moment of inertia of the molecule. Assuming that the lines represent a rotation spectrum, the B constant of the spectrum, which is defined by $h/8\pi^2Ic$, would be roughly equal to 65 cm.$^{-1}$. My fellow worker, Ian Sandeman, who discussed the Fulcher bands of hydrogen at the Royal Society of Edinburgh on Jan. 7, finds $B'' = 33{\cdot}39$ for this system, a value only one-half the above. This led me to search for intermediate lines in the rotation spectrum, resulting in the discovery of most of the remaining members. The first member, however, instead of appearing at 65 cm.$^{-1}$, is displaced and is found at 70 cm.$^{-1}$. It should be mentioned that in many cases lines are observed having a frequency *exceeding* the frequency of the exciting line by the appropriate infra-red frequency.

There are indications that in addition to the pure rotation spectrum described, there are lines due to vibration-rotation spectra. These are at present being investigated. The claim made by Raman and Krishnan that light-scattering serves as a powerful, convenient, and accurate method of exploring molecular spectra seems to be fully justified. It appears probable that it will be of the greatest service in disentangling the complex structure of the 'many-lined' spectrum of hydrogen. H. S. ALLEN.

The University,
St. Andrews, Jan. 10.

Variation of Latitude with the Moon's Position.

RECENT investigations at this laboratory have suggested a possible connexion between the variation in latitude of a given place on the earth's surface and the position of the moon in the sky at the time observations for latitude are made. An analysis of the whole series of the latitude observations which were made by Ross at Gaithersburg from 1911 to 1914, has revealed a striking correlation between the moon's hour angle and the value of the latitude obtained. The data were restricted to results obtained with the photographic zenith telescope, thus eliminating all personal equation. For convenience the observations were divided into two periods, one from 1911 to 1913, the other from 1913 to 1914. According to Ross's estimates, the 1913 to 1914 observations were considerably superior to those of the earlier years, as is evidenced by the smaller probable error.

In conducting the analysis a card catalogue was made of the results of the observations of latitude for each night and each group of stars. The mean right ascensions of the group give the necessary data for ascertaining the moon's hour angle at the time of

observation. From the mean curve of latitude variation at Gaithersburg, extending over the period 1911 to 1914 and published by Ross, corrections were obtained to reduce each night's data to the mean latitude of Gaithersburg, determined from the observations of the whole period. The resultant values of latitude were then tabulated against the mean value of the moon's hour angle for each group of stars, and the

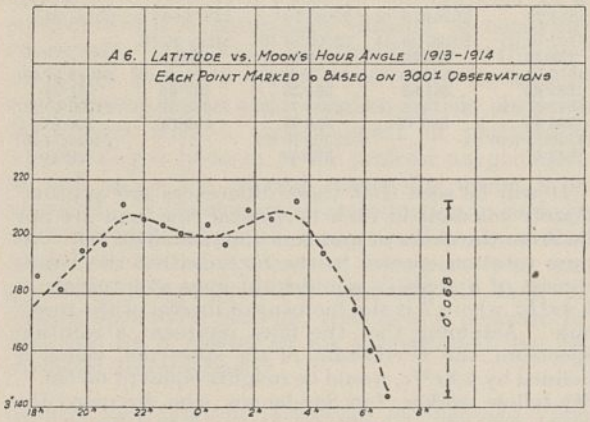


FIG. 1.

running mean, taking three at a time, gave the results graphically shown in Fig. 1.

Since the declination of the moon, and hence the observer's distance from the sub-lunar point, may vary greatly even for the same values of the hour angles, the hour angle and declination were transformed into altitudes and bearings by suitable tables. Again, the observations were divided into two series, one including those made when the moon was above the horizon, and the other when it was below the horizon.

The striking rise in the value of the latitude with the increasing altitude of the moon is shown strikingly in the altitude–latitude curve, Fig. 2, which again was plotted from the running means. The maximum latitude occurs at altitude 30°, or when the observer was 60° from the sub-lunar point. It should be stated that the extreme range of variation of latitude due

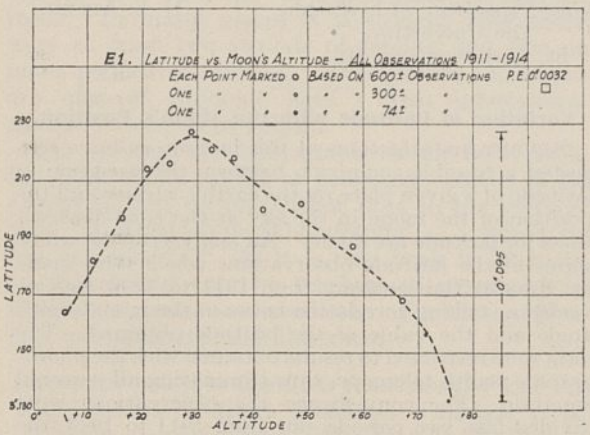


FIG. 2.

to this lunar effect was 0·08″ for the 1913–1914 series and about 0·09″ for the whole series 1911–1914. On account of the relatively greater degree of precision obtained in the 1913–14 series and the larger number of observations included, double weight was given this series in plotting the final graph as exhibited in Fig. 2. The fact that the total variation is about twenty times the probable error for each point on the curves leaves little ground for interpreting the curve as a chance phenomenon. The curve of observations for the moon below the horizon is radically different. A marked fall in the value of latitude follows the negative altitude of 30°.

In seeking an explanation for this extraordinary relationship, one is at a loss to account for the fluctuation on the grounds of any deflection of the vertical due to a theoretical tide in the earth's crust.

Meteorological causes, unless a function of the lunar hour angle, should have been practically eliminated in the averaging of between two and three thousand observations. The possibility, however, of the effect of an atmospheric tide may need some consideration. It should be noted that a change in refraction systematically introduced by the passing of an atmospheric tide is of the correct sign for the observed effect, but the magnitude of the variation seems too large to be accounted for on such a hypothesis.

One is led to interpret the result as a change in the

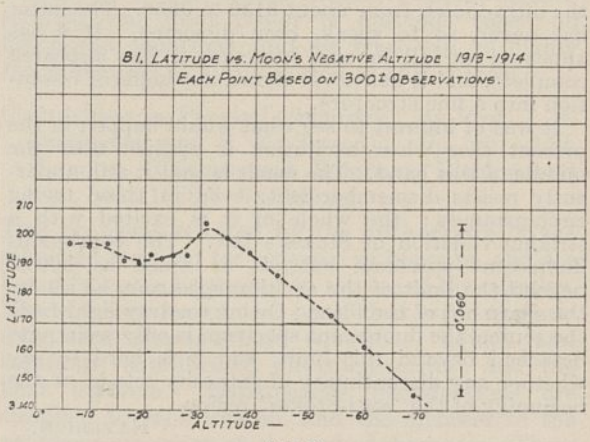


FIG. 3.

direction of the earth's instantaneous axis of rotation unless the more fanciful hypothesis of an actual displacement of the earth's crust is to be entertained. It is to be emphasised that various attempts to detect deflections in the direction of gravity by the plumb line, horizontal pendulum, or a pipe experiment such as that of Michelson and Gale, refer all changes to the positions of the earth's crust, whereas the location of the zenith as in the Talcott method for latitude determination refers the vertical to the direction of the earth's axis in space.

Whatever may be the causes involved, the importance of the consequences of such an observed effect scarcely needs to be emphasised, as it vitally concerns the fundamental determination of star positions. It is suggested that a possible explanation of the notable discrepancies in stellar co-ordinates from star catalogues of widely distributed observatories may, at least in part, be traceable to this lunar effect.

The investigation is now being continued in an analysis of the latitude observations made with the same instrument after its removal to the Naval Observatory at Washington. This latter investigation has now so far progressed as completely to confirm the correlation of the change in latitude with the lunar hour angle discovered in the Gaithersburg series of observations. In the preparation of the data for the analysis I have had the invaluable assistance of Miss Margaret Olmsted.

HARLAN TRUE STETSON.
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Structure of Pearls.

THE origin of pearls has been a subject of speculation of both laymen and men of science alike. In the literature on this subject, one finds that most of the scientific work has been done on pearls of commercial value, such as those from *Margaritifera vulgaris*, *M. margaritifera*, and *Mytilus edulis*, and that those from other molluscs, like *Pinna*, have been studied only by a few workers. Réaumur (*Mémoires de l'Académie des Sciences*; 1717) stated that shell extrusions were the causes of pearl formations in *Pinna*. Raphaël Dubois (*Annales de l'Université de Lyon*, Fasc. 29; 1909) on *Pinna* pearls states, "Je n'ai jusqu'à présent jamais rencontré dans le noyau des perles de *Pinna* rien qui ressemblât à un Distome ou à un Ver quelconque. Mais, dans deux exemplaires, dont un est né dans le parc du laboratoire, j'ai vu très nettement de petits corpuscles ovoïdes, de

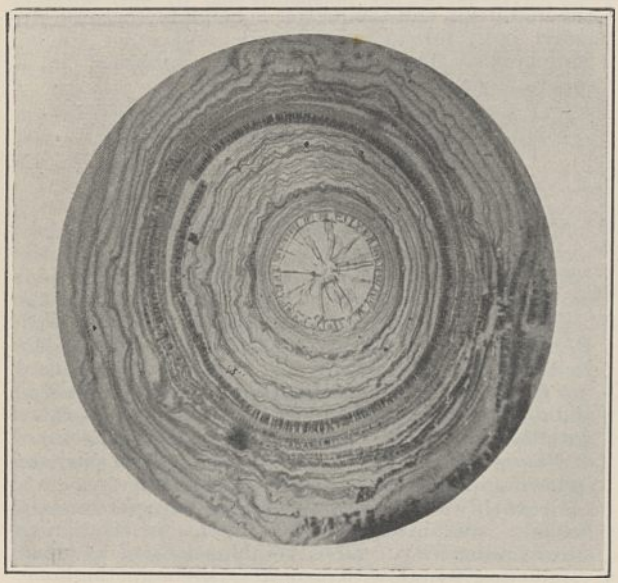

FIG. 1

1 centième de millimètre, dans l'intérieur du noyau; ils étaient semblables à ceux que j'ai signalés dans les perles de Pintadines du Golfe de Gabès et dans les perles de Modioles de la même localité. Je les considère comme des *spores de sporozoaires*."

Thirty-two pearls from the tissues of a *Pinna*, dredged in the Salcombe Estuary in February 1928, were kept in Dubosq-Bouin for about nine months to dissolve the calcium carbonate and to fix any soft organic matter that may be present. All the specimens were dehydrated, cleared, and sectioned by the usual method; four of these could not be completely sectioned as the nucleus fell out in the process. The sections were stained either in iron hæmatoxylin and eosin or in water-blue and safranin. From the work of Alverdes (*Zeitschr. wiss. Zool.*, Bd. 105; 1913), it is known that water-blue stains the conchyolin of the nacreous layer, and safranin the periostracum.

On microscopic examination, sections of twenty pearls showed that there were few concentric conchyolin bands in which the supporting organic matrix was radiating out in a manner similar to that found in the shell of *Pinna* as shown by Biedermann (*Jenaische Zeitschr. f. Naturwiss.*, Bd. 36; 1902; Taf. 1, Fig. 5); the arrangement of the layers in seven other pearls showed that it was identical with that found in 'white' pearls of *Ostrea edulis*, except that there were no discontinuous layers of brown horny material; one pearl had an alveolar layer round the nucleus, with the normal arrangement of concentric layers on the periphery, as shown in Fig. 1, and still another had an alveolar layer on the outside, added to the two layers already present as described in the previous one.

It was also observed that one pearl had small ovoid corpuscles in the nucleus, probably similar to those found by Dubois (loc. cit.); one had a network of conchyolin which stained blue, indicating that before decalcification there was a piece of nacreous material; eight had an irregular mass of conchyolin, the remnant of an amorphous layer; twenty-one had brown conchyolin which was not acted upon by either of the stains, and finally, the nucleus of one could not be ascertained. Thus it would appear that in *Pinna*, the origin of pearls is due to abnormal secretion of the epidermis, a view similar to that enunciated by Jameson (*Proc. Zoo. Soc.*, 1912) for the Ceylon pearl oyster.

C. AMIRTHALINGAM.
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University College, London.

The Methodology of the Inexact Sciences.

ON the rare occasions when I dip into some book on one of the non-quantitative sciences, such as those which deal with folk-lore, analysis of literary documents, or the human unconscious, I am puzzled and a little scandalised by a canon of logic which appears to be very freely adopted in these branches of thought. It consists in the use of the following argument: "It is possible to work out an analogy between *A* and *B*. Therefore *A* must be the cause of *B*, or vice versa." This canon used to be used very freely in the interpretation of sacred writings, and especially of prophecy, but it seems now to have passed over intact into the sciences I have mentioned above.

To give one example: in the very interesting article on "Christmas Customs and their Origins" in NATURE of Dec. 22, it was stated that "the Cave of Mithra survives in the cult of the Manger" of Bethlehem. The reason implied for this attribution is that there are two analogies between the two cults—(1) That both relate to events which took place indoors (any event must take place either indoors or out of doors, so that the coincidence is not a very surprising one); and (2) that in both cults animals are represented. It happens that the Mithraic animals—the snake, bull, scorpion, and dog—are different from those found in the stable, but in any case amongst agricultural people animals are so ubiquitous that there seems to be nothing very remarkable in the fact of their presence. This, then, is the argument: 'In Mithraism and in the Catholic Crèche you have (1) an indoor transaction, and (2) animals present (although of different species and characters); hence the cult of the manger is a survival of Mithraism.'

Arguments of this type constantly recur in the non-quantitative sciences—notably in the phallic interpretation of dream symbols. They appear to me to be fallacious, for the reason that *it is almost always possible to trace an elaborate analogy between any two groups of events whatever, chosen at random.* Any biography can be used to interpret any dream: Freud's "Gradiva" affords an outstanding example of this fact.

There is, of course, no harm whatever in the innocent pursuit of tracing such analogies, but it seems extremely misleading to apply the same term,

'science,' to those studies which employ the method freely, as to other studies in which quantitative measurement or statistics play a part and in which objective verification is practicable. Would it not be preferable to coin some other term to denote the former—a suitable one could surely be found in the writings of Philo of Alexandria, who excelled in the method of research under discussion.

C. W. HUME.

14 The Hawthorns,
Finchley, London, N.3,
Dec. 31.

I HASTEN to reassure Capt. Hume. No right-minded anthropologist would regard the argument framed by him as scientific. A science need not be judged by its camp followers and aberrant devotees. Mathematical demonstration is possible only in proportion to the degree of abstraction. The criterion of proof in each science depends upon the character of its subject matter and the potentialities of the methods which that subject matter admits. To estimate the conclusiveness of a proof, apart from the general rules of logic, in any given subject must therefore, to a considerable extent, depend upon knowledge and training. Capt. Hume's example is not well chosen. The connexion between Christianity and Mithraism, as well as other forms of paganism, is dependent not upon one or two resemblances, which might be fortuitous, but upon a series of similarities sufficiently close to warrant their being regarded as identities, quite apart from the admission of the early Christian Church that borrowing and assimilation had taken place. THE WRITER OF THE ARTICLE.

Blue Rock Salt.

IT was suggested by Prof. Baly that the blue colour of certain specimens of rock salt from Stassfurt might be explained by a difference in energy content between the blue and the ordinary colourless salt, and that this difference might be manifested by a difference in the heats of solution of the two varieties.

That there must be a higher energy content in the blue form was shown by heating some of the blue product to about 350° C. in an electric muffle in a dark room. A distinct glow was observed soon after dropping a blue crystal on the floor of the muffle, and after the glow ceased it was found that the blue colour had disappeared without disintegration of the crystal. Colourless portions of rock salt, taken from different parts of the same sample, showed either no glow at 350° C. or only the faintest trace, which was probably due to the presence of a few specks of blue salt enclosed in the white.

No light was emitted on dissolving blue salt in water, nor could any radiation be detected by a panchromatic plate.

Several series of experiments were carried out on the relative heats of solution of the blue and colourless salt, in an adiabatic calorimeter, and by using the same range on the Beckmann thermometer throughout each series, any error due to scale inaccuracy was eliminated. These experiments resulted in a difference of only about 0·5 per cent, the blue portions having a smaller negative heat of solution, as was to be expected. This corresponds to a difference of only two thousandths of a degree between the falls in temperature on solution of the blue and white portions under the best conditions that could be attained.

Experiments were also carried out on the relative heats of solution of purified sodium chloride and of specimens of blue salt prepared by means of cathode rays, in the hope that a larger difference in the heats of solution might be obtained than in the case of the natural product. The difference was now found to be 1·5 per cent; but this cannot be directly compared with that obtained in the case of the Stassfurt halite, because the artificially prepared blue salt was found to give an alkaline solution, whereas the natural variety gives a neutral one. This points to a liberation of heat due to a reaction between metallic sodium and water, and it is therefore not justifiable to rely on the heat of solution as a measure of the energy associated with the coloured state in the case of the artificially prepared blue salt.

Whilst the investigation shows that there is a very slightly greater energy content in the coloured than in the colourless halite, the difference was found to be too small for accurate determination.

(During the preparation of pure sodium chloride it was observed that by fusing it in a platinum vessel in air, a product was obtained which invariably gave an alkaline solution. This is contrary to statements in the literature, and the matter is being further investigated both for sodium chloride and other similar compounds. The results will be published in a separate communication.)

F. C. GUTHRIE.

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Newly Discovered Superconductors.

AT the Glasgow meeting in September last of the British Association, I read a paper on investigations on superconductors which I am carrying out in the cryogenic laboratory, Leyden, in co-operation with Prof. van Aubel, of Ghent, and Mr. J. Voogd, of Leyden. In my opinion, the superconductivity of the metals is not only connected with the electron configuration in the atoms, but also with the atomic weight and perhaps with the zero-point energy (*vide* W. J. de Haas, *Journal de Physique*, **9**, 9; 1928). From this point of view the following investigations may be interesting.

Recently we have investigated not only pure metals, but also combinations of two metals in relation to superconductivity. First, combinations of a superconducting metal with a non-superconducting one, namely, copper, silver and antimony with the superconducting tin, bismuth with the super-conducting thallium. The combinations of antimony with tin and of bismuth with thallium become superconductors. The resistance of Ag_3Sn diminishes continually from about 3·4° abs. to 1·3° abs., without vanishing, however. (The resistance of the 'classical' superconductors diminishes within a temperature interval of $\frac{1}{30}$° to $\frac{1}{50}$° from a measurable to an unmeasurable value.) Perhaps this combination represents a transition case, as the combination of copper with tin (Cu_3Sn) does not become superconducting.

I formed the opinion, however, that combinations of two non-superconducting metals could also form a superconductor. The atomic weights of the metals considered are: copper, 63·57; silver, 107·88; tin, 118·7; antimony, 120·2; gold, 197·2; mercury, 200·6; thallium, 204·0; lead, 207·2; bismuth, 208. The eutectic alloy of gold–bismuth was chosen. As to their atomic weights, these two metals lie just below and just above the group of the heavy superconductors respectively. (The numbers of the electrons in the outer layers for gold, mercury, thallium, lead, bismuth, are 1, 2, 3, 4, 5 respectively.)

Again, in co-operation with Prof. van Aubel, who had prepared the samples, and with Mr. Voogd, the resistance–temperature curve was determined. The combination gold–bismuth really becomes superconducting. The fall of the resistance is very great. The

resistance, which is 0·7 of its value at room temperature at about 2·1° abs., has vanished $\frac{1}{20}$° lower. The level, from which the resistance falls steeply, lies about three hundred and fifty times higher than for the 'classical' superconductor mercury, and about a thousand times higher than for the 'classical' superconductor tin.

Of course, it may be that superconductivity is a much more general property than has been supposed until now. At 1·5° abs., however, neither gold nor bismuth is a superconductor.

W. J. DE HAAS.

University of Leyden,
Dec. 28.

The Arc Spectrum of Chlorine.

L. A. TURNER (*Phy. Rev.*, vol. 27, p. 397; 1926) discovered the fundamental or resonance lines of chlorine due to the transition $4M_2(M_2 \leftarrow\!- N_1)$. De Bruin (*Amsterdam Proc.*, vol. 30, p. 20; 1927) found a number of lines in the visible with the constant frequency difference of 530, and Laporte in a note to NATURE (vol. 121, p. 1021; 1928) announced the discovery by Asagoe of a set of lines between λ4700 and λ4200, which he ascribed to the transition $4M_2(N_1 \leftarrow\!- N_2)$.

In a paper to the *Indian Journal of Physics* (vol. 3, p. 67; 1928), it has been shown that if a group of successive elements (for example, Al, Si, P., . . , . . , K) be taken, the wave-numbers of the lines of the elements due to the transition $N_1 \leftarrow\!- N_2$, increase linearly with the atomic number. This enables us to predict that the lines of chlorine arising from the above transition will lie in the infra-red, the strongest line having the wave-length λ8400. The lines of chlorine which Laporte mentions cannot, therefore, be due to the transition $4M_2(N_1 \leftarrow\!- N_2)$, but may be due to the transition $4M_2(N_1 \leftarrow\!- O_2)$, forming the higher Rydberg sequence of the infra-red lines. Using a special kind of chlorine tube, I have been able to photograph these infra-red lines on a neocyanine plate. The lines lie exactly where they were expected. The quartet combinations, namely, $^4(PD)$ and $^4(PS)$, have been obtained, the $^4P_{321}$-differences being 530 and 340. The $^4(P\bar{P})$-lines lie beyond λ8700 and have not yet been obtained. With this data the ionisation potential of chlorine is estimated at about 13 volts.

It is interesting to note here that most of these infra-red lines seem to be identical with some of the unidentified lines in the solar spectrum as given in the "Revision of Rowland's Preliminary Table of Solar Spectrum Wave-lengths" by the staff of the Mount Wilson Solar Observatory. Infra-red lines of sulphur have been traced in the sun by Meissner (*Phys. Zeit.*, vol. 15, p. 668; 1914), but the corresponding argon lines are clearly absent. Chlorine lines seem to be present. It may not be impossible that, like the helium lines, these infra-red lines of elements from silicon to argon may come out strongly in the spectrum of the solar chromosphere.

K. MAJUMDAR.

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Nov. 25.

Salmon Disease.

I AM particularly interested in the reference to the work of Dr. F. H. A. Clayton and Miss Isobel J. F. Williamson on salmon disease which appeared in NATURE of Dec. 29, 1928.

As Dr. Clayton refers in his concluding remarks to the possibility of the existence of 'carriers' spreading salmon disease, the following note on the occurrence of this disease among coarse fish may be of interest to readers of NATURE.

In 1914 and 1915 this disease was very prevalent locally among gold fish both in private aquaria and in the laboratory stock. It also assumed epidemic intensity among roach in a private ornamental pond. The occurrence of this disease among coarse fish so well removed from any stream or contact with salmon was of considerable interest. An investigation was made and the results reported to the Board in 1915; from this report the following conclusions are quoted:

(1) That coarse fish are subject to a bacterial disease which resembles in many respects that occurring among salmon.

(2) That this disease, or a disease producing similar pathogenic conditions, occurs fairly commonly among coarse fish both in aquaria and in relatively open situations where salmon and similar fish do not occur.

(3) The great similarity between the diseases found attacking coarse fish and salmon, and also between the organisms isolated, suggests that it is one disease fairly frequent among coarse fish generally, and that occasionally it attains a marked virulence among salmon and is then known as the 'salmon disease.'

Since this investigation was made the disease has not been so prevalent and the laboratory stock has been relatively free, but roach taken from a local lake in May last were infected with this disease. It would appear, therefore, that the disease is endemic among coarse fish, where it may attain epidemic virulence as in the 1914–1915 outbreak, and that coarse fish may readily provide the necessary 'carriers.'

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The Average Life Period of an Atom.

I QUITE agree with Dr. Jeffreys (NATURE, Jan. 19, p. 87) that a reader of my original letter would not have gathered much about Dr. Jeffreys' views on earth history from my remarks about the average life period of an atom. The whole point of my letter was that as the earth at present appears to be approximately in thermal equilibrium, the life period of a terrestrial atom must be very large compared with that of the universe. Dr. Jeffreys' contention that 13 per cent approximately of the present heat loss must, of necessity, be attributed to primeval heat, leaving only 87 per cent to be explained by all atomic disintegration processes, known or unknown, only strengthens this proposition.

Personally, I am not prepared to accept Dr. Jeffreys' view that the equation of heat conduction in a solid material is sufficient to determine the whole past and future history of the earth's crust. At certain epochs in that history it is possible that we may be confronted with the problem of a liquid substratum overlain by its own solid. In considering the probable history of such a case, it would appear not to be sufficient to consider the heat flow due to conduction in the upper solid alone. The transference of heat in the liquid layer by convection and the physical properties of the liquid must also be taken into account.

Readers interested in this problem might consult two papers by Dr. Joly and Dr. Jeffreys in the *Philosophical Magazine* for January 1928, and one by Dr. H. H. Poole and myself in the same periodical for March 1928.

J. H. J. POOLE.

Trinity College, Dublin.

Astrophysics and the 200-inch Telescope.

DURING the past few years, NATURE has published from time to time supplements containing the views of some of our leading astronomers and physicists on problems of the structure and history of the physical universe. These supplements have aroused widespread interest, and the progress which has lately been made, and is still going on, in physical astronomy is probably the most significant aspect of the scientific developments of our time. We may perhaps be pardoned for a feeling of pride that in Great Britain we possess some of the most brilliant workers in this field, whose labours have largely determined the direction of inquiry and inspired the forward march. It is a matter of intense satisfaction that we are second to none in the quality and extent of contributions to knowledge of the universe and its laws, and there is every prospect that the position which British astrophysicists have won will be well maintained in the years to come.

Of all inquiries, however, the study of the universe is the one in which an insistence on national boundaries is least appropriate. If British theoretical workers were asked to what they chiefly attribute the present progress they would undoubtedly reply: to the results achieved by the 100-inch telescope at Mount Wilson. Since that famous instrument was installed, not more than ten years ago, the new facts, of the utmost importance, which it has been the means of revealing, can scarcely be appreciated in their entirety and full significance. There is scarcely an advance in theoretical knowledge during that time that does not owe something, directly or indirectly, to the unrivalled light-grasping power and resolving power of this chief among telescopes. Every advance in knowledge depends in the last resort on an inprovement in means of observation, and behind every legitimate theory of the universe is a collection of photographs of fields of stars.

The proposal of the California Institute of Technology to erect a 200-inch telescope, to which we directed attention in NATURE of Nov. 3, is therefore a project of which it is scarcely possible to exaggerate the importance. We have received further particulars of this great undertaking from which it appears that the construction of the telescope itself is but one item in a scheme of wider scope. It is proposed to establish a new observatory consisting of two parts. "One of these will comprise the 200-inch telescope, with its building, dome, and auxiliary equipment to be erected on the most favourable high-altitude site that can be found within effective working distance of the associated groups of investigators and their extensive scientific equipment. The other will be an Astrophysical Laboratory on the campus of the California Institute. This Laboratory will serve as the headquarters in Pasadena of the Observatory staff and the Graduate School of Astrophysics. Its equipment will include instruments and apparatus for the measurement of photographs, the reduction and discussion of observations, and for such astrophysical investigations as can be made there to the best advantage. Its instruments for the interpretation of astrophysical phenomena will be designed to supplement those of the laboratories of the Institute and the Pasadena laboratory of the Mount Wilson Observatory. It will also include an optical shop, but the astrophysical instrument shop will be housed in a separate building, to avoid the effects of the vibration of machine tools."

The promoters of this far-reaching scheme approach the problem in a broad-minded manner which augurs well for its success. "In the operation of the telescope," the statement continues, "the same policy will be maintained which has been followed in the past at the California Institute and the Mount Wilson Observatory of inviting eminent authorities in astronomical and astrophysical research to use the instrument in connection with their investigations. It is hoped that in this way the Astrophysical Observatory will also become an international centre for research."

It is impossible to foresee what further knowledge may come to light if the proposal becomes an accomplished fact: the most important revelations are probably beyond our present powers of anticipation. No one could have foretold that Lord Rosse's great reflector would have revealed the spiral character of the extra-galactic nebulæ, or that the 100-inch telescope would have given us their distances and fine structure. A fairly well defined preliminary programme of research has nevertheless been drawn up. "The increased light-collecting power of the 200-inch telescope should permit further studies of the size and structure of the galactic system, the distance, radiation, and evolution of stars, the spectra of the brighter stars under very high dispersion, the distance and nature of spiral nebulæ, and many phenomena bearing directly on the constitution of matter. The possibility that a 40-foot Michelson stellar interferometer, designed to rotate in position angle, may be attached to the telescope is under consideration. The measurement of the separation of the components of any spectroscopic binary stars within the range of such an instrument would give very complete information regarding the nature of these systems and the masses of their components."

The chief difficulty in the matter is of course the construction of the large mirror, and it remains to be seen whether the confidence of the promoters will be justified. A 22-inch disc of fused silica is already being experimented on. It is proposed to coat it with a layer of bubble-free silica, and afterwards to repeat the experiment with a 60-inch disc, which would be used as one of the minor mirrors of the telescope. If this proves to be satisfactory, a still larger disc will be made before the casting of the 200-inch disc is attempted. It is intended to employ the exceptionally small focal ratio of 3·3 for the 200-inch mirror. "The field of sharp definition in the principal focus of such a

mirror will be small, but the possibility of photographing extremely faint stars, especially in the spiral nebulæ, makes such a powerful concentration of light highly advantageous. Dr. Ross, who will devote himself to these optical problems during the coming year, also believes that a lens can be designed, for use in the converging beam, which will serve when desired to give a much larger field, also with a short equivalent focal length. It is planned to use a Cassegrainian combination with a ratio of F : 10, having a sharp field 30′ (17 inches) in diameter, for spectrographic and other work. A Coudé arrangement similar to that of the 100-inch Hooker telescope, permitting the images of celestial objects to be formed in a constant temperature laboratory, for study with large fixed spectrographs, radiometers, or other auxiliary instruments, is also projected."

The device of overcoming the difficulties of casting so large a disc by making only the surface layer of homogeneous material recalls a somewhat similar idea put forward by Sir Norman Lockyer so long ago as the year 1884. He proposed the construction of an 8-foot reflector, of which the body of the mirror was to be of porcelain and the surface of glass. At that time astronomical photography was in its infancy, and Lockyer's ideas of the work which could be done with such an instrument, revolutionary as they then were, have a very modest appearance beside the schemes now contemplated.

In the matter of mounting the telescope, much additional study will be required before even a preliminary design can be adopted. It is hoped that "an equatorial design of the fork type, of sufficient rigidity to carry a 40-foot interferometer and meet other severe requirements, will soon be worked out."

In selecting a site for the instrument, precise measures of the 'seeing' rather than estimates have been aimed at. Dr. Anderson has devised "a simple means of measuring the atmospheric oscillations of star images under a power of 600 with a 4- or 5-inch telescope, and Mr. Ellerman has tested it satisfactorily on Mount Wilson, in comparison with the estimates of experienced observers with the 60-inch and 100-inch telescopes. Preliminary observations with this method by Messrs. Ellerman and Humason have been made at Palomar Mountain and 'Horse Flats' (north of Mount Wilson), and some tests made by Dr. Abbot and Mr. Moore at Table Mountain show that this site, like the others, deserves careful examination. Dr. Hubble, with the kind co-operation of the authorities of the Grand Canyon National Park, is engaged in the investigation of conditions near the Grand Canyon and at other points on the high plateau area of Central and Northern Arizona."

The thoroughness which is evident in this part of the plan is characteristic of the whole. Not only the installation of the great telescope itself, but also the arrangements for all the auxiliary instruments and apparatus used to receive, record, and interpret the celestial images, are being subjected to a searching inquiry by an army of the greatest experts in the United States. If determination, skill, and energy can bring the plan to a triumphant issue, it is assured of success. We trust that the practical difficulties of so enormous an undertaking will not prove insurmountable.

The Transport of Carbohydrates in the Plant.

VERY little is certain as to the movements of carbohydrates in the plant. It is generally agreed that the green plant can build them up for its own needs in leaves exposed to the light, and that these supplies are then utilised in growth throughout the plant, so that considerable movements of sugars must take place from the leaves to the roots and fruits and various storage organs. There is no agreement, however, as to the tissue through which this movement takes place. Only two tissues, regularly present in this plant axis, are so extended in the longitudinal direction as to be very likely to convey such substances for long distances through the axis ; these are the wood or xylem, and the phloem or bast. Usually, the sieve-tubes of the phloem have been regarded as the channels of sugar transport, as micro-chemical observations, such as those of Prof. Mangham, seemed to show considerable quantities of sugar in these tissues. The phloem in many trees is confined to a narrow layer near the periphery, so that it is possible to cut this channel completely by removing a narrow strip of tissue from the outside of the stem, and there is evidence that such ringing experiments always interfere with carbohydrate transport. Prof. H. H. Dixon pointed out, however (NATURE, vol. 110, 547-551 : 1922), that the xylem sap usually contains appreciable quantities of sugar, and that in the ringing experiment it is very difficult to remove the phloem without doing some damage to the wood. As a result, the wood may be partially blocked, so that the interruption of the carbohydrate movement, attributed to the ringing of the phloem, may be really due to the partial choking of the xylem channels.

In much of the experimental work done to elucidate this problem, the transfer of carbohydrates through the region of the axis experimented upon is gauged by the amount of growth afterwards made as the result of supplies assumed to come from sources on the other side of the ring. Thus Prof. Otis F. Curtis has published a series of observations upon ringed shoots which were defoliated above the ring, and as a result made little growth, presumably through the failure of supplies to cross the ring. In such experiments the plants have obviously to be left for some time following the original ringing operation, and though Prof. Curtis has on many occasions followed up his observation of growth by quantitative analyses of his plants for carbohydrates, nitrogen, etc., it is difficult to know how much the redistribution observed has been determined by metabolic activities connected with growth, and how much it has been directly the

result of the interruption of translocation in the phloem. None the less, the work of Prof. Curtis has established a very strong presumption that the phloem is at least very active in the transfer of carbohydrates and probably many other substances through the axis of the plant. In two recent papers by Messrs. Mason and Maskell in the *Annals of Botany* (vol. 42, January 1928 and July 1928), a great deal of new evidence is supplied which points in the same direction. The Empire Cotton Growing Corporation has recently issued a reprint of these papers,[1] which form an outstanding contribution, based upon an intensive study of the cotton plant, to the solution of the general problem of the transport of carbohydrates in the higher plant. The papers occupy together more than 120 pages, and they describe much suggestive experimental work, with critical discussion of procedure and results, for which reference must be made to the original papers.

The experimental method adopted by Messrs. Mason and Maskell has been to follow, by analytical methods that permitted of certain standard determinations on numerous samples in a limited time, the changes in carbohydrate content in isolated samples of leaf, wood, and bark (the latter tissue including the phloem) within periods of time usually not greater than two or three hours. Sucrose, reducing sugars, and reserve carbohydrates were estimated separately, and the results expressed on the basis of the residual dry weight (total dry weight less carbohydrates) as a quantity that is less liable to fluctuation than either fresh weight or dry weight. Unfortunately, at each sampling an experimental plant is sacrificed, so that large numbers of plants of one strain of Sea Island cotton were grown under as uniform cultural conditions as possible, several samples taken and analysed separately on each occasion, and statistical methods applied to the whole series of results obtained in any one experiment, so that significant correlations and differences might be determined. In these experiments, therefore, any movements of carbohydrates that may be indicated will be the direct result of a fairly rapid longitudinal movement of these substances through the tissues, and not the indirect result of growth activities, which are not likely to produce very appreciable changes in such short time periods.

The immediate result of the new experimental method was to establish a significant correlation between the diurnal variation in the concentration of sugars in the leaf with similar variations in the bark, but not usually in the wood. At a distance some 50 cm. or more below the leaf, the variation of concentrations in the bark seems to follow the same curve, but is two or three hours later in reaching similar points on the curve. Reserve carbohydrates, which fluctuate greatly in the leaf, show little or no change in wood or bark, and are not considered further in the present brief discussion. In experiments in March, fruit bolls were included, and samples of wood and bark lying between leaf and boll. The result was to show significant correlations with similar time lag in the sugar content of leaf and bark and the dry weight increase in the developing fruit.

In September and later months, the results of ringing experiments were examined by the same methods at six-hourly intervals after the ring was made, with the result that above such a ring, made below the leafy region of the plant, an accumulation of sugars was soon observed in both wood and bark, whilst in the 6½ inches of wood and bark just below the ring there is a marked fall in total carbohydrates. In this case correlated changes were noted in both wood and bark, and these and other experiments suggest to the investigators that an accumulation of sugars in the bark at any region is followed by a slow radial transfer of sugar into the wood in this region. Other ringing experiments, however, in which flaps of bark were lifted off the wood and separated from it during experiment by paraffined paper or vaseline, showed that, provided these strips of isolated bark remained connected to the foliar region above by continuous channels in the bark, accumulation of sugar still took place in them, though they ceased in the wood in the same region.

These experiments, on the whole, seem to provide very definite evidence that the major movement of carbohydrates from the synthetic centres of the leaves takes place through the phloem, though the possibility of carbohydrate movement under certain conditions in the xylem is, of course, not excluded. Experiments in the second paper, in which different regions of the phloem are analysed separately, suggest that the inner region, which consists more predominantly of sieve tubes, and possibly to a large extent of developing ones, is the region in which most of the longitudinal movement takes place, because the concentration of sucrose is much higher in the inner region, so that the concentration gradient of sucrose outwards in a radial direction is 300 - 500 times as steep as in a longitudinal direction.

Whilst Mason and Maskell have thus supplied striking experimental evidence in favour of movement of sugars through the phloem, they do not fail to point out the difficulties in the way of understanding this phenomenon. Changes of sugar concentration in the leaf sap are followed by changes in the phloem of the axis, as if the concentration gradient determined the movement of sugar, as it would do in the case of movement by diffusion. But from the rapidity with which these concentration changes are registered at distances of more than fifty centimetres, they calculate that the longitudinal movement of the sugar in the sieve tube is at least 20,000 times too fast to be due to diffusion of sugar through an aqueous medium. Furthermore, there is another stumbling-block in the way of regarding the concentration gradient as the driving force determining movement. In the leaf the variation is principally in reducing sugars, and this is followed by changes in the concentration of sucrose in the phloem. They conclude,

[1] "Memoirs of the Cotton Research Station, Trinidad, Series B, Physiology, No. 1. Studies on the Transport of Carbohydrates in the Cotton Plant." By T. G. Mason and E. J. Maskell. Empire Cotton Growing Corporation, 2 Wood Street, Millbank, London, S.W.1. 1928.

therefore, that sugar moves in the sieve tubes by a process analogous to diffusion, but that the mechanism by which such high absolute rates of movement are maintained is unknown.

In this connexion the possibilities of streaming movements in the segments of the sieve tube might be worthy of further examination. It is a well-known fact that in many elongated living cells the protoplasm of the cell rotates within its wall at speeds which would permit of movement along the cell at rates of several centimetres an hour. There is still the need of transfer from one rotating protoplast to the next on the opposite side of a cellulose wall, but the distance thus traversed by diffusion will not be more than $\frac{1}{100}$ the total distance travelled in the sieve tube. This method of transfer would then result in movement, which would obey the concentration gradient, and yet be very much more rapid than diffusion in water. Mason and Maskell apparently reject it because protoplasmic rotation is rarely seen in the adult sieve tube—although it has been reported by Lecomte. On the other hand, in sections of young developing phloem, as in tangential longitudinal sections through the inner bark of trees, which are mounted in water, most lively streaming movements are usually visible. Strasburger has also shown how readily similar movement can be seen in long cells in the phloem of herbaceous plants which were very possibly developing sieve tubes.

Whilst the adult sieve tube, therefore, may act as a reservoir, which is gradually depleted by local utilisation of its contents, the streaming segment of the developing tube may be responsible for the rapid longitudinal transfer of the carbohydrates. Mason and Maskell eliminated, so far as possible, the complications introduced by growth activities by cutting down the duration of their successive experiments so far as possible. But the inner segment of the phloem in which the very high concentration of sucrose was observed would contain all the young sieve tubes developing from the cambium.

This consideration might throw some light upon a gradient of reducing sugars in the leaf being followed by an equivalent gradient of sucrose in the phloem of the axis. Any enzyme synthesis of sucrose from glucose and fructose *in vitro* has so far proved impossible, and in the light of modern knowledge of the difficulties of sucrose synthesis (NATURE, Oct. 13, 1928, p. 578), this is quite explicable. In the sieve tube it is difficult to see how the direct conversion of reducing sugar to sucrose is to be brought about, but if the reducing sugars are employed in the construction of living protoplasm, which is then utilised in the construction of a new series of sieve tubes from the cambium, in the differentiating sieve tube sucrose may be found instead of the hexoses which originally entered into the composition of the protoplasm. J. H. PRIESTLEY.

Obituary.

DR. J. W. L. GLAISHER, F.R.S.

DR. J. W. L. GLAISHER died on Dec. 7, 1928, at the age of eighty years. At the time of his death he was the senior among the actual fellows of Trinity College, Cambridge; was the senior member of the London Mathematical Society; and was almost the senior in standing among the fellows of the Royal Society and the fellows of the Royal Astronomical Society. In his prime he ranked as one of the recognised English pure mathematicians of his generation, pursuing mainly older subjects by methods that were direct and simple. Throughout his life he was devoted to astronomy, chiefly in its mathematical developments. In the later part of his life he attained high rank as an authority on pottery, of which he had made a select collection, famous and invaluable.

Glaisher was the elder son of James Glaisher, F.R.S., himself an astronomer, a mathematician specially devoted to the calculation of numerical tables, and a pioneer in meteorology, sometimes at the risk of his life. For the father was an aeronaut of note; with Coxwell in 1862 he made the dangerous balloon ascent which reached the greatest height (about seven miles) ever recorded by survivors. This aeronautical achievement inspired a popular music-hall song of the day; and "Up in a balloon, boys," was sung by the undergraduate gallery in the Cambridge Senate-House as the aeronaut's distinguished son was being admitted to his first degree.

James Whitbread Lee Glaisher was born at Lewisham, in Kent, on Nov. 5, 1848. He was sent to St. Paul's School in London, which in 1867 he left as the Campden Exhibitioner. In that year he went into residence at Trinity College, Cambridge; and that was his home for the rest of his life. He was duly elected a scholar in 1868. He graduated as Second Wrangler in 1871, the Senior Wrangler being John Hopkinson, also a Trinity scholar, later the distinguished engineer. He was elected a fellow of his College in that same year; the election was doubly notable, for it was the first held after the parliamentary removal of dissenters' disability of fellowship tenure, and all the three successful candidates (the other two being Hopkinson and the present Dean of Ely) were elected at their earliest date of candidature.

Glaisher was appointed assistant tutor of his College on Oct. 12, 1871, an office that qualified for the lay retention of his fellowship, though celibate restrictions existed for another eleven years. He was tutor from 1883 until 1893, for the then customary normal period. He remained a lecturer on the mathematical staff until 1910, having been continued beyond the normal maximum period by the College Council.

Glaisher never held any permanent appointment outside Cambridge. It was currently believed that, on Airy's retirement in 1881, he refused the office of Astronomer Royal which had been offered to him; the duty would, of course, have exacted

residence at Greenwich. He remained a bachelor. When first a fellow, he lived in Whewell's Court; his rooms then resembled a rather cheerless set of chambers, with pigeon-holes and cabinets for documents, pamphlets, notes of calculations, and bookcases for his growing library. In 1885 he changed into a spacious set of rooms, with a view down the lime avenue across the river away to the Coton fields; with the change, there came a change in the appearance of his surroundings. His library naturally continued to increase. But he began to collect objects of beauty and rarity, in arts of several kinds. Once begun, his collection never ceased to grow, always under his unlimited and unstinted care; yet his favourite working-corner between the fireplace and the window, remembered by every visitor, remained his mathematical shrine of duty to the very end of his life; and, there, a jealously reserved portion of each working day in Cambridge was spent in his mathematical researches with a regularity that never failed.

His personal pursuits, outside his teaching, his research, his attendances at scientific meetings, and his passion for collecting, were varied. He was a vigorous walker, and covered ground at an amazing pace. In his youthful donnish days he rode a bicycle of the 'penny-farthing' type, his tall lean frame lending itself to the claims of that forgotten machine; and he was an active president of the Cambridge University Bicycle Club. In his middle years he often went to the United States to spend vacations with his friends Prof. and Mrs. Woolsey Johnson and their sons; or when they crossed the Atlantic he would have them in Cambridge, or would travel with them on the Continent. He maintained a wonderful vitality and a surprising appearance of comparative youth, even in his early seventies. It was only in the last few years that his health gave way, and it broke badly; but the spirit remained.

In 1875 Glaisher was elected a fellow of the Royal Society. His first original paper, full of cognate historical matter, dealt with the non-evaluable sine-integral, cosine-integral, and exponential-integral, and contained elaborate tables of those integrals, calculated by himself; it had been written by 1870, while he still was an undergraduate, and was communicated by Cayley. He served on the Council of the Society for three periods, 1883–84, 1890–2, 1917–19, during the last of which he was one of the vice-presidents. In 1913 he was awarded the Sylvester medal of the Society.

He had joined the Royal Astronomical Society in 1871, and became a member of the Council in 1874; he remained a member of that Council for the rest of his life, and his fifty-four full years of continuous membership may be a 'record,' to use a popular word of to-day. He held the office of secretary from 1877 until 1883. He was president of the Society in two distinct periods of office, 1886–88, and 1901–3; during those tenures, it became his duty to present the Medal of the Society to G. W. Hill (1887), to Auwers (1888), to Kapteyn (1902), and to Struve (1903), delivering masterly summaries of the original work of the several recipients on the respective occasions.

Throughout his scientific life Glaisher devoted much attention to the affairs of the London Mathematical Society. He was elected a member on Feb. 8, 1872, and he became a member of the Council in the succeeding November; he retired from that body in 1906, after a continuous service between those dates. He was vice-president in 1880, 1881, 1886, 1887; and president in 1884–85. Thus his own experience gave him full knowledge of the development of the Society almost from its beginning. At a meeting in 1926 to celebrate a belated jubilee of its existence, he gave a charmingly genial account of its activity, particularly of its early stages, and of the personal inspiration of members like Cayley, Sylvester, H. J. S. Smith, and Clifford. In that account there was one defect, characteristic of the man: it ignored his own contributions to the Society's influence upon mathematical science. He was awarded the De Morgan medal in 1908. There is no record of his reply of thanks on the presentation; but, as later in 1926, his words—he would have disdained to call them a speech or an address—were the expression of a friendly retrospective review of the Society, of which (so little did he say of himself) he might at the moment have been the least known member, instead of the most honoured.

In early and middle years Glaisher was a frequent attendant at the annual meetings of the British Association. He took an active part in its work, as secretary of Section A for a considerable period, and as a member of several committees dealing with tables of numbers, or with reports upon the progress of various branches of mathematical science. He was president of Section A at the Leeds meeting in 1890: his address dealt with relations between applied mathematics and pure mathematics, at a time when it still was not unnecessary in England to plead occasionally for a fuller recognition of pure mathematics.

It was a matter of course that he was a member of the Cambridge Philosophical Society. He often served on its Council in various capacities, frequently contributed papers to its *Proceedings*, and was in regular demand as a referee upon papers contributed by others. He was president of the Society in 1882–84.

Glaisher proceeded to the newly established degree of doctor of science at Cambridge in 1887; at the time of his death he had come to be the senior in standing among his fellow doctors. He was made an honorary doctor of science by Dublin on the occasion of the tercentenary celebrations of Trinity College; and, later, he received the same honorary degree from the Victoria University. He was one of the British honorary fellows of the Royal Society of Edinburgh, as also of the Manchester Literary and Philosophical Society; and he was a foreign member of the National Academy of Sciences of Washington. He was also president of the Cambridge Antiquarian Society in 1899–1901, an office that is uncommon for a man so actively engaged in mathematical teaching and research

and in the current administration of scientific societies (in the most restricted sense of the term). But, as already indicated, the study of pottery was one of his hobbies: what began as a hobby developed into one of the absorbing interests of his life; and he became[1] ". . . one of the leading pottery collectors of his time. His attention in this direction was at first occupied by Delft ware, but from the Dutch pottery he was led to take an interest in the English wares made in emulation of it, and so in other types of English pottery of early date. The collection which he had been forming through a long period of years is, as regards the 17th and early 18th centuries, the largest collection of English pottery ever made; and it is satisfactory to reflect that, by becoming the permanent possession of the Fitzwilliam Museum, in which a large part of it has already been for many years on view, it will be accessible to all who wish to study it. . . ." It may be added that he had made (and at the time of his death was still engaged in) a catalogue of his collection in nearly forty manuscript volumes, which may well prove a valuable addition to the literature of ceramics.

When he was a lecturer at Trinity, Glaisher had his share of work that belonged to the ordinary round, such as astronomy or hydrostatics for the Tripos range, even a 'poll' lecture. His happiest efforts were devoted to subjects such as differential equations, combination of observations, elliptic functions. In each of these subjects his lectures in the late 'seventies were a revelation to students. The Tripos was never mentioned: the subject was expounded. His exposition was the more illuminating because concurrently (though unknown to his class) he was writing paper after paper dealing with details unmentioned in the text-books (if any); and enterprising students were encouraged to proceed to original sources. Such lectures were an intellectual treat. Then his course on combination of observations was at once critical, synthetic, constructive; he was singularly clear in setting forth assumptions made and the restrictions imposed by the assumptions. But, above all, he revelled in elliptic functions. It was not that he was opening unknown regions of new theories; at that date he never even mentioned the more comprehensive general theory of functions, scarcely known in Cambridge, even by title; but his results were a sheer development of Jacobi's work, the calculations being made with the ease of a controlling master. Some of us who were members of his class used to believe that he had discovered all possible formulæ in elliptic functions and q-series, which were being incorporated in an expected treatise in the grand style. His enthusiasm was infectious; in his lectures there was a human note, something of the nature of the man, a little fun, a little whimsical touch now and then, not untypical of that geniality which marked his intercourse with fellow-men.

Yet Glaisher never published a volume of his own. Perhaps the sheets of that treatise on elliptic functions existed only in our undergraduate imaginations; perhaps they ceased gradually when he found that much of his presentation of the subject was only an incident in the wider theory of functions. Perhaps also, in the midst of his own researches, he was reluctant to devote the time and the labour that are demanded by the preparation of a continuous treatise; there is a germane passage in his presidential address to the London Mathematical Society which might be an autobiographical confession of his own hesitation in attempting such a task. But when others went forward, sometimes stimulated by himself, he was ever the first and the most generous in the recognition of their labour.

The tale of Glaisher's separate papers, mathematical and astronomical, was large, amounting to something like four hundred in all. They were not distributed evenly over his long scientific life. Thus, down to the end of 1873, when he was only twenty-five years of age, he had published more than sixty papers, not all of them brief. In the next ten years—with him, as with many men, the most prolific period of production—he published more than a hundred and fifty. In 1883 he became tutor of Trinity, and held that busy office for the canonical period of ten years; even so, he found leisure enough to produce some fifty papers in that time; and he continued this rate of production more or less to the end, amid the growing absorption of his pottery and, even latterly, in spite of the distractions of discomfort and pain and ill-health.

The subjects over which his published investigations range belong to certain well-defined regions. Glaisher had an unfailing interest in the history of mathematics; he would range over the historical introduction of the plus and minus signs, over the work of Napier and Briggs in the construction of logarithms, to a treatment of recent changes in the Mathematical Tripos. He was fascinated by sheer arithmetical computation and revelled in the construction of numerical tables; or he would be absorbed in the properties of certain numerical functions in the theory of numbers at large. Weird series and extracted identities were an unfailing attraction for his mental activity. Differential equations, mainly ordinary linear equations and their integration in series, absorbed much of his earlier attention. In England down to his time, progress in this subject had centred in formulæ that were 'elegant'; 'symbolic' solutions had been accumulated by the ingenuity of mathematicians like Leslie Ellis, Gaskin, Boole. Of all this lore Glaisher was the master and, in its range, a creator. Yet, wandered he never so far afield, he returned time and again to his beloved elliptic functions.

Mention also must be made of the addresses Glaisher prepared, some of them official, some of them personal tributes. Among the latter may be recorded his NATURE notice of Cayley, early in 1895: his biographical notice of J. C. Adams, prefixed to the "Scientific Papers": and the introduction to the "Collected Scientific Papers of

[1] For the following estimate, extracted from a part of the (unsigned) obituary notice of Glaisher in the *Times* of Dec. 8, 1928, I am indebted to Mr. Bernard Rackham, of the Victoria and Albert Museum.

H. J. S. Smith." He was at his appreciative and genial best in general addresses. His careful lecture, delivered in the ante-chapel of Trinity in 1887, in commemoration of the bi-centenary of the publication of Newton's "Principia," was a wonderful tribute to a great spirit. His address as the president of the London Mathematical Society in 1890 is a valuable monograph on the long history of the Senate-House Examination, more commonly called the Mathematical Tripos, since 1824. The last of his addresses, in 1926, already quoted, may continue to stand as the best authentic history of the early stages of the London Mathematical Society.

In person Glaisher was very tall, slim all his days, with an upright figure which even his long illness could only partially bend. His smile of appreciation was delightful and infectious; when appreciation waxed into admiration, his attractive eyes could glow with sympathetic delight. He was singularly fluent in speech, though he never aimed at eloquence; yet dignified passages abound in his formal addresses. He was a don, not of the old-fashioned type, scarcely indeed of any recognised type; there was no shred of pomposity; there was a persistent note of good-nature, not devoid of the occasional touch of whimsical mischief, with which he sometimes would quiz too seriously solemn persons. The deeper notes of human feeling were not wanting when, as occurred to him during his tutorship, he had to help others to face issues of life and death.

In mathematical science Glaisher now appears to have been a man mainly of stimulating influence upon others, and an inspiring teacher, rather than a pioneer whose manifold contributions to his science could be proclaimed as notable and memorable. The earlier years of his teaching at Cambridge were a time of transition in the mathematical thought and activity of the University. Cayley was almost a voice crying in the wilderness; and Glaisher himself described Cambridge pure mathematicians of those days as generals without armies. When he ceased teaching, Cambridge pure mathematics had gone far beyond his active vision, mainly under men whom, as his students, he had encouraged and stimulated at the beginning. His influence was rather that of the inspired preacher and herald. His voice was that of a great teacher, yet not in any way similar to the great Cambridge coaches of the past; for throughout his life he was ever a contributor to the knowledge of his science as well as a guide through ranges of knowledge outside the conventional examinational learning. He was a distinct personality in his day; a stimulus to other men, especially young men who came within the sphere of his influence; and he has left a name, high among the noted names of his own generation, in two widely different fields of constructive thought and human activity. A. R. F.

WE regret to announce the following deaths:

Sir William Boyd Dawkins, F.R.S., honorary professor of geology and palæontology in the Victoria University of Manchester, the doyen of students of prehistoric man, on Jan. 15, aged ninety-one years.

Dr. H. J. H. Fenton, F.R.S., honorary fellow of Christ's College, and formerly lecturer in chemistry in the University of Cambridge, on Jan. 13, aged seventy-four years.

Prof. Wm. North Rice, emeritus professor of geology in Wesleyan University, president in 1891 of the American Society of Naturalists and a vice-president in 1905 of the American Association for the Advancement of Science, on Nov. 13, aged eighty-three years.

News and Views.

THE paper by Prof. A. S. Eddington on the charge of an electron which appears in the January issue of the *Proceedings of the Royal Society* (vol. A, 122, p. 358), and was read and discussed at the meeting of the Society on Jan. 17, is based upon the fundamental principles of the theory of relativity and of the new mechanics. The so-called exclusion principle of the statistics of Fermi and Dirac prescribes an interaction of two electrons; this interaction is identified with their electric repulsion, and the details of the latter phenomenon can thus be predicted on essentially statistical grounds. The problem is taken to be one of a 'space' of sixteen dimensions, and it follows that the ratio $hc/2\pi e^2$ (where h, c, and e have their usual significance of Planck's constant, the velocity of light and the electronic charge respectively) should be simply the number of symmetrical terms in an array of sixteen rows and sixteen columns, which is 136. The experimental value of the ratio is 137·1, but Prof. Eddington believes that the discrepancy, although some three times the reputed probable error of experiment, does not originate with the theory. Prof. Eddington's conception of the meaning of the factor $2\pi e^2/hc$ can be best given in his own words. It "expresses a kind of property attributed to every pair of points in space; it turns space from a mathematical conception into a possible site of physical phenomena by associating with a pair of points some degree of probability that they may be the scene of this interaction. There is no room for elaborate integrations or for differential equations in the theory of such a fundamental factor." Again: "Modern theory has virtually abolished all structure of an electron," and with this, the expectation "that the value of e would depend on the singular solution of some differential equation expressing the transition from charge to field."

THE issue of the *Proceedings of the Royal Society* for Dec. 3 (Series A, vol. 121, No. A788) is especially interesting to students of quantum-mechanics; it contains no less than five papers which are excellent examples of the process of consolidation going on at both ends of the new theory. Any new theory, naturally enough, especially one developed at the rate of the theory of quantum-mechanics, is liable to be presented at first with a lack of complete-

ness, symmetry, or elegance. The lack of such elements is of course no ground for criticism, but it may prove a stumbling-block to further advances or cause unnecessary difficulty to the student. At the applications end of the new theory we find here papers by Temple and Nordheim—one presenting with really delightful elegance the quantum theory of the scattering of electrons by the field of force of a bare nucleus, the other completing the theory of the emission and reflection of electrons by clean metal surfaces—a theory which is proving of great help in the understanding of thermionic phenomena. At the foundations end of the theory there are papers by Eddington, Whittaker, and Flint. These all aim in different ways at expressing the principles of quantum mechanics in more general or more symmetrical ways than have yet been achieved. The results obtained at this end of the theory are always harder to appreciate than those of the other end; but one cannot avoid the feeling that further steps in the development of the foundations of the theory will not be long delayed.

ON Jan. 28 occurs the centenary of the death of Thomas Tredgold, who, though he died at the early age of forty, yet during the last ten years of his life gave the engineering world three works of first-class importance: "Elementary Principles of Carpentry," an "Essay on the Strength of Cast Iron," and a "Treatise on the Steam Engine." Though not destined to rise to the same eminence as his contemporaries Rennie, Fairbairn, or Stephenson, like them he started life with no advantage of environment, and like them he possessed an untiring industry. Born at Brandon, Durham, on Aug. 22, 1788, he received a village school education, and then at the age of fourteen was apprenticed to a cabinetmaker. From 1808 until 1813 he worked as a journeyman carpenter in Scotland, from 1813 until 1823 was an assistant in the office of a relative, William Atkinson, a London architect, and for the last few years of his life practised as a civil engineer in London. His "Principles of Carpentry," of 1830, was the first serious attempt in England to determine practically and scientifically the data of resistance; his essay on cast iron of 1824 was the earliest systematic treatise on that subject, while his book on the steam engine of 1827 was used by later writers, and enjoyed a popularity equal to that of the later works of Bourne and Rankine. Besides these separate works, which went through several editions, Tredgold wrote valuable articles in the "Encyclopædia Britannica," Thomson's *Annals of Philosophy*, and Tillock's *Philosophical Magazine*. He died in London and was buried in St. John's Wood Chapel Cemetery.

THE recent official announcement that the Government will ask Parliament for a vote of 5½ million pounds for future forestry work in Great Britain will be regarded with satisfaction by all who realise that this matter is one of economic importance to the nation, and should stand outside of party politics. The Forestry Commissioners were appointed, under the Forestry Bill of 1919, for a period of ten years, which comes to an end in April of the present year. A sum of 3½ million pounds was sanctioned for the first ten years' work. The Government now intends asking Parliament to sanction the continuance of the work of the Forestry Commissioners, increasing the grant for the next two years by 2 million pounds. In addition, the Commissioners anticipate receiving a total revenue from forest receipts of £1,400,000 during the next ten years. With these sums they expect to provide 225,000 acres of new plantations, to devote £1,000,000 to forest workers' holdings, and to make grants for other purposes, including the planting of municipal and private lands and forestry education and research.

THE ten years' work of the Forestry Commissioners now coming to an end has not proceeded without some of its operations being called in question in more than one part of Great Britain. This has proved rather an unfortunate aspect of the new work, since it has led to the attitude and acts of the Commissioners being regarded with suspicion by many who should have been secured as active allies. From the professional point of view the forest policy of the Commission, where such has been apparent, is open to grave doubts. The concentration, for example, on the formation of coniferous plantations (124,000 acres), and the total neglect of our valuable British broad-leaved species (4000 acres only in the period), has been strongly criticised. On the other hand, the Commission has put through a great deal of good work, and its well-wishers will hope to see it continued. It may be suggested, however, that the House of Commons, when considering this vote, should make itself acquainted with the work undertaken during the past ten years. Over that work the House has had little control, since the Commission, unlike all other departments of the State, is not under a Minister of the Crown.

THE second annual Report of the Oxford Preservation Trust, recently issued, gives an interesting record of the past year's achievements in the way of saving many of the sites in and around Oxford from the damage done to the amenities of the city by ill-considered building operations. An excellent map which accompanies the report shows five several plots of country within the five-mile radius which have been secured from the intrusion of the speculative builder by private benefaction and by the present Trust and its predecessor. The fauna and flora of the Oxford district are well known to be of a rich and varied character, as was amply shown by the volume on the natural history of the district brought out under the editorship of Commander J. J. Walker at the time of the meeting of the British Association in 1926. Even then the growth of the city had done much to deprive the immediately surrounding country of its suitability for the support of wild life; but it is satisfactory to know that some compensation for the loss is to be found in the sites saved from further encroachment through the activity of the Trust. In the words of Prof. E. G. R. Waters, speaking of the micro-lepidoptera, "the many sheltered woods and copses, rough pastures and swampy meadows, which are the principal habitats of these delicate and local insects,

have been much reduced by the constant advance of cultivation, cattle, building, and (most destructive of all) golf-links; but the remarkable concentration of lepidopterous life in some of the surviving localities partly compensates for what they have lost in extent." The reconciliation of commercial with æsthetic aims within the city itself—a still more difficult problem—is also being taken in hand by the Trust, which makes a strong appeal for pecuniary help.

AT the time of writing, little is known about the strong earthquake that, at 7.24 A.M. on Jan. 17, destroyed many buildings at Cumana, an important seaport town of Venezuela. Though the damage to the town is considerable and is probably greater than the early reports indicate, the earthquake seems to have been far inferior in strength to the great shocks that destroyed the town on Oct. 21, 1766, and Dec. 14, 1797. The latter earthquake, which occurred nearly two years before Humboldt's visit to the country—he himself felt two of its after-shocks on Nov. 4, 1799—is described in his "Personal Narrative" (translated by H. M. Williams, vol. 2, pp. 214-238; vol. 3, pp. 316-327). The number of lives lost was 16,000, while the first official estimate for the recent earthquake places the number at 30. Humboldt notices that, both in 1766 and 1797, swellings were observed in the shoal of Morro Roxo, near the mouth of the Rio Bordones. He traces the migration of the focus from the south coast of the Gulf of Cariaco in earlier years to Cumana in 1797, and attributes it to the opening of new underground communications, and remarks that the rapidity with which the undulations are propagated to great distances proves that the centre of action or focus—he was one of the earliest to use this term—is very remote from the surface of the globe.

ON Jan. 19 a conference was held at the John Innes Horticultural Institution, Merton Park, London, S.W., to mark the hundredth anniversary of the birth of the founder, John Innes. John Innes was a city merchant of an old Scottish family, who with his brother bought a considerable estate in Merton, and while living there proceeded to build what was then the pleasant and almost isolated suburb of Merton Park. John Innes in his lifetime gave many examples of his generosity to his neighbours, and finally left his residual property to found a school of gardening. As the endowment promised to become of considerable value, the Charity Commission, in drawing up the scheme for the administration of the trust, made provision for a research station which at the same time would train practical gardeners. The Institution thus founded began work in 1908, and, being fortunate to obtain the late William Bateson as its first director, became immediately identified with the then young study of genetics.

THE conference on Saturday last dealt with various aspects of polyploidy, as a source of species and horticultural varieties. After Mr. J. B. S. Haldane, for the benefit of the non-technical part of the audience, had explained what a polyploid was, Dr. C. C. Hurst illustrated by reference to the genus *Rosa* how cytology discriminates between species and varieties. Prof. E. W. MacBride objected that such distinctions are unknown among animals. Prof. Ruggles Gates discussed the origin of polyploids, and the variation of the size of the cells with polyploidy, but, as he and other speakers pointed out, it is difficult to make any generalisation that will cover all the cases. Dr. C. D. Darlington discussed the pairing of the chromosomes in polyploids, and Mr. J. B. S. Haldane, in explaining the laws of inheritance in polyploids, showed that their structure involves such a complexity of combinations that the chance of fixing a particular variation is greatly reduced as compared with diploids. Dr. C. L. Huskins dealt with polyploidy in cereals, where such important groups as the bread wheats and ordinary oats are hexaploids. Mr. M. B. Crane gave some remarks on polyploidy in *Prunus* and *Rubus* preparatory to a demonstration of some of the seedlings that have been raised at Merton. Miss Pellew demonstrated polyploidy in *Primula kewensis*, and Dr. F. W. Sansome some of the tetraploid tomatoes that can be produced vegetatively.

SIR WILLIAM BRAGG described recent progress in crystal analysis in his discourse delivered at the Royal Institution on Friday, Jan. 18. Discussing the use of X-rays in revealing the structure of solids, Sir William dealt with the results which have followed their application to the examination of alloys. In pure copper the atoms are piled together in close packing, like spherical shot; each sphere then touches twelve neighbours. When a small number of zinc atoms are added, they distribute themselves at random amongst the copper atoms without disarranging the pattern very much. But there is a limit to this addition. If too much zinc is put in a new pattern is formed, in which each atom now has only eight neighbours. As more zinc still is put with the copper, a very complicated pattern is formed, the unit of which is twenty-seven times as large as in the preceding case, and there are fifty-two atoms in it; this alloy is very hard and brittle. Curiously enough, there is an alloy of copper with aluminium, and again of copper with tin, in which the same properties are exhibited, the same pattern is found, and the same number of atoms in the pattern: moreover, there is the same number of free electrons. These curious alloys are composed of five atoms of copper to eight of zinc, nine of copper to four of aluminium, and the third very approximately in the ratio of thirty-one of copper to eight of tin. In each case there are thirteen atoms to twenty-one electrons. These new and interesting results are due mainly to the work of Owen and Preston, Bradley, and Bernal in England, Westgren and Phragmén in Sweden. They open up new ideas of the conditions in the alloy. They suggest that we ought not merely to think of an alloy as a mixture of atoms, but in some cases at least as a mixture of electrons with atoms, the latter having considerable latitude as to nature.

IN his presidential address, delivered on Jan. 16 to the Royal Meteorological Society, on "Amateurs as

Pioneers," Sir Richard Gregory stated that until relatively recent times all scientific societies were organisations of amateurs. At a later stage, when their inquiries became of practical value, professional institutions are established, and much of the work is taken over by industrial or national services. In the middle of last century, James Glaisher formed an organisation of voluntary observers for meteorological records, and the Royal Meteorological Society maintained this service until it was taken over by the Meteorological Office in 1912. The systematic collection of rainfall records, which was started by G. J. Symons in 1859, has similarly become part of the organised work of the Meteorological Office. The systematic study of upper air conditions, now carried on for practical purposes of aviation, originated with W. H. Dines and C. J. P. Cave. It was an amateur, Benjamin Franklin, who established the identity between the discharge from an electric machine and lightning by his famous kite experiment in 1752. An amateur also, Oliver Heaviside, first pointed out that electromagnetic waves might be reflected by a conducting layer in the upper air, now called the Heaviside layer, which makes radio communication around the world possible, and amateurs first established world communication with short waves, 300 metres or less in length. In transport also, through the experiments of Wilbur and Orville Wright, the conquest of the air has been due chiefly to the pioneer work of amateurs. Every encouragement should be given, therefore, to all such voluntary workers in scientific fields.

THE following officers were elected at the annual general meeting of the Royal Meteorological Society, held on Jan. 16:—*President:* Sir Richard Gregory; *Vice-Presidents:* Mr. R. Arniston, Lieut.-Col. E. Gold, Mr. I. D. Margary, and Mr. R. A. Watson Watt; *Treasurer:* Mr. F. Druce; *Secretaries:* Dr. C. E. P. Brooks, Commander L. G. Garbett, and Dr. A. Crichton Mitchell; *Foreign Secretary:* Mr. R. G. K. Lempfert.

THE following officers were elected at the meeting of the Royal Microscopical Society on Jan. 16:—*President:* Mr. J. E. Barnard; *Vice-Presidents:* Dr. R. S. Clay, Dr. J. A. Murray, Dr. A. S. Parkes, and Mr. E. A. Robins; *Treasurer:* Mr. Cyril F. Hill; *Secretaries:* Prof. R. Ruggles Gates and Dr. Clarence Tierney.

PROF. D'ARCY W. THOMPSON, professor of natural history in the University of St. Andrews, has been elected a corresponding member of the Société de Biologie, of Paris.

PROF. P. W. BRIDGMAN, Hollis professor of mathematics and natural philosophy at Harvard University, will deliver the Guthrie Lecture for 1929 of the Physical Society of London on April 19 next.

MR. FRANCIS P. LE BUFFE, managing editor of *Thought*, objects to a comment made in an article on "Evolution and Fundamentalism," in NATURE of Dec. 22. He did not in his article in *America* suggest "that science should be looked on askance." In a letter correcting this remark he adds, however, "I did most emphatically suggest that so-called 'scientists' and romancing scientists should 'be looked on askance.'"

MR. THOS. J. OFFER, a member of the organising committee of the scientific, optical, and photographic section in the forthcoming British Industries Fair, informs us that readers of NATURE who may be interested can obtain an invitation ticket to the Fair on application to the Department of Overseas Trade, 35 Old Queen Street, S.W.1. The scientific instrument section of the Fair has grown considerably in size and importance (see NATURE, Oct. 20, 1928, p. 631), and we hope that all scientific workers who are at hand will take the opportunity of visiting it.

ON Tuesday, Jan. 29, at 5.15, Prof. Julian S. Huxley begins a course of six lectures at the Royal Institution on evolution and the problem of species, and on Thursday, Jan. 31, Sir William Bragg gives the first of three lectures on the early history of X-rays. The Friday evening discourse on Feb. 1 will be delivered by Prof. J. L. Myres on geometrical art in south-eastern Europe and western Asia, and on Feb. 8 by Mr. C. E. R. Sherrington on recent problems of rail transport.

AT the monthly general meeting of the Zoological Society of London, held on Jan. 16, it was stated that the total number of visitors to the Society's Gardens during the past year was 2,225,662, the receipts amounting to £71,656, an increase of more than £3000 as compared with the previous year, and an increase of nearly £10,000 when compared with the average for the previous five years. The year 1928 was by far the best in the history of the Society. The visitors to the Society's Aquarium during the year numbered 444,177, the receipts amounting to £17,393, showing a decrease of £900 as compared with the previous year.

AT the autumn meeting of the Iron and Steel Institute at Bilbao, Prof. Henry Louis, formerly professor of mining and metallurgy at Armstrong College, Newcastle-on-Tyne, was unanimously nominated for election as the next president of the Institute, and he will take office at the annual meeting in London on May 2. Prof. Louis being a prominent citizen of Newcastle-upon-Tyne, the members resident in that neighbourhood considered that it would be very appropriate to hold the autumn meeting of this year in that city, and the Lord Mayor and corporation of the city have sent a cordial invitation to the Council of the Institute to hold the meeting there. The date of the meeting has been fixed for Sept. 10–12.

RECENT appointments to scientific and technical departments made by the Secretary of State for the Colonies include the following:—Mr. D. P. McGregor to be geologist in the Gold Coast, and Mr. K. R. S. Morris, assistant entomologist in the same Colony; Mr. J. D. Shepherd to be irrigation officer in the Agricultural Department, Palestine; Mr. M. Vardy to be manager, Experimental Fruit Farm, Sierra Leone; Mr. E. Messervy to be veterinary officer in Tanganyika Territory. Among the transfers and

promotions are the following:—Mr. H. M. Gardner, senior assistant conservator, to be conservator of forests, Kenya Colony; Mr. L. P. Henderson, agricultural instructor, Federated Malay States, to be superintendent, Agricultural Department, Nigeria. Mr. G. N. Sale, assistant conservator of forests, Cyprus, to be director of forests, Mauritius; Mr. D. Stevenson, deputy conservator of forests, British Honduras, to be senior assistant conservator of forests, Northern Rhodesia.

A SHORT catalogue (No. 6) of books, mainly of botanical and zoological interest, has reached us from Mr. J. H. Knowles, 92 Solon Road, S.W.2.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time lecturer in electrical engineering in the Leicester College of Technology—The Registrar, College of Technology, Leicester (Jan. 31). A resident librarian at the Liverpool Medical Institution—The General Secretary, Medical Institution, Liverpool (Feb. 4). A principal of the Kirkcaldy High and Technical School—The Education Offices, Kirkcaldy (Feb. 9). A junior technical officer in the design section of an Admiralty Establishment at Portsmouth—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Feb. 9). A research assistant in agricultural economics and a student assistant in agricultural economics in the Department of Agriculture of the University of Leeds—The Registrar, The University, Leeds (Feb. 11). An assistant in pathological chemistry in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Feb. 26). A bacteriologist in the department of agriculture of the Irish Free State—The Secretary, Civil Service Commission, 33 St. Stephen's Green, Dublin, C.2 (Mar. 19). A senior lecturer in psychology in the Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (April 1). Civilian education officers in the Royal Air Force Educational Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1. An assistant master, to teach physics and mathematics, at the Guildford Junior Technical School—The Clerk to the Governors, Technical Institute, Guildford. A Government chemist for Fiji—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1. Short-service officers in the Royal Air Force—The Secretary, Air Ministry, Kingsway, W.C.2. Aircraft apprentices in the Royal Air Force—The Royal Air Force, Gwydyr House, Whitehall, S.W.1. A junior assistant (male) under the Directorate of Radiological Research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. An assistant civilian experimental officer for a Governmental Experimental Establishment—The Secretary, R.E. Board, 14 Grosvenor Gardens, S.W.1.

Our Astronomical Column.

NEW COMET: SCHWASSMANN-WACHMANN, 1929 *a*.—Prof. A. Schwassmann and Dr. A. Wachmann discovered a very remarkable comet on Nov. 15, 1927, at Bergedorf Observatory. They have now found a second comet; the following details have been communicated in a telegram from the I.A.U. Bureau, Copenhagen: Time of observation, Nov. $17^d\ 22^h\ 21{\cdot}9^m$ U.T.; R.A. $5^h\ 40^m\ 32^s$; N. Decl. 20° 30′; daily motion -28^s, N. 3′; magnitude 11. The comet is close to the ecliptic, and was doubtless discovered, like the other one, in the course of the photography of minor planets that is carried on at Bergedorf. If the motion continues slow, there ought to be no difficulty in picking the comet up by Jan. 25, the moon being then out of the way at the beginning of the night.

RECENT SOLAR ACTIVITY.—A large group of spots crossed the sun's disc between Jan. 11 and 23. The spots were in stream formation with a large leader spot when seen on Jan. 16, but when next observed on Jan. 19, the group had altered considerably and the spots were breaking up. No magnetic disturbance was registered at Greenwich about the time of central meridian passage of the group. Besides this group there was another group, somewhat smaller, about 60° of longitude eastwards and on the other side of the equator. Particulars of position and area of the two groups are as follows:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Max. Area.
1.	Jan. 11–23	Jan. 17·4	7° N.	1/800 of hemisphere.
2.	Jan. 16–28	Jan. 21·8	11° S.	1/1200 of hemisphere.

Sunspot activity during 1928 was considerable. Notes on about a dozen large groups, each seen for at least two or three days as a naked-eye object, were given in NATURE at their times of occurrence. According to a report in *Jour. Brit. Astron. Assoc.* for December 1928, the mean daily area of spots for the year was about 1250 millionths of the sun's hemisphere, as compared with 1058 for 1927 and 1262 for 1926. The maximum of the present cycle is therefore not sharply defined as was that in 1917 of the preceding cycle. The curve for mean areas gives for the present cycle a double peak in 1926 and 1928, whilst the curve plotted from the average daily number of spots, irrespective of size, gives a rather indefinite maximum centring about 1927, although the top of the peak seems to have been reached in 1928. It may be anticipated that the sun's activity will show signs of a decline during 1929.

MARS.—Few results for the present apparition of Mars have yet been published; Dr. W. H. Steavenson has noted the reappearance of a broad, oblique, dark marking sloping upwards to the right, south of Pandoræ Fretum. *L'Astronomie* for December contains some beautiful drawings made at the 1926 opposition by M. E. M. Antoniadi with the 0·83 m. refractor at Meudon. There is some trace of the above oblique band shown on them. He notes that in the regions enjoying summer there is a tendency for yellowish veils, which he ascribes to clouds of fine sand raised from the desert regions, to dim the surface markings. The darker markings showed a great variety of tints; red, green, blue, violet, and brown all appear in his descriptions. Solis Lacus was green in September 1926, greenish grey in November, and brown in December. This marking appears to have expanded in the north-south direction as compared with former years.

Research Items.

EUROPEAN GYPSIES IN EGYPT.—In the *Journal of the Gypsy Lore Society*, vol. 7, ser. 3, pt. 2, Dr. John Sampson, citing a paper published by Capt. Newbold which appeared in the *Journal of the Royal Asiatic Society* in 1856, analyses a vocabulary there given of the Ghagars, one of the three gypsy tribes which the author met in Egypt. The Ghagars themselves spoke of having brethren in Hungary, but this reference had been overlooked by later writers, who had not doubted that they belonged to the eastern Romani groups, which includes the Helebis of Egypt, the Nawar of Palestine, the Kurbat of Syria and Persia, and the Karaci of Asia Minor and Transcaucasia. A re-examination of the vocabulary, however, shows close affinities with the dialects of western Romani, especially of the Balkan and eastern European gypsies, though coupled with borrowings from the eastern Romani with whom they obviously have been in contact for a considerable time. It would appear from their vocabularial and phonetic peculiarities that the Ghagars must have originated in the region of Moldavia, of which Bukowina and Bessarabia are the modern linguistic representatives. In 1322, Symon Simeonis, in his "Itinerarium," recorded the existence of a people in Alexandria and Cairo who from their characteristics were clearly gypsies who had come as prisoners of war from the Danube, and though these are probably too early in date for it to be likely that they are Ghagars, it is possible that the latter are transported prisoners of the later wars between Turk, Hungarian, and Pole in the seventeenth century.

SIGNIFICANCE OF THE MOULTING OF FEATHERS.—In a careful analysis of the succession of moults in the loggerhead shrike (*Lanius ludovicianus*) and its subspecies, Alden H. Miller finds evidence of a correlation with climatic differences (*Univ. California Pub. Zool.*, vol. 30, No. 13; 1928). The adaptive significance in the moult lies in the need for keeping the minimum level of plumage (or flight) efficiency as high as possible. In the wings and tail this end is supposedly accomplished by the alternating moults of different series of feathers, and in the remiges and rectrices, particularly, by the replacement of the least important feathers first, in order that more of the series may be new when the most important feathers are lacking. But this does not meet all the case. The facts that the long central pair of rectrices and the largest of the inner secondaries drop first, and that the alula and outer primaries are lacking at the same time, are not easily explained on the same basis. The author reaches the conclusion, therefore, that although all phases of moult order must be adjusted at least to the extent that the birds are able to survive, there is still to be seen in the moult behaviour of certain feathers, in addition to adaptation, a definite reflection of either embryonic or phylogenetic homologies, or perhaps both. The extent to which all these factors enter in various degree into the moults of different subspecies can only be elucidated by further investigation of the phenomena in this and other species.

AN AMERICAN GENUS OF LIZARDS.—Knowledge regarding the genus *Ctenosaura*, a series of large tree and rock lizards, some of which may exceed three feet in length, has been unsatisfactory, and the extent of the unsatisfactoriness may be gathered from John Wendell Bailey's "Revision," in which the 27 reputed species have dwindled under critical examination by more than 50 per cent (*Proc. U.S. Nat. Mus.*, vol. 73, art. 12, 1928). The thirteen recognised species are confined to Mexico and Central America, and the most widely distributed, and at the same time the most primitive species, happens to be that first described in 1802. The new analysis shows that it is impossible to distinguish *Ctenosaura* from allied genera by any structure of skeleton, and reliance has been placed upon the usual external characters. Indefiniteness also shrouds the geological history of the genus, but it would appear to be closely related to, and to have been derived from, a common iguanid stock, from the headquarters of which in central western Mexico it spread in even waves north and south. At the present day, the transition in morphological characters from this centre of distribution is a gradual one, without any break in the series. These lizards are active and powerful, and are able to inflict nasty wounds by the use of their small sharp teeth, and by the lashing of their spiny tails.

SOME INDIAN FISHES.—Dr. Sunder Lal Hora and Mr. D. D. Mukerji give a detailed survey of the genus *Esomus* ("Notes on Fishes in the Indian Museum, XVI. On Fishes of the Genus *Esomus*. Swainson," *Records of the Indian Museum*, vol. 30, pt. 1, 1928). These are small cyprinid fishes with elongated and strongly laterally compressed body, and amongst other characters, with two pairs of barbels at the corners of the mouth, one pair short and the other pair very long, sometimes extending as far back as the base of the anal fin. These barbels give the fishes a peculiar and distinctive appearance. The genus occurs in British India, Ceylon, Nicobars, Malay Peninsula, Malay Archipelago, and French Indo-China. The authors have reduced the Indian species, of which there were a number, to five. *Esomus danicus* is the commonest, inhabiting ponds and ditches; *E. altus* is a Burmese species, a fine series of which was purchased by Dr. Annandale from the Mandalay market; probably the commonest species in Ceylon is *E. thermoicus*, originally described from the hot springs in Kanniya, but apparently no longer to be found in them. In the same volume of the *Records* the senior author describes a new species of *Brachydanio* and gives a few notes on other Burmese fishes ("Notes on Fishes in the Indian Museum. XV."). In part 2 Mr. J. R. Norman continues his report on the Indian Heterostomata ("The Flatfishes (Heterostomata) of India, with a List of the Specimens in the Indian Museum," part 2), the first part having appeared in the previous volume. The families Soleidæ and Cynoglossidæ are now dealt with. There are eight genera of the Soleidæ in Indian waters and three of the Cynoglossidæ, by far the larger number of these last belonging to *Cynoglossus*. Plates representing four of the Soleidæ show the striking form of *Brachirus macrolepis* and three species of *Zebrias* with their wonderful transverse markings from which the genus is named.

BRYOZOA OF THE AUSTRALIAN-ANTARCTIC EXPEDITION.—Mr. Arthur A. Livingstone, assistant zoologist in the Australian Museum, Sydney, gives a detailed supplementary report on the Bryozoa of the Australian Antarctic Expedition, 1911–14 (*Scientific Reports*, Series C, Zoology and Botany, vol. 8, Part 4, 1928). The first report was made by Miss L. R. Thornely and published in New South Wales by the Australasian Antarctic Publication Committee (Series C, 6, 6, Polyzoa, 1924). It was found, however, that the material sent to Miss Thornely was not complete, as a large portion of it had been overlooked. Hence the present volume, in which the original classification and many of the identifications have been considerably

altered. Two of Miss Thornely's new species have been placed in new genera: *Cellaria membranacea* in the new genus *Mawsonia*, *Aspidostoma obliquum* in the new genus *Pseudocellaria*. *Membranipora elongata* Thornely is shown to be *Ogivalana lata* (Kluge), and this forms only the second record from the Antarctic, Kluge's original description being here supplemented by further notes. The paper is illustrated by beautiful photomicrographs by Mr. G. C. Clutton and by clear diagrammatic text figures by the author.

THE PLANT WALL IN THE LIGHT OF DIGESTION EXPERIMENTS.—Max Rubner gives, in *Die Naturwissenschaften* for Nov. 30, 1928, a general account of the physiological significance of the main components (pentosans, celluloses, and lignins) of the plant wall from the point of view of digestion experiments that were carried out in Germany during the War and the immediate post-War period. From this account, several conclusions of general interest emerge. In experiments upon animals and upon man, there was often a remarkable difference in the degree of digestion of cellulose material from the same foodstuff in different experiments upon the same subjects. Some of this difference may be due to difference in the bacterial flora of the intestinal tract, but the differences are so marked that Rubner concludes they point to the existence of many different forms of cellulose. As the same differences appeared when the purified celluloses from these food products are fed to animals, it does not seem possible to attribute them to the different extent to which the plant membrane is impregnated with fatty substances or lignins. Rubner discusses the wide variations in the methods used by different investigators to separate the lignin from the plant membrane, with the result that very different substances are probably included under this name. In any case it appears from the analysis of pentosans, cellulose, and lignin in a vegetable food material, before and after its passage through the mammalian alimentary canal, that in many cases a certain amount of the lignin fraction must undergo digestion. Whilst it is probably true that heavy lignification is associated with relative indigestibility, it would not seem safe to assume that the only constituent of a lignified plant wall to undergo digestion is any inner lining of pentosan character that may be present.

NITROGEN CYCLE IN THE SOIL.—Carsten Olsen (*Comptes rendus du Laboratoire Carlsberg*), working on the significance of the hydrogen-ion concentration for the cycle of nitrogen transformation in the soil, has determined that ammonification can proceed in soils with *p*H values between 3·7 and 9·0, the process being most active when this value lies between 7·0 and 8·5. Nitrification can proceed in soils with *p*H between 3·7 to 8·8, the optimum being at *p*H 8·3 in soils rich in ammonia. Under natural conditions, in soils with *p*H between 4·0 and 8·0, the rapidity of nitrification is determined by the rate of ammonification, as the latter process limits the former. In strongly acid soil which is rendered alkaline by the addition of calcium carbonate, there takes place very rapidly a powerful nitrification unless it is necessary to add inoculating soil from an alkaline reacting soil. Provided the nitrifying bacteria working in the acid soil are special kinds which cannot work in alkaline soil, the bacteria working in the alkaline soil must either be found in small quantities in the originally acid soil or be introduced in dust. The latter suggestions seem quite feasible, as the nitrifying organisms are not killed when soil containing them is dried out at ordinary room temperature, and transportation as dust from one locality to another is therefore possible.

CLASSIFICATION OF OCEANS AND SEAS.—Oceanographers have made several attempts to find a satisfactory classification of oceans and seas, but no general agreement has yet been reached. M. C. Vallaux has an article on this subject in *La Géographie* for September–October 1928 (vol. 50, Nos. 3-4). He develops the idea that most classifications take too much account of the arbitrary divisions of the waters that are the outcome of practical use, and thus in consequence the important physical considerations tend to be lost to sight. The classification M. Vallaux suggests is a simple one. He recognises four oceans, Southern, Pacific, Indian and Atlantic. The Southern Ocean has climatic limits, lat. 35° S. and the Antarctic Circle. The others have mainly topographical boundaries, except that the Atlantic Ocean ends at the Arctic Circle in the north-east. Seas are divided into four groups. Icy seas (*mers glacées*) are the Arctic sea and the marginal Antarctic seas. Garland seas (*mers guirlandes insulaires*) include the Bering, Okhotsk, Japan, China, and Andaman Seas. Mediterranean seas, which generally have deep basins, mark lines of instability in the earth's crust. Lastly, shallow seas include the Persian Gulf, the Baltic, Hudson Bay, the Gulf of St. Lawrence, the North Sea, the English Channel, and the Irish Sea. According to M. Vallaux, calculations gives the areas of the oceans in millions of square kilometres as follows: Southern, 85·5; Pacific, 126·9; Indian, 42·4; and Atlantic, 58·2. The areas of seas are also given in the paper.

NEW PENDULUM APPARATUS FOR GRAVITY WORK.—Interesting and important advances in pendulum apparatus for the determination of gravity are embodied in the new Cambridge apparatus described by Sir Gerald Lenox-Conyngham, its inventor, at the Royal Geographical Society meeting of Jan. 14. The instrument is made by the Cambridge Instrument Company, Ltd., and many of its parts were specially designed by the late Sir Horace Darwin. The object aimed at was the determination of the time of swing to 2×10^{-7} second, when the time is reduced to its estimated value under ideal conditions, that is, *in vacuo*, at standard temperature, with an infinitesimal arc of vibration, and in a perfectly steady and rigid stand. In the Cambridge apparatus, an airtight chamber is used and the pressure is reduced to between 60 mm. and 80 mm. of mercury, the value being easily measured and controlled, while the pressure constant is well determined. The rods which start or lift and lower the pendulums pass through stuffing-boxes which possess an oil seal. The pendulums are made of nickel-steel, of the same composition as invar, and the temperature correction is small and well-determined. Provision is made for measuring the arc of swing, in order to allow for it. In order to prevent the motion of the pendulum from setting its case and stand in vibration, two pendulums, carefully adjusted to the same period, and swinging in opposite phase in the same plane, are used. In order to eliminate any influence of movements of the pillar on which the apparatus may be placed, use is made of the device of Vening Meinesz, in which a third stationary pendulum of similar construction, and able to swing in the same plane, is placed between the two pendulums. The optical arrangements for observing the motion of the pendulums are ingenious, and are described in detail in the account which is to appear in the *Geographical Journal*.

A NEW METHOD FOR INVESTIGATING γ-RAYS.—A method for finding the direction of hard γ-rays which does not require the delineation of a pencil by screens has been devised by W. Bothe and W. Kolhörster.

It employs instead the fact that secondary electrons which have been set free by waves of very high frequency move off from their parent atoms approximately in the direction of the radiation. The trajectory of the electrons can be found by setting a pair of Geiger electron counters in various positions until they show a maximum number of coincident discharges due to the individual electrons affecting each in turn, when their common axis must be in the line of the incident γ-rays. So far, the authors have only published a short preliminary account of their method (*Die Naturwissenschaften*, Dec. 7), but it has an obvious application to the problem of the origin of the cosmic rays, which can be particularly well studied by means of it because of their extremely short wave-lengths. They mention that when relatively soft rays are excluded by a filter of 10 cm. of lead, the number of coincident discharges of the counters which cannot be ascribed to the presence of radioactive substances is increased threefold by rotation of the detecting system from the horizontal to the vertical.

ELECTRIC HEATING AND VENTILATION.—Most of the problems connected with the electrical heating of rooms have now been satisfactorily solved. A problem which deserves more careful consideration, however, is that of the ventilation of electrically heated rooms, especially when they have no chimney or when, as is usually the case, the chimney has been bricked up. In the case of large shops, where there are crowds of customers, the difficulties to be overcome are many. Messrs. Bourne and Hollingsworth, Ltd., of Oxford Street, London, are to be congratulated on the arrangements they have made for heating, ventilating, and cooling their departments. A full account of the arrangements made is given in the *Electrical Review* for Jan. 11. Provision has been made with the Marylebone Corporation for a supply of 3500 kilowatts. The installation is probably the largest of its kind in the world. The floor space is 160,000 square feet and the volume of the air is two million cubic feet. The air is maintained at an average temperature of 62° F. throughout all the rooms and floors served. It is also renewed seven times every hour. The operating principle employed is that of blowing hot or cold air by means of fans into the various departments. The temperature and volume of the air admitted is regulated from a central control room. From this room all the motors, fans, heaters, and dampers are controlled by switches. The temperatures registered at fifty appropriate places are indicated in the control room and four records can be taken simultaneously. It is claimed that the temperature of the entire building can be maintained within one degree Fahrenheit no matter how the outside temperature and the number of persons in the building vary. This scheme was adopted as the estimates showed that it was cheaper than any of the others proposed.

ROWLAND'S WAVE-LENGTH AND TABLES.—For just over thirty years, Rowland's "Preliminary Table of Solar Spectrum Wave-lengths" has provided the world with a valuable standard of reference. But since it was published our standard of accuracy has risen, a new system of laboratory standards has been developed and adopted, and the time has come for the "Revision of Rowland's Preliminary Table of Solar Spectrum Wave-length," with an extension to the present limit of the infra-red (10,218 I. A.). For this most valuable work we have once more to thank the United States, and in particular Dr. C. E. St. John and his colleagues. In their identifications of the lines they have many physical considerations unknown in Rowland's day to help them towards their decisions; in particular, the knowledge of the excitation potential required to raise the atom from its lowest energy state to the state in which it can absorb a given line is now very frequently known and also the groups of lines which should occur together. Only one criticism need be made of the necessary economy in printing and choice of data to be given. In Table VI. the designations for excitation potentials corresponding to the higher terms involved in any transition might have been added. This would have enabled a student to give the complete multiplet designation of any line in which he was interested without reference to the source used in preparing the main table. The list of references to these sources is not the least valuable part of the volume. We may note that 57 elements have been identified in the sun, and 32 of these as ionised elements also. No evidence of double ionisation has been found. Of the 35 elements not identified definitely, 18 are doubtfully possible of detection. Only 175 lines of intensity 2 or higher remain unidentified. The work is a fine performance, and it is in its favour that it must leave the reader with an even higher opinion of the value and accuracy of Rowland's original table than he had before.

CONTACT CATALYSIS.—The National Research Council of the U.S.A. has recently published the Sixth Report of the Committee on Contact Catalysis, by R. E. Burk, in collaboration with other members of the committee (*Reprint and Circular Series of the National Research Council*, No. 83 (Washington, D.C.: National Academy of Sciences)). The report first appeared in the *Journal of Physical Chemistry*, vol. 22, 1928, p. 1601. In addition to covering new developments, the present report summarises the five previous reports, and an attempt has been made to include relevant work in other fields.

ALKYL ORTHOSILICATES.—The *Journal of the American Chemical Society* for November contains an account by A. W. Dearing and E. E. Reid of an improved method for the preparation of ethyl orthosilicate and the synthesis of a number of new orthosilicate esters. The ethyl orthosilicate has been converted into silica gel by the addition of the calculated amount of water together with 1·5 times its volume of alcohol. This gel, which was free from strong electrolytes, showed the same absorption as ordinary silica gel obtained from sodium silicate, but had a greater catalytic activity. A non-aqueous gel was prepared by refluxing the ester with acetic acid, excess of which was removed by dry benzene.

THE DISCOVERY OF ETHER.—The discovery of diethyl ether is usually attributed to Valerius Cordus (1515–1544). In an article in the *Journal für praktische Chemie* (Bd. 120, 74-88; 1928), Dr. Ernst Darmstaedter critically considers Cordus's account of the preparation of *oleum vitrioli dulce* and reaches some very interesting conclusions. He shows that Cordus first mixed fuming sulphuric acid with alcohol and allowed the mixture to stand for one or two months. At the end of this time the liquid was placed in a distillation apparatus and gently heated "until the alcohol originally added" was removed. The temperature was then raised and the distillate collected. This consisted of two layers, namely, water and the 'sweet oil of vitriol' assumed by later writers to have been ether. Darmstaedter points out that the properties of the oil as described by Cordus do not agree with those of ether, and demonstrates conclusively that the *oleum vitrioli dulce* must have been diethyl sulphate. He believes that Cordus probably never once suspected the existence of the very volatile ether. Cordus mentions that only a small yield is obtained, a statement in agreement with modern observations (Villiers, 1903, says that 200 grams of ethyl alcohol yield only 30 grams of diethyl sulphate).

Annual Prize Awards of the Paris Academy of Sciences.

AT the annual public meeting of the Paris Academy of Sciences on Dec. 17, the prizes and grants awarded in 1928 were announced as follows :

Mathematics.—The Poncelet prize to Gaston Julia for the whole of his mathematical work ; the Francœur prize to Szolem Mandelbrojt for his work in mathematical analysis.

Mechanics.—The Montyon prize to Filippo Burzio for his work in ballistics ; the Henri de Parville prize to F. C. Haus for his researches in aeronautics.

Astronomy.—The Lalande prize to Bernard Lyot for his work on the polarisation of the planets ; the Valz prize to Georges van Biesbroeck for the whole of his astronomical work ; the Janssen medal to William Wright for the whole of his work.

Geography.—The Delalande-Guérineau prize to Paul Serre for his scientific collections during the last thirty years ; the Gay prize to Henri Gaussen for his contributions to the study of the flora, climate, and geology of the eastern Pyrenees ; the Tchihatchef foundation to Eugène Poilane for his botanical and entomological collections in Indo-China ; the Binoux prize (in equal parts) between Carlos Ibañez de Ibero for his work in connexion with the proposed tunnel under the straits of Gibraltar, and the late Paul Soulier for his work on the origin and evolution of the earth's relief.

Navigation.—The prize of six thousand francs to Dieudonné Costes and Joseph Marie le Brix for their remarkable flight ; the Plumey prize to Albert Thuloup for his memoir on the fatigue of thin pipes.

Physics.—The L. Lacaze prize to Charles Mauguin for the whole of his work in crystallography ; the Kastner-Boursault prize to Pierre Auger for his work on the structure of the atom ; the Hébert prize to Jean Granier for his book on electrical measurements ; the Hughes prize to Jean Thibaud for his work on the X-rays ; the Danton foundation to Pierre Bricout for enabling him to continue his researches on the measurement of radiation ; the Clément Félix foundation to Paul Woog for the continuation of his work on oiliness.

Chemistry.—The Montyon prize (unhealthy trades) to Mme. Mélanie Rosenblatt, for her work on the study of poison gas and of the means of protection against it ; the Jecker prize to Victor Auger for the whole of his work ; the L. La Caze prize to Paul Pascal for his work in pure and applied chemistry ; the Cahours foundation to Mme. N. Demassieux for her physico-chemical work ; the Houzeau prize to Albert Portevin for his work in metallurgy.

Mineralogy and Geology.—The Victor Raulin prize to Jean Orcel for his work on the chlorites ; the James Hall prize to Jean Piveteau for his memoir on the Permian of southern Madagascar and its quadruped vertebrate fauna.

Botany.—The Desmazières prize to Léonidas Grigoraki for his work on parasitic fungi ; the Montagne prize to Roger Werner for his memoir on biological and experimental researches on the ascomycetes of lichens ; the de Coincy prize to Mlle. Gabrielle Bonne for her memoir on the pedicel and flower of the Rosaceæ. An honorable mention to (the late) Eugène Perrier de la Bathie.

Anatomy and Zoology.—The Cuvier prize to Louis Boutan for the whole of his zoological work ; the Savigny prize to J. L. Dantan for his study of the plankton flora of the bay of Algiers and other biological work ; the Jean Thore prize to Étienne Hubault for his work entitled "Contribution à l'étude des Invertébrés torrenticoles."

Medicine and Surgery.—Montyon prizes to Maurice Chiray and Ion Pavel (2500 francs) for their work on the gall-bladder ; Edmond Papin (2500 francs) for his book on the surgery of the kidney ; Gustave Worms (2500 francs) for his memoir on the pathological anatomy of the thymus. Honourable mentions (1500 francs) to Albert Berthelot, to Gaston Ramon, and to Mlle. Germaine Amoureux for their biochemical researches on the toxins and their derivatives ; to Charles Foix and Julien Marie for their work entitled "La sclérose cérébrale centro-lobaire à tendance symétrique, ses rapports avec l'encéphalite périaxale diffuse" ; to Édouard Schoull and Louis Weiller for their work on the use of creosote in the treatment of pneumococcus. Citations to Pierre Dombray, Charles Lombard, Jean Nicolaïdi, and to A. W. Turner and J. Davesne. The Barbier prize to Joseph Belot and François Lepennetier for their memoir on the radiographic anatomy of the normal skeleton ; the Bréant prize between Georges Blanc (3000 francs) for his experimental researches on herpes, and Édouard Rist (2000 francs) for his work on tuberculosis ; the Godard prize to Paul Bordas for his studies on the kidney and surrounding tissues ; the Bellion prize to Noël Fiessinger and Henry Walter for their work on the functional exploration of the liver and hepatic insufficiency ; the Larrey prize to Antony Rodiet and Fribourg-Blanc for their work on mental troubles and the War of 1914–1918.

Physiology.—The Montyon prize to Maurice Rose for his work on phototropism and on plankton ; the La Caze prize to Louis Lapicque for the whole of his work in physiology ; the Pourat prize to Robert Courrier for his work on the determinism of secondary sexual characters ; the Martin-Damourette prize to Eugène Jamot for his researches on the treatment of sleeping sickness ; the Philipeaux prize to François Granet for his work on the pseudobranch of fish.

Statistics.—The Montyon prize to Georges Darmois for his memoir on mathematical statistics.

History and Philosophy of Science.—The Binoux prize to André Metz for his work entitled "Une nouvelle philosophie des sciences : Le causalisme de M. Émile Meyerson" ; the Henri de Parville prize (2500 francs) to Alfred Chapuis and Édouard Gélis for their book "Monde des automates, étude historique et technique" ; also prizes (1000 francs each) for the books "Science et travail : Grande encyclopédie illustrée des nouvelles inventions" (editor J. L. Breton) and "Microbiologia aquaria e tecnica," by Gino de Rossi.

Medals.—Berthelot medals to Mme. Mélanie Rosenblatt, Victor Auger, and Albert Portevin.

General Prizes.—The prize founded by the State (Grand Prize of the mathematical sciences) to Georges Giraud for his work on partial differential equations ; the Bordin prize to Louis Fage for his zoological work ; the Lallemand prize to Mlle. Fernande Coupin for her work on anthropoid apes ; the Vaillant prize to Maurice Frechet for his work on abstract ensembles ; the Estrade-Delcros prize to Pierre Jolibois for his chemical work ; the Houllevigue prize between Paul Danguy for his researches on the flora of Madagascar and of Siberia, and Mme. Yvonne Gubler-Wahl for her work on the geological survey of France ; the Saintour prize to Émile Terroine for his researches on the physiology of nutrition ; the Lonchampt prize to Maurice Javillier for the continuation of his work on the mineral composition of plants ; the Wilde prize to Albert Pérard for his work in metrology and physical optics ; the Caméré prize to Louis Biette for his book entitled "Les chemins de fer urbains parisiens" ; the Roux prize to François Divisia for his memoir on rational economics ; the Thorlet prize to Adolphe

Richard ; the Albert 1st of Monaco prize to A. Cotton for the continuation of his researches on powerful magnetic fields.

Special Foundations.—The Lannelongue foundation between Mmes. Cusco and Rück ; the Helbronner-Fould prize to Mme. Marcel Bertrand for assisting the publication of the collected researches of the late M. Bertrand.

Prizes of the Grandes Écoles.—The Laplace prize to Pierre Robert ; the L. E. Rivot prize between Pierre Robert, Alphonse Grange, Roger Dodu, and Marcel Davin.

Foundations for Scientific Research.—The Trémont foundation to André Charrueau for his researches on the equilibria of fluids ; the Gegner foundation to Maurice Vèzes for his treatise on physical chemistry ; the Jérome Ponti foundation to Pierre Cappe de Baillon for his researches on the teratology of insects ; the Hirn foundation to Maurice Gevrey for his work on partial differential equations ; the Henri Becquerel foundation to Paul Lévy for his works on functional analysis.

THE LOUTREUIL FOUNDATION.

The Academy received 31 requests for grants from this foundation, 25 of which were acceded to as follows:

National Museum of Natural History, 11,000 francs for the establishment of a catalogue of the books in the laboratory libraries : 12,000 francs to the École Polytechnique for the use of the library ; 2000 francs to M. Nicolas, director of the National Veterinary School of Alfort, for his biochemical researches on thiourea and its derivatives ; 4000 francs to M. Maignon for continuing his researches, especially on the influence of the seasons and of the genital glands on basal metabolism and the specific dynamic action of foods in the dog ; 4000 francs to the National Veterinary School of Lyons for the completion of sets of foreign periodicals in the library ; 4000 francs to the National Veterinary School of Toulouse for additions to its library ; 4000 francs to the National Agronomic Institute for the completion of sets of periodicals in its library interrupted by the War ; 3000 francs to Paul Nottin for his researches on the saccharification of starch.

Conservatoire national des Arts et Métiers.—5000 francs to Léon Guillet for the purchase of material for researches on the action of repeated stresses on metals and for the development of installations for thermal treatment ; 4000 francs to the library for the purchase of books.

Grants other than to Institutions.—5000 francs to René Jeannel for the publication of parts 57 to 59 of the zoological studies undertaken on material collected in the course of the expedition made by him (with M. Alluaud) in Central Africa ; 5000 francs to Louis Bazy for his researches on the curative and preventative properties of the bacillus of paratuberculous enteritis of cattle and of its extracts ; 5000 francs to Mme. Delage as the last contribution to the publication of the last volume of the biological annual ; 1000 francs to Édouard Doublet for the publication of a historical work on Gustave Lambert ; 2000 francs to Henri Douvillé for the research in the field of fossils permitting the completion of the study of the Rudist limestones of the Pyrenees ; 5000 francs to the "Faune des Colonies françaises" ; 2000 francs to Gaston Fayet to ensure the regular publication of the *Bulletin* of the Nice Observatory ; 5000 francs for the publication of material collected by the cruises of the *Travailleur* and the *Talisman* ; 6000 francs to Henri Humbert to contribute to his studies of the flora of the high mountains of Madagascar and its comparison with that of tropical Africa ; 3000 francs to the Institut d'Optique for the purchase of books to complete its library ; 8000 francs to Jean Mascart to contribute towards the cost of printing observations of work carried out or centralised at Lyons ; 5000 francs to the Paris Observatory for completing the publication of Lalande's catalogue ; 8000 francs to the Zo-Se Observatory to assist in the publication of observations made at this Observatory ; 4000 francs to Jean Piveteau to undertake geological and palæontological researches in southern Tunis ; 8000 francs to J. Risbec for the purchase of apparatus to enable him to carry on his biological researches in New Caledonia.

The Mme. Victor Noury foundation between Fernand Blondel (4000 francs) for his work on the geology of Indo-China, René Fortrat (3000 francs) for his work on spectroscopy, and Lucien Klotz (3000 francs) for his work in connexion with the rights of authors and scientific men and the protection of scientific property ; the Bouchard foundation to Constantin Toumanoff for the continuation of his researches on the normal and pathological (microbial diseases) physiology of insects ; the Ray-Vaucouloux foundation to Claudius Regaud for the whole of his work on the action of radium and of the X-rays on normal and on pathological tissues, with special reference to the use of the radiations in the treatment of various cancerous growths.

Annual Meeting of the Mathematical Association.

"WHERE you find a low standard of education, there you find with it dark superstition and enslavement to formulæ in every aspect of life." No reader of NATURE is likely to quarrel with this statement (liberally misquoted from memory) with which Mr. N. J. Chignell began his paper on "The Use and Abuse of Formulæ" at the annual meeting of the Mathematical Association on Jan. 7 and 8. Happiest among his examples of the general formulæ that are being questioned by a world awaking to thought, before he came to those which belong distinctively to mathematics or science, was this : "That a cloth cap must always be taken off in the presence of a top-hat." Not many years ago, the ensuing discussion would certainly have brought to light some of our dear old friends with their final argument that "memorising formulæ gets boys through who are too stupid to pass in any other way." These are not extinct ; but "the sun ariseth and they get them away together, and lay them down in their dens." Even the examiner, formerly the arch-enemy, looks now for understanding rather than memory, so Prof. Neville told us : there is much that the examiner can do to help, by forbidding the use of unproved formulæ or by setting a question to which no 'crammable' formulæ apply.

One of the quaintest of our modern superstitions is that the common methods of voting give us the representatives we want. A singularly interesting paper by Prof. J. E. A. Steggall, illustrated by numerous examples from his own experience at Dundee, showed how remarkably effective they can be in giving us just those representatives whom the majority decidedly prefer to do without. When two prizes for valour were to be awarded after the battle of Salamis, it is recorded that the commander of the contingent from every Greek state modestly recommended himself for the first prize and Themistocles for the second : the system of counting first places only would have left the greatest soldier of his time at the foot of the poll. Nearer home than that, it is no uncommon thing for *A* to be elected out of three candidates on

'first-choice' votes alone, when actually a majority prefers B to A, and at the same time C is also preferred to A by a majority of the voters. The impact of mathematical thought upon human affairs lags far behind the work of chemistry, electricity and psychology in making a world for man to live in: this matter of elections of various kinds is conspicuously one in which the mathematician should feel his responsibility for making to the national thought that contribution for which his gifts and training fit him.

Proportional representation, a plan lying outside the limits which time set to Prof. Steggall's discussion, deserves from mathematicians (and others) far more notice than it has yet received; but this is distinctively a method of electing two or more: it has nothing to tell us about the best way to pick out from a number of candidates the one who is preferred to the others individually by the largest majorities of the voters. If twenty such candidates compete for one place, we should regard the contest as 190 duels between one candidate and another: it is surprisingly easy, both for voter and for counter, so to arrange the election that the algebraic sum of every candidate's majorities in his 19 contests emerges directly from a single ballot.

It is safe to forecast that for some centuries to come "Modern Mathematical Problems in Aerodynamics" will be a fruitful meeting-ground for science and mathematics. Prof. H. Levy's researches into the vortex motion set up in the air by the passage through it of an aeroplane's wing deserves something better than the comments of one ignorant of aerodynamics: therefore let it pass unsung, but not unhonoured.

"Should a candidate for School Certificate be allowed to take, in place of the Mathematics and Science Group, a Group containing Drawing and Music and possibly other subjects?" This was the principal subject for general discussion—a somewhat one-sided discussion, because, though on details there was as much divergence of opinion as one would expect, there was but little opposition to the general principle involved, that children well gifted and well taught in subjects of three different kinds should not be classified as educational failures because of weakness in a fourth. Music, drawing, and handicraft constitute a group at present generally inferior for certificate-winning purposes to the other three, which are English subjects, languages, and the science-mathematics group.

This arrangement finds few defenders: some of its opponents are for republican equality between all groups, others for supremacy of one only, the English group. A powerful advocate of this supremacy was Mr. F. H. Knight, who boldly claimed for English subjects the place of honour as most of all a means of access to 'the things of the spirit,' without which other learning will not save the world. Mr. Knight also stressed the educational value of handicraft, not only as being for many children the only form in which solid geometry can be digested, but also for its influence on the development of mind on a wider scale than the mere book-learner can ever appreciate.

Science and mathematics are strong enough to stand on their own merits without needing to entrench their position by decrying the value of other subjects. Generosity, justice, and common sense would alike have been outraged if the Mathematical Association had denied that to the artist his subject is of no less value than is ours to us. Best of all, Demetrius the silversmith was conspicuous by his absence, "which made silver shrines for Diana," and whose trump-card against a rival to his goddess was that "by this craft we have our wealth." W. HOPE-JONES.

The Circulation of Seismological Information by Wireless Telegraphy.

IN a recent issue of NATURE (Dec. 22, p. 968) a short account was given of the existing arrangements for broadcasting early information concerning important earthquakes, and it was announced that the co-operation of American seismological stations would commence this month.

The large earthquake which occurred on Jan. 13 afforded an interesting test of the scheme, and it is satisfactory to record that data from all stations issuing broadcast seismological messages were picked up by the Air Ministry and communicated to Kew Observatory. An early knowledge of the position of the epicentre and of the time of origin was thus obtained. The following table summarises the information received at Kew:

Station.	Arrival of P. G.M.T.	Interval $(S-P)$.	Distance of Epicentre Δ	Azimuth of Epicentre (from N. through E).	Time of origin deduced from $(S-P)$ using B.A. tables.
	h. m. s.	m. s.	Km.		h. m. s.
Kew . .	0 14 49	9 34	8290	19°	0 3 4
Helwan .	0 15 41	10 9	8970	..	0 3 17
Bombay .	0 14 12	9 0	7600	..	0 3 5
Stonyhurst [1]	0 14 39	9 21	7850	..	0 3 8
Georgetown	0 15 14	9 51	8620	330°±5°	0 3 9
Honolulu .	0 11 32	6 50	5150	330°±5°	0 2 50
Strasbourg	0 14 54	9 39	8380	..	0 3 3

[1] The Stonyhurst figures were not broadcast, but were received by post.

The agreement between the figures in the last column is satisfactory, and for a preliminary value of the time of origin we may accept 0 h. 3 m. 6 s. G.M.T.

The accompanying diagram (Fig. 1) is taken from

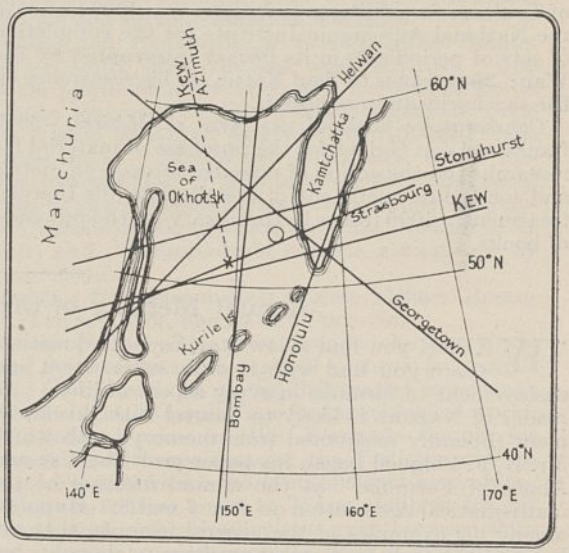

FIG. 1.

the globe on which the epicentral distances were marked off; the arcs in the neighbourhood of the epicentre are shown. From the intersections the epicentre is estimated to have been approximately at the point which is marked with a circle; that is, 53° N., 153° E., in the Sea of Okhotsk near the western coast of Kamtchatka. The initial impulse registered by the Kew seismographs (3 components) was sufficiently large to give a trustworthy estimate of the

bearing, which, together with the epicentral distance, gives 50° N., 150° E., for the co-ordinates of the epicentre. This determination is marked by a cross on the diagram. The agreement with the result obtained by using data for the seven stations is as good as could be wished.

The earthquake occurred in a region where such occurrences are frequent. There were considerable earthquakes there on Feb. 16 and Dec. 28, 1927.

University and Educational Intelligence.

BIRMINGHAM.—Mr. R. G. MacGregor has been appointed lecturer in physiology.

The University Appointments Board has issued its fourth annual report. The report shows a marked increase in the number of new graduates registered, and in the number for whom employment has been found. The demand for men and women with a university training appears to be definitely on the increase, particularly in commerce and industry. It is noted that, of a total of 45 vacancies notified for civil engineers, 44 were for posts abroad. A significant fact is that, of the 64 registered graduates who are unemployed, 50 are seeking appointments in the teaching profession.

CAMBRIDGE.—The official letter conveying the offer of the International Education Board of £700,000 on condition that within a few years the University finds a further £229,000, in addition to the £250,000 already secured for the new Library, has now been received and published. It deals most generously and helpfully with many minor points in connexion with the University, but there is a stipulation that no legacies shall be contributed towards the supplementary sum to be provided by the University, a stipulation not without interest to the University at the moment.

Three further benefactions are announced. A very valuable collection of medical, engineering, electrical, and optical apparatus, bequeathed to the University by the late Sir David Goldsmid-Stern-Salomons, Gonville and Caius College, subject to the life interest of his widow, has now been offered by Lady Salomons to the University. The late Dr. J. W. L. Glaisher, Trinity College, has bequeathed his mathematical books to the University Library, and his collection of china and pottery and other works of art to the Fitzwilliam Museum, with a sum of £10,000 to be applied in making provision for the care, preservation, and exhibition of the collection. Messrs. Bernard, Reginald, and Kenneth Pretty have offered to the University, at the wish of the late Miss Gwynaeth Pretty, Girton College, her residuary estate of the approximate value of £5000 for the furtherance of research for the prevention of disease. The diseases in which the testatrix was most interested were those that cripple or disable in childhood.

Dr. R. A. McCance, Sidney Sussex College, has been appointed to the Pinsent-Darwin Studentship in mental pathology.

THE Ella Sachs Plotz Foundation is at present assisting research on problems in medicine or surgery, especially group researches on a single problem; for example, for the past five years the general subject of nephritis, and to a lesser extent internal secretion and infection, have been given special consideration. Twenty-one grants were made during 1928, of which thirteen were to workers outside the United States. Applications for grants to be held during 1929–30 must reach the secretary of the executive committee, Dr. Joseph C. Aub, Huntington Memorial Hospital, 695 Huntington Avenue, Boston, Mass., before May 15.

Calendar of Patent Records.

January 27, 1778.—One of the many improvements in the water-closet was due to Joseph Bramah, who was granted a patent for his 'valve' closet on Jan. 27, 1778. Bramah's was not only the pioneer in this type of closet, but it also remained superior in its action to all the many inventions in the same class that followed it. The modern water-closet was first described by Sir John Harington in his "Metamorphosis of Ajax," published in 1596, many years before it came into general use.

January 28, 1589.—The saltpetre monopolies of Elizabeth and James I. are notorious from the fact that it was partly the abuse of their privileges by the saltpetre men appointed by the various patentees that led to the popular agitation against monopolies and ultimately to the Statute of Monopolies of 1623, but there was at the time a clear case for the establishment of a national source of supply for the manufacture of gunpowder. One of these patents was that granted to George Evelyn, Richard Hills, and John Evelyn on Jan. 28, 1589. Certain districts, notably London, being already covered by other grants, were excluded from its operation, but in 1591 a new grant was issued to the Evelyns that gave them a virtual monopoly. George Evelyn was the grandfather, and John Evelyn the uncle, of the diarist.

January 28, 1724.—The faking of expensive materials is not peculiar to the present day. On Jan. 28, 1724, a patent was granted to Robert Redrich and Thomas Jones "as well for staining, veining, spotting, clouding, damasking, and otherwise imitating the various kinds of marble, porphiry, and other rich stones and tortoiseshell, on wood, stone, and earthenware and all and every such goods, wares, utensils, and things, as are cut, made, or fashioned thereout."

January 28, 1832.—Steel pen nibs were known early in the last century, but they were not extensively used until James Perry, who had been making them from 1819 onwards, introduced the use of cross slits and apertures between the shoulder and the point. This construction he patented on Jan. 28, 1832. The firm of Perry and Co. was founded in 1829.

January 30, 1808.—The first band-saw was patented in England by William Newberry on Jan. 30, 1808, but it was thirty years and more before it came into practical use, and it was in France where it was fully developed. The two French patents of Mdlle. Crespin (1846) and M. Perin (1853) may be regarded as the foundation of the modern band-saw.

February 1, 1800.—One of the earliest patents for a screw propeller for ships was that granted to Edward Shorter on Feb. 1, 1800, for what he called a 'perpetual sculling-machine,' probably intended to enable large vessels to be manœuvred in a calm. Two or more blades similar to the sails of a windmill were mounted on a spar proceeding from any convenient part of the stern of the vessel obliquely downwards until its end dipped into the water, a buoy being provided to prevent it dipping too far. The spar was connected by a Hooke universal joint to a horizontal shaft, to which motion could be given by the capstan worked by man power or by a steam engine. By moving the spar transversely the ship could be steered. The invention is said to have been successfully tried on H.M. Ships *Dragon* and *Superb*.

February 3, 1818.—The patent for Jeremiah Chubb's original 'detector' lever lock is dated Feb. 3, 1818. The special feature of this lock was the use of a 'detector' device which came into action immediately if a wrong key with too long a bit were used in an attempt to open the lock, and effectively blocked the bolt until re-set by its proper key.

Societies and Academies.

LONDON.

Royal Society, Jan. 17.—**A. S. Eddington**: The charge of an electron (see p. 138 of this issue).—**R. H. Fowler**: The thermionic emission constant A. Nordheim's theory of the emission coefficient of electrons from metals is used to explain the remarkable relation between the constants A and χ of the thermionic emission formula, first recorded by O. W. Richardson and recently reformulated by Du Bridge. This theory regards the emission as due to the passage of electrons through simple surface potential steps and double layers, to be calculated according to the wave mechanics.—**J. A. Gaunt**: The triplets of helium.—**G. Temple**: The tensorial form of Dirac's wave equations. Darwin's transformation of Dirac's wave functions is incompatible with the theory of relativity. Dirac's wave equations are cast into tensorial form, from which are deduced the Lagrangian function, the charge and current tensor, the magnetisation and polarisation tensor, some associated quadratic invariants.—**H. M. Macdonald**: The reflection and transmission of electric waves at the interface between two transparent media.—**D. K. Bhattacharyya**: On the analysis of the first spark spectrum of sulphur. The data of Eder and Valenta between λ3028 to λ5819, and certain observations of Keeler and Lockyer regarding the occurrence of S^+-lines in stellar spectra, are used. The spectrum in the red region up to λ7715 was also photographed, using neocyanine plates and a Wood type of discharge tube. A band-system in the red, seemingly analogous to atmospheric bands of oxygen, has been found.—**J. S. Foster**: Effect of combined electric and magnetic fields on the helium spectrum. Parallel electric and magnetic fields are applied to a helium source, and the light analysed by a prism spectrograph of high dispersion. The effects in the parhelium and orthohelium spectra are clearly additive in the sharp and principal series, and for the components of the diffuse lines which are resolved. The magnetic separation is independent of the magnitude of the Stark-effect.—**R. W. B. Pearse**: The ultra-violet spectrum of magnesium hydride (1). In addition to the well-known visible (α) band system, two others, a β-system, represented by a strong band at λ2430 and a γ-system covering the range λ5500-λ2300, have been found in the ultra-violet.—**J. S. Foster** and **W. Rowles**: Patterns and Paschen-Back analogue in the Stark-effect for neon. In an attempt to determine Stark-patterns in neon, 150 lines were examined by the Lo Surdo method in fields as high as 140 kv./cm. An appreciable number of the diffuse and combination lines have a new pattern.—**J. K. L. MacDonald**: Stark-effect in a violet region of the secondary spectrum of helium. Effects for twenty lines are observed in the region 3980-4080 A. The Lo Surdo type of discharge tube is used; displacements are measured at a field strength of 95,000 volts per cm. Certain apparently complex effects are resolved into simple displacements of closely lying lines.—**J. S. Foster** and **M. L. Chalk**: Relative intensities of Stark components in hydrogen. A report of a quantitative investigation of the relative intensities of the stronger Stark components in the first four members of the Balmer series. In all cases the results agree within experimental error with the new calculations by Schrödinger.—**O. R. Baldwin**: The relativity theory of divergent waves. The solution given be Einstein for the general problem of the propagation of gravitational waves was used by Eddington to find the solution for waves created by a spinning rod. An attempt is now made to discover all the non-spurious waves of the same general character at infinity as Eddington's.—**G. W. C. Kaye** and **W. F. Higgins**: The thermal conductivity of solid and liquid sulphur. The temperature range was 20° C.-210° C. A 'plate' method with a small temperature drop across the specimen was used.—**S. Barrett** and **C. P. Stein**: On bromine chloride. From spectrophotometric observations on the colour changes on mixing carbon tetrachloride solutions of bromine and chlorine, the two halogens give an equilibrium concentration of bromine monochloride. The formation of a chemical compound between them is further indicated by the appearance of a new ultra-violet absorption band with its maximum at 3700 A., peculiar to the mixtures, and also by the fact that the colour change in carbon tetrachloride solution takes an appreciable time.—**C. W. Gibby**, **C. C. Tanner**, and **I. Masson**: The pressure of gaseous mixtures (2). The compressibilities, up to 125 atm., of helium, hydrogen, and ten mixtures of the two, at 25°, and of each pure gas and an equimolecular mixture at seven temperatures from 25° to 175° have been measured.—**J. Chariton** and **C. A. Lea**: Some experiments concerning the counting of scintillations produced by alpha-particles (Parts 1-3). (1) Determination of the smallest amount of luminous energy perceptible by the eye. (2) Determination of the efficiency of the transformation of the kinetic energy of the α-particle into radiant and luminous energy for various zinc sulphides. (3) Investigation of the way in which the number of scintillations observed is affected by the numerical aperture of the optical system used.

Geological Society, Dec. 19.—**W. J. Pugh**: The geology of the district between Llanymawddwy and Llanuwchllyn (Merioneth). The rocks belong to the Bala and the Valentian Series. There are important lateral changes within the Bala Series, and these reveal the transition from the succession described at Corris and Dinas Mawddwy to that around Bala. The Bala rocks become more arenaceous and more calcareous from south to north, and this general change in lithology is accompanied by a gradual increase in the number and variety of shelly fossils. Individual rocks are traced from the south to the Bala district, and direct correlation is made between rock groups represented by very distinct facies in the different districts. The district is situated on the eastern flank of the Harlech Dome, and the rocks strike from south-south-west to north-north-east. They dip east-south-eastwards, but there is some minor folding. There are important strike-faults, which conceal parts of the succession in certain localities. The rocks are highly cleaved. The strike of the cleavage-planes is approximately parallel to the strike of the strata, but the direction of cleavage-dip is variable.

PARIS.

Academy of Sciences, Dec. 26.—**Paul Appell**: On certain invariants.—**Charles Moureu**, **Charles Dufraisse**, and **Pierre Laplagne**: Autoxidation and antioxygen action. The catalytic properties of silicon, boron, and their derivatives. Details of results obtained with ten silicon compounds and six boron derivatives, with some typical curves.—**J. B. Charcot**: An arrangement allowing acoustic depth sounding in the polar regions. Description of a modified Marti recorder and of results obtained by its use.—**O. Borůvka**: A class of minimum surfaces in a five-dimensional space with constant curvature.—**Z. Horák**: The curvature of non-holonome varieties.—**L. Pirot**: Some determinations of the deviation from the vertical by means of the prism astrolabe. Results of observations made at Fort-de-France (Martinique), Pernambuco (Brazil), Lorient, Quiberon, and Brest.—**J. Errera**: Molecular associa-

tions. The relations between the viscosity of binary liquid mixtures and the polarity of the molecules of the constituents. The following conclusions are drawn from available data: when one of the components is dipolar and the other non-polar, the viscosity curve, if not a straight line, is always concave. When this curve is convex, the two components are always dipolar.—**A. Turpain and de Bony de Lavergne**: The magnetic field and Brownian movement.—**Maurice Curie and Adolphe Lepape**: The dielectric cohesion of the rare gases. Bouty's experiments with helium, neon, and argon were repeated with purer material, and krypton and xenon were also examined. In the series neon, argon, krypton, and xenon, the dielectric cohesion increases with the atomic number.—**L. Goldstein**: Some difficulties in the spontaneous emission of radiation.—**J. Cayrel**: The effect of a magnetic field on the electrical resistance of a contact.—**G. A. Beauvais**: Very short waves. The short waves described had a wave-length of 16-20 cm. They were reflected by parabolic and plane mirrors according to the laws of optics.—**Henri Belliot**: The development of inverted or solarised photographic plates after fixing.—**E. Carrière and P. Castel**: The experimental study of the transformation of chromates into bichromates.—**J. Orcel and S. Pavlovitch**: The microscopic characters of the oxides of manganese and of the natural manganites.—**P. Sédallian, A. Leulier, and Mme. Clavel**: The distribution and stability of the antigen properties of the diphtheric toxin. The rôle of the non-specific colloids.

Official Publications Received.

BRITISH.

Department of Scientific and Industrial Research. Report of the Building Research Board, with the Report of the Director of Building Research, for the Year 1927. Pp. viii+132+10 plates. (London: H.M. Stationery Office.) 3*s.* net.

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 17: A Note on the Early History of Cotton. By A. N. Gulati and Arthur James Turner. (Technological Series, No. 12.) Pp. 10. (Bombay.) 8 annas.

The Scottish Forestry Journal: being the Transactions of the Royal Scottish Arboricultural Society. Vol. 42, Part 2, October. Pp. 35-110+28-38. (Edinburgh.) 7*s.* 6*d.*

Ollsgoil Na h-Eireann (The National University of Ireland). Calendar for the Year 1928. Pp. viii+327+465. (Dublin.)

Ministry of Health. Circular 939: Circular as to the Contents and Arrangement of the Annual Reports of Medical Officers of Health for 1928. Pp. 11. (London: Ministry of Health.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 67, No. 384, December. Pp. 124+xxxviii. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 1, No. 5: On some points in the Anatomy and Habits of the Lophogastrid Crustacea. By Dr. S. M. Manton. Pp. 102-119+3 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 3*s.*

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 1927. By Joseph Baxendell. Pp. 28. (Southport: The Fernley Observatory; London: Meteorological Office.)

Scottish Marine Biological Association. Annual Report 1927-28. Pp. 23. (Glasgow.)

Nyasaland Protectorate. Report on some Diseases of Tea and Tobacco in Nyasaland. By Dr. E. J. Butler. Pp. 30+4 plates. (Zomba: Department of Agriculture; London: Colonial Office.)

Memoirs of the Indian Meteorological Department. Vol. 25, Part 2: Summary of Indian Rainfall for the Fifty Years 1875-1924. Pp. iii+15-108. (Calcutta: Government of India Central Publication Branch.) 8 rupees; 13*s.* 6*d.*

The Deeside Field. Issued under the Auspices of the Deeside Field Club. Fourth Number. Edited by J. B. Philip. Pp. vi+88+28 plates. (Aberdeen.) 3*s.* 6*d.*

FOREIGN.

Bulletin of the Terrestrial Electric Observatory of Fernando Sanford, Palo Alto, California. Vol. 5: Observations on Solar and Lunar Diurnal Variations of Earth Potential due to Changes in Distribution of the Earth's Surface Charge, including Two new Methods of recording such Variations, and on the accompanying Variations in the Atmospheric Potential Gradient for the Year 1927. Pp. 26. (Palo Alto, Calif.)

Contributions from the Dudley Herbarium of Stanford University. Vol. 1, No. 2: Preliminary Report on the Flora of the Tres Marías Islands. By Roxana Stinchfield Ferris. Pp. 32+4 plates. (Stanford University, Calif.: Stanford University Press.) 1.00 dollar.

Proceedings of the United States National Museum. Vol. 73, Art. 12: A Revision of the Lizards of the Genus Ctenosaura. By Prof. John Wendell Bailey. (No. 2733.) Pp. 58+30 plates. (Washington, D.C.: Government Printing Office.)

Department of Commerce: U.S. Coast and Geodetic Survey. Special Publication No. 146: Radio Acoustic Position Finding. Pp. iv+62. (Washington, D.C.: Government Printing Office.) 20 cents.

Department of Commerce: Bureau of Mines. Coal in 1926. By F. G. Tryon, O. E. Kiessling and L. Mann. (Mineral Resources of the United States, Part 2.) Pp. x+419-585. (Washington, D.C.: Government Printing Office.) 30 cents.

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions. Vol. 50: Whales and Whale Foetuses; Statistics of Catch and Measurements collected from the Norwegian Whalers' Association, 1922-25. By Sigurd Risting. Pp. iii+122. (Copenhague: Andr. Fred. Høst et fils.)

Department of Commerce: Bureau of Standards. Miscellaneous Publications, No. 88: Annual Report of the Director of the Bureau of Standards to the Secretary of Commerce for the Fiscal Year ended June 30, 1928. Pp. iv+46. (Washington, D.C.; Government Printing Office.) 5 cents.

Proceedings of the United States National Museum. Vol. 74, Art. 3: New Fossil Pearly Fresh-water Mussels from Deposits on the Upper Amazon of Peru. By William B. Marshall. (No. 2748.) Pp. 7+1 plate. (Washington, D.C.: Government Printing Office.)

Section de Géodésie de l'Union Géodésique et Géophysique internationale. Publication spéciale No. 2: Tables de l'ellipsoïde de référence internationale adopté par l'Assemblée générale de Madrid le 7 octobre 1924 dans le système de la Division sexagésimale de la Circonférence. Calculées sous la direction de Général G. Perrier par E. Hasse. Pp. 20+91. (Paris.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1566: The Sorghum Midge, with Suggestions for Control. By C. H. Gable, W. A. Baker and L. C. Woodruff. Pp. ii+10. (Washington, D.C.: Government Printing Office.) 5 cents.

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin." Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Suppl., Livraison 2, Novembre: Fauna Buruana; Acari. Von Dr. A. C. Oudemans. Pp. 37-100. (Buitenzorg: Archipel Drukkerij.) 2.50 f.

Obras completas y correspondencia científica de Florentino Ameghino. Volumen 7: Los mamíferos fósiles de la República Argentina. Parte 2: Ungulados. Edición oficial ordenada por El Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 524. (La Plata: Taller de Impresiones Oficiales.)

R. Osservatorio Astrofisico di Catania. Catalogo Astrofotografico Internazionale 1900·0. Zona di Catania fra le declinazioni +46° e +55°. Vol. 7. Parte 2ª: Declinaz. da + 52° a + 54°, ascens. retta da 3ʰ a 6ʰ. (Fascicolo N, 50.) Pp. viii+36. Vol. 8, Parte 2ª: Declinaz. da + 53° a + 55°, ascens. retta da 3ʰ a 6ʰ. (Fascicolo N. 58.) Pp. viii+39. (Catania.)

Diary of Societies.

FRIDAY, JANUARY 25.

BRITISH MYCOLOGICAL SOCIETY (London Meeting) (at University College), at 11 A.M.—Miss D. M. Cayley: Some Observations on Mycetozoa of the Genus *Didymium*.—A. Chaston Chapman: A New Species of *Oidium*.—Miss E. H. M. Farries: An Investigation on the Metabolism of *Nematospora Gossypii* Ashby and Nowell.—M. Mitra: *Phytophthora parasitica* Dast. as a Parasite on Cotton Seedlings and Guava Fruit.—Dr. A. Smith: Observations on *Puccinia Menthæ* Pers.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Gaiety Theatre, Dublin), at 4.—Ll. B. Atkinson: How Electricity does Things (Faraday Lecture).

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual General Meeting) (in Botany Lecture Room, Imperial College of Science and Technology), at 5.—S. G. Tallents: The Work of the Empire Marketing Board.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Prof. C. V. Boys: A Fused Quartz Pendulum Rod for Clocks.—G. W. Sutton: A Method for the Determination of the Equivalent Resistance of Air-Condensers at High Frequencies.—L. Hartshorn: The Measurement of the Anode Circuit Impedances and Mutual Conductances of Thermionic Valves.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.—Dr. F. J. Poynton and Dr. A. Moncrieff: A Case of Mediastinal Teratoma in an Infant.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Anatomy and Evolution of the Human Brain.

INSTITUTE OF TRANSPORT (Manchester, Liverpool, and District Section) (at Liverpool), at 6.30.—C. C. Taylor: The Reasons of Development of Road Transport in Recent Years.

ENGINEERING AND SCIENTIFIC CLUB (Wolverhampton), at 7.—A. C. Baker, C. O. Silvers, and others: Debate on Trams *versus* Buses.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Engineers' Club, Birmingham), at 7.—Prof. W. E. S. Turner: Some Important Minor Constituents in Glass.

INSTITUTION OF LOCOMOTIVE ENGINEERS (North-Eastern Centre) (at Hotel Metropole Leeds), at 7.—J. C. Armstrong: Pulverised Fuel Locomotive.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—J. E. Lea: Measurement of Coal Supplies in Small or Large Quantities.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—F. T. Usher: Bromoil.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—J. Mitchell: The Manufacture of Iron and Steel Tubes.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Students' Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.15.—S. Gibson: The City of Winnipeg Hydro-electric Power Station.

BLACKBURN TEXTILE SOCIETY (at Bradford Technical College), at 7.30.—W. Wilkinson: Power Loom Pickers and Picking (Lecture).

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—M. J. McCarthy: Notes on Winches, Derricks, and other Lifting Appliances used in Modern Building Construction.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. Ledingham, Dr. G. F. Buchan, and others: Discussion on Vaccination Against Smallpox in the Light of Recent Experience.

INSTITUTION OF PRODUCTION ENGINEERS (at 83 Pall Mall), at 8.—L. H. Pomeroy: The Designer *versus* the Production Engineer.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof A. C. Seward: The Vegetation of Greenland.

SATURDAY, JANUARY 26.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Southern District) (at Town Hall, Oxford), at 11.15 A.M.—H. V. Overfield and others: Discussion on Road Surfaces and a Standard of Maintenance.—W. L. Williams: Notes on the Construction of a New Public Convenience.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Gateshead-on-Tyne), at 2.45.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. E. Cammaerts: Flemish and Belgian Art (II.): The Landscape.

MONDAY, JANUARY 28.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4.30.—Sir Ernest Rutherford and Dr. J. Chadwick: Energy Relations in Artificial Disintegration.—R. H. Fowler: An Analogy for Beams of Particles of a Reciprocal Optical Theorem due to Helmholtz.—Dr. D. R. Hartree: The Distribution of Charge and Current in an Atom with Several Electrons Obeying Dirac's Equations.—N. Feather and R. R. Nimmo: The Distribution of Range of the α-particles from Radium C′ and Thorium C′.—*To be communicated by title only*:—R. M. Gabriel: Some Further Results concerning the Integrals of Moduli of Regular Functions along Curves of Certain Types.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Evans: Developmental Enterogenous Cysts and Diverticula.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—F. C. Raphael and others: Discussion on Mains Testing.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.—J. L. Carr: Recent Developments in Electricity Meters, with particular reference to those for special purposes.

ROYAL SOCIETY OF ARTS, at 8.—Dr. C. H. Lander: The Treatment of Coal (Cantor Lectures) (II.).

MEDICAL SOCIETY OF LONDON, at 8.—Dr. E. Spriggs and others: Discussion on Starvation in Treatment.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—G. B. Pritchard: The Origin and Prevention of Gingivitis.—A. T. Pitts: Two Compound Composite Odontomata.—Dr. J. Kingston Barton: The Prevention of Diseases of the Teeth in Children.—W. Rushton: The Use of Cement Linings in Cavities.

UNIVERSITY OF BIRMINGHAM CHEMICAL SOCIETY.—Dr. Twiss: Sulphur and Rubber.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Bristol).—Ll. B. Atkinson: How Electricity does Things (Faraday Lecture).

TODMORDEN TEXTILE SOCIETY (at Todmorden).—B. Sutcliffe: Steam Engine Testing (Lecture).

TUESDAY, JANUARY 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. S. Huxley: Evolution and the Problem of Species (I.).

INSTITUTE OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—B. P. Dudding: Errors in Testing Bulk Supply by Random Selection.

ELECTRICAL ASSOCIATION FOR WOMEN (at 15 Savoy Street), at 7.—F. W. Purse: How Electricity is Generated at West Ham (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (Informal Meeting) (at North British Station Hotel, Edinburgh), at 7.—E. Seddon: Recent Extensions to Portobello Power Station.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—J. Wright and C. W. Marshall: The Construction of the Grid Transmission System in Great Britain.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—F. F. Renwick, Dr. T. Slater Price, and others: Discussion on Fixation.

INSTITUTE OF CHEMISTRY (Bristol and S.W. Counties Section) (at Bristol University), at 7.30.—E. Russell: Some Toxicological Cases.

SHEFFIELD METALLURGICAL ASSOCIATION (at Sheffield), at 7.30.—Prof. F. C. Lea: The Influence of Surface Conditions and Internal Stresses on the Physical Properties of Cold-worked and Quenched and Tempered Steels, with Particular Reference to Fatigue Resistance.

ROYAL ANTHROPOLOGICAL INSTITUTE (Anniversary Meeting), at 8.30.—Prof. J. L. Myres: Presidential Address.

MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Athenæum, Manchester).—Dr. Urquhart: Cotton and Moisture (Lecture).

WEDNESDAY, JANUARY 30.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. G. E. Gask: The Treatment of Malignant Disease by Radium, with Demonstration of Patients who have been Treated.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—H. G. Cousins: Design and Construction of Victoria House.

LIVERPOOL ENGINEERING SOCIETY (at The Temple, Liverpool), at 6.30.—J. Austin: Water Tube Boilers *versus* Scotch Boilers.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—B. Reed: Locomotive Power and Proportions.

HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7.30.—C. T. Hobson: Short-time, its Effects and how to cost it (Lecture).

ROYAL SOCIETY OF ARTS, at 8.—G. Fletcher: The Shannon Scheme and its Economic Consequences.

GLASGOW ROYAL PHILOSOPHICAL SOCIETY (207 Bath Street, Glasgow), at 8.—Prof. W. Kerr: Vibration.

THURSDAY, JANUARY 31.

ROYAL SOCIETY, at 4.30.—Prof. S. Chapman: On the Theory of the Solar Diurnal Variation of the Earth's Magnetism.—Dr. G. M. B. Dobson, D. N. Harrison, and J. Lawrence: Measurements of the Amount of Ozone in the Earth's Atmosphere and its Relation to other Geophysical Conditions.—Prof. S. Chapman and J. M. Stagg: On the Variability of the Quiet-Day Diurnal Magnetic Variation at Eskdalemuir and Greenwich.—L. H. Gray: The Absorption of Penetrating Radiation.—*To be read in title only*:—R. d'E. Atkinson: The Probability of Excitation by Electron-Impact.—N. W. McLachlan: Pressure Distribution in a Fluid due to the Axial Vibration of a Rigid Disk.—J. D. Cockcroft: Skin Effect in Rectangular Conductors at High Frequencies.—L. Rosenhead: Systems of Line Vortices in a Channel of Finite Breadth.—Prof. T. P. Hilditch and N. L. Vidyarthi: (*a*) The Products of Partial Hydrogenation of some Higher Polyethylenic Esters; (*b*) The Products of Partial Hydrogenation of some Higher Monoethylenic Esters.—P. K. Kichlu and D. P. Acharya: Infra-red Radiations of Active Nitrogen.—Prof. T. H. Havelock: The Vertical Force on a Cylinder in a Uniform Stream.—R. C. J. Howland: Stress Systems in an Infinite Strip.—A. H. Wilson: Perturbation Theory in Quantum Mechanics.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: The Early History of X-Rays (I.).

BIOCHEMICAL SOCIETY, BIRMINGHAM UNIVERSITY, at 5.30.—Chemo and Radio Therapy (Student Papers).

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—W. S. Farren: Monoplane or Biplane?

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science), at 7.—Dr. T. Slater Price: Some Problems of Photographic Research.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—H. L. Guy: Modern Development in Steam-Turbine Practice.

FRIDAY, FEBRUARY 1.

ANDERSONIAN CHEMICAL SOCIETY (at Royal Technical College, Glasgow), at 3.15.—Dr. R. Hay: Manufacture of Sulphuric Acid by the Contact Process.

ROYAL SANITARY INSTITUTE, at 5.—F. R. Humphreys and others: The Civilian Population and Chemical Warfare.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. C. A. Pannett: Local Anæsthesia in the Surgery of the Upper Abdomen.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—Prof. V. G. Childe: Philology and Archæology.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. A. S. Eddington: Engineering Principles in the Machinery of the Stars (Thomas Hawksley Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Liverpool Section) (at Engineers' Club, Manchester), at 7.—Dr. F. Challenger: The Sulphur Compounds of Shale Oil and Petroleum.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—J. L. Carr: Recent Developments in Electricity Meters, with particular reference to those for special purposes.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7. P. Fripp: Some Aspects of Craftsmanship.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—T. H. Cross: Notes on Road Construction.

TEXTILE INSTITUTE (Lancashire Section) (jointly with Nelson Textile Society) (at Nelson), at 7.30.—O. S. Hall: The Economic Aspect of some Developments in the Textile Industry (Lecture).

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Dr. R. D. Lawrence: Post-operative Acidosis.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. J. L. Myres: Geometrical Art in S.E. Europe and Western Asia.

SATURDAY, FEBRUARY 2.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. E. Cammaerts: Flemish and Belgian Art (III.): Genre Painting.

PUBLIC LECTURES.

SATURDAY, JANUARY 26.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Harcourt: The Lure of India.

MONDAY, JANUARY 28.

KING'S COLLEGE OF HOUSEHOLD AND SOCIAL SCIENCE, at 5.15.—Sir Robert Witt: Dutch Art.

UNIVERSITY OF LEEDS, at 5.15.—Prof. A. Holmes: Radioactivity and Geological Time.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Dr. H. E. Woodman: The Conservation of Young Grass for Winter Feeding as a Protein Concentrate.

SIR JOHN CASS TECHNICAL INSTITUTE, at 7.—F. S. Sinnatt: Coal Carbonisation: Theory and Practice (Introductory Lecture).

UNIVERSITY OF LEEDS, at 8.—Prof. J. R. R. Tolkien: Celts and Teutons in Early Times.

TUESDAY, JANUARY 29.

UNIVERSITY COLLEGE, at 5.30.—Prof. Karl Pearson: A New Theory of Progressive Evolution.

THURSDAY, JANUARY 31.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—H. V. Lanchester: Indian Architecture.

EAST LONDON COLLEGE, at 5.30.—Prof. R. Robinson: Some Aspects of Polarity Theories in Organic Chemistry.

FRIDAY, FEBRUARY 1.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—C. E. R. Sherrington: The Steam Railways and the Localisation of Industry in the Nineteenth Century.

SATURDAY, FEBRUARY 2.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: The Ancient Egyptian Potter and his Clay.