NATURE

SATURDAY, OCTOBER 29, 1927.

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

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

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

No. 3026, Vol. 120]

Natural Science in Adult Education.

THE growth of knowledge, and the necessary limitation arising from the age and duration of school life, create an ever-widening gap between the actualities and possibilities of education. The boy or girl who leaves school to enter some profession is usually able to secure suitable further training in part-time classes at a local technical school or college. But there are many men and women who have no need of special training, or have already obtained what they require, but have intellectual needs which call for satisfaction. They read newspapers and books; they are members of clubs or societies; they acquire an interest in social or political or economic problems, or in philosophy, or literature, or science; and they enter into eager controversy on the problems of the day. Those who possess depth of feeling or understanding, whose interests are not the languid ephemeral interests of the man in the street, realise the need for wider and deeper knowledge, for training in methods of study, for direction of reading, and for friendly guidance and criticism.

Training of this kind has been provided for many years in University Extension Courses, in the last quarter of a century in classes under the Workers' Educational Association, and more recently in the London Literary Institutes. The work has become an integral part of national education. It is aided by Local Education Authorities, and has acquired sufficient magnitude and importance for Treasury grants to be administered under a separate set of regulations — the Adult Education Regulations of the Board of Education.

The training in these classes exists in response to a distinct demand. This demand is usually for something which bears upon the wider aspects of intellectual life rather than upon the narrower requirements of an occupation. It represents a desire for knowledge for its own sake, a desire to share in the intellectual heritage and to understand some aspect of the material or intellectual progress of the generation in which they live. It arises at a later age than that at which students pass into technical schools or universities for professional or occupational study; and however complete may be the facilities for the continuous full-time education of all who appear when young to be capable of profiting by it, the need for this kind of training will remain.

From this point of view the field of adult education is not limited to economics, to history, or to literature, but extends over the whole field of

human knowledge; and we welcome the interesting and instructive report [1] of the Adult Education Committee recently issued by the Board of Education. When the Committee commenced its labours in 1921, most of the classes were in economics and history. At the first meeting, Mr. Fisher, then president of the Board, expressed the hope that the Committee would "investigate the possibility of extending the range of studies in the adult education movement." As a result of its observations the Committee is able to note in 1927 "a distinct tendency in this direction." In particular, "classes in English Literature have increased greatly both in numbers and in proportion to the whole," and "the growth of interest in Music and the Drama has also been considerable." But the Committee deplores the fact that "there has been no corresponding growth in the number of classes in Natural Science."

After reviewing the value of natural science as a humane study, in everyday life, and in industry, the report discusses the evidence of an interest in the subjects which fall under the vague yet comprehensive title. There appears to be some doubt whether the interest is now so great as it was fifty years or more ago; but the conditions of life are so different that no comparison is of much value. A much greater proportion of young people obtain instruction in the elements of natural science at school; a greater number of students attend technical schools in which the instruction is far more specific and highly organised, far less academic or of general interest, than it was even twenty-five years ago; local travelling facilities have immensely improved, and the means of employing leisure are more varied than they used to be; Local Education Authorities are more independent of external aid, and inclined, on the ground of expense, to concentrate on what appears to be the primary function of the local technical school. The pioneer work of the famous men who upheld the banner of science in the last century can scarcely be compared with that expected in a tutorial class conducted by the Workers' Educational Association to-day. The circumstances have altered and the aims are not the same.

In regard to the existing provision, we note that in 1925–6 "the number of courses in Natural Science recognised under the Adult Education Regulations was 47 out of a total of 1224; the number of students attending these courses was 935 out of a total of 26,806." These figures do not include non-vocational courses promoted by Local Education Authorities. From such statistics as the Committee has been able to obtain, it concludes that "the study of Natural Science is being neglected in comparison with other studies."

The courses described or commented upon cover a wide field, but are conveniently grouped under biology, geology and geography, and the physical sciences. By reason of their human interest, classes in biology have been especially successful, and in some cases have been continued for four years or more. Very little apparatus is required, and the classwork is supplemented by field excursions and visits to museums. Geology and geography also call for little special accommodation or equipment. The requirements for physical science vary widely with the branch chosen, but even where laboratory work is not necessary there may be a need for a degree of mathematical knowledge not usually possessed by adult students.

Apart from differences of method, advocated by different witnesses, there appears to be a greater similarity of content, and more uniformity of aim, in courses in biology and geography than in physical science. The former almost invariably suggest a wide view of the universe and of the evolution of living things; the latter vary from "Chemistry of Everyday Life" or "Chemistry in the Home" to "Modern Views of Matter" and similar subjects.

There is an implication on page 20 of the report that biology is more widely studied in Tutorial Classes and the physical sciences in Extension Classes; and on page 52 the mathematical and experimental requirements are referred to in support of the view that physical science is less suited "to the method of a Tutorial Class." But since the original condition of the Adult Education Regulations that "the instruction must aim at reaching, within the limit of the subject covered, the standard of University work in Honours," now only applies if the subject is such as to make that a possible aim, the suitability of physical science for a Tutorial Class seems to depend mainly upon the syllabus and the teacher.

The report recognises the need for competent teachers, and advocates the appointment by the universities of staff tutors for this work. It complains that the high degree of specialisation at the universities does not provide men with the requisite breadth of training. On this matter we are at one with the Committee. But something more than breadth of knowledge is required. The man who is to attract and retain adult students

[1] "Natural Science in Adult Education." Paper No. 8 of Adult Education Committee. (London: H.M. Stationery Office, 1927.) 6d. net.

requires personality. He must have sympathy and understanding, and be able to realise the content and attitude of mind of those who come to him for instruction and inspiration. He must have such a grip of his subject that he can break down traditional and academic barriers between branches of knowledge—barriers which, while not inappropriate in a full-time university course, are unnecessary and frequently out of place in a course which will rarely permit of more than 150 hours' instruction; he must know not only how to learn himself, and how to present his subject attractively, but also how to train his student to learn for themselves. Also, if he wishes to enjoy, and help others to enjoy, the pleasure of learning, if he wants to feel, and make others feel with him, the exquisite thrills which accompany mental growth, he must have a command of language which will enable him to clothe the dry bones of fact and theory, and make them live.

While we share the desire of the Committee to see an increasing number of classes devoted to the study of natural science, we do *not* desire a rate of increase greater than that of the supply of competent teachers. For if the teaching is to be humane, if it is to reveal the patient and accurate observation involved in scientific investigation, if it is to train judgment, if it is to create awe and reverence for the wonders of the universe, it must be based upon qualities for which academic attainment is neither a measure nor a guarantee.

X-Ray Analysis.

Die Verwendung der Röntgenstrahlen in Chemie und Technik: ein Hilfsbuch für Chemiker und Ingenieure. Von Dr. Hermann Mark. (Handbuch der angewandten physikalischen Chemie in Einzeldarstellungen, herausgegeben von Prof. Dr. Georg Bredig, Band 14.) Pp. xv + 528. (Leipzig: Johann Ambrosius Barth, 1926.) 48 gold marks.

DESPITE the recent large output of books dealing with X-rays and their applications, this addition is a very welcome one. Himself a leader of the German school, Dr. Mark has brought to his task a quite exceptional knowledge of the theory and practice, and it would be difficult to find any one better fitted to produce a sound as well as a helpful text-book of this subject. Issued as a volume of a new handbook of applied physical chemistry, it is described by its author as a book intended for the guidance of chemists and engineers. It is more than this; it is a book to be possessed by all who have to deal with X-ray problems.

The main object is to introduce the reader to, and train him in the methods of, X-ray crystal analysis, and for such an end to be successful it is necessary to discuss the nature and properties of X-rays, the theory of the older crystallography, and then the applications of X-rays to the problem of the solid state. This is briefly the general scheme of the book. In the earlier chapters the methods of production of X-rays are described in a very practical way. Details and working instructions of the essential apparatus are given, details sufficient to enable even the inexperienced to select a suitable equipment and to know in advance the difficulties he is likely to meet and how they may best be overcome. There follows an account of X-ray spectrometers and spectroscopy, and of the most important properties of the rays themselves, with very complete tables of wave-lengths and other useful data.

In the same masterly way, the subject of crystallography is introduced, and this section contains all the formulæ and information that are likely to be required. Before proceeding to discuss the actual procedure of X-ray analysis, Dr. Mark inserts a chapter on the essentials of the wave theory of diffraction, leading up to the crystal grating by a discussion of the simpler optical systems. He thus gives the necessary analysis to which he can refer when the question of intensity interpretation has to be discussed later.

The author is now in a position to deal with his main problem, the application of X-rays to the structure of the solid, and he proceeds to do so in a very thorough and systematic manner. So far as it is possible to lay down definite rules of procedure, he does it and reproduces for this purpose, in convenient form, tables differentiating the various space groups. These tables, although not quite free from errors, should reduce the time and labour of obtaining the space group of a crystal to a minimum. This determination of space group, or classification of the crystal as belonging to one of the 230 possible configurations, is now a routine business and should always be possible if suitable material is available. But the details of atomic arrangement are not, as a rule, determined when the space group has been found. The complete solution of the structure involves also a discussion of the intensities of the X-ray reflections. This is a much more difficult problem, but in the section devoted to this question the reader will find an excellent survey of the position as it stands to-day.

It is difficult to think of anything essential which has been omitted. Whether his material is in the

form of a single crystal, a random collection of small crystals, or in that very interesting state in which the crystallites are not oriented at random but have some direction in common, the worker will find here the necessary information to enable him to attack his problem. No attempt has been made to gloss over the difficulties, but, in spite of this, the book is essentially a practical one. Some of those to whom it is especially addressed may find it difficult in places, but they can rest assured that they are not likely to find a simpler yet equally comprehensive account elsewhere. The occasional excursions into mathematics need not deter them unduly. They will find that the working rules are often independent of this analysis and quite intelligible even if all the steps leading to their deduction have not been followed in detail.

Here, then, is a book especially for the practical worker, a book which he will keep on his desk and to which he will find himself continually referring. Every one whose interest lies in this field owes Dr. Mark a debt of gratitude for his labours in writing such a sound and such an eminently useful work, and there will be many among them who would appreciate the appearance of an English translation in due course. We have but one quarrel with it, and that is its price. It is certainly a large volume, and the many excellent illustrations and tables must have increased the cost of production, but it seems a pity that a book which is invaluable to all concerned should be issued at a price which puts it almost beyond the modest purses of many to whom it would be most helpful.

Primitive Peoples of Assam.

The Ao Nagas. By J. P. Mills. With a Foreword by Henry Balfour and Supplementary Notes and Bibliography by Dr. J. H. Hutton. (Published by direction of the Government of Assam.) Pp. xviii + 500 + 32 plates. (London: Macmillan and Co., Ltd., 1926.) 30*s.* net.

THE Government of Assam is evidently not content with that superficial knowledge of the decaying culture of its subjects which is so frequent a failing of governments which have to deal with primitives; for the present volume, published under Government auspices, is an addition to an important series of monographs on the more primitive peoples of Assam and maintains the high standard of the earlier volumes. Mr. Mills gives us the results of an intensive study of one important group (comprising a population of some 30,000) of the peoples of the Naga Hills. Material culture, social organisation, and religion are exhaustively dealt with, and a short grammar of the language is given.

It is interesting to find that the clans in most of the Ao territory are grouped into three exogamous phratries, an unusual form of organisation, while in one part there is a 'dual organisation' such as we find in parts of Melanesia. It has not escaped Mr. Mills's notice that Melanesian affinities are very numerous, and his book affords further proof of the close cultural connexion between the two areas. A feature of the social organisation, worthy of special remark, is the grouping into three-year age-grades, a grouping not brought about by initiation but directly dependent on the year in which a person is born. Grades within the 'men's house' result from this arrangement, and even the elected councillors of the village form a wider age-grade of a generation, the older generation of councillors being eventually replaced *en bloc* by the next generation below.

The Ao believes that he has a number of souls, one of which is, perhaps, better regarded as 'soul-substance,' though Mr. Mills does not use this term. Head-hunting, a most important institution of the Nagas, is closely connected with these beliefs, for the souls of dead men are wanted to fertilise all vegetable and animal life and to add to the general stock of vital essence in the village, and the soul is located in the head above all other parts. Sacrifices to stones and spirits are most important, and there is a complex series of feasts with sacrifices by means of which a man acquires merit. Some interesting notes on the effects of mission work are given in an appendix, and Mr. Mills reaches the conclusion, favoured by most anthropologists, that, although the mission may confer considerable good on the native, much harm is also done by the destruction of tribal life beyond the point of political necessity.

The usefulness of the book is augmented by a chronological bibliography of the Naga Hills by Mr. Hutton, who has also added valuable notes to the text. The book is well illustrated and provided with a map. There is an excellent index.

Mr. Mills is to be congratulated on his valuable contribution to ethnology, for, as Mr. Balfour remarks in the foreword to the work, "detailed ethnographical monographs, such as the present work, compiled without the bias of any fixed and inelastic theory, afford to the comparative ethnologist reliable material upon which he can work," and, it may be added, such monographs are comparatively rare. W. E. ARMSTRONG.

Science and Survival.

The Bridge: a Case for Survival. Compiled by Nea Walker. With a Prologue and an Epilogue by Sir Oliver Lodge. Pp. xi+314+16 plates. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1927.) 21*s.* net.

SERIOUS study of the phenomena of the 'mediumistic' trance can be divided into two main classes: the work hitherto done through mediums on supposed supernormal communications which are alleged to come from the dead; and the elucidation of those products of automatism usually styled the 'cross correspondences.' Of these, the first class is of some considerable scientific interest, and the present volume is a further contribution to the subject along those lines.

A devoted married couple, Mr. and Mrs. White, were separated by the death of the former; and the latter, seeking consolation, applied to Sir Oliver Lodge for assistance. As is usual in such cases, the applicant was put in touch with Sir Oliver's secretary, Miss Nea Walker, the compiler of the present volume. With her help Mrs. White visited certain mediums in Cardiff near her home, and with them she obtained information which, it is alleged, they could not have normally known. This beginning was supplemented by sittings on behalf of Mrs. White taken by Miss Walker with the medium Mrs. Leonard, and also by private sittings with Miss Walker's sister, Damaris, who is supposed also to possess 'psychic' faculties. Later, Mrs. White herself had sittings with Mrs. Leonard, and finally dying she 'came through' at sittings which Miss Nea Walker arranged with Mrs. Leonard. This is, in short, what is known as the White Case, and it is here presented as evidence for the survival of bodily death and the continued interest in, and knowledge of, earth conditions by those who have passed beyond the veil.

The evidence consists in the main of a mass of intimate and trivial information recognised as appropriate by Mrs. White, and in many cases given through mediums and to sitters unknown to her or to her deceased husband. Such trivialities do not weaken the evidence. In certain cases they strengthen it, especially when the material is of such a nature as not to lend itself easily to coincidence. Thus, at one sitting when Miss Walker was acting as deputy for Mrs. White, the 'communicator,' purporting to be Mr. White, remarks that he thinks that at the end of the previous week, about nine days ago, they were looking at a sunset together. As a matter of fact, exactly nine days previously, Mrs. White had noted down in her diary that she had been looking at a sunset and had been thinking of her life with her husband whilst doing so. There are a good many incidents of a similar character scattered up and down the records of the sittings, and interspersed among them are names of persons connected with Mrs. White which would not have been easy to obtain through normal means.

Now it would be hazardous to advance the supposition that all the information given through the various mediums and here described was derived from normal sources revealed fraudulently. Certainly it would seem that at least some of it was derived from some hitherto unrecognised source which is usually described as 'supernormal.' However that may be, it is a pity that some competent psychologist, alive to possible sources of error, did not supervise and systematise the experiments from the start. Thus, we are told that Miss Walker originally sent Mrs. White's letter asking for assistance to "a man in Cardiff." Is it not legitimate to ask who this man was; whether he knew of the mediums to whom Mrs. White afterwards went; whether he showed the letter to any one, and if so, whether these persons knew the mediums concerned? These and many more similar questions immediately arise, but no answer to them will be found in the pages of this book. Again, how unsatisfactory it is to have one of the principal mediums, Damaris Walker, living in the same house with the principal investigator. Moreover, what an opportunity was missed when Mrs. White herself died. Instead of sending someone *who was not aware* of Mrs. White's death to take a sitting for Mr. White to 'communicate,' Miss Nea Walker herself goes, and, presupposing some telepathic *rapport* between herself and the medium, it is not surprising that Mr. White affirms the presence of his wife, although strangely enough the control, Feda, does not seem aware of it.

To any one acquainted with the history of the evolution of the human mind and not already persuaded, "The Bridge" will scarcely carry conviction. It may stimulate independent investigation of the problems underlying the real meaning of the odd phenomena associated with the mediumistic trance. Systematic experiments, independently checked and verified at every stage, are, it is admitted, very difficult of execution, but certainly ought to be attempted. Thus, it ought not to be permitted, as was done in the present case, for the sitter to be present alone with the medium and take personal notes in long-

hand. It is admitted in the 'White Case' that a selection has been made, and it is obvious in what direction it operated. If telepathy occur at all, then the laws underlying it will only be discovered through the most rigid control conditions being applied.

At present we see little appreciation of this fact in the writings of psychical researchers. It remains to be seen whether, when sufficiently strict control conditions are applied, the 'phenomena' tend to disappear as seems to be the case with the so-called physical phenomena of spiritualism. When normal knowledge, chance coincidence, common associations, deliberate fraud, and hyperæsthesia are eliminated, what remains? Is there, in fact, any residue left for examination? Certainly in such 'phenomena' as are exhibited in the published 'cross correspondences' there would appear to be little, if any. In the communications given through mediums there would seem to be something for which no normal explanation is readily available, and this volume provides a good example of the latter category.

Indian Malarial Research.

Malaria: its Investigation and Control; with special reference to Indian Conditions. By Major Robert Knowles and Ronald Senior-White. Pp. vii + 220 + 6 plates. (Calcutta and Simla: Thacker, Spink and Co., 1927.) 7.8 rupees.

WHEN the professor of zoology in the Calcutta School of Tropical Medicine, and a worker in the Central Malaria Bureau of the Government of India with previous wide field experience in Ceylon and India, collaborate in a monograph on the investigation and control of malaria intended for men of the Indian assistant-surgeon class, its scientific and practical hygienic value are assured; when they dedicate it with respectful homage to the wives of research workers, in recognition of their sufferings in the cause of science, the illumination of humour helps perspective; and when they permit in the book the issue of advertisements of material pertinent to the subject, they perhaps but follow closely in the footsteps of the School's distinguished founder, for it was he who persuaded the merchants of Calcutta to contribute so liberally, and, so far as they were concerned, so unexpectedly, to its finances that they assured him that his missed vocation was that of company promoter.

The first two chapters of the book deal with the malaria parasites in man and anopheles and acknowledge fully the writer's indebtedness to Wenyon's "Protozoology," although Knowles is in error in attributing to that book and author the original intimation that if *Plasmodium ovale* Stephens be valid species its valid name is *P. minutum* Emin, 1914. That effect of the working of the Code of Zoological Nomenclature was indeed pointed out in the *Tropical Diseases Bulletin* three years earlier. While on this subject, it may be noted that the specific names of the anopheles cited do not all appear to comply with the law of priority. These chapters contain three valuable coloured plates of the various stages of development of the three species of Plasmodium parasiting the blood of man, and a fourth, particularly striking in its simplicity and clearness, of the relations of the human and anopheline cycles of the plasmodial life-history.

There is one point on which Knowles lays some stress, the statement that gametocytes do not appear early in an infection, not perhaps for ten days or more, their appearance being due, it is suggested, to conditions becoming unsatisfactory for schizogonic multiplication. Warrington Yorke and Macfie, in their transmissions of *P. vivax* by mosquitoes in the treatment of general paralysis, have, though rarely, found gametocytes in the circulating blood as soon as any forms have been discovered there, and, in all instances, two or three days later. It is reasonable to conclude that gametocytes come into existence as soon as do schizogonic forms, but in numbers too sparse to be detected in the circulating blood by our present diagnostic means.

The reasonableness of this explanation is strikingly illustrated by an incident cited in the book where some fifty thin smears from one man were distributed among the School class with the view of eliminating *P. falciparum* infection, for it was intended to use this blood, which was infected with *P. vivax*, in the treatment of general paralysis. Rings suspicious of subtertian malaria were found in three smears, and a crescent in a fourth. Should the sexual forms, essential for the survival of the species, appear only when conditions are unfavourable for schizogonic multiplication, the observation would have wide zoological implications, so that hesitation in accepting this position is justified.

With experience of the diagnostic uncertainty of thin films, such as has just been indicated, there is little wonder that Knowles is a convinced advocate of the thick film for the diagnosis of malaria, and full and careful directions are given for its preparation with a view of ensuring that plasmodia

shall always be detected therein if they are present. Culture is advocated for diagnosis if the thick film prove negative and doubt still remains, thus following Sinton, in whose hands it has in these conditions been successful, the amount of blood usable amounting to 1 c.cm. A fifth coloured plate illustrates the normal and abnormal cells which may be found in a stained blood film.

Very convincingly, Knowles unfolds the argument against 'parthenogenesis' in Plasmodium, but, unfortunately, it is not, as he writes, "now as dead as mutton"; it has recently been sponsored by a great French scientific society in considered advice to the French Government.

The line of treatment inclined to is Sinton's alkaline quinine mixture, but as regards total dosage sufficient stress seems scarcely to be laid on the difference in reaction to the cinchona alkaloids which is shown by a recent and by an 'established' infection, both conveyed by the mosquito. Perhaps for the book's purpose such stress is useless, in view of the unlikelihood of detecting a new early infection in those who have been infected in, and have relapsed or been reinfected since, childhood. The cinchona alkaloids other than quinine, and the mixture known as cinchona febrifuge, are considered. The very strong reasons against giving quinine by the intra-muscular route are fairly marshalled, the invariably resulting necrosis is stressed, and some of the appalling consequences illustrated. After all, seeing that the Indian sub-assistant surgeon does give intravenous injections of tartar emetic for kala-azar at the rate of about two a minute in Assam, there is little excuse by any one to avoid the sure and rapid intravenous route for quinine, where the oral route is contraindicated.

Senior-White describes the making of a malarial survey, and the design, construction, and maintenance of anti-malarial measures, and furnishes appendices. These comprise the breeding places and distribution of Indian anopheles, and a key for the identification of the imagines. A corresponding key for the mature larvæ is accompanied by a sketch of the entire larva with its anatomical parts named; an idea which will, no doubt, be extended to the imago in another edition. Both keys are usefully illustrated throughout. The last appendix consists of a copy of the specification which has been found so valuable for the construction of subsoil underdrains in the Federated Malay States. A considerable bibliography follows. The book fills well the limited function for which it is intended.

CLAYTON LANE.

Our Bookshelf.

Comets and the Sun: New Theories regarding their Structure. By Dr. John W. Weir. Pp. xvi + 72. (London: Longmans, Green and Co., Ltd., 1927.) 12*s.* 6*d.* net.

THIS book is very well illustrated; it contains reproductions of photographs and drawings of Halley's and other comets, made at the principal observatories, also photographs of sunspots and the corona, and a large coloured drawing of a solar prominence. A considerable part of the text is taken up with quotations from the writings of well-known astronomers; some of the passages quoted were, however, written before the recent advances in atomic physics, and are now somewhat out-of-date.

Cometary physics are very difficult to explain in a perfectly satisfactory manner, and it is unwise to be too dogmatic in condemning any suggestion as being certainly unsound; some of the author's suggestions are, however, rather difficult to accept. Thus he suggests that the tails of comets are bounded by an envelope, which he appears to picture as a sort of membrane. It must be admitted that the well-known drawing by Gen. G. H. Willis of the great comet of 1882 lends some support to the suggestion; yet it is difficult to reconcile it with our knowledge that the tail is not at rest with respect to the head, but is continually being driven outward by powerful forces. Again, the author invokes currents in the interplanetary medium to explain some features of the tail. The study of cometary movements clearly shows that the medium offers no sensible retardation to the motion of the comet as a whole; still less could its differential action between different parts of the comet be sensible. There are similar difficulties in some other suggestions; still we may admire the author's enthusiasm for his subject, and his desire to throw new light upon it, even if we are unable to accept all his ideas.

A. C. D. C.

A Text-Book of Geology. By Philip Lake and R. H. Rastall. Fourth edition. Pp. xiv + 520 + 33 plates. (London: Edward Arnold and Co., 1927.) 21*s.* net.

THE fourth edition of the deservedly popular "Lake and Rastall" remains unaltered in plan, but a considerable number of minor changes and a few brief additions have been made. For the most part these are insufficient to indicate to the student the remarkable developments in geological interpretations that are at present in full swing. It may be that the authors feel that the time is not yet ripe for the incorporation of modern advances into the scheme of an elementary text. Certainly it would be difficult to introduce the newer outlook into any already existing text-book. Nevertheless, more attention might have been given to isostasy; the structure of the crust as revealed by earthquake records; the work of the Carnegie Institution of Washington on the nature of volcanic activity; and the far-reaching consequences of the recognition

of radioactivity as a source of internal energy. Only nine lines are devoted to the continental drift hypothesis, and vulcanicity in all its forms is still regarded as "merely a secondary effect of the greater class of phenomena dependent on the cooling and contraction of the globe as a whole."

At present there is generally a marked difference between geological text-books and courses of lectures, and the above comments are offered in the hope that in future editions of this and other books of similar scope (*e.g.* American) some serious attempt will be made to make the gap less obvious. Meanwhile our "Lake and Rastall" remains by far the most generally useful text which is at present available for elementary students. We welcome its improvements and hope for more when the present edition is exhausted.

La construction collective de la maison en Kabylie: étude sur la coopération économique chez les Berbères du Djurjura. Par Prof. René Maunier. (Université de Paris: Travaux et Mémoires de l'Institut d'Ethnologie, Tome 3.) Pp. iii + 81 + 3 planches. (Paris: Institut d'Ethnologie, 1927.) 45 francs.

IN this study of the erection of a Kabyle house the author is primarily concerned with the sociological aspect, and the technological and religious aspects —for certain stages of erection involve a religious ritual with sacrifice—are dealt with only summarily and incidentally in so far as some account of them is necessary to comprehension of its building as a social activity. The character of the Kabyle house is determined to a large extent by the environment and by the economic activities of the people. The intensive character of the occupations of the people, as is usual in the circumstances, tends to the concentration of a completely self-supporting unit under each roof. Each house is inhabited by a single family. It is, however, essentially the place of women's occupations; the men use it only for eating and sleeping, while unmarried sons of adult age sleep in a kind of club-house. But as a small group of this kind is not adequate to the labour of erecting a new house, the help of relatives and then of the whole community is called in. New houses are usually erected on the marriage of a son, and there is a tendency for each new house to be grouped around that of the parents, thus creating a community within a larger unit. M. Maunier's book is a valuable piece of work which well illustrates the function of and method of working of a communal activity.

The Story of Myths: for the Use of Students in Training Colleges, and Others. By E. E. Kellett. Pp. v + 275. (London: Kegan Paul and Co., Ltd., 1927.) 7*s.* 6*d.* net.

IN the course of the lectures, or rather informal talks to training college students, which furnished the material from which this book has been made, the author disclaims any attempt at exhaustive treatment of the various classes of myth. He has, however, covered a sufficiently wide field, and within the limits he has imposed upon himself, his treatment of the subject is scholarly and shows wide reading. The chapters on psychological elements in the growth of myth and on existing relics of old custom and myth will be found especially valuable in giving the student the point of view of the student of folklore in approaching his material, and the conditions, both psychological and cultural, of the myth-making stage in the development of the human mind. The principal classes of myth which the author analyses are those relating to the heavenly bodies, sky and sea, creation, great catastrophes such as the flood, birth and death, and twins. The chapter on the history of folklore might have been a little more systematic. Some notable names are not mentioned, for example, Sir Laurence Gomme and Sir John Rhys. A select bibliography would have been an advantage, and have added materially to the value of what is, within its limits, an excellent book. The index is particularly good and useful.

Applied X-rays. By Prof. George L. Clark. Pp. xiii + 255. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 20*s.* net.

IN this admirable volume, Prof. Clark gives what is probably the first extensive and scientific account of the progress made in the application of X-rays to the solution of the special problems of industry. Even to readers more or less in touch with X-ray work in general, the extent and variety of the subjects dealt with in the book will come as a surprise. The application of X-rays to the solution of problems connected with the behaviour of metals and alloys under strains, with the composition of chemical compounds, with catalysts, colloids, textile fibres, varnishes, dyes, soaps, dielectrics, adhesives, abrasives, cements, coal, and gems, are some of the many subjects with which the author deals. It is not surprising that he foresees a great future for this new and rapidly growing branch of applied science.

Prof. Clark writes not only with enthusiasm but also with knowledge and judgment, and has succeeded in condensing into small compass a considerable amount of information, much of which is drawn from sources not too easily available in Great Britain. The book is excellently written, well illustrated, and charmingly produced. We congratulate the author on having so admirably filled a real gap in our current scientific literature.

The Theory of Strong Electrolytes: a General Discussion held by the Faraday Society, April 1927. Pp. iii + 333-544. (London: The Faraday Society, 1927.) 15*s.* 6*d.* net.

THE Faraday Society's general discussion on "The Theory of Strong Electrolytes," held at Oxford on April 22 and 23, 1927, was noted somewhat fully in these columns (May 7, p. 676). A full report, containing the original papers and the discussion upon them, has now appeared, and will be welcomed as a work of first-class importance on one of the most controversial aspects of physical chemistry.

Letters to the Editor.

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

The Origin of the Nebulium Spectrum.

THE identification by MM. F. Croze and C. Mihul of a number of intercombinations between quartet and doublet terms of O II (*C. R.*, vol. 185, p. 702), which has been announced since my letter of last week was written, provides important data for the further consideration of Mr. Bowen's suggestion as to the origins of certain lines in the spectra of gaseous nebulæ.

Bowen's values for the quartet terms of O II were based upon a sequence of three ^4P terms, and it was understood that while these were relatively correct among themselves, they were not necessarily quite correct with respect to the previously determined doublet terms. The discovery of intercombinations, however, leads to a correct relation between the two sets of terms. Without going into details, it may be stated that while Bowen's estimate for the $^4S_2$ term was 283366 (*Phys. Rev.*, vol. 29, p. 243), the new data indicate a value of 283028, within limits of error depending upon the measurement of lines in the extreme ultra-violet. Thus, adopting Bowen's interpretation of the nebular lines λ3728, λ3726, we have

λ air.	ν (vac.).	Combn.	Bowen.
3728·91	26809·9	$^4S_2 - {}^2D_3$;	$^2D_3 = 256208$; $^4S_2 = 283018$
3726·16	26829·7	$^4S_2 - {}^2D_2$;	$^2D_2 = 256192$; $^4S_2 = 283022$

The mean value of $^4S_2 = 283020$, is in remarkable agreement with $^4S_2 = 283028$, as determined entirely from laboratory spectra, involving lines in the extreme ultra-violet. Taken in conjunction with the evidence in favour of similar irregular combinations of terms of N II and O III, this result leaves little doubt that Bowen's interpretation of some of the chief nebular lines is correct.

Since the ordinary combinations which build up the laboratory spectra of O II, O III, and N II do not occur in nebulæ, it would appear that the conditions in nebulæ which facilitate the occurrence of irregular combinations of deep spectroscopic terms are such as to prohibit the regular combinations which produce the familiar laboratory spectra of the same elements.

I should like to take the opportunity of making a small correction to my letter. In the paragraph on p. 582 in NATURE of Oct. 22, beginning with "Bowen's assignment of the strong nebular lines λ3728·91 and λ3726·16 to O II leads to term values for $^2D_{32}$ of the expected order of magnitude, and the consequent calculation of the red line λ7325 . . .", $^4S_2$ should have been substituted for $^2D_{32}$, and the word 'consequent' should have been omitted. A. FOWLER.

Imperial College of Science,
South Kensington,
Oct. 19.

Absorption Bands of Ergosterol and Vitamin D.

WE have recently shown (*Jour. Chem. Soc.*, 1927, p. 2000) that as the reaction

$$\text{ergosterol} \xrightarrow{\text{u.v. light}} \text{vitamin D}$$

proceeds, the characteristic selective absorption of ergosterol in the region 260-320 μμ diminishes in intensity at a uniform rate. At the same time a new *selective* absorption in the region 230-270 μμ, with a maximum at 247 μμ, gradually makes its appearance, and under our experimental conditions of concentration and light intensity the band is most clearly defined (that is, shows the maximum persistence) after 120-150 minutes' irradiation. Further irradiation now brings about the gradual disappearance of the band at 247 μμ. Animal experiments have indicated that preparations exhibiting this band show great antirachitic potency, whereas the over-irradiated samples are much less active.

As a necessary consequence of these results it follows: (*a*) that anything approaching a satisfactory yield of vitamin D requires prolonged irradiation, because the pro-vitamin bands disappear slowly, and (*b*) that the mercury vapour lamp is unsuitable for this particular photo-chemical reaction because it emits radiations capable of decomposing the product (vitamin D). Our assumption that the band at 247 μμ is due to vitamin D provides an explanation for the well-known instability of the vitamin to light, and unless this assumption is made, not only is the meaning of the band unknown, but we are also left without any physical mechanism for the photochemical decomposition of the vitamin.

The absorption bands of ergosterol and vitamin D overlap to some extent in the region 230-270 μμ, so that the two substances will compete for these radiations. With a high concentration of ergosterol most of the energy at these wave-lengths will tend to *form* vitamin D rather than to decompose it, that is, the reactant will act as a screening agent hindering the secondary decomposition of the resultant. It is inevitable that the concentration of vitamin should rise to a maximum and ultimately fall to zero as the time of irradiation is prolonged, the exact value of the maximum depending on the initial concentration of sterol and the spectral distribution of intensity in the light source. We suggested that in order to obtain a high yield of vitamin, only rays longer than 270 μμ should be used, and in order to do so we stated that either the light from the mercury vapour lamp must be screened, or an alternate source used.

The conclusions (*a*) and (*b*) have been severely criticised by Messrs. Rosenheim and Webster (*Lancet*, Sept. 17, 1927) as not being in agreement with the results of their animal experiments. Indeed, these authors express the fear that their results involve the necessity for rejecting the 247 μμ band as a property of vitamin D, and they also issue a warning against the too-ready acceptance of conclusions based on spectrographic analysis. We are of the opinion, however, that our work supports in a most striking manner the results arrived at by them, and that these were indeed foreshadowed by the spectroscopic evidence. They find that under their conditions of irradiation a maximum antirachitic potency is reached after 30 minutes, this potency then remaining fairly constant for a further 210 minutes. By a roughly quantitative method they show, however, that at the end of half an hour only ten per cent. of the ergosterol has been removed, so that the maximum amount of vitamin D present at any time cannot exceed this figure. Actually, the quantity would almost certainly be less, since some must inevitably have been further changed into inactive material. How much this may be is unknown, as up to the present no quantitative relationship exists between vitamin D and antirachitic potency. Neither the animal nor the spectroscopic test is as yet able to express vitamin D in more than relative terms. Although we are wholly ignorant of the nature of the chemical change which occurs when vitamin D is formed (*i.e.* whether the maximum yield

could be 100 per cent. or only 25 per cent. provided no decomposition occurred), it still remains true that the presence of 90 per cent. of unchanged material is hardly consistent, from a strictly scientific point of view, with its efficient utilisation.

Again, Messrs. Rosenheim and Webster find that even after 240 minutes' exposure, 10 per cent. of ergosterol still remains in the irradiated mixture. Such a result is in complete accord with our observations that prolonged irradiation is actually necessary for the complete conversion of the ergosterol, irrespective of the ultimate fate of the vitamin. These authors seem to have completely mistaken our contentions regarding the employment of the quartz mercury lamp. The spectroscope rendered it perfectly clear that vitamin D was formed from ergosterol by use of the mercury vapour lamp. We would, however, again emphasise that as long as the light source contains radiations between 230-270 $\mu\mu$, photodecomposition of the vitamin must ensue, and this will become the more rapid the more the screening effects of the original ergosterol is lost by its conversion into the vitamin.

Mr. A. E. Gillam, working with one of us (R.A.M.), has been studying the actinometric control of the irradiation process. Using the same concentration as was studied by Rosenheim and Webster, it was found that the persistence of the 247 $\mu\mu$ band remained constant over a long period. It has also been found that irradiation behind vitaglass screens does not effect the expected increase in vitamin concentration. While these results do nothing to weaken the argument for the validity of the correlation between the 247 $\mu\mu$ band and the vitamin, it must be concluded that there is still ample reason to justify us in pursuing the study of the irradiation process by spectrographic means. Finally, we would emphasise that our argument, which is based solely on the disappearance of the pro-vitamin D bands, is not affected if it be eventually shown that these are not due to ergosterol but to some constituent contained therein.

I. M. HEILBRON,
E. D. KAMM,
R. A. MORTON.

The University, Liverpool.

Barrier Reefs of Tahiti and Moorea.

To answer completely the letter from Prof. Davis, published in NATURE of Sept. 3, would take too much space, so, as he suggests, I leave my papers to speak for themselves when they appear. To explain the presence of basaltic stones on the 'barrier' reef by a filling in of the lagoon, and its re-excavation, is really a special pleading against the simpler hypothesis of a once continuous reef; I can myself suggest a much simpler alternative, namely, by their being floated across entangled in the roots of trees, floated out to sea by floods. I reject this means of transport, however, because the stones are *invariably* rounded, which could only be the case when the tree has been uprooted from an alluvial flat. The reefs and their embedded stones are certainly pre-glacial, when such flats were of small extent, especially if, as Prof. Davis holds, the valley mouths were drowned, and the stones, in the great majority of cases, could have been only angular fragments of the rocky sides of torrents.

I can assure Prof. Davis that the geological aspect in general, and his own work in particular, are fully recognised by all workers who, like myself, have been so greatly influenced by Prof. J. Stanley Gardiner, and his forthcoming book will be read with the greatest interest. At the same time biologists cannot agree that their contribution has been, or will ever be, "the less significant side" of the problem, and I suspect that Prof. Davis did not quite intend this meaning; the geological aspect is fundamental, but alone it is as dead as 'faith without works.' The mention of such names as Gardiner and Mayor is sufficient to prove the value of biology, but, as the present discussion is on the reefs of the eastern Pacific, it may be more interesting to take new, and as yet unpublished, examples from that region.

The Marquesas have been the subject of much geological theory, but it was reserved for a biologist to find that the absence of reefs from that group is a matter of coral ecology after all. The foundation, growth, and recession of reefs cannot be completely understood without even more knowledge of the life of corals than we have at present. This subject is only at its beginning. These basaltic stones scattered upon, and bedded into, the Tahitian "barrier" could never have been seen by a geologist, and I think their discovery may be a by-product of the long hours I spent during seventeen years inspecting pearl beds in the Red Sea. Also the fact of the recession of these reefs is as interesting to the geologist as to the biologist, but it can safely be said that it would never have been discovered by the former. The importance of the origin of *surf-resisting* reefs, as distinguished from mere loose heaps of coral, has been insisted upon by Prof. Davis himself. This is decidedly a biological problem, depending upon the interaction of the stony seaweeds and other organisms with coral, as described by Gardiner, and it is also illustrated by the rejuvenated portions of the Tahitian reef edge.

Prof. Davis explains the occurrence of high cliffs on the north side of Moorea Island by a local delay in reef building through the outwash of alluvium from the two fjords of this coast. As he states, this alluvium would be carried westwards, and it would therefore affect only the western two-thirds of the coast, and the reefs would be markedly narrower westwards than they are to the east, which is not the case. The uniformity of the width of the reefs is one of the curious features of the whole group, and those of Moorea well exemplify this. In my account of the Island I have taken the view that the straight north coast is faulted, the two fjord-like bays are due to explosions, while the south coast has tilted downwards and drowned its valleys. All this occurred early in the island's history *and has had no effect upon the form of its reefs*. I have no wish to make this a general statement, applicable to any other island.

Agassiz gives no detail of his dredging in the Tahitian lagoons, and I have good reason for distrusting his general statements. My own dredgings have been far too few, but the most enclosed of all the lagoons, from Papeete round the north-west quadrant of the island to Taapuna Pass, was thoroughly explored by dredge. Its sand is surprisingly uniform in character, angular and fairly coarse, and contains only 15 per cent. of non-calcareous matter. The absence of the red mud, which is poured in at every heavy rain, is remarkable. I conclude that *this* lagoon is filling in, but much more slowly than I, for one, expected. Proof is wanting of what is happening at the *bottoms* of those lagoons of Tahiti which are certainly being excavated for the first few fathoms of their sides, and I hope to obtain it by a series of dredgings on my next visit. If at the same time some inexpensive borings could be taken (1) in the valley flats, (2) at the bases of the marine cliffs, (3) in the reefs, we should not be dependent upon inference for the discussion of the points raised by Prof. Davis, and by my own work. I do not reject the evidence for subsidence given by the valley flats, but pending positive information, they are as well

accounted for by lateral cutting of their streams as by the infilling of bays. Flat-bottomed valleys abound wherever a stream's load of alluvium is excessive, conspicuously, *e.g.*, among the mountains of the Red Sea. Finally, I see no reason why subsidence should convert a fringing into a barrier reef, but, in Tahiti, see evidence that drowning would tend the other way, to the production of a wide flat.

CYRIL CROSSLAND.

The Zoological Laboratory,
Cambridge, Sept. 2.

Earthquake Warnings.

IN a letter in NATURE of Oct. 13, 1923 (p. 538), I proposed a possible method of obtaining warnings of the occurrence of earthquakes. "It seems probable," I wrote, "that the rupture, whatever its nature may be, that gives rise to the actual vibratory shock of an earthquake is preceded by a strain or distortion of the earth's crust, which gradually increases till the stress that causes it is suddenly released. The existence of this strain should be evidenced by a progressive sag or tilt of the surface." I suggested that a new form of the Milne-Shaw seismometer, which has a fixed mirror, as well as the mirror attached to the pendulum, might be employed for detecting such a tilt, and that, "if it be found that shocks are in fact heralded by a definite tilt, it may be possible to arrange for an electric bell to attract the attention of the observer when such a tilt occurs. If he is satisfied that there is sufficient evidence of an approaching earthquake, a general alarm can be sounded."

At the meeting of the Geodetic and Geophysical Union at Prague in September, I had the good fortune to meet Dr. Akitune Imamura, professor of seismology at the Tokyo Imperial University, and to learn from him that in Japan earthquakes have in fact been preceded by such tilting as I had suggested. In his report to the Union (printed in Paris in the present year) he tells us (p. 7) that the Tango earthquake of Mar. 7, 1927, was indicated by an upheaval a metre at a maximum at Mitu and Sunakata, *i.e.* along the coast in the east of the Gomura fault, attaining this state two and a half hours before the great shock took place, although the change was less pronounced on both sides of those places.

Similar phenomena were observed on the occasion of previous destructive earthquakes on the coast of the Sea of Japan. Prof. Imamura gives a table showing an upheaval before the shock in five earthquakes between 1793 and 1927. The maximum temporary elevation varied from one to two metres and preceded the actual earthquake by from half an hour to five hours. He concludes "that the assumption that *topographical change precedes earthquake*" (Dr. Imamura's italics) "may not be so absurd."

"Ishimoto's clinograph, which can register a tilting as small as a decimal of a second, registered at Tokyo a characteristic tilting which appeared from a few weeks before, to the day of the great Tango earthquake. Similar phenomena were observed with his instrument installed at Miyadu, in the case of the shock on Apr. 1, the biggest of the after-shocks of the Tango earthquake."

"The Earthquake Research Institute of the Tokyo Imperial University is attempting to have, among others, a network of stations, each equipped with a pair of clinographs and other auxiliary instruments necessary for carrying on the study concerning the earthquake prediction."

I am not aware that my suggestion has been acted on anywhere else.

It would seem desirable that, in regions subject to serious earthquakes, a number of local stations should each be equipped with a pair of simple horizontal pendulums, so adjusted that if any unusual tilt occurs a bell should ring automatically in the office of a central observer and the locality indicated there by a signal. He would then judge from the number of stations affected, and the record of his own seismometer, whether the indications were sufficient to warrant him in giving the alarm.

I may add that I am informed by Sir Gilbert Walker that a slight tilt has sometimes been observed in the seismographic records of Simla setting in a few minutes before the vibrations from an earthquake with a comparatively near epicentre.

In conclusion, I should like to point out that the earthquake *warnings* to which I have been referring are quite distinct from *long-period* earthquake *predictions* based on observation of the secular relative movement of adjoining masses of the earth's crust. Such movement results in a stress in the tract intervening between them. When this stress exceeds the limit of elasticity of the rock, rupture will take place followed by an earthquake shock (H. F. Reid, *Beiträge Geoph.*, vol. 10, pp. 328-345; 1910; J. W. Evans, *Q.J.G.S.*, vol. 66, p. 346; 1910). From such observations it may be possible to form some idea when the limit will be exceeded, and thus to predict the occurrence of an earthquake with an error of, perhaps, not more than, say, half-a-dozen years. The actual disruption of materials under stress is, however, as is well known, immediately preceded by increased deformation, and it is the tilt that results from this that provides the earthquake warning. The interval between the commencement of the warning tilt and the shock is usually brief, but in most cases it will be long enough to enable loss of life to be largely, if not entirely, prevented.

The same report contains interesting details of the horizontal and vertical movements accompanying the earthquakes of 1923 and 1927 respectively. These are clearly shown in the maps and reproductions of photographs that accompany it.

JOHN W. EVANS.

Athenæum Club,
London, Pall Mall, S.W.1.

The Consistence of Mixtures of True Fluid and of a Fluid with Solid Particles.

WHEN two fluids which have no chemical action on one another and are mutually insoluble, are well shaken together, the mixture consists of small globules of one fluid embedded in a matrix of the other, and is in general less fluid than either of the constituents taken separately. Common examples of this sort of stiffening are to be found in cream, mayonnaise sauce, and butter (mixtures of oil and watery fluid), but the most striking case is that of oil and mercury, which forms a stiff black mud. In the first three examples it is the oil which takes the globular form, and in the last the mercury.

Since the surface tension of oil-water is much less than that of mercury-oil, it would seem that the surface tension difference is not the factor determining which of the two fluids shall persist as globules. This probably depends on the qualities which tend to make fluid films stable. The stiffening of these mixtures may be explained by the fact that when they are stirred or distorted, a flow has to take place in the narrow channel separating the globules and that this is resisted by viscosity.

Suppose that a large number of small solid spheres are placed in a vessel, and are so disposed as to occupy

the minimum space (*i.e.* that each is touched by its neighbours at twelve equidistant points), and that then fluid is added until the spheres are just covered. If now the arrangement of the spheres is disturbed in any way, the level of the fluid will fall in consequence of the increase of the volume of the interstical cavities, and the viscous resistance to be overcome is proportional (among other things) to the aggregate surface of spheres—or, in other words, inversely as their diameter.

When the spheres are globules of liquid, distortion of the mass will also cause a deformation of the individual globules, and this will be resisted by an elastic reaction due to the internal pressure, which exists in them by virtue of surface tension. The internal pressure in a globule of diameter D where the surface tension constant is T is equal to T/D, and this becomes considerable when D is small. In a mercury-in-oil globule, for example, if D is 1/2000 in. the pressure will exceed 40 lb. per square inch—about as much as the pressure in an ordinary bicycle tyre, but in a collection of such globules, if deformed, the internal pressure may be much greater, for the deformation tends to make the globules into dodecagons, and the pressure is inversely proportional to the least radius of curvature of the deformed sphere. (In such fats as butter, in which the oil solidifies at low temperature, additional viscous resistance is offered to deformation.)

It would be a waste of space to go fully into the quantitative (and fairly simple) relations between volume of the interstices as the arrangement of the globules departs from the minimum volume pattern, but the results may be shortly stated thus :

(1) In a collection of fluid globules closely embedded in a second fluid, resistance is offered to deformation by a force which is partly elastic and partly viscous, the viscous force being much the more important.

(2) The resistance increases as the diameter of the globules diminishes.

(3) When the globules are closely packed any deformation of the mixture involves an increase of volume, not, of course, of the globules, but of the spaces between them.

The expansion of mixtures from this cause is well shown in such material as glazier's putty (oil and chalk). Putty when well kneaded is soft, and if rolled into a cylinder can be easily lengthened or shortened for a certain distance by applying force to the ends. If, however, the alteration of length exceeds a definite limit, the resistance increases very rapidly, as if the motion were opposed by a mechanical stop. At the same time, the appearance of the surface suddenly changes, losing its shiny gloss and becoming dull and 'matt.' This happens when the particles of chalk, which at first were separated by oil, have been brought into contact, and further distortion withdraws the oil from the surface to fill the enlarged internal cavities. The same explanation applies to the dry patches which (as most people must have observed) appear for a short time round footsteps on wet sand recently left by the tide. Most people also must have noticed that by tapping on the sand with the foot, the surrounding area becomes wet and soft—a quicksand in fact—thus showing that the sand particles are separated by fluid, but the wet area quickly resumes the dry appearance when a steady pressure is applied.

Many superstitions have collected about the character of real quicksands, and it would be a matter of interest to examine the conditions under which they are formed.

A. MALLOCK.

9 Baring Crescent,
Exeter.

The Thickness of the Continents.

THIS important datum, as arrived at on seismic evidence, has been referred to frequently in the pages of NATURE. Most readers, I think, will agree that the conflicting character of the results is discouraging. Within the last two or three years the average depth of the continental layer has varied from 12 to 60 km.!

There is little doubt that the most trustworthy information available is that based upon isostasy. The object of the present letter is to direct attention to an important paper by Alfred Wegener in the current number of Gerlands *Beiträge zur Geophysik* (Bd. 17, H. 3), which bears directly upon the isostatic method of estimating continental thickness and, as I think, involves a correction upon all previous calculations based on isostasy.

In the course of a discussion of Gutenberg's conclusion as to the existence of a great depth of sial spread over the Atlantic floor, Wegener points out that the average depth of the ocean should not be taken as defining the surface of the sima but, rather, those soundings which are found to prevail over the greatest areas. The 'Haufigkeits Maximum,' so far as the observations go, defines a depth of about 4700 m., and he considers that further knowledge of ocean depths probably will refer the sima surface to a depth of about 5000 m. The lesser soundings obtained over the ocean are to be ascribed to the presence of more or less sial, which floats in the denser sima. In the Azores such oceanic sial attains the surface. There are considerable areas in the Atlantic floored by such submerged plateaus and islands but, also, great areas floored by sima as indicated by the greater depths. In the Pacific the sial is absent or scarce.

This interpretation of oceanic soundings commends itself as almost certainly correct. We must accept it if we are to remain true to isostasy and profit by the results obtained by Meinez over great ocean areas : results brought before the recent International Union of Geodesy and Geophysics (NATURE, Oct. 1, p. 494).

Wegener's interpretation of the soundings directly affects our application of isostasy to finding the average continental thickness, as he, himself, recognises. Thus, some few years ago I sought to estimate continental depth on isostatic grounds, taking the mean depth of the ocean (3·8 km. Murray) as defining the surface of the sima. The thickness came out as 30·7 km. ("The Surface History of the Earth," p. 35). The other data involved the average density assigned generally to continental materials, that is, that of granite (2·67) and that proper to the substratum, that is, that of basalt (3·00) ; it being further assumed that pressures and temperatures prevailing in the depths leave the ratio of these densities unaffected. But in this calculation the average emergence of the continents over the surface of the sima is taken on the *prima facie* plausible assumption that the mean depth defines the surface of the latter. Correcting the figures in accordance with Wegener's views (as above) the average continental thickness is found to be 37 km.

This result appears to possess the minimum degree of uncertainty. The thermal methods cannot be regarded as sufficiently dependable to over-ride it. For, in fact, it may well be that the radio-activity of the continents diminishes somewhat downwards as it appears to do in the whole depth of the substratum so far as we can ascertain. Such a diminution in radio-activity would probably be attended with some increase in density. But the latter change may be small. Thus if anorthosite, which Daly regards as probably a gravitative differentiate of gabbroid

(basaltic) magma, entered considerably into the basal structure of the continents, the radio-thermal effects would seem to be reduced some fifty per cent. and the density be only slightly affected. If diorites shared in the deeper continental structure (as Holmes has suggested) the same effects would arise, but in lesser degree.

It would seem that upon the thermal aspects of the question all we can say is that our estimates point clearly and unmistakably to basal temperatures adequate to annul or greatly reduce escape of heat from the underlying sima or, even, possibly to give rise locally to some downward flux: and that as regards surface gradients the data are so uncertain that beyond their testimony to the continued ascent of heat from beneath in amount sufficient to support and confirm our views as to its radioactive origin throughout continental materials of relatively high radioactivity—we cannot go. J. JOLY.

Trinity College,
Dublin, Oct. 3.

Dug-out Canoe in Algoa Bay.

MR. F. W. FITZSIMONS has sent me a fragment of wood from the dug-out canoe washed ashore in Algoa Bay, described by him in NATURE of May 21, and since referred to by other correspondents in these columns. I am naturally far from desirous of entering into the discussion on the exact origin of the canoe, but the results of my examination of the wood show, I think conclusively, that the canoe had its origin somewhere in the Bay of Bengal off the coast of Burma or the Malay Peninsula, and that the Nicobar Islands cannot have furnished the particular timber from which it was made.

Examination of the fragment received from Mr. FitzSimons shows that the wood is derived from an Indo-Malayan tree of the family Anacardiaceæ. The anatomical structure, which is quite distinctive, identifies the specimen with one of two closely related genera, Gluta and Melanorrhœa. Species of both these genera are distributed throughout Indo-Malaya and are represented in the Mergui Archipelago by *Gluta tavoyana* Wall. and *Melanorrhœa glabra* Wall., but so far neither genus has been recorded from the Nicobar Islands. A study of specimens or descriptions of all the genera of the Anacardiaceæ represented in the Nicobar Islands has not revealed any indigenous wood which bears more than a family resemblance to the timber of the canoe. B. J. RENDLE.

Imperial Forestry Institute,
University of Oxford.

An Aspect of the Biochemistry of Sugars.

THE issue of NATURE of July 9, p. 44, contains a communication by Prof. R. Robinson, in which, on purely speculative grounds, far-reaching conclusions are drawn (1) regarding the origin in Nature of galactose, and (2) regarding the configuration of the pentose of the plant nucleic acid. The second conclusion met with the approval of Haworth.

The views of Prof. Robinson are contradicted by recorded facts.

(1) Glucose-3-phosphoric acid ferments at the same rate as glucose. Should glucose-3-phosphoric acid on hydrolysis pass into allose, then the rate of fermentation would be lower than that of glucose. Glucose-6-phosphoric acid (very stable ester) ferments at a lower rate than glucose.

(2) In the pentosephosphoric acid of the yeast nucleic acid, the phosphoric acid is attached to carbon atom (5) which is symmetric.

Furthermore, Dr. A. L. Raymond and the writer have found that on hydrolysis of glucose-3-phosphoric acid, only one sugar, namely, glucose, is obtained.

A more detailed analysis of Prof. Robinson's communication will be published in the *Journal of Biological Chemistry* in connexion with the report on the hydrolysis of glucose-3-phosphoric acid.

P. A. LEVENE.

The Rockefeller Institute for
Medical Research,
New York, Sept. 16.

The Isolation of Protoactinium (Element 91).

THE exact relation of the actinium to the uranium-radium disintegration series has been a matter for discussion since the discovery of actinium. A. S. Russell (NATURE, Sept. 17, p. 402) has recently discussed the problem and made a new attempt to predict the atomic weight of the longest-lived member of the series, protoactinium. He mentioned that experimental verification of the suggested values was difficult owing to the great difficulty of separating protoactinium from tantalum.

Recently it has been shown in this laboratory that the separation of protoactinium from other elements is not so difficult as has been thought, and about 2 mg. of almost pure oxide of protoactinium has been isolated. An account of this will shortly be published. The half-value period of this product has been redetermined by O. Hahn and E. Walling as 20,000 years. For each gram of radium, therefore, in a mineral there is approximately 0·4 gram of protoactinium.

It is hoped that the difficulties, both financial and technical, of preparing a sufficient quantity of the element for an atomic weight determination will soon be overcome so that this outstanding problem of radioactivity may be settled.

ARISTID GROSSE.

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Berlin, Sept. 27.

Formation of Anthraquinone by Vapour-phase Oxidation of Toluene, and Toluene-containing Petroleum Distillates.

THE recent paper of C. R. Downs (*Jour. Soc. Chem. Ind.*, **46**, 383T; 1927), stating some facts and also speculations concerning catalytic oxidations, is of much interest, and we wish to confirm the interesting oxidation and condensation of toluene to anthraquinone. Experimental details of most of these vapour-phase reactions are almost entirely lacking, the processes being covered by numerous patents.

We have obtained small amounts of anthraquinone with benzoic acid and benzaldehyde by passing air mixed with toluene vapour, or the vapour of a toluene-containing petroleum distillate, over a catalyst consisting of aluminium grains coated with vanadium pentoxide. The gas rate used was about 12 litres per hour, and the catalyst maintained at 400° C. The gas mixture was obtained by bubbling air through the toluene held at 50° C. The greater portion of the anthraquinone and benzoic acid formed under these conditions crystallised out in the cooler parts of the exit end of the catalyst tube.

A. R. BOWEN.
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Causes and Effects of Mining Subsidence.

By Sir RICHARD REDMAYNE, K.C.B.

THE final report of the Royal Commission on Mining Subsidence,[1] appointed on Mar. 17, 1924, has recently been published. The Commission was asked to inquire into the operation of the law relating to support of the surface by underlying minerals, the extent and gravity of the damage caused by subsidence owing to the extraction of minerals, and to report as to what steps should be taken by legislation or otherwise to remedy equitably the hardships that may arise in existing conditions—a wide and controversial field—and Lord Blanesborough, the chairman, is to be congratulated, not only in securing unanimity, but also in having presented an admirable and lucid report.

The subjects of the report, which is concerned almost exclusively with the coal-mining aspect of the case as "the extraction of other minerals presents in this country no feature sufficiently outstanding to call for separate attention" at their hand, are considered under convenient heads which allow of the matter being easily and quickly digested. To the technical expert, perhaps, the matter dealt with under the earlier headings is the most interesting, namely—the physical aspects of subsidence, and the uncertainty of its incidence, as well as the definition of the problem before the Commission, the legal position. The definition given of subsidence is worth reproduction in view of some of the decisions that have been arrived at in the Law Courts. "Where," says the report, "a seam of mineral is completely extracted the unsupported roof falls. If the overlying beds consist of comparatively soft strata, these will bend down gradually and fill the void almost completely, and the superincumbent beds will come down in turn until the subsidence reaches the surface. In every case the descent of the superincumbent strata is accompanied by more or less fracturing and, therefore, by an increase in the volume of the strata thus let down. It follows that the surface subsidence is never equal to the thickness of the mineral extracted."

The full meaning which is meant to be conveyed by the words, "where a seam of mineral is completely extracted," is not clear. Literally interpreted, they would mean that the area of extraction involved would extend over the whole coalfield. The sentence should have read, "where a certain area of a seam of mineral is completely extracted." What that area has to be before subsidence commences has been a source of much argument in the Law Courts and elsewhere, is subject to variation, and is largely determined by circumstances, such as the thickness of seam worked, depth of the seam from the surface, inclination and nature of the strata overlying the seam, and the presence of faults. To maintain, as was asserted in a recent classic law case, that, on extraction of a coal-seam (only very small temporary support being left by odd pieces of coal which were left in the process of working), the roof, consisting of a strong bed of sandstone, would bend, and eventually a period of quiescence be attained *without the roof and floor meeting*, is a most erroneous view, but one more widely held than is generally supposed. It is pleasing, therefore, to find the Commission upholding the correct view and stating that the roof in such a case will break into comparatively large blocks which, piling up irregularly on each other, afford at the outset a certain measure of support to the overlying beds. The presence of these beds gradually crushing down partly reconsolidates the broken blocks, and in this way the subsidence ultimately reaches the surface. The movement, too, continues longer, and the total amount of surface subsidence is less than when the superincumbent strata consist mainly of softer and more plastic rocks.

The Commission arrives at the conclusion that the amount of subsidence is not quantifiable and "cannot be predicted with any accuracy, even when all the conditions are tolerably well ascertained." I should hesitate to be so positive as this. Given the thickness of the seam, the method of working practised, the nature and thickness inclination of the superincumbent strata, it should be possible to arrive at a fairly close approximation, not only as to the amount, but also the period of the subsidence consequent upon extraction of the underlying mineral.

The "problem of damage" from subsidence, as regarded by the Commission, can perhaps be epitomised thus:

1. It may be better in the national interest in some cases to leave minerals unworked than to work them, for example, in such a case as where lowering the surface would cause the land to become a swamp.
2. The determination of cases in which a remedy is called for where damage has been done to the surface and building, etc., where the owners have no claim for redress or compensation under existing conditions.

Most people are under the impression that the right of surface support is universal, but such is not the case. The right of support to the surface may have been lost through severance at some time of the ownership of the minerals from the ownership of the surface, but "unless the power to let down the surface be found in the instrument of severance," said Lord Swinfen (M.R. 1915, 1 ch. 264), "and unless the power to let down the surface be found there expressly or by necessary implication, the common law of right of surface owner to support will prevail." Conveyancers in settling instruments of severance have devised provisions unambiguous in respect of power to

[1] Second and Final Report of the Royal Commission on Mining Subsidence. Pp. 68. (London: H.M. Stationery Office, 1927.) Price 1*s*. 3*d*. net.

let down the surface, so there exists to-day in Great Britain a class of surface owner who has no right of support of the surface. Again, the introduction of the Mines (Working Facilities and Support) Act, 1923, excellent measure though it is, has erected machinery for the purpose of enabling minerals to be worked irrespective, speaking generally, of the resulting effect upon specific surface property, and notwithstanding that, apart from the Act, the surface is entitled absolutely to support. In such a case the owner is entitled to, but he must be content with, pecuniary compensation.

The Commission recommends that private owners or occupiers of dwelling-houses of an annual value not exceeding £40 be entitled to compensation for damage to property arising from subsidence due to the extraction of adjacent minerals, such damage being manifest at the time of or subsequent to the passing of an Act allowing compensation, the compensation to be recoverable from any person who has worked the minerals under or adjacent to the house, which impresses one as being a wise and fair solution. The statement of the legal position, and the arguments which have influenced the Commission in arriving at this decision, are set out with admirable clearness and precision, and should be read with care by all of those interested in the subject, whether mining engineers, local authorities, lawyers, or property owners.

The remarks under the heading "Methods of Mitigating Subsidence Damage" are particularly interesting to the mining engineer. Upon this aspect of the matter the report considers three suggestions, namely:

(*a*) The hydraulic stowage of the excavated areas and more scientific methods of mining.
(*b*) The scientific lay-out of the surface; and
(*c*) Precautions possible in the construction of surface buildings.

As to the first, the conclusion is reached that the universal adoption in Great Britain of the filling of the mine wastes with débris under hydraulic pressure—a system so largely practised in the Pas de Calais, the Westphalian, and some other continental coalfields—is impracticable, chiefly because of the cost, a conclusion which was also arrived at a few years ago, for a similar reason, by the Government Committee on Spontaneous Combustion in Mines, of which the present writer was chairman. Except in a very few areas, such as South Staffordshire, where the circumstances in respect of the presence of the necessary material and underground conditions are more favourable to its introduction—at Motherwell, in Scotland, where it is being advantageously employed, the cost is estimated at 1*s*. 3*d*. per ton of coal raised.

Under a system of longwall working with regular advance of an even face and close and systematic packing of the goaf or waste, the subsidence resulting from the extraction of the coal is less than under the irregular working of coal. The longwall system is not, however, always practicable, for example, in the case of a very thick seam.

The disadvantage of erecting houses in long terraces, and the advantage of building them in blocks of two or four instead, is pointed out. "The more scientific 'zoning' and development of the surface according to current conceptions of Town and Regional Planning should also do much to mitigate the damage caused by subsidence."

Under the third suggestion the Commissioners are impressed by the view expressed by Dr. Faber, who gave evidence before them, namely, that ordinary brick buildings would suffer much less from subsidence if lime mortar were replaced by cement mortar, the tensile strength of the latter being many times greater, the increase in cost not amounting to more than two or three per cent. The ordinary miners' cottage, he considered, would be perfectly safe "if built of ordinary brickwork with cement mortar on a properly constructed ferro-concrete raft."

The interests involved are classified by the Commission under three heads, namely: (1) The National Interest; (2) the Local Authorities; (3) Private Owners.

Under the first the matter involved has already been touched upon, namely, the possibility in some cases of the surface being rendered valueless by its being lowered. The Commission has the Doncaster area chiefly in mind, and in accordance with the recommendations made prior to the issue of this, the final report, a Commission of Inquiry has been set up.

The interests of local authorities in respect of possibility of subsidence are chiefly concerned with waterworks and sewage works. The Public Utility Companies, the Statutory Tramways Companies, and the Statutory Gas and Electricity Companies are likewise involved. Under the Railway Clauses Act, 1845, it is assumed that subsidence only takes place, more or less vertically, above the mineral workings—an assumption which all mining men now know to be erroneous—and a limit of forty yards was imposed as the distance beyond which the workings should not approach the thing to be supported. It was considered that the forty-yards' limit gave ample support from subjacent minerals.

The special code of the Support of Sewers Act is a modification of the code in the Waterworks Clauses Act, 1847, the main difference being that the Local Authority may specify *any* distance within which they require the minerals to be left unworked. The matter in respect of railways has been modified by the Mines (Working Facilities and Support) Act, 1923, the statutory distance being enlarged to one-half the depth of the seam from the surface—though this is not a 'scientific' distance—and provides payment by the mine-owner of partial compensation for damage caused by his workings within the statutory distance in cases where the right to purchase support has not been exercised by the railway company. The Commissioners are of the opinion that the right given under Part 1 of the Mines (Working Facilities and Support) Act, 1923, to prohibit and

restrict the working of minerals should be extended to Local Authorities and Statutory Undertakings, which seems to be only right. It is to be hoped, however, that a more scientifically defined limitation in regard to the extent of lateral support to be left from subjacent minerals will be devised than that existing in respect of railways.

The exigencies of space prohibit a longer dissertation on this most valuable and interesting report, which is a model of conciseness and clarity, and should be widely and carefully read.

The Chemistry of Hormones.

THE British Association has the advantage over a number of specialist societies in that it brings together investigators in different branches of science. It makes good use of this advantage in the joint meetings of cognate sections and by discussions on the border line between two sciences. In framing his programme for the Leeds meeting, the recorder of Section B (Chemistry) must have had these advantages in view, for he secured contributions from a number of physiologists to a valuable discussion on Sept. 5 on the chemistry of hormones.

In opening the discussion, Prof. G. Barger (Edinburgh) began by explaining what is meant by a hormone. In contradistinction to the long-known method of stimulation by a nervous impulse, Bayliss and Starling first recognised, in the case of secretin, that a stimulus may also be brought about by a chemical messenger or hormone, set free in one organ and travelling through the blood stream to another organ which is then excited to activity. Thus the hormones are highly active and highly specific drugs which the body elaborates for its own uses. The preparation and study of the hormones is therefore of the greatest importance to medicine, since they may produce effects quite unobtainable by the ordinary vegetable or synthetic drugs. The recent introduction of insulin in the treatment of diabetes is a case in point.

With the aid of lantern slides, Prof. Barger illustrated the course of development of our knowledge by reference to the two hormones which have so far been synthesised, adrenaline and thyroxine. There is first the recognition by the clinician or physiologist of the importance of the organ producing the hormone. In the two cases mentioned, this was followed by the discovery in it of some chemical peculiarity (chromogen in the adrenal gland, iodine in the thyroid). The biochemist then attempts the isolation of the active substance in a state of purity, and when this has been achieved, the organic chemist can investigate the molecular structure of the hormone and finally synthesise it; when the physiologist certifies the synthetic product to have the same degree of activity as the natural substance, some degree of finality has been reached.

For this reason Prof. Barger did not deal with the constitution and synthesis of adrenaline and thyroxine as *choses jugées*, but focussed attention on the crystalline substance of high molecular weight, obtained recently from commercial insulin by Abel and his co-workers, and having in a high degree the physiological activity characteristic of this hormone. The substance can be recrystallised and retains its activity; indeed, the residue left on evaporation of the mother liquor is, weight for weight, much less active than the crystals. This would constitute a *prima facie* claim that insulin has thus been obtained in a state of chemical purity, but Abel, aware of the pitfalls which beset investigations of this kind, himself suggests the alternative, that the crystals may carry down "an unknown substance of almost unbelievable potency." The carrying down of insulin by a crystalline precipitate of a much simpler substance, benzoic acid, formed in its solution, has actually been used in the manufacture of insulin.

Prof. Barger directed attention to the analogous difficulty in appraising the recent work of Jansen and Donath, who described the isolation of the enormously active vitamin from rice polishings. These authors crystallised a hydrochloride from acetone and alcohol, converted it into the crystalline picrolonate and gold salt, and passed back from these to the original hydrochloride without loss of activity. Here adsorption would seem to be excluded. In the case of insulin the substance can only be crystallised from water in the same way as it is formed originally, *i.e.* by the careful addition of ammonia to a highly buffered solution.

The subsequent discussion showed that this method did not entirely satisfy organic chemists; Prof. J. L. Simonsen compared it to the precipitation of barium sulphate; Prof. J. Mellanby pointed out the analogy to the crystallisation of proteins. A letter was read from Mr. F. H. Carr (unfortunately prevented from being present); he had carried out the crystallisation according to Abel's directions but found that the crystals were only one and a half times as active as the starting material (the ordinary commercial product of British Drug Houses, Ltd.). Others have also considered that the low potency of Abel's crystalline substance raises doubts as to its purity. This is, however, only an argument drawn from analogy; pure insulin *may* be less active than other hormones, and the only ways of settling the matter would seem to be, either to get the same crystals with a much smaller potency, or to synthesise them; the latter would be a formidable undertaking.

Prof. Barger ended by putting forward a theory of the action of adrenaline and related amines, based on their adsorption by lecithin. He imagined the amino group of the hormone to be attracted by the phosphoric acid residue and the residual affinity of the acidic phenolic nucleus by the basic choline grouping; this would explain the optimal length of the side chain of two carbon atoms, the favourable effect of a phenolic hydroxyl, etc.

Prof. H. S. Raper (Manchester) dealt next with the possible mode of formation of adrenaline in the organism. Although the organic chemist has disposed of adrenaline by synthesis, there is still work for the biochemist. Tyrosine appears to be the only possible precursor, and recently he has shown that this amino acid is actually changed by an animal oxidase to a catechol derivative, dihydroxy phenyl alanine. The latter is then converted to an indole derivative, which might, however, not occur if the amino group is substituted.

Prof. J. C. Drummond (London) referred to the enormous activity of irradiated ergosterol in preventing rickets. In his laboratory as little as 0·5-1 millionth of a milligram per day has lately been found sufficient for 100 grams of rat. The isolation of hormones is rendered difficult by a similar great potency. He referred to Abel's extremely active tartrate of a pituitary active principle, and to the fact that the same organ may produce several substances with different physiological actions. Similarly, the investigation of the ovarian hormone is complicated by the existence of a substance, 'anti-oestrin,' balancing the action of oestrin.

Prof. E. C. Dodds (London) discussed the ovarian hormone, which he has been unable to distil, as described for example by Fränkel and Herrmann; he doubts whether the active substance is really volatile. (The later experiments of Hartmann and Isler, who distilled the purified hormone after treatment with acetic anhydride, would seem, however, to leave little doubt on this point.) Prof. Dodds also questioned whether the ovarian hormone is a lipoid, and considered that it has a true solubility in water. He referred to experiments with solutions of adrenaline in oil, which retained some pressor activity after shaking with dilute hydrochloric acid. In any case the chemical purification of the ovarian hormone does not seem sufficiently far advanced to draw many conclusions as to its chemical nature.

Prof. J. Mellanby (London) described his experiments on the purification of secretin, which have resulted in an intensely active preparation, free from depressor substance. Contrary to Bayliss and Starling's view, that secretion is liberated from a 'pro-secretin' by acid hydrolysis, Prof. Mellanby considers that the substance is merely set free from an adsorption compound and in the normal process of digestion becomes fixed on bile acids. It is by adsorption on these acids that he has been able to effect so considerable a purification. Adsorption (on fuller's earth) is also the most effective preliminary stage in the purification of vitamin B. Although highly active, Prof. Mellanby's secretin is not yet chemically pure; one of its most significant properties is the absence of any reaction with ninhydrin.

In the general discussion, Dr. N. V. Sidgwick (the president of Section B), Prof. J. L. Simonsen, Dr. T. A. Henry, Mr. H. J. Channon, and others took part; Prof. G. Barger replied. It was generally felt that the discussion had been valuable in bringing chemists and physiologists together to consider debatable border-line problems on which their outlook is apt to differ with the nature of their studies.

Obituary.

PROF. A. LIVERSIDGE, F.R.S.

THROUGH the death on Sept. 26 of Prof. Archibald Liversidge, science in Australia and New Zealand has lost one of the best and most unselfish of its friends. His death, due to heart trouble, in his eightieth year, came as a shock to his many friends, for even up to within a week or two of his decease he had always enjoyed robust health, and was exceptionally hale and hearty for his age. His nearest of kin surviving are his sister, Mrs. Balfern, of Buxted Lodge, Bexley, Kent, and his nephews Rear-Admiral E. Liversidge and Rear-Admiral J. G. Liversidge.

Born at Turnham Green in 1847, after studying at a private school and with tutors, Liversidge entered the Royal School of Mines and Royal College of Chemistry. Among his teachers were Frankland, Tyndall, and Ramsay. He gained an open scholarship in natural science at Christ's College, Cambridge, in 1867; and he was one of the two first students to work in Sir Michael Foster's physiological laboratory. After having been instructor in chemistry at the Royal School of Naval Architecture, he was appointed in 1870 demonstrator in chemistry at Cambridge. In 1873 he was elected to the chair of chemistry at the University of Sydney, a position which he held until 1908. He at once threw himself whole-heartedly, and with singleness of purpose, into the scientific life of his newly adopted country. His great energy, meticulous method combined with a breadth of outlook, a shrewd financial acumen and a keen desire to serve science for its own sake, at once marked him as a coming organiser.

Liversidge originated the Faculty of Science at the University of Sydney in 1879, serving as its dean from that date until 1904, and the University School of Mines in 1890. Thanks to him also the Royal Society of New South Wales now owns a fine scientific library and a valuable building as its home. The first great impetus to technical education in New South Wales came largely from Liversidge, when a Member of the first Board of Technical Education at Sydney. As trustee of the Australian Museum, Sydney, from 1874 to 1908 he rendered invaluable service in helping to get together their fine collection, in greatly adding to their library, and in helping to secure for them their present fine building.

In 1885, Liversidge accomplished his greatest work in founding the Australasian Association for the Advancement of Science. Even those who know the relative isolation of scientific workers in Great Britain and Ireland previous to the founding of the

British Association can scarcely realise the extreme isolation of Australasian scientific workers separated from one another by distances as great as from London to Constantinople. As in the case of the British Association, so, and even more so in the case of the Australasian Association, the crowning triumph of the work has been the bringing together for personal interchange of thought of so many remotely separated scientists.

In regard to Liversidge's work at the University, as a teacher he was always remarkably successful and impressive with his practical demonstrations and lecture experiments. Starting with very small buildings and next to no equipment, he was able, when he retired from the chair in 1908, to hand over to his successor, Prof. Fawsitt, a large and flourishing school provided with laboratories, lecture-rooms, and equipment reasonably up to date in view of the great distance of Australian universities from centres of science in the old world.

In spite of the time spent in teaching and organising, Liversidge's output of research work was considerable. His researches were directed chiefly to descriptive and experimental mineralogy. His chief published work was "The Minerals of New South Wales." He did much to stimulate interest in meteorites, collecting, analysing, and describing many Australian meteorites. Meteorites led him to study Australian meteoritic dust, especially the very finely divided red dust deposits which, in the hot dry climate of Australia, owe their origin to the transporting power of circular storms in the interior of the continent. He also published several papers on the origin and precipitation of gold, gold in solution in sea water, and the possible growth of gold nuggets in Australian alluvial deposits.

Altogether Liversidge contributed more than one hundred papers relating chiefly to chemistry and mineralogy, to the Chemical Society, the Royal Society of New South Wales, and the Royal Society of London. He made a hobby of acquiring minerals and meteorites, and his collections have frequently been displayed at exhibitions in Australia and in the northern hemisphere. Since retiring from the chair of chemistry at the University of Sydney, he continued until lately his researches at London laboratories. He was vice-president of the Chemical Society (1910 to 1913); vice-president of the Society of Chemical Industry (1909 to 1912); president of the Royal Society of New South Wales (1886, 1890, and 1901); president of the Australasian Association for the Advancement of Science (1888 to 1890); and vice-president of the British Association (1896). He was also a member of the Philosophical Society of Cambridge, of the Physical Society, of the Mineralogical Society of Great Britain and France, and he was elected a fellow of the Royal Society of London in 1882. Honorary degrees or memberships were conferred upon him by universities and scientific bodies, totalling thirteen in number.

Liversidge to the last was no less loyal to Australia than to the mother country, and after his return to England he continued to correspond overseas and to study carefully Australian journals, and if he found any matter needing his help either in Australia or New Zealand that help was freely given. Previously to the migration of Liversidge to Australia, the case of scientific men there might be described as that of *quot homines tot sententiae*, but after his years of residence there and the founding and fostering of the Australasian Association, men of science in Australia and New Zealand spoke with one voice, a voice which met with such a fine response in the visit to Australia of the British Association in 1914 and the Pan-Pacific Science Congress in 1923.

Liversidge's beautiful home and grounds, Fieldhead, Coombe Warren, Surrey, with the historic spring from which Cardinal Wolsey carried the water in large lead pipes all the way thence, with a dive under the Thames, to Hampton Court, was for many years past the Mecca of pilgrims of science from Australia. There, too, he frequently entertained—for he loved hospitality—not a few of his old colleagues whom he used to meet regularly at the Athenæum.

One thing surely stands out among the many for which Liversidge will be gratefully remembered, and that is his splendid striving for the *fraternity* of science.

"*Frater ave atque vale.*" T. W. E. D.

PROF. GÖSTA MITTAG-LEFFLER, FOR. MEM. R.S.

THE mathematical world is appreciably poorer by the death of Mittag-Leffler, of Stockholm, who died there on July 7 last. He was born at Stockholm on Mar. 16, 1846.

For the best part of his long life of eighty-one years, Mittag-Leffler had been a proud standard-bearer in the extraordinary march of the theory of functions during the nineteenth century. How wonderful the progress has been we may realise by comparing the scope of some of the earliest with that of some of the latest publications. A sort of warning is given by the title of Lagrange's volume, dated Prairial, an V. (Second Edition, 1806): "Théorie des fonctions analytiques, contenant les principes du Calcul différentiel dégagés de toute considération d'infiniment petits ou d'évanouissans, de limites ou de fluxions, et réduits à l'analyse algébrique des quantités finies." But compare its contents with that of Weierstrass's posthumous paper, published in 1903, "Allgemeine Untersuchungen über $2n$-fach periodische Functionen von n-Veränderlichen"; this is described by Mittag-Leffler as only a fragment of Weierstrass's "Lösung des Rätsels dass sein ganzes Leben in Anspruch genommen hat," which remains, he says, in 1916, "noch eine ungelöste Aufgabe, eine der grössten, die den Mathematikern unserer Tage obliegt." Think of the contributions of Abel, of Cauchy, of Gauss, of Jacobi, of Riemann, of Weierstrass, of Poincaré, and of others, who, from the first recognition that the complex variable is the natural foundation of a general theory, have steadily erected a structure of constantly increasing grandeur and beauty.

Of all this progress in the branches of mathematics to which he was devoted, Mittag-Leffler was an enthusiastic observer, and, of its later phases, a conscientious historian; and he took upon himself the mission of fostering, in every way he could, amicable relations between mathematicians of different nationalities, and encouraging a disinterested pursuit of high intellectual aims, unaffected by any political or material bias. With evident joy he tells how, three years after "la funeste année 1870" "je vins à Paris suivre le cours d'Hermite; je n'oublierai jamais la stupéfaction que j'éprouvai aux premiers mots qu'il m'addressa: 'Vous avez fait erreur, Monsieur,' me dit-il; 'vous auriez dû suivre les cours de Weierstrass à Berlin. C'est notre maître à tous.' Hermite était Français et patriote; j'appris du même coup à quel degré aussi il était mathématicien." But Mittag-Leffler was more than a standard-bearer of a mighty army; he was keenly anxious for the success of his subject. He quotes Weierstrass's plea for the unity of all scientific endeavour, "Die einzelnen wissenschaftlichen Disziplinen erhalten ihre Bedeutung dadurch, dass sie alle zu diesem Zwecke mitwirken—in dem Mit- und Nacheinandersein der Dinge Ordnung und gesetzmässigen Zusammenhang zu entdecken—aber nicht zusammenhanglos, sondern gleichsam eine Kette bildend." But he is aware of the conflict of his own subject with others whose aims have a more popular appeal; and when, in 1916, on his seventieth birthday, he devotes his house and library to the perpetual service of research in pure mathematics, he writes (*Acta Math.*, 40), "Peu de gens, en dehors des spécialistes, comprennent l'importance et la mission des mathématiques pures," "un peuple que n'accorde pas aux mathématiques un rang élevé dans son estime, ne sera jamais en état de remplir les plus hautes tâches civilisatrices et de jouir, par suite, de la considération internationale."

Mittag-Leffler was the son of J. O. Leffler, headmaster of a secondary school, and of G. V. Mittag. He was university lecturer in 1872 at Upsala, where he took his doctor's degree. After three years of travel (1873–1876) in Germany and France, he was professor of mathematics at Helsingfors until 1881, when he became professor at Stockholm (and Rector in 1885–6 and 1891–2). He resigned this post in 1911. In 1882, with an editorial staff of mathematicians from the four Scandinavian nations, and under the patronage of King Oscar II. of Sweden, he founded the journal *Acta Mathematica*, having noted, as he explains, that, after 1870, the German *Crelle's Journal*, and the French *Liouville's Journal*, had both ceased to have an international character. Of his own journal he remained editor in chief for forty years, until Vol. 40 (1925), maintaining, through this long period, it may safely be said, both the devotion to modern developments and the high standard set by Poincaré, in expounding his theory of Fuchsian functions in the early volumes. Special volumes were devoted to papers sent from all parts in commemoration of the centenary of the birth of Abel (1902); a volume (**38**, 1921) was given to contributions by various writers in memory of Poincaré, and a volume (**39**, 1923, 258 quarto pages), written largely by Mittag-Leffler himself, is in effect a first hand critical history, of extreme value and interest, of the ideas associated with the names of Weierstrass and Poincaré. Beside the 57 pages dealing with the personal history and work of Weierstrass, this volume contains a paper of 65 pages largely composed of letters from Weierstrass to Sonja Kowalewsky. Mittag-Leffler was in a good position to write, as he had collected the necessary documents over many years.

The latter paper directs attention to another side of Mittag-Leffler's activity, and helps also to a better understanding of a book written by his sister, Anne Charlotte Leffler (Mme. Eddgren, and, later, Duchess of Cajanello); this is a biography of Sonja Kowalewsky, written in continuation of the autobiography of the early years of the latter; it is a book which every one who is interested in contemporary intellectual movements will have, or should have, read.[1] It appears that after Mme. Kowalewsky had spent her four student years with Weierstrass (in continuation of her studies at Heidelberg), and was settled in Russia, it was suggested by Weierstrass to Mittag-Leffler, then in St. Petersburg, that he should call on Mme. Kowalewsky. The final outcome was that, very soon after Mittag-Leffler had been appointed professor in Stockholm, he took great trouble to open the way for Mme. Kowalewsky to settle there as lecturer in mathematics. Of his admiration for her personality, and of his feeling that he was doing a great thing for higher education, and for Stockholm, there is ample evidence—there is also evidence in Weierstrass's letters to Sonja of the regard which he had conceived for the personality of Mittag-Leffler. The end of the experiment at Stockholm is given in graphic phrase in the book referred to. The gist seems to lie in A. Ch. Leffler's description of Sonja's "ardent besoin d'intimité intellectuelle, et de la souffrance intense que lui causait le sentiment de la solitude. . . . Le travail par lui-même, la recherche abstraite d'une vérité scientifique, ne la satisfaisant pas, il fallait qu'elle fût comprise, devinée, admirée, encouragée à chaque pas, à chaque nouvelle idée qui naissait en elle. . . . Mittag-Leffler disait souvent à ce sujet, que ce besoin d'être comprise était chez Sophie une faiblesse de femme; un homme de génie ne dépend jamais ainsi de la sympathie des autres."

It will be gathered from what has been said how important was the service of Mittag-Leffler, as a link, as a sort of gracious master of the ceremonies, for one aspect of modern mathematics; it were to be wished that in England we gave more of the reverent care which animated him, to the historical and personal side of the development of the subject. His own personal contributions to the theory of functions need no long comment here. One of his

[1] "Souvenirs d'enfance de Sophie Kovalewsky, suivis de sa biographie" (Hachette, 1895). Also in Swedish, German, and English (Walter Scott).

papers, dealing with the formation of a function of which the behaviour at its singular points is specified *a priori*, was the occasion for a paper presented to the Berlin Academy, in association with the name of Mittag-Leffler, by Weierstrass. It is perhaps opportune to remark that the intimately related construction, by Weierstrass, of an integral function with given zeros, which one might naturally have thought to be suggested by Gauss's factorisation of the gamma function, was given only in 1874, when Weierstrass was fifty-nine years old (letter to Sonja Kowalewsky, *Acta Math.*, **39**, 151); and that the form of Gauss's factorisation which exactly suggests the general theorem was given in 1848, by F. W. Newman, in the *Camb. and Dublin Math. Journal*, **3**. This was remarked by the late G. B. Mathews in the pages of NATURE, long ago; it is not referred to by Mittag-Leffler in dealing with Weierstrass's early investigations (1843, 1856) on the analytical *Facultäten*. Another matter of a different kind occupied Mittag-Leffler in a series of papers: the expression of a function, with singularities for finite values of the independent variable, in a form which is valid over the whole plane as dissected by lines passing to infinity from the singular points of the function. Other papers, many written in Swedish journals, are not as yet so well known.

News and Views.

AGRICULTURE is the oldest of the chemical industries. The business of feeding man and his friends has, fortunately, been able to jog along for a very long time without entering into any close relationship with synthetic chemical industries other than that carried on so universally and so successfully by certain of the lower organisms of the soil. There has, moreover, been a disinclination to apply some of the new knowledge that has been placed at the service of the farmer, it being dismissed as being of little consequence when compared with the accumulated practical experience of generations on the land. Doubtless, too, the lack of consideration has not all been evidenced on one side. However this may be, it is a fact that we cannot continue indefinitely to live on the reserve fertility of the virgin plains of the earth. Sir Alfred Mond, in an address read before the delegates to the Imperial Agricultural Research Conference at Billingham on Oct. 18, based his remarks on this truism, and on the part which synthetic chemical industry must play in the future development of agriculture. So far as the British Empire is concerned, the economic aspect of the situation is no less considerable than the scientific. As was pointed out in the address, for many years Europe has paid to South America millions upon millions of pounds for nitrogen in the form of guano or of sodium nitrate. Imperial Chemical Industries, Ltd., has set itself the ambitious task not only of supplying the whole Empire with fertilisers, but also of acquiring and disseminating information concerning their application to soils of varying qualities and varying needs.

NITRAM, LTD., the selling organisation which has been set up to deal with the new synthetic fertilisers, has, said Sir Alfred Mond, already instituted a free and disinterested advisory service to farmers. It has also established a research station, with upwards of 400 acres of farm lands, where problems relating to the use of fertilisers and to the feeding of stock are to be investigated. The activities at Billingham, however, will not be confined to the manufacture of simple synthetic nitrogenous fertilisers, but will extend to the production of compound fertilisers, containing nitrogen, phosphorus, and potassium—the three chief plant foods—according to the demands of experiment and experience. Naturally, the fertiliser requirements of the British Isles will be the first to receive attention.

A CAREFUL consideration of Sir Alfred Mond's address leads one to the conclusion that, although he had no startling or even new thesis to present, he was able to show that Imperial Chemical Industries, Ltd., fully realises the nature of the problem—that of most effectively using chemical and mechanical knowledge in the multiplication of the fruits and riches of the earth—in its future as well as in its present aspects, and that the organisation is solving it in a patriotic as well as in a commercially successful manner. It is not merely a question of there being so many more mouths to feed and bodies to clothe each year. Neither is it entirely a question of meeting a demand for a more varied food supply; for satisfying the requirements of a generation better instructed than its fathers in the relation of diet to health. There is also an increasing demand from the chemical industries themselves for new material. The artificial silk industry is a case in point; the alcohol motor-fuel industry is another; and man has only just begun to learn the rules for training bacteria, in 'commercial numbers,' to do his will.

THE Slaughter of Animals (Scotland) Bill, which comes before the House of Commons for its third reading on Nov. 15, provides for the licensing of slaughtermen in order to check unskilful slaughtering, and for the stunning of animals with a mechanically operated instrument before slaughter. At the committee stage considerable concessions had to be made to the opponents of humane slaughtering: the effect of the bill was restricted to slaughter-houses and knackers' yards, swine were exempted from the operation, and the usual exemption for Jewish slaughtering was introduced. While the first two, at least, of these concessions will be generally regretted by humanitarians, there can be no doubt that they were wisely made, for in exchange the opponents of the bill have undertaken to allow it to pass into law. Indeed, the Government would not need any great courage to adopt the bill as its own during the final stages. The subject is to be discussed at a debate arranged by

the University of London Animal Welfare Society at Birkbeck College, Bream's Buildings, Chancery Lane, at 8 P.M. on Friday, Nov. 4. The principal speakers will be Mr. A. C. Dewbury, representing the Royal Society for the Prevention of Cruelty to Animals, and Mr. A. C. Knight, representing the Meat Traders' Federation; the chair will be taken by the president of the University society, Prof. F. T. G. Hobday, principal of the Royal Veterinary College. The public will be admitted to the debate without ticket.

DR. WILLIAM G. SAVAGE delivered the Malcolm Morris Memorial Lecture (under the Chadwick Trust) on Oct. 17, the subject being "Food Poisoning." After paying a tribute to the memory of Sir Malcolm Morris, the lecturer said that food poisoning in the main is a result of the complexity of our food supply and might be classified thus: (1) the poison is inherent in the food, *e.g.* poisonous fish; (2) the poison may be an admixed poisonous substance accidentally introduced, *e.g.* arsenic; or (3) the poison may be of bacterial origin, by far the largest class. Earlier conceptions of food poisoning were dominated by the idea that the poisoning was from decomposed food in which poisonous chemical substances were generated by bacterial action, and this was commonly known as 'ptomaine poisoning.' This idea is, however, entirely erroneous—there is no such thing as ptomaine poisoning. Tainted food does not as a rule cause food poisoning; in nearly all cases the food is perfectly good physically. The cause is elsewhere, and is generally due to certain special bacilli gaining access to the food and having poisonous properties but do not decompose the food; it is a definite infection of the food. It is particularly manipulated and much handled foods that become infected, such as chopped meat, meat pies, sausages, and canned foods. The bacilli usually gain access to the food from an outside source, through lack of adequate care in preparation or storage, or by contamination through flies or vermin. The prevention of food poisoning depends upon a knowledge of where the bacilli live and how they gain access to the food, and in adequate supervision of the preparation and storage of made-up foods.

THE stone implements recently discovered by Mr. J. P. T. Burchell in Co. Sligo, Ireland, will be on exhibition in the rooms of the Society of Antiquaries of London, Burlington House, Piccadilly, between the hours of 10 A.M. and 6 P.M. from Monday, Nov. 21, until Tuesday, Dec. 6, inclusive. The rooms of the Society will be closed to the public at 1 P.M. on the following dates: Nov. 23, 24, and 26, until 10 A.M. Monday, Nov. 28; Dec. 1 and 3, until 10 A.M. Monday, Dec. 5.

THE Huxley Memorial Lecture of the Royal Anthropological Institute for the year 1927 will be delivered by Dr. Aleš Hrdlička, of Washington, on Nov. 1, at 8.30 P.M., at the rooms of the Royal Society, Burlington House. Dr. Hrdlička has taken as his subject "The Neanderthal Phase of Man"—a subject which he has made peculiarly his own and upon which he may be expected on this occasion to put forward views of no little importance for the study of early man. At the conclusion of the lecture the Huxley Memorial Medal of the Institute will be presented to Dr. Hrdlička. Tickets for the lecture may be obtained on application to the Hon. Secretary of the Royal Anthropological Institute, 52 Upper Bedford Place.

MISS CATON-THOMPSON has left for Egypt, where, during the coming winter, she will continue her work of exploration in the Northern Fayum. She proposes this year to devote herself to an examination of the graves in the hope that she may be able to find material which will throw light upon the dating of the early civilisation of this area which she has discovered in her previous season's work. A very high antiquity has been attributed by some authorities to this remarkable culture. If, therefore, the investigations of this year should meet with any measure of success, the results should prove of very special importance. As the arrangements under which Miss Caton-Thompson has worked hitherto have now lapsed, the present expedition is being carried on under the direction of the Council of the Royal Anthropological Institute, which has applied to the Egyptian Department of Antiquities for a concession. The Council of the Institute invites subscriptions towards the cost of the expedition, which will amount to at least £1000. Contributions should be addressed to the Hon. Treasurer, Royal Anthropological Institute, 52 Upper Bedford Place, W.C.1.

AMONG the recent acquisitions at the British Museum (Natural History), we notice the following:—A large collection of mammals, birds, and birds' eggs from Abyssinia; a large collection of leeches, earthworms, tapeworms, etc., and a collection of millipedes from Colombia, and two shells of the extremely rare and much prized gastropod *Voluta bednalli*. Only two or three examples of this species are known. A collection of European and exotic Coleoptera and of Hemiptera Heteroptera (plant bugs) bequeathed by the late Mr. G. C. Champion. The major portion of the bequest consists of some 120,000 beetles from various parts of the continent of Europe, forming probably the richest European collection in Great Britain. Also a collection of 8406 Lepidoptera (butterflies and moths) presented by Mr. G. T. Bethune Baker. This donation includes a large number of types and paratypes of species described by its late owner, as well as 5574 specimens of British Tortricidæ (small moths, many of them of great economic importance), comprising the entire collection of these insects formed by Mr. Richard South. About 500 seeds and fruits collected by the donor, Miss M. Chandler, in the Upper Eocene clay of Hordle, Hants, and described by her in the monograph of the Palæontographical Society. Many of these are new to science; the whole flora shows relations to that now living in the Far East, and indicates a warmer climate. Some fine ammonites and other fossil cephalopod shells recently collected from the Gault of Dorset have been presented by Lt.-Col. R. H. Cunnington, and the Gault of Glynde, Sussex, has yielded to the

careful search of Mr. C. T. A. Gaster nearly a thousand tiny ammonites belonging to about 14 species. The Lower Permian Sandstones near Exeter have from time to time yielded footprints and other tracks of extinct animals, and Mr. Clayden has added to the national collection four slabs with very unusual tracks of origin as yet unexplained.

AN Italian Arctic expedition by airship is being planned for next year. The *Times* announces that the expedition will be organised and led by General U. Nobile, who accompanied Capt. R. Amundsen in his polar flight in 1926. The Italian government has offered airship N.4, which is a sister ship of the *Norge*, used on that occasion, and the Norwegian Aero Club has promised the use of airship sheds at Vadsö and King's Bay. General Nobile intends to make his Arctic base in Spitsbergen and to explore eastward to the north of Siberia, intending no doubt to throw light on the unknown northward extension of Nicholas Land. He proposes also to make a flight to the Pole. The Soviet Government has expressed a wish to help by establishing a base with supplies at the mouth of the Yenisei River. At present a committee at Milan is considering the cost of the project. The Royal Italian Geographical Society has promised its support.

THE newly formed Greenland Association of Copenhagen, which is seeking to open up this great sub-Arctic territory, learns that the University of Michigan, U.S.A., is sending a scientific expedition to this great island to study and report on the meteorological conditions prevailing there. The expedition will be under the charge of Herr Helge Bangsted, who proposes to build an Ice-station somewhere in the centre of Greenland, where the condition of the great ice-cap will be studied and general glacial researches made. Mr. Bangsted, it may be remembered, was a member of the Knud Rasmussen expedition to Greenland sometime ago.

AN original suggestion has been made to Signor Mussolini by an engineer and architect named Pio Franchi. His idea is to execute an exact model, in high relief, of the Italian peninsula from the Alps to Cape Passaro, the southernmost point of Sicily, to be placed in a miniature lake sixty metres in diameter, representing part of the Mediterranean and Adriatic Seas, with the exact imitation of every geographical detail—mountains, rivers, lakes, towns, railroads, etc. The principal rivers, such as the Po, the Tiber, and the Arno, would be represented by rivulets of running water, reproducing the exact curves. It is proposed to place this relief model in the Villa Umberto, the object being to give children and the general public a clear idea of their country. The idea has, says the *Monitor*, met with the Duce's approval, so that it will be shortly carried out.

THE eighteenth annual exhibition of electrical, optical, and other physical apparatus, organised by the Physical Society and the Optical Society, is to be held on Jan. 10–12, 1928, at the Imperial College of Science and Technology, South Kensington. The exhibition committee invites offers from research laboratories and institutions, and from individual research workers, of suitable exhibits for the research and experimental section of the exhibition. Offers of exhibits in this section should be communicated immediately, and in any case not later than Nov. 16, to the secretary, Physical and Optical Societies, 1 Lowther Gardens, Exhibition Road, London, S.W.7.

AT the annual statutory meeting of the Royal Society of Edinburgh, held on Oct. 24, the following officers and members of council were elected :—*President*, Sir James Ewing; *General Secretary*, Prof. R. A. Sampson; *Treasurer*, Dr. J. Watt; *Curator of Library and Museum*, Prof. D'Arcy W. Thompson; *Councillors*, Prof. G. Barger, Mr. J. Bartholomew, Prof. C. G. Darwin, Prof. D. Waterston, Mr. J. W. Peck, Dr. J. Ritchie, Prof. R. Stanfield, Dr. A. L. Turner, Dr. G. W. Tyrrell, Prof. J. H. Ashworth, the Hon. Lord Constable, Prof. E. Taylor Jones.

VIOLENT earthquake shocks were recorded in various parts of the United States and Canada on Oct. 24. The greatest disturbances seem to have been registered between 11 A.M. and 11.20. Mr. J. J. Shaw, of West Bromwich, records in the *Times* that his instruments registered large movements, beginning just after 4 P.M. on Oct. 24, which corresponds to 11 A.M. Eastern time, and continuing until about 5.20.

THE Report of the Progress of the Ordnance Survey for 1926–27 has been published (London: H.M. Stationery Office. 9*d*. net). Among the achievements may be noted the completion of the "Popular Edition" of the 1-inch map of England and Wales, and the publication of fifteen sheets of the same map of Scotland, making a total of twenty-five sheets of that country. The 10-inch map of Great Britain is now complete in three sheets; the 1/M physical map of England and Wales is being improved, and a similar map of Scotland is in hand. The usual revision in the field of the large-scale maps has been carried out, but the reversion to quarter sheets of the 6-inch map has caused some delay in publication. A revised edition of the map of Roman Britain will shortly be ready. A considerable amount of archæological work has been undertaken. Lastly, it may be noted that the output of maps, exclusive of those for other departments, reached more than three-quarters of a million, and sales of maps showed a marked increase.

THE long spell of wet weather in Great Britain that began in June and continued with extraordinarily few breaks up to the end of the holiday season, had a very abrupt end when a ridge of high pressure advanced from the Atlantic on the night of Oct. 2 behind an unusually fast-moving depression which had caused gales and very heavy rain in the north. A general sustained upward 'surge' of the barometer then occurred over a wide area, and this converted the 'ridge' into a large circular anticyclone in the space of twelve hours. At 7 A.M. on the morning of Oct. 3 this anticyclone lay centrally over the British Isles, and was still growing in size. It proved very persistent, and inaugurated a long spell of dry weather over the whole country. At Kew Observatory slight rain fell on

Oct. 1 and 2, amounting altogether to two millimetres, but from then up to the 21st there was an unbroken succession of days with no rain or only a fraction of a millimetre. At Glasgow and Plymouth a dry spell of almost equal length has been recorded, which would have been a general experience over practically the whole of England and a large part of Scotland but for some local rain in the Midlands and the north on Oct. 12. This has been the longest spell of drought at Kew this year, and unless some decided change takes place, October, normally the wettest month, may prove to be for London very much the driest in the present year.

THE Compton medal of the Institution of Automobile Engineers has been awarded to Mr. H. R. Ricardo for his paper entitled "Some Notes on Petrol-Engine Development."

THE Cambridge University Press will shortly publish "A Short History of Western Civilisation," by Prof. A. F. Hattersley, the aim of which is to trace the origin and growth, in its essential features, of the European civilisation of to-day. The same publishers are also issuing "The Antiquity of Man in East Anglia," by J. Reid Moir, who has endeavoured to give an easily understood account of the remains discovered in Norfolk and Suffolk which, in many cases, are of such a nature as to have implications extending far beyond the relatively small area in which they were found.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A pathologist and curator at the Royal London Ophthalmic Hospital—The Secretary, Royal London Ophthalmic Hospital, City Road, E.C.1 (Oct. 31). A lecturer in the pharmacy department of the Sunderland Technical College—The Chief Education Officer, 15 John Street, Sunderland (Nov. 7). A farm director at the Rothamsted Experimental Station—The Secretary, Rothamsted Experimental Station, Harpenden, Herts (Nov. 14). A chemical assistant in the laboratories of the Research Association of British Flour Millers—The Director of Research, Research Association of British Flour Millers, Old London Road, St. Albans. A teacher in mechanical engineering at the Barnsley Mining and Technical College—The Principal, Mining and Technical College, Barnsley. An engineering assistant in the electrical engineer's department of Stoke-on-Trent—The City Electrical Engineer, St. George's Chambers, Kingsway, Stoke-on-Trent. A clinical pathologist at the Crichton Royal Mental Hospital, Dumfries—The Physician Superintendent, Crichton Royal Mental Hospital, Dumfries.

Our Astronomical Column.

BRILLIANT METEORS ON OCT. 17.—Mr. W. F. Denning writes that "on the night of Oct. 17 three brilliant meteors were visible at the following times respectively: $21^h\ 55^m$, $22^h\ 15^m$ and $23^h\ 36^m$. The meteor of $22^h\ 15^m$ was a Capricornid; the other two were fine Orionids. The one which appeared at $23^h\ 36^m$ was a very brilliant object and observed from Yorkshire and from Erith, Kent. The meteor passed from over Cromer to east of Nottingham, and fell from a height of 86 to 52 miles. The luminous flight was about 92 miles long, and the velocity 38 miles per second. The maximum of the Orionid shower usually occurs on Oct. 20 or 21, and the appearance of several large meteors from it as early as Oct. 17 induces the supposition that the display may have been of rather unusual richness this year."

THE ATMOSPHERES OF THE GIANT PLANETS.—The *Scientific American* for October contains an article on this subject by Prof. H. N. Russell, who writes from the Lowell Observatory, Flagstaff, and utilises many of the beautiful planetary photographs obtained there by Dr. E. C. Slipher, some of which are reproduced. (A small slip should be noticed; the markings seen on Saturn in 1876 and 1903, and used for finding the time of rotation, are described as *dark* instead of *bright*.)

The radiometric observations of Coblentz and Lampland are quoted as proving that the outer regions of the atmospheres of the giant planets are at a very low temperature; but that, as there is a series of cloud layers many thousands of miles thick, these would be an effective blanket to outward radiation, and the temperatures at the surfaces of the planets may be much higher.

As is well known, the spectra of these planets show a series of strong absorption bands, which steadily increase in strength as we travel out from Jupiter to Neptune. This suggests that a very low temperature is required for their production; the suggestion is made that, if a long tube were cooled by a surrounding jacket of liquid air and filled with various gases, a study of their spectra might give a clue to the identification of the gases producing the bands. It is noted as a possible clue that some of the oxides of nitrogen can be protected from decomposition only by keeping them very cold. The great variety of colours seen on the discs of Jupiter and Saturn is given as an additional proof that a large number of gaseous compounds are present.

The photographs that are reproduced were taken in light of different colours. As might be expected, those in violet light show much greater darkening at the limbs, for the same reason that the setting sun looks red. The polar regions of Saturn are especially dark. The light from the ring, when photographed in yellow light, looks about equal to that from the middle of the disc, but in violet light the ring is the brighter.

TABLES FOR MOTION IN AN ELLIPSE.—Dr. Innes has published a very useful table, giving the abscissæ and ordinates of a point describing an elliptical orbit under gravitation. The focus is the origin, and the major axis is the axis of x. The values are given to five places of decimals, the semi-major axis being taken as unity. They are given at intervals of one degree of M, the mean anomaly, and for intervals of 0·01 in the eccentricity, extending from 0·00 to 1·00. The tables are mainly intended for work with rectangular co-ordinates, but they are also very useful for those who prefer polar co-ordinates, since $\tan v = Y/X$ and $r = X \sec v$ or $Y \operatorname{cosec} v$. Similar tables have appeared before, but not on quite such an extended scale. They are useful both in the computation of ephemerides and of perturbations. They form an appendix to *Union Observ. Circular*, No. 71.

Research Items.

CLIMATIC CONTROL OF WHEAT AND WOOL IN AUSTRALIA.—Mr. Henry Barkley, the Senior Research Meteorologist of the Commonwealth Weather Bureau, has published preliminary results of the control exercised by rainfall during critical periods on production in Australia. The first paper (*Wheat and Grain Review*, Aug. 6) shows that after allowing for the gradual improvement due to improved methods, 90 per cent. of the variations in the Victorian wheat harvest depend on fluctuations of the rainfall in August and September, thus enabling a very good forecast to be made two months ahead. The relationship is not linear, but the wheat yield is roughly proportional to the logarithm of the rainfall. In other parts of Australia the critical periods vary from June to August. Another interesting result which the author obtains is that there is very fair agreement between the spring wheat yields of Victoria and the contemporary autumn yields of Canada and, until 1916, Russia. This is attributed to a general control of the climates of all three countries by solar variations, which cause a cyclic change of roughly three years. Mr. Barkley's second paper (*Pastoral Review*, August) deals with the control of the wool yield in November by rainfall as early as January and February. The relationship is again very close; the weight of the wool clip shows a progressive increase as the rainfall of the two months together rises from 1 to 4½ inches; the latter is the optimum value and heavier rain causes a slight falling off. It is not yet clear, however, whether the increase of weight represents a real gain of that amount, or whether it is partly due to an increase of greasy matter, and further data are required to settle this and some other doubtful points. It is to be hoped that Mr. Barkley will be able to continue these valuable researches, which have a direct bearing on Australian production.

CANADIAN SALMON.—Few observations have been made on the biology of the Atlantic salmon (*Salmo salar*) from Canadian waters, and a recent publication by W. L. Calderwood on the salmon of the River Grand Cascapedia in the Quebec Province is welcome (*Proc. Roy. Soc. Edinburgh*, vol. 47, pt. 2, No. 10, 1927). The number of scales examined was unfortunately low, but they appear to furnish information of considerable interest. The smolt ages were remarkably high, the three and four-year-old smolts forming 58·8 and 34·1 per cent. of the whole respectively. There were no one-year-old smolts and two were five years old. In this respect they resemble those from certain northern rivers in Norway, although they do not agree with results from the River Moisie in Canada, which lies north of the Grand Cascapedia, where two-year-old smolts were the most common. There were no grilse, neither were there any small spring fish represented in the samples. In fact only eleven fish returned after two winters in the sea, while the majority did so after three winters. Although the fish do not come into the fresh water early because the river is not open, no summer feeding appears on their scales. The fish of the predominant three-winter group averaged 23·6 lb. and the average length was 38·3 in. Of the 182 fish, 62 had spawned previously—48 once and 14 twice.

TANNING MATERIALS OF AUSTRALIA.—The Council for Scientific and Industrial Research of Australia has just published a survey of the tanning materials of the commonwealth (*Bulletin No.* 32, by D. Coghill). The survey was designed to explore the possible commercial resources of Australia in vegetable tanning materials. With this end in view, all the barks, woods, twigs, leaves, and fruit from which tannin could be extracted have been examined, and their possible utilisation discussed. While no new sources of importance have been discovered, the availability and quantity of the tannins previously known have been thoroughly re-examined, with the view of establishing a flourishing tannin extract industry in Australia. Western Australia is rich in natural sources of tannins, while the eastern provinces provide a fertile and broad ground for the cultivation of those species which give a good yield of tan bark, and grow quickly. The proposition is a praiseworthy one. New sources of tannins are urgently needed. Already Australia has to import some of her tan extracts, and during the last few decades there has been an increasing dependence of the older countries on tan stuffs imported from new and less-developed regions, a condition of things accentuated recently by the ravages of the chestnut blight, which is seriously reducing the supplies of tanning materials obtained from that tree.

STIMULATION OF PLANT ACTIVITY.—Many chemical substances, apart from those ordinarily recognised as fertilising elements or yielding energy to plants by oxidation, are known to increase in several ways the rate of growth. F. E. Denny, of the Boyce Thomson Institute for Plant Research, discusses some such effects (*Proc. U.S. Acad. Sciences*, vol. 13, July 1927). The yellowing of commercially mature but still green lemons and oranges may be very much accelerated by exposure to minute quantities of ethylene gas—one part or less in 10,000 parts of air. A study of the respiration of lemons so exposed showed that the physiological activities of the fruit were greatly increased, the rate of production of carbon dioxide being doubled or trebled in 48 hours. So far, the mechanism of this respiratory increase is unknown. Furthermore, the stimulating effects of ethylene are not confined to Citrus fruits, for Rosa found that the rest period of dormant buds of potato could be shortened by suitable treatment with that gas. Denny now finds that several chemical agents will break the rest period of plants; *e.g.* ethylene chlorhydrine, ethylene chloride, various thiocyanate solutions, acetaldehyde. The chemicals that were found to cause stimulation varied greatly in character, so that no evident relation could be established between the type of chemical used and the result obtained. In most cases it did not seem possible that the substance was used by the plant directly as food, and in no case could it have supplied sufficient energy to account for the resulting increased activity. Now Carrel and Baker found that the substance in embryonic tissue which markedly stimulated multiplication of isolated cells was the product of the partial hydrolysis of a protein. The present author suggests that possibly the slight injury produced by those chemical stimulants may cause a slight and partial decomposition of constituents of the tissues, resulting in the release of growth-promoting substances which start up renewed cell division and bud growth.

ORIGIN OF MUTATIONS.—Some experiments by Dr. A. M. Banta and Mr. T. R. Wood of the Station for Experimental Evolution at Cold Spring Harbour are described in a recent bulletin of Science News Service of Washington. Dr. Banta has been investi-

gating the genetics of Cladocera for many years, growing great numbers of them in water bottles under controlled conditions. One mutation which appeared recently failed to thrive under the ordinary conditions, but flourished and multiplied when kept in water at a higher temperature. It is suggested that the organisms inhabiting hot springs have originated in a similar way, through mutations adapted to high temperature conditions occurring near a hot spring where their descendants could reach the environment necessary for their prosperity.

NORTHERN CYCLOSTOMES AND ELASMOBRANCHS.—Recent additions to the fishes in "Die Tierwelt der Nord- und Ostsee" (Leipzig: Akademische Verlagsgesellschaft, 1927) are the Cyclostomes (*Cyclostomi*, by W. Schnackenbeck, Teil XII. d), and the Elasmobranchs (*Elasmobranchii*, by E. Ehrenbaum, Teil XII. e). The cyclóstomes in this area consist of three genera, each represented by one species, namely, *Petromyzon marinus*, the sea lamprey; *Lampetra fluviatilis*, the river lamprey; and *Myxine glutinosa*, the hag-fish. The true fresh-water lamprey, *Lampetra planeri*, although mentioned in this work, does not strictly come within its limits. Dr. Ehrenbaum gives a good account of the elasmobranchs. *Chimæra monstrosa* is the only representative of the Holocephali in north European waters, and most of this section is taken up with the description of the Selachii (sharks) and the Blatoidei (skates and rays). The low salinity of the Baltic bars the presence of elasmobranchs except as occasional visitors, therefore nearly all the species recorded are from the North Sea area and several of these are very rare, such as the electric and eagle rays and some of the sharks. On the other hand, certain rays, such as *Raia clavata* in the North Sea, the Skager Rack, and Cattegat, and *Raia batis* with a wider range, have here their maximum distribution, whilst the cosmopolitan *Acanthias vulgaris* is the commonest dogfish and is to be seen in swarms in the North Atlantic. Sharks and rays feed upon almost all the groups in the animal kingdom—fishes of all sorts, molluscs, crustacea, echinoderms, annelids, and even sea-anemones and ctenophores, *Selache maxima*, the basking shark, being entirely a plankton feeder, eating small crustacea and even diatoms. Good notes are given on the feeding and breeding habits of all known forms.

JAPANESE PLIOCENE MOLLUSCA.—The molluscan fauna of the lower part of the Kakegawa (Lower Pliocene) Series in the province of Tôtômi forms the subject of a monograph by Jirô Makiyama (*Mem. Coll. Sci. Kyoto Imp. Univ.*, ser. B, vol. 3). The beds in question, Dainitian, occur between Hutamata and Minamiyama on the Tôkaidô, or East Sea Road, and seem referable to the Plaisancian. The fauna contains 171 species of which 46·8 per cent. are known as living. Detailed descriptions of these, including many new species, are given and accompanied by six excellent plates.

PEAT AS A SOURCE OF WAX.—The curious metabolism of peat plants, which releases large quantities of fatty substances, and impresses very characteristic structural features on the plant form, was investigated a few years ago by Priestley and Hinchliff (see *The Naturalist*, 1922, p. 263, and 1924, p. 201). These fatty by-products are now being turned to commercial account. In the current issue of the *Bulletin of the Imperial Institute* (vol. 25, No. 3) an account is given of some experiments which have been carried on there on the extraction of wax from some samples of peat from Chatham Islands. The work follows on similar researches already carried out in Germany. Hot extractions made in a Soxhlet apparatus with chloroform as a solvent gave the remarkably high yield of 25 per cent. of crude wax, the yield in the case of most peats so far tested being from 6 to 8 per cent. The cost of chloroform, however, prohibits the use of this method as a commercial venture. Other experiments showed that benzene or mixtures of benzene and alcohol were almost as efficient for extracting wax from the peat, besides showing considerable advantage in regard to cost. Preliminary trials indicated that kerosene might possibly be used, but its high boiling point made the subsequent separation of the wax difficult. The crude wax had a dark colour, a melting point from 70° to 74° C., and could not readily be bleached. It is estimated that a market could be found for 500–2000 tons of the wax per annum for use in boot polish and related industries. An analysis of the peat remaining after extraction of the wax showed that the residue would form a useful fuel.

SMALL ELECTRIC FURNACES FOR THE LABORATORY.—The *Chemiker-Zeitung* of Sept. 28 contains a description of a new type of small electric furnace, with which a crucible can be heated in one hour to a temperature of about 860° C. The furnace is most easily adapted to a tension of 110 volts, and if the current does not exceed 2·2 to 2·4 amperes the heating coils will last for several thousand hours. The furnaces are made by the firm Hugo Helberger, of Munich, and are provided with specially adapted regulating resistances, by means of which it is easily possible to control the temperature.

THE WEATHERING OF TEXTILE FIBRES.—The *Chemiker-Zeitung* for Oct. 8 contains an account by Dr. H. Sommer of experiments on the weathering of textile fibres, carried out on the roof of the observatory at Neubabelsberg, near Potsdam. The complete record of the investigation will be found in the *Leipz. Monatsschrift für Textilindustrie*. It has been found that the weathering is chiefly a surface effect produced mainly by ultra-violet rays and is helped, particularly in the case of wool, by the presence of moisture. Of the different materials examined, silk proved to be the least and wool the most resistant to the disintegrating action of sunshine. The sunshine-hours required to produce comparable effects were as follows: silk, below 200; jute, 400; artificial silk, 900; cotton, 940; flax, 990; hemp, 1100; raw wool, 1120; chromed wool, about 1900; but differences in thickness were not taken into account.

THE CARBON ARC.—The issue of the *Physikalische Zeitschrift* for Sept. 1 contains a paper by Drs. R. Seeliger and H. Schmick, of the University of Greifswald, on the mechanism of the carbon arc. By the use of an arc enclosed in a vessel, they have been able to study the effects of reducing the air pressure from atmospheric to 2 or 3 cm. of mercury, on the positive crater and the light it emits, and on the volt-ampere characteristic of the arc. They find that in air and in nitrogen, the area of the crater increases, and the current per unit area of the crater therefore decreases as the pressure decreases. The increase of area of the crater is accompanied by a decrease of its temperature and a decrease of the voltage between the carbons. If the decrease of pressure is slow, at 1 or 2 cm. of mercury, the pressure rises from below 40 to 50 or 60 volts, and at about 0·5 cm. of mercury falls suddenly to 32 volts, at which it remains steady, the crater being much reduced in area. No theory of the arc has been propounded which will account for the facts observed.

The New School of Biochemistry at Oxford.

THOUGH the study of chemical physiology in Oxford began some three hundred years ago, it is only within the last few years that this subject has been recognised as a separate school of science. It then became clear that the importance of the study of the chemistry of living things together with the rapid extension of knowledge in this field made it imperative that recognition should be given to biochemistry by the foundation of a readership or chair. The University was fortunate in the generosity of Mr. Whitley, of Trinity College, who made possible the foundation of a chair, thenceforward known as the Whitley Chair of Biochemistry. To this chair was elected, in 1920, Dr. Benjamin Moore, who may be regarded not only as the first to hold the chair of biochemistry at Oxford, but also as among the pioneers of biochemistry in Great Britain. Unfortunately for Oxford, Moore did not live long to enjoy his new position. The present holder of the chair, Dr. Rudolph A. Peters, was elected towards the beginning of 1923. Shortly after he came to Oxford, the University received from the Rockefeller Foundation an offer of £75,000 towards the erection of a new Department of Biochemistry. £55,000 of this was to be devoted to the building and its equipment, and the remaining £20,000 towards maintenance. This offer was accompanied by the condition that the University should guarantee to contribute the sum of £25,000 or its equivalent in annual income towards the general maintenance of the new Department. This munificent gift was gratefully accepted by the University. Not only did it provide for a proper development of biochemistry, but also it solved the acute problem of providing additional accommodation for the Department of Physiology, a need that had been long delayed.

By the possession of these new buildings, which were opened by the Rt. Hon. Viscount Cave, Chancellor of the University, on Oct. 21, biochemistry ceases to be taught in the premises of the Department of Physiology, and this Department therefore gains valuable extra accommodation. It has, however, been an important feature of the development to keep the Departments of Physiology and Biochemistry in intimate connexion with one another. In order to accomplish this, the new building is L shaped and forms with the old Department of Physiology part of a quadrangle. There has also been incorporated in the scheme of development a conjoint library and a conjoint large lecture room. The buildings are further connected by passages upon two floors, a great convenience for students.

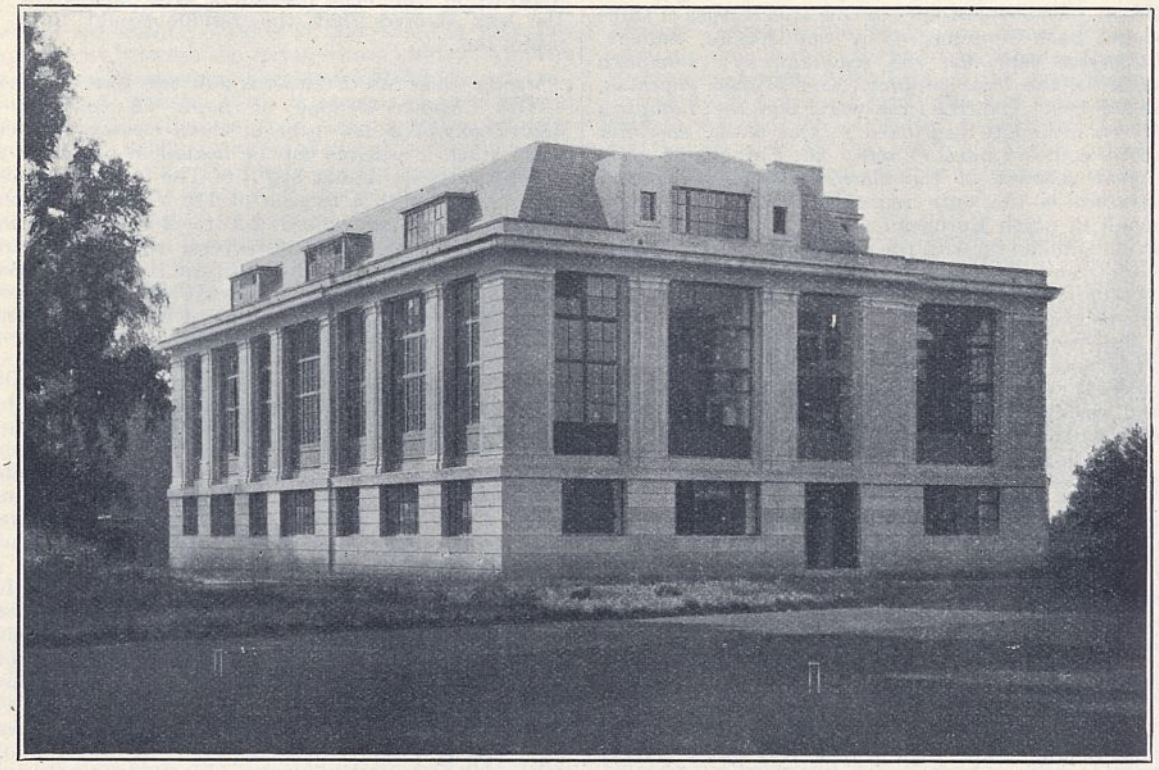

FIG. 1.—School of Biochemistry University of Oxford.

The building has been designed by Mr. H. Redfern and is built in a classical order, which was made necessary by the need for large windows and therefore narrow wall spaces between them. It consists of three floors and a mezzanine floor. Upon the ground floor are found, besides the usual offices, the conjoint lecture theatre capable of holding some two hundred persons, cold storage, a dark room for photographic work, and one for physical work. There are also a workshop and preparation room, and a small room for nutrition work upon rats. The first floor, which may be styled the teaching floor, is connected by through passage with the Department of Physiology. It consists of two large class rooms built side by side and capable of accommodating about one hundred students at a time. They can be used either as one room or two. In addition to the class rooms there are students' balance room, a polarimeter room, and a demonstration lecture theatre. The upper or second floor is reached through a mezzanine floor made possible by the height of the class rooms. Upon this floor is to be found a rest room, a room for constant

temperature work, a research room with roof lighting, and the entrance to the indoor animal house. The second floor is entirely devoted to investigation. Besides a professor's research suite and other research rooms, there is also a sterilising room, a small bath room, an operating suite, an outdoor laboratory, and an aquarium room. This floor opens direct to a flat roof.

With regard to the fittings, gas, water, and electric power have been brought into all rooms, and a trough system has been adopted for the drainage of water. Using this in conjunction with movable tables and cupboards designed upon a unit system, it will be possible for each research worker to arrange the benches to suit the particular investigation upon which he is engaged.

Subject to any unforeseen development, the present building should satisfy in the main the needs of biochemistry in the University for the present. Smaller wants are not yet, however, adequately met. There is, for example, the question of the research library, for which separate endowment is required. The modest sum of £2000–£3000 would go far to provide what is required in this direction. The most serious want of all, however, is believed to be that of providing studentships to enable the better men to stay behind for a period of one to two years to obtain training in research work, and so obtain the fullest possible use of the scientific opportunities of the University. This is a need which the Department of Biochemistry shares with other scientific departments, and until it is properly met there is no doubt that Great Britain will not make the best possible use of the brains of the younger generation at the University.

The University of Birmingham.

NEW BIOLOGICAL BUILDINGS.

WITH the progress of the biological sciences, both methods and needs have changed. The laboratories and apparatus of a generation ago are no longer adequate even for teaching purposes, still less for research. At Birmingham the three cognate Departments of Botany, Zoology, Brewing and Biochemistry of Fermentation have long been inadequately housed in the older part of the University in Edmund Street. This session, however, they have moved to their new quarters at Edgbaston. The new biological block was formally opened on Oct. 20 by the Prime Minister, Mr. Stanley Baldwin.

The buildings, the site and general character of which form part of the original design of Sir Aston Webb, face University Road, being situated between the Chemical Department and the Harding Library. The total cost of buildings and equipment is upwards of £120,000, towards which Sir William Waters Butler, Bart., has generously contributed £40,000, and an anonymous donor £5000.

Zoology occupies the ground floor of the new block, brewing and biochemistry of fermentation the greater part of the first floor, and botany the second floor, with certain rooms also on the first floor. A large lecture theatre, shared by all three departments, each of which also has its own lecture room, forms a third floor.

One important development is the recognition of the principle of departmental libraries. Each of the three departments in the new block has its own separate library, in which will be housed nearly all the periodicals and books dealing with the three subjects respectively. These departmental libraries will be under the general supervision of the University Librarian and the Library Committee.

The three departments have already started work in the new buildings, although the internal equipment and furnishing is not yet complete. The following accounts deal with the new departments.

ZOOLOGY.

The new Zoological Department, which forms the ground floor of the biological block, has been constructed on a spacious scale. There are three teaching laboratories, for elementary, for advanced, and for post-graduate honours students respectively. The laboratories have ample accommodation, good lighting, both daylight and artificial illumination, and modern fittings. The Department possesses a small lecture theatre for advanced teaching, while the zoologists, botanists and biochemists between them share a large theatre. This lecture theatre accommodates the large elementary class, the greater proportion of whom are medical students.

Original research is as much the *raison d'être* of a university scientific department as is teaching. For the purposes of research the new department is admirably equipped. The apparatus includes not only the microscopes and microtomes of the classical zoological laboratory, but also the numerous and often elaborate apparatus used in the newer experimental developments of the science. The members of the staff have each a private room fitted out as a laboratory. There is a research laboratory for other original investigators working in the department, with a special room for entomologists, dark rooms, an animal room, a tank room, etc.

The Department has a distinguished past record. Prof. T. W. Bridge, one of the original professors at Mason College, Birmingham, carried out much valuable research work on fishes. His successor, the late Prof. F. W. Gamble, is known to zoologists all over the world for his researches on the colour changes in crustaceans and for his study of the remarkable composite organism Convoluta, a planarian worm with symbiotic algæ. The late Prof. Leonard Doncaster was a member of the staff when he did his epoch-making work on sex-inheritance in the moth *Abraxas grossulariata*. Mr. H. G. Newth, the present senior lecturer, is an embryologist who has made a number of important original investigations. Incidentally, a large share in the design of the laboratories and fittings falls to his credit. The present head of the Department is Prof. H. Munro Fox.

BREWING AND BIOCHEMISTRY.

The British School of Malting and Brewing and Department of Biochemistry of Fermentation was founded at an earlier date than the incorporation of the University of Birmingham. Accordingly, at first, it was a department of Mason University College. The School was formally declared open by Mr. H. Cosmo O. Bonsor, on Jan. 18, 1900. The late Prof. Adrian Brown had been appointed, and held the position until his death in 1919, the School being maintained during that interval by contributions from the brewing industry. After the death of Prof. Brown, a further appeal was made to the brewing industry, with the result that a full endowment was provided for the chair, to which the name of Adrian Brown is attached.

The Department consists of a series of sixteen rooms running from east to west. There is a spacious general laboratory, a well-appointed microscope room,

and a research laboratory. The professor and the lecturer have each a private room and a laboratory assigned to them, and there is a special laboratory for analysis, and incubator room and dark rooms for photography and polarimetric work.

One of the objects of the School is to advance research in the many fields open to investigation in connexion with the fermentation industries, and the professor possesses wide powers with regard to aiding the investigations of competent workers by finding accommodation in his laboratories, and in other ways. Applications concerning such questions should be made to the professor direct.

Prof. Adrian Brown's research work is well known. It dealt with studies on micro-organisms—bacteria and yeasts—and the products of their action on different substances. He studied specially alcoholic fermentation, and made many notable contributions to the chemistry of enzymes. The high reputation of the Department for training and research built up by the late Prof. Adrian Brown has been well maintained during the eight years which have elapsed since his death.

BOTANY.

The new Botanical Department, comprising some thirty-three rooms, occupies the second floor of the new block, as well as the eastern portion of the first floor. On the first floor are sterilising and incubating rooms for mycological work, staff and preparation rooms, and the herbarium. The latter contains a number of important collections, being particularly rich in cryptogams.

The eastern end of the second or main floor is designed chiefly (though not exclusively) for teaching purposes, and the western end for research. Between these two parts, conveniently placed for both, are the departmental library, museum, store rooms, etc. So far as possible, laboratories and staff and other rooms in which microscope work is carried on, have been arranged on the north side of the building.

Special provision has been made for the study of plant physiology. The physiological laboratory is a large, well-lighted room at the extreme eastern end of the department. It extends across the entire width of the building, being provided with north and south windows as well as three large roof-lights. Adjacent to this laboratory are a small chemical laboratory and a physiological dark room. For experiments in which open air is necessary, a working bench of concrete and lead has been erected on the roof. This bench, like the ordinary laboratory benches, is provided with water, gas, and electric current, and communicates with the physiological laboratory below.

In addition to the building and its fittings, a considerable sum of money has been set aside for apparatus. It may therefore be claimed that the new Botanical Department is well equipped and thoroughly up-to-date. In particular, the facilities for research have been vastly improved.

THE PRIME MINISTER'S TRIBUTE.

The new buildings were formally opened by the Prime Minister at a special congregation in which the Chancellor (Viscount Cecil of Chelwood) conferred upon Mr. Baldwin the honorary degree of LL.D. The choice of Mr. Baldwin was singularly appropriate, for not only is he a Midlander, but he was also at one time a student at Mason College, and the University of Birmingham can thus claim that it is the only provincial university which has a Prime Minister on its register of students. The function was in every way a success, and the Prime Minister, in proposing the toast of "The University" at the luncheon which followed, made an eloquent and impressive speech. He thought that few developments in Great Britain were more full of hope than the development of the modern universities, a development of modern times which would be looked on by the historians of the future as the genuine renaissance of the nineteenth and twentieth centuries—a renaissance as genuine and as pregnant in its hopes for the future as the renaissance of the fifteenth century. "You have to go back about a century to see the first roots of this movement. At that time Oxford and Cambridge were more or less monastic institutions in which learning was preserved, with some skill, in cold storage. About that time you begin to see the rise of the literary and philosophical societies, in cities like Manchester and Birmingham pre-eminently. They were societies on which (as with all good movements) much scorn was poured in their own day. The *Quarterly* and *Edinburgh Reviews*, which stood then for the highest forms of culture, used to denounce them on the ground that they encouraged the vice which has always been a favourite vice in Birmingham—they complained that they showed an exclusive fondness for speculation on the constitution of matter—no uninteresting or unimportant subject."

It was not until the last half of the nineteenth century that the university movement began to gather strength; and in Birmingham it was associated with the wonderful activity of Joseph Chamberlain and his fellow-workers, who showed what enlightened municipal government could do. When the University of Birmingham obtained its charter, mainly through the energy of Joseph Chamberlain, the magnetic personality of that statesman secured the necessary financial support. But he passed away, and, not long after, the War came; and the University went through difficult times.

Financial help was needed. Recent Governments had done what they could, the City of Birmingham gave £15,000 a year, and the surrounding district about £4000. Vast fortunes are not so common in the Midlands as in some other parts of the country, but that did not make it any more difficult for co-operative effort to raise money. "We are probably standing at the beginning of one of the periods of increasing knowledge which will mark more than ever that renaissance of which I spoke. The transformation of the world is proceeding apace; the civilisation of the west is overflowing into the east, and the dead east is giving itself up from the sandhills of the desert; and the human panorama, more vivid and more extended than ever, is rolling itself out before our eyes in a way which would have filled our parents with amazement. So in science the problems of power and space, of the atom and the electron, are being attacked and invaded with more vigour and more success than at any time in the past. This work is being done by the co-operative effort of men in a thousand colleges, such as this, all over the world. We cannot live on the sacrifices of those who have gone before. A double duty lies before us of maintaining the work which they began, and pushing forward into realms of which they had no conception. . . . I believe that in time the people of this country will learn to realise that the teachers in these universities are the helpers and servants and the friends of humanity. And when once that essential truth has been grasped, there will be no doubt then that all the help that you need in material matters will be forthcoming."

In the afternoon the Prime Minister went to Chancellor's Hall to open the new wing of the hall of residence for men students (built through the generosity of Sir Charles Hyde), where he insisted on the value of corporate life in a university education.

The Imperial Agricultural Research Conference.

A NUMBER of valuable reports and memoranda have been drawn up and circulated to delegates of the Imperial Agricultural Research Conference for their information and consideration. We print below some notes on points raised in these memoranda.

Agricultural Officers Overseas.

The recruitment in Great Britain for the agricultural services overseas has always been a matter of difficulty. Appointments were formerly few and irregular, and no arrangements were made to prepare men for them; with the result that, for many years, these services were more or less dependent on the flotsam and jetsam of English schools, that is, those who had not made good in Great Britain. Recruitment began to improve with the present century, in the establishment by Mr. Chamberlain of the West Indian service, and by Lord Curzon of the much larger one in India. Latterly, first India and then Egypt have closed their doors to the purely agricultural candidates, although they still appear to require scientific 'experts' in connexion with agriculture.

The finding of suitable men for the Colonial service was rapidly becoming an impossible task, when the Empire Cotton Growing Corporation started its career, with the creation of a number of attractive studentships in Great Britain, with the idea of providing a sort of pool of specially trained men, from which candidates could be drawn, when needed, for pushing the growth of cotton in British dependencies. When appointed, these men were attached to the local agricultural departments. The Colonial Office followed suit, and similar scholarships have been given for several years. A leaflet has now been placed in the hands of the delegates of the Imperial Agricultural Research Conference advertising the creation, among others, of sixteen to eighteen post-graduate scholarships "annually, at any rate till 1933 inclusive," by the Colonial Office, and twelve studentships by the Empire Cotton Growing Corporation for the current year. The difficulty in recruitment may now be regarded as solved, in that a career is opened up for any promising student who qualifies himself in any branch of science connected with agriculture.

Among the questions which have been discussed at the Conference is that of the position of scientific officers in agricultural departments and their relation to the administrative staff. Two memoranda on this subject have been submitted from Tanganyika. It is pointed out that the agricultural departments in the older tropical colonies have usually evolved from botanic gardens, to the staffs of which have been added a chemist, an entomologist, a mycologist, and in some cases a geneticist and an agricultural economist. The chemist frequently has his attention diverted from agricultural matters by demands for his services as an analyst or toxicologist, and the biological officers can rarely give adequate time to research owing to the amount of advisory work which they are expected to undertake. It is urged that the primary work of a technical officer should be that of an observer and investigator, and that his opportunities for travelling should be increased, to enable him to keep in close touch with the executive agricultural officers in the various districts, and the problems actually arising in the field. These officers, and the owners of plantations and farms who are willing to do so, should be invited to make observations on definite lines laid down by him, and thus increase the thoroughness of his investigations.

To enable such a policy to be carried out, it would be necessary to supply the technical officers with assistants who could carry on work at headquarters while they were travelling, and also to prepare technical memoranda for use in advisory work by executive officers. A memorandum from New Zealand on the same subject indicates that the adoption of such a policy in that Dominion has proved very valuable.

Information Bureaux on Indian and Colonial Agriculture.

The English public is not much interested in what goes on in India, unless perchance some Rajah visits England or there is a recrudescence of Hindu-Mohammedan religious riots. The main employment of the people, agriculture, is scarcely ever referred to in the daily Press; and, indeed, it would be looked upon as a very dull and uninteresting subject. But it is not really so, if properly presented; and it must be confessed that writers on scientific subjects are sometimes not very lucid. This point of view is stressed by the chief agricultural officer in India in introducing the report which he has prepared for the Conference. Starting at home, he asks for a publicity officer for the Indian Agricultural Department, to popularise the work being done, for all classes in the country. He goes a good deal further, and pleads for a closer liaison between all parts of the Empire for the same purpose; India and the tropical colonies on one hand, and the torrid zone and temperate regions on the other. In short, he suggests the establishment of a publicity bureau in London, to act as a popular clearing house of the results of agricultural research within the Empire—a very different thing, of course, from the publicity section of the Empire Marketing Board. The natives of most of our African Colonies grow crops similar to those in India, and largely under like conditions of climate. The hundred folio pages of this report on the present position of agricultural research in India, prepared by the heads of the various sections, on crops and their treatment, agricultural practices, cattle and all veterinary matters, should prove extremely useful to the officers engaged in trying to improve the undeveloped agriculture of our African Colonies.

One of the greatest difficulties in the study of agriculture in the British dependencies overseas lies in the matter of literature. The whole range of crops in the warmer parts are different from those in Great Britain, and text-books, except on certain individual crops, are practically non-existent. The literature, therefore, consists of journals and pamphlets. Even in London, it is often a matter of considerable difficulty to locate a particular pamphlet or report, although there are important collections in various places. The Colonial and India Offices both contain a considerable number of journals and pamphlets on agricultural subjects, but these appear to be primarily intended as official records, and are not arranged for the convenience of the occasional visitor. The Imperial Institute and Kew Gardens have also accumulated a large amount of material, and this is admirably arranged for study; while the Bureaux of Entomology and Mycology will have all the information required in their respective subjects.

There are also scattered collections of less importance, and the London agencies of different countries are generally willing to supply copies of such pamphlets as they have for distribution. But there is a rather urgent need for strengthening one of these centres, or creating a new one, where the student of any

crop or practice or country may, without undue labour, find all that he wants. This subject is presumably being explored by the Colonial Office, and if the publicity bureau for India advocated above is established, this bureau will in the natural course of events be located where such a library is formed. Attention to this subject has been directed by the circulation of a leaflet describing the Science Library in South Kensington, where some quarter of a million 'references' have been got together on 'Agriculture, Economic Botany, and Forestry.'

The difficulties experienced in the collection of information as to the agricultural research going on in the different parts of the overseas Empire had to be faced by the Organising Committee of the Imperial Agricultural Research Conference. The Dominions, including India, are large enough to employ a numerous and well-organised staff, and it is never a difficult matter to obtain excellent summaries of progress being made year by year. But this is not the case with the colonies, varying as they do from countries the size of France to a few minute and poverty-stricken oceanic islands; and it was a happy inspiration which led the Marketing Board, with the help of the Colonial Office, to circularise the various British colonies in the tropics, asking them to prepare and forward by a certain date summaries of the present position of agricultural research in them and the most pressing needs for its increase in their territorities. One can imagine the interest which this circular must have caused in some of them, the ready response, and the incentive to make as brave a show as possible for submission to the collective authority of the Imperial Conference.

A summary of these reports has been prepared by the Organising Committee in handy form and printed under the title "Agricultural Research in the Overseas Empire"; and a copy has been placed before each member of the Conference. Canada, Australia, New Zealand, the Union of South Africa, and the Irish Free State lead off with some 56 pages; and, with the exception of a couple of pages on Cyprus and Palestine, the rest of the 120 pages are generously devoted to tropical colonies, concluding with a note on the activities of the Empire Cotton Growing Corporation in various parts of the Empire. This pamphlet should be a veritable godsend to the student of British tropical agriculture, a subject hitherto overshadowed by the often excellent literature so freely dispensed by Java, Cuba, Porto Rico, Hawaii, and the Philippines.

As a kind of addendum to the summary of reports referred to above, a series of extracts have been issued in folio form, typed and bound, each dealing with a separate aspect of agricultural research in the tropics (it is obvious that it would be impossible for members of the Conference to go through the originals in the short time at their disposal in Great Britain). One of these "Memoranda" deals, for example, with "Crops and Plant Breeding," and includes extracts of special interest at the present time. Such are: Breeding as applied to long-term crops, such as cacao, coffee, palms, tea and rubber, which occupy the ground for many years; shifting cultivation and its replacement—a system under which isolated areas of bush or forest are felled and burnt, and for a year or two food crops are grown, after which the land is allowed to become jungle again; the effect of grass and wild plants or cover crops on long-term plants; the problems requiring investigation in West African cacao, which is grown as a forest by the natives over large areas, without any attention to ordinary agricultural practice; the problems connected with Burma rice, the main source of this cereal food in the British Isles; the effect of soil and climate on the quality of Nyasaland tobacco, from which country the bulk of our "Empire tobacco" comes; the efforts being now made to evolve new kinds of banana on account of the spread of the 'Panama disease' (the cultivated bananas do not usually form seed and are always reproduced for crop purposes by suckers, on the same principle as the sugar cane and our potatoes); while the concluding third of this memorandum of 47 pages refers exclusively to various problems which are met with in the Empire cane sugar industry, now severely threatened by the fiscal support given in almost all foreign countries in the tropics to their own sugar factories. Various other crops are merely mentioned at the end of the memorandum, including sisal hemp, coconuts, oil palms, and so on; and to this list is added the question of industrial alcohol, now of special importance because the production of petrol in the British Empire is so very small.

Investigations aided by the Ministry of Agriculture.

The Ministry of Agriculture has issued for the use of the Conference two valuable publications describing the research work in agricultural science conducted at institutions in receipt of grants from the Ministry. The investigations deal with practically every important branch of agricultural science, and although conducted at many different centres, show little or no evidence either of overlapping or of lack of co-ordination. Only a few items can be selected for comment.

The question of the necessity for change of seed in potatoes is under investigation. The practice of employing seed produced under more rigorous climatic conditions is almost invariably adopted in England, and is supposed to prevent 'physiological degeneration'; however, no evidence of the superiority of yield of Scotch seed over home-grown seed has yet been obtained in careful tests over several consecutive years, provided the crop be kept free of virus disease. Although the yields of crops are more effected by season than by any other factors, a dull summer, such as the past one, is not necessarily associated with a low yield, as would at first sight be expected. In studies of barley one reason for this has been elucidated. In dull light the leaf surface is larger but less active in rate of food production than in bright light, so that the plant maintains a fair level of activity over widely variable weather conditions. Methods of statistical inquiry have been developed to deal with the data obtained from the field experiments, and their applications to results from the long-time Rothamsted experiments have brought to light previously obscure factors influencing the yield, thus enabling direct experimental tests to be undertaken. Besides climatic factors, variations in the soil conditions, even within a small area, affect the yield; the so-called 'even' crop of the farmer, if harvested and weighed in small plots, is in reality very uneven. Soil heterogeneity includes variations in physical, chemical, and biological characteristics. The latter two can only be shown at present by laboratory examination of numerous samples from the area in question, but the former is susceptible to rapid demonstration by measurements with a dynamometer of the soil resistance to a cultivation implement.

In the realm of animal husbandry, the famous permanent pastures of British agriculture have come under critical examination. The presence of wild white clover has been regarded as the essential characteristic of a good fatting pasture, and the earlier work was largely devoted to the encouragement

of leguminous plants by phosphatic manures, and basis slag in particular, with striking results. Afterwards it was shown that the effects were only observed to their full extent on originally poor grass land and under fairly high rainfall. Recently, the necessity for clover as an appreciable constituent of the herbage has been questioned. The work originated in Germany and has been actively taken up in Great Britain. It is claimed that by frequent applications of quick-acting artifical nitrogenous fertilisers, and by close stocking, a constant supply of young grass herbage is secured, which in both feeding value and amount is much greater than can be obtained by the older methods, thus enabling more head of stock per acre to be kept. Investigation is being made of certain technical difficulties that may arise, such as the effect of periods of drought, the prevention of rankness in the herbage due to the animal excreta, and the possibility of the soil becoming sticky or poached in wet periods by the treading of the animals.

A closely allied line of investigation is the examination of the mineral content of pastures. It has been found, especially in certain overseas regions, that serious diseases among stock are associated with a deficiency in the pasture of some essential element, *e.g.* iodine, normally present only in minute amounts. The study of these deficiency diseases, and the methods of remedying them, either by manuring the grazing area or by direct supply in supplementary rations of the missing ingredients, has necessitated the co-operative investigation of pathologists, chemists, and agronomists. This illustration of team-work among different investigators—and different institutions—is only one of many others to be found in the researches conducted with the financial assistance of the Ministry of Agriculture.

Empire Soil Problems.

Memorandum 8, issued by the Organising Committee of the Conference, contains the technical papers relating to soils and manures, which are up for discussion. Almost the whole field of pedological work is touched upon, though very naturally problems relating to tropical soils form a large proportion of the whole. The Parliamentary Under-Secretary for the Colonies points out our ignorance with regard to tropical soils and the important chemical and physical problems arising in connexion with irrigation and soil deterioration. The extensive and intensive methods of carrying out a soil survey are dealt with by Sir John Russell, who emphasises the need for standardisation of methods and for more general agreement as to the determinations which shall be carried out.

Practically all the Dominions and Colonies represented submit accounts of the work being carried out by them and the special difficulties and problems with which they are faced. From West Africa, as a result of a previous conference between neighbouring colonies, comes the request for the establishment of a Bureau of Soil Science the duties of which shall be the collection and collating of the results of soil investigations, the publication of approved methods of soil classification and analysis, and the provision of the machinery for assisting colonial agricultural chemists to carry on soil research to a point beyond that possible in their local laboratories.

As might well be expected, the assistance which soil survey work can give to irrigation problems comes out in several of the memoranda. Australia and the Union of South Africa both pay attention to the types of soil and the composition of the water suitable for irrigation, and the latter Dominion has some further interesting notes on exhaustion of soil by pine-apple cultivation. The Barbados review their own special soil problems connected with the sugar cane, whilst Ceylon discusses soil erosion, and Nyasaland the soil problems of tobacco growing. Altogether the memorandum presents a useful survey of Empire soil problems and will repay perusal by workers in Great Britain.

Storage and Transport of Agricultural Produce.

Matters of outstanding importance relating to the preservation and transport of agricultural produce, and in particular of perishable fruits of Australia, New Zealand, and South Africa, were discussed at the Conference. It has been pointed out that if the problems of immigration and land settlement are satisfactorily settled, the total production of food-stuffs from British colonies can be greatly increased. At the present moment, only some five per cent. of fruit produced in Australia is exported, while for New Zealand and South Africa the successful marketing of perishable food-stuffs, produced in great quantity, is still exceedingly difficult.

It is matter for congratulation for all concerned that arrangements have been made for Dr. Franklin Kidd, of the British Food Investigation Board, to visit Australia for the survey of local problems, the investigation work already in progress, and the possibilities of further work. It is anticipated that on the evidence of his report extensive lines of new investigation will be initiated.

The chief problems of transport for Australia relate to frozen lamb, mutton, beef, poultry, rabbits, and fruit, all of which present considerable difficulty. It is well known, for example, that the time taken on the voyage from Australia to England is, in general, too long to enable the export of chilled beef to be commercially feasible; that this fact has for long been a serious handicap to the Australian cattle-raising industry, and that owing to low prices realised for frozen materials, the ordinary method of freezing does not provide a way out of the difficulty. Much will depend on the matter of Dr. Kidd's report, as it is clear that improvements are called for in the pickling of meat, the treatment of slaughter-house wastes, and the defrosting of beef. Regarding fruit, much valuable information is now available relating to brown-heart in apples, the atmospheric and temperature conditions existing in ships' holds carrying apples from Australia, the storage properties of Victorian varieties of apples, and the incidence of the conditions known as 'bitter bit,' 'scald,' and 'internal breakdown.' The experience acquired in the investigation of such matters should be of infinite value when the problems of preservation and transport of oranges, pears, peaches, apricots, grapes, and tomatoes have been more fully assailed.

The problem of apple storage for New Zealand is also one of prime importance. The main damage to exported fruit is due to 'brown heart,' while in local storage there is extensive 'flesh-collapse' due to low storage temperature combined with high humidity. It is gratifying to note that improvements in storage have been assured and are further prefigured by the reduction in the water-content of apples. It cannot yet be said that the preservation of pears is satisfactory, but much practical success has followed storage at comparatively low temperatures. It has been shown that orchard conditions greatly affect the ability of the fruit to withstand bad storage conditions, and that in certain cases prematurity of the fruit tends to occur with extreme susceptibility to 'flesh-collapse.' It is hoped that this difficulty may be overcome by storage under relatively high temperatures and low humidity. It would further appear

that increasing the water-holding capacity of soils on which prematurity regularly occurs may enhance the resistance of fruit to 'flesh-collapse,' and that on such soils green manuring is decidedly advantageous.

In a paper to the Conference communicated by Dr. E. A. Griffiths, Government Physicist of the Department of Agriculture of South Africa, it was pointed out that it is neither practical nor sound to carry out investigations on fruit in England when such fruit has already undergone a period of long transport. On the other hand, the Dominions have neither the personnel of research workers nor the facilities for the conduct of the essential work. He urged that extensive investigation in England would help mainly to the understanding of the influence of respiration products on the storage of fruit and in the improving of technical methods in determining the conditions and effects of storage.

Agricultural Economics.

In a paper presented to the Conference on "Research in Economics for Tropical Countries," it was pointed out that since the raising of crops is the main industry in tropical countries, research must be carried out in agricultural economics. Tropical planters turn out partly manufactured produce, *e.g.* sugar, coffee, or sisal, and are thus confronted by a twofold problem. At present more attention is usually paid to the economics of the factory than to agricultural economics, and thus the gain in the factory is largely discounted by loss in the field. When profits are good, work is often uneconomically performed, and thus when bad years come it is difficult to prevent disaster. In such cases the action necessary depends on the nature of the crop, though the general aim must be to control the quantity of produce reaching the market, *e.g.* coffee valorisation and rubber production restriction.

In the tropics, methods of research—which must be concerned largely with cost accounting—are usually simpler than in temperate climates, as it is usual to farm one main crop only and that generally for export. Research in agricultural economics is necessary, and should be a public charge. To provide information, an agricultural census, the co-operation of planters, and the provision of agricultural colleges are required, while the formation of agricultural accounting societies like those at present under trial in Wiltshire might be beneficial.

In a memorandum by Mr. W. J. Lamont, Chief of the Division of Agricultural Economics and Marketing, Union of South Africa, consideration was urged of a scheme to provide statistics and other information required by agriculturists seeking new outlets for their products. Lack of such information has been frequently felt, as, for example, when a South African commission was inquiring into the possibility of increasing wine exports.

Some system is required whereby Britain and the Dominions may be provided with the latest available information about custom duties, trade agreements, restrictions on imports, and statistics of exports and imports, etc. Publication might be undertaken by the Empire Marketing Board or the *Board of Trade Journal*, with perhaps special supplements dealing with a different Dominion each month. Probably the best method would be to issue a special annual volume with monthly or quarterly supplements. If an annual volume were published, a few special articles might be included on such subjects as the Canadian and American wheat pools, the compulsory pooling of tobacco in the Union of South Africa, or the wine trade of the British Dominions. In conclusion, Mr. Lamont urged that the adoption of some such scheme would be of the greatest service to all the Dominions.

Suggestions for Co-operative Research.

In a comprehensive memorandum on "Co-operation in Agricultural Research," prepared for the Conference by R. W. Thornton, Director of Field and Animal Husbandry in the Union of South Africa, the following are among the subjects suggested as suitable for research on co-operative lines in various parts of the Empire: (*a*) The farming of Angora goats for the production of mohair, an industry which has seriously declined in recent years; (*b*) the relative cost and efficiency of horse versus mechanical transport for various farm purposes; (*c*) 'rust' in wheat, the principal factor limiting the production of this most important crop; (*d*) the production of legumes, particularly the soya bean, which could be grown in rotation with maize and might be produced in equal quantity in those parts of the Empire where maize is largely grown; (*e*) the ocean transportation of live-stock and agricultural products with the view of greater uniformity in regulations.

University and Educational Intelligence.

Bristol.—The opening of the new physics laboratory by Sir Ernest Rutherford on Oct. 21 was marked by a notable address by him on the significance of fundamental research and the splendid facilities which the laboratory affords for its pursuit. "Under such excellent conditions," he remarked, "we may confidently anticipate that this laboratory will fulfil the wishes of the donor by developing into one of our most important centres of training and research." What is now needed is the endowment of a number of research fellowships of about £250 a year each, to enable young men or women who have shown marked ability for research to carry out investigations in the laboratory.

At a special congregation held in the great hall of the University on Oct. 21, Prof. A. M. Tyndall, Henry Overton Wills professor of physics in the University, presented to the Chancellor, Lord Haldane, the following distinguished men of science for the honorary degree of doctor of science: Prof. Max Born, professor of theoretical physics, Göttingen; Sir William Bragg, director and Fullerian professor of the Royal Institution; Prof. A. S. Eddington, Plumian professor of astronomy, University of Cambridge; Prof. A. Fowler, Yarrow professor of the Royal Society; Prof. P. Langevin, professor of general and experimental physics, College de France, Paris; and Sir Ernest Rutherford, Cavendish professor of experimental physics, University of Cambridge, and president of the Royal Society.

Cambridge.—It is announced that Sir Arthur Shipley bequeathed some of his library to the Molteno Institute, the Balfour Library, and the Cambridge Philosophical Society.

Mr. F. R. Parrington, Sidney Sussex College, has been appointed Assistant to the Superintendent of the Museum of Zoology.

A grant of £150 has been made from the Worts Fund on the recommendation of the Polar Research Institute committee to the recent Cambridge expedition to Edge Island, Spitsbergen.

Mr. Norman McLean, fellow and tutor of Christ's College, and University lecturer in Aramaic, has been elected master of the College in succession to the late Sir Arthur Shipley.

Leeds.—The University Council has placed on record its grateful indebtedness to Sir Edward Allen

Brotherton, Bart., for his munificent generosity towards the University. The New Library Building, to be called 'The Brotherton Library,' will link the name of Sir Edward Brotherton inseparably with the history of the University. An offer by Messrs. Briggs, Son and Company to provide funds for a Scholarship of £150 a year, tenable in the Mining Department for a period of five years, has been gratefully accepted.

LONDON.—The following doctorates have been conferred by the Senate: D.Sc. in chemistry—Mr. J. W. Baker, an internal student of the Imperial College (Royal College of Science), for a Thesis entitled "A Correlation of the Effect of Certain Groups on the Reactivity of Aliphatic and Homocyclic Substitution." D.Sc. in physics—Mr. R. E. Gibbs, an internal student of University College, for a thesis entitled (1) "The Variation with Temperature of the Intensity of Reflection of X-rays from Quartz and its Bearing on Crystal Structure"; (2) "The Structure of α-Quartz"; (3) "The Polymorphism of Silicon Dioxide and the Structure of Tridymite"; (4) "An X-ray Investigation of the Lower Members of the Fatty Acid Series". D.Sc. (engineering)—Mr. G. W. Burley, an external student, for a thesis entitled "An Investigation into the Temperatures and Thermal Quantities involved in Lathe Turning Operations on Plain Carbon Steel," and other papers.

The Gow Lectures on the "Colloid Chemistry of the Rubber Industry" will be given, in English, by Dr. E. A. Hauser, of Frankfurt-on-Main, at University College, at 5.15 on Nov. 7, 9, 11, 14, 16, and 18. Free lectures on "Statistical Mechanics Old and New" will be given by Mr. R. H. Fowler, at the Imperial College of Science and Technology, on Nov. 10 and 24 and Dec. 8, at 5.45. No tickets will be required in either case.

OXFORD.—On Friday, Oct. 21, the Rockefeller School of Biochemistry, described elsewhere in this issue, was opened by Viscount Cave, the Chancellor of the University, in the presence of a large gathering which assembled in the Sheldonian Theatre to hear the Chancellor's address, and afterwards accompanied him to the fine new building in the Parks in which the School is housed. The Vice-Chancellor (Dr. Pember, Warden of All Souls'), in accepting the gift on the part of the University, gave expression to the gratitude due to the generosity of the Rockefeller Trust, and to the anticipation of the great results that might be expected to follow from the splendidly equipped department under the charge of the Whitley professor, Prof. R. A. Peters.

Dr. Gilbert Bourne, of Merton College, has been reappointed an elector to the Linacre professorship of zoology and comparative anatomy. Mr. David Murray-Rust has been appointed lecturer in natural science at Balliol College.

According to the report of the Institute of Agricultural Engineering for 1926 which has just been presented to congregation, the principal work of the institute was in connection with the desiccation process for producing sugar from beet. The work on sub-soiling has been continued.

IT is announced that the postponed fifth Pan-American Child Congress, referred to in our issue of April 16, p. 583, will be held at Havana, Cuba, beginning on Dec. 7, next.

PROF. MAX PLANCK, the well-known professor of physics of the University of Berlin, is retiring after forty years' service. He will be succeeded by Dr. Erwin Schrödinger, of the University of Zurich.

Calendar of Discovery and Invention.

October 30, 1786.—So early as 1780, Galvani made experiments on muscular contractions due to electric charges. Pursuing his studies in 1786 with his nephew Camillo Galvani, in September of that year it was observed that these contractions could be brought about by the use of metals touching the nerves. The experiments with the exact dates are preserved in a paper in Galvani's handwriting, "Esperimenti circa l' Elettricità dei metalli"; and the results were formally drawn up in a Latin dissertation of 62 pages, bearing the date Oct. 30, 1786, forming the substance of the most important section of his "Commentary on the Electric Forces . . ." published five years later but differing from it in some important particulars.

October 31, 1896.—Thirty-one years ago, on Oct. 31, 1896, Prof. Kamerlingh Onnes communicated to the Royal Academy of Sciences, Amsterdam, a paper by Dr. Zeeman "on the influence of magnetisation on the nature of the light emitted by a substance. Pursuing a hint given by Faraday, several experiments were tried. The principle was this: the light of the electric arc being sent through a heated tube containing sodium vapour, is analysed by a Rowland's grating. The tube is placed between the poles of an electro-magnet. When acted on by the magnet, a slight broadening of the two sodium lines is seen, tending to show that forced vibrations are produced in the atoms by the action of magnetism" (see NATURE, Dec. 24, 1896, p. 192).

November 1, 1895.—The first experiments with a cinematograph in Germany were made by the photographer, Max Skladanowsky, on Nov. 1, 1895, in the Wintergarden at Berlin.

November 4, 1745.—It was the attempt to electrify water in a phial which led to the invention of the Leyden jar, an invention which Sir John Leslie described as constituting an epoch in the annals of science. The discovery was made by Ewald Jürgen von Kleist at Cammin, Pomerania, and by him communicated to the German physicist Lieberkühn on Nov. 4, 1745. The experiments were immediately repeated by Cuneus and Lallemand at Leyden and described by Musschenbroeck. Von Kleist was a president of the high court of justice, and the house he lived in at Cammin bears an inscription to the memory. He was born on June 10, 1700, and died on Dec. 10, 1748.

November 4, 1847.—The use of anæsthetics began with the discovery of the action of nitrous oxide by Davy, but a new era in surgery was ushered in by the work of Morton, at Boston, Mass., in 1846, with sulphuric ether, the news of which led to Simpson's experiments. Late on the evening of Nov. 4, 1847, Simpson and his friends Keith and Duncan sat down to the hazardous experiments in Simpson's dining-room, which resulted in the discovery of the value of chloroform. "With each tumbler newly charged, the inhalers resumed their vacation." They became hilarious, bright-eyed, loquacious, "but suddenly there was a talk of sounds—louder and louder—a moment more, then all was quiet, and then a crash."

November 4, 1869.—Founded by Sir Norman Lockyer, NATURE first appeared on Nov. 4, 1869. Writing in the Jubilee number, M. Deslandres said: "During its existence the journal has ably recorded the magnificent discoveries which have distinguished the last fifty years in every branch of science . . . and it has been the better able to present them to the public because the founder has himself been one of the foremost builders of this noble edifice."

E. C. S.

Societies and Academies.

LONDON.

Optical Society, Oct. 13.—L. C. **Martin**: Experiments in ultra-violet refractometry. The experiments described have for their object the application of critical angle methods for the refractometry of liquids in the ultra-violet. A thin film of liquid can be held between two quartz hemispheres which are traversed centrally by an approximately parallel beam; the film receives the radiation at the varying angles of incidence resulting on rotation of the system. In this way, analysing the transmitted radiation with the aid of a quartz spectrograph, the critical angles for definite wave-lengths are measured, from which refractive indices can be calculated. The procedure necessary in seeking precise results is discussed, and a series of measurements on glycerine-water mixtures likely to be useful for immersion fluids in ultra-violet microscopy is given. A set of interesting phenomena of the extinction bands is described and explained.—Guy **Barr**: The construction of wave-length scales for spectrograms. A method is described by which an approximate scale of wave-lengths may be projected geometrically from a uniformly divided scale on to a spectrogram whereon a sufficient number of lines have been identified to enable constants of a Hartmann interpolation formula to be derived. Such a scale is of value in assisting the recognition of other lines between which accurate interpolation may be required.

ROME.

Royal Academy of the Lincei, June 1.—A. **Lo Surdo**: Thermionic balance.—L. **Rolla** and G. **Piccardi**: Ionisation potential of terbium. By comparison with sodium and calcium, the ionisation potential of terbium is found to be 6·74 volts. This value falls into place on the portion of the ionisation potential curve characteristic of the rare earths, and furnishes further confirmation of the conclusion that, in the rare earth group, such potential increases with the atomic number.—A. **Angeli** and B. **Bigiavi**: The two *p*-nitroazoxybenzenes. When treated with bromine in the presence of a small amount of iron filings, the two *p*-nitroazoxybenzenes behave differently, the isomeride melting at 148° yielding a tribromo-compound, and that melting at 152° a monobromo-derivative.—G. **Bruni** and E. **Geiger**: New derivatives of caoutchouc. The action of nitrosobenzene and other nitroso-compounds on caoutchouc in benzene solution or on the latex of *Hevea brasiliensis* in pyridine solution results in the formation of compounds termed nitrones. These do not react with hydroxylamine, but with phenylhydrazine the nitrone of isocaoutchouc yields the phenylhydrazone of a ketone which contains the carbonyl in the caoutchouc chain.—F. **Zambonini** and S. **Restaino**: Double sulphates of rare earth metals and alkali metals. (8) Double sulphates of cerium (cerous) and sodium. The compounds $Ce_2(SO_4)_3$, Na_2SO_4, $2H_2O$ and $4Ce_2(SO_4)_3$, $5\ Na_2SO_4$, $8H_2O$ are described.—F. **Zambonini** and A. **Stolfi**: Double sulphates of rare earth metals and alkali metals. (10) Sulphates of neodymium and ammonium. Under the various experimental conditions employed, only the compound $Nd_2(SO_4)_3$, $(NH_4)_2SO_4$, $8H_2O$ could be detected.—L. **Cambi**: The diazohydrates. The available facts concerning the structure of the alkali salts of the normal diazohydrates are in no way contradictory to the structural formula attributed to the hydrates by Angeli, but do not agree with Hantzsch's view of this structure.—L. **De Marchi**: The origin of the thermal waters of Montegrotto.—B. **Morpurgo**: The influence of inanition on homoplastic grafting.—C. **Rosati**: The permutable correspondences for an algebraic curve.—L. **Laboccetta**: A general method for replacing an inequality and a limitation by an equation, and its use in analytical geometry. E. **Pini**: Investigation of the primitive function for functions of several variables.—G. **Thomsen**: The kinematics of rigid bodies in general relativity.—A. **Masotti**: Dynamic action which a perfect liquid exercises on a solid cylinder, of any section, movable of itself.—F. **Sbrana**: Plane motions of an incompressible fluid in which the lines of flow are isotachic.—G. B. **Lacchini**: A new variable star.—F. **Neri**: Certain properties and applications of the neon lamp. Observations on the relationship between the effective ignition voltage for a neon lamp under alternating current and the frequency of the current indicate that the phenomenon of ignition requires a certain time and that the ignition of one electrode is profoundly influenced by the state of ionisation in which the medium has been left by the other.—G. **Charrier**: Organic compounds of quinquevalent bismuth. In hydrochloric acid solution, bismuth trichloride reacts with aryldiazonium chlorides to form stable crystalline compounds which contain quinquevalent bismuth and in which the chlorine atoms are readily replaceable by sulphuric or nitric residues.—G. **Malquori**: Hydrates of aluminium nitrates. From the cryohydric point for the system, $Al(NO_3)_3 - H_2O$, namely, −27°, to 73°·5, at which temperature the monohydrate melts, the only compound in equilibrium with the saturated solution is $Al(NO_3)_3$, $9H_2O$. At higher temperatures, the solubility curve exhibits marked discontinuity, corresponding with the existence of two hydrates poorer in water and the octo- and the hexa-hydrate.—V. **Caglioti** and A. **Stolfi**: Double sulphates of bismuth with the alkali metals. (1) Sulphates of bismuth and potassium. Investigation of the system, $Bi_2(SO_4)_3 - K_2SO_4 - H_2O$, indicates the existence of the compound $Bi_2(SO_4)_3$, $3K_2SO_4$, but not that of $KBi(SO_4)_2$.—Remo **de Fazi**: Alcoholic fermentation of solutions of glucose in water exposed to radiations from a mercury vapour lamp. Exposure of water to the radiation from a quartz mercury vapour lamp results in increase of the velocity of fermentation of a solution of glucose in the water.—A. **Cavinato**: Dehydration of apophyllite.—E. **Remotti**: Assumption of vitellin during the embryonic development of the fowl.—B. **de Finetti**: Conservation and diffusion of Mendelian characters. (1) Panmittic case.—M. **Muccioli**: Astringent juice of the fruit of the bitter *Diospyros kaki* and its application in China and Japan as an impregnating material for paper and wood.

BRUSSELS.

Royal Academy of Belgium, April 2.—The following grants were made from the Potter Foundation: W. Conrad (2000 francs) to assist him in the pursuit of his researches on the Belgian fresh water flagellates; J. Pasteels (500 francs) for the study, at Wimereux, of the cyto-physiological action of the dilution of sea water on the eggs of lamellibranchs; the "Jardin expérimental Jean Massart" (5000 francs) for the continuation of experiments in plant physiology commenced by the late Jean Massart; Edg. Zunz (6000 francs) for the purchase of apparatus necessary for his researches on the regulation of glycæmia by the method of pancreatico-jugular anastomosis; Th. De Donder (7500 francs) for assisting in the publication of a work on the theory of integral invariants; Gilta (1000 francs) for the execution of

plates relating to chemical crystalligraphy.—Paul Stroobant: The work on stellar and planetary photography of the Royal Observatory (Uccle).—Fred. Swarts: Trifluordimethylketone. This is readily obtained by heating trifluoracetylacetic ester with 10 per cent. sulphuric acid under a reflux condenser, the products being the above ketone, alcohol, and carbon dioxide. Details of its chemical and physical properties are given.—J. E. Verschaffelt: The physical signification of the second fundamental law of thermo-dynamics.—Th. De Donder: The signification and generalisation of Schrödinger's equation.—Th. De Donder and G. Van Lerberghe: The invariantive theory of waves.—R. Moens and A. Juliard: Some chemical reactions in the gaseous phase in high frequency electro-magnetic fields. The gases studied were submitted to high frequency (wave-length about 100 metres) in tubes without electrodes, initial pressure about 12mm. Hydrogen and oxygen combined totally in less than a second; ammonia was produced from hydrogen and nitrogen. No reaction was observed with a mixture of hydrogen and carbon monoxide or oxygen and nitrogen.—T. Van Hove: Some researches on the direct introduction of substituents in the aromatic mercaptans.—L. Van den Berghe: Preliminary note on the stimulation of the cardiac tissue of fishes by momentary extensions.—J. Guillissen: A mode of application of Tammann's method of thermal analysis to the study of reactions between solid phases. To increase the sensitiveness of the method the use of the time–temperature curve has been replaced by the curve temperature–difference of temperatures, using the double galvanometer of Le Chatelier–Saladin. The reaction temperatures of the following mixtures have been determined by this method: lead oxide–copper sulphate, lead oxide–molybdic anhydride, ferric oxide–barium carbonate, ferric oxide–baryta, ferric oxide–calcium carbonate.—J. Guillissen and Richard: The temperature of formation of zinc ferrite starting from the solid constituents.

May 3.—P. Stroobant: An account of the work done by the National Committee of Astronomy during the year 1926.—Seligmann and Maury: The geodesic work of the Institut cartographique militaire in 1926.—Paul Levy: Classical logic. Brouwerian logic and mixed logic.—Louis Giltay: The discovery of a species of Gobius, new to Belgium (*Gobius pictus*) and on the ethological conditions of its habitat.

SYDNEY.

Royal Society of New South Wales, Sept. 7.—A. R. Penfold and F. R. Morrison: The essential oils of *Eucalyptus micrantha* and *E. hæmastoma*, part i. The principal constituents were found to be: *E. hæmastoma*: Eudesmol, sesquiterpenes (aromadendrene and probably eudesmene), d-a-pinene, cineol (10-15 per cent.) with a very small quantity of phellandrene. *E. micrantha*: l-a-phellandrene, sesquiterpenes, terpineol and piperitol and their Caproic acid esters, d-a-pinene, cineol (less than 10 per cent.), with sesquiterpene alcohols and traces of the aromatic aldehydes. Piperitone, if present, did not exceed 5 per cent. in quantity. Solid eudesmol, a characteristic and constant constituent of the oil of *E. hæmastoma*, was found only in the oil obtained from Hill Top; altitude has a considerable bearing upon the production of this solid sesquiterpene alcohol. The presence of solid eudesmol in the coastal material of *E. hæmastoma* and the non-detection of phellandrene in the crude oils by the B.P. test, offered a ready means of distinguishing the oils from that of *E. micrantha*.

Official Publications Received.

BRITISH.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 57, 1927, January to June. Pp. 248+5 plates. (London.) 15*s*. net.

Annals of the (Mededelingen van het) Transvaal Museum. Vol. 12, Part 2, 22 September 1927. Pp. 55-189+plates 3-7. (Cambridge: Printed at the University Press.)

Empire Cotton Growing Corporation. Cotton Growing in Southern Africa and the Rhodesias: Report on a Tour undertaken in Southern and Central Africa by the Director, Mr. J. S. Addison, and Mr. H. C. Jefferys, April-June 1927. Pp. 31+8 plates. (London.) 2*s*.

(University of London): County Councils of Kent and Surrey. The Journal of the South-Eastern Agricultural College, Wye, Kent. Edited by Dr. S. Graham Brade-Birks. No. 24. Pp. 196. (Wye.) 7*s*. 6*d*.; to Residents in Kent and Surrey, 3*s*. 6*d*.

Proceedings of the Royal Society of Edinburgh, Session 1926-1927. Vol. 47, Part 2, No. 18: On the Consistency of Cardinal Function Interpolation, Parts i and ii. By W. L. Farrar. Pp. 230-242. 1*s*. Vol. 47, Part 3, No. 19: Observations on the Fragment of a Horse Skull from an Interglacial Deposit near Pulawy, Poland. By R. Prawochenski and B. Kaczkowski. Pp. 243-251+1 plate. 1*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Aeronautical Research Committee: Reports and Memoranda. No. 1063 (Ae. 245): Model Experiments on R.A.F. 31 Aerofoil with Handley Page Slot. By H. B. Irving, A. S. Batson and D. H. Williams. (A.3.a. Aerofoils-General, 168.—T. 2335.) Pp. 8+4 plates. 6*d*. net. No. 1064 (Ae. 246): The Effects of Stagger and Gap on the Aerodynamic Properties of Biplanes at Large Angles of Incidence. By H. B. Irving and A. S. Batson. (A.2.a. Stability Calculations and Model Experiments, 116 and 123.—T. 2334; T. 2357.) Pp. 37+20 plates. 1*s*. 9*d*. net. No. 1094 (Ae. 273): A Full Scale Determination of the Angle of Downwash below an Aeroplane. By E. T. Jones. (A.4.a. Full Scale Work Aeroplanes-General, 135.—T. 2457.) Pp. 6+2 plates. 6*d*. net. No. 1096 (Ae. 275): Full Scale Measurements of Lift and Drag of the Fokker F. VII.-3M Monoplane. By J. K. Hardy. (A.4.a. Full Scale Work Aeroplanes-General, 136.—T. 2459.) Pp. 4+5 plates. 6*d*. net. (London: H.M. Stationery Office.)

FOREIGN.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 26: Some Experiments on Motions of Fluids, Part iv. By Torahiko Terada and Kunio Hattori. Pp. 287-326+plates 8-20. (Tôkyô: Koseikai Publishing Office.) 1.45 yen.

Institut Royal Météorologique de Belgique. Mémoires, Vol. 2: Sur la distribution de la pluie en Belgique. Par Emile Vanderlinden. Pp. 50+7 planches. (Bruxelles.)

Bernice P. Bishop Museum. Bulletin 34: Polynesian Religion. By E. S. Craighill Handy. (Bayard Dominick Expedition, Publication No. 12.) Pp. 342. 3 dollars. Bulletin 35: Geology of Kaula, Nihoa, Necker and Gardner Islands, and French Frigates Shoal. By Harold S. Palmer. (Tanager Expedition, Publication No. 4.) Pp. 35+3 plates. 1 dollar. Bulletin 36: Geology of Mangaia. By P. Marshall. Pp. 48+3 plates. 1 dollar. Bulletin 37: Food Values of Poi, Taro and Limu. By Carey D. Miller. Pp. 25. 1 dollar. Bulletin 38: Fishes of the Tropical Central Pacific. By Henry W. Fowler. (Whippoorwill Expedition, Publication No. 1.) Pp. 32+1 plate. 1 dollar. Bulletin 39: String Figures from Fiji and Western Polynesia. By James Hornell. Pp. 88. 1 dollar. Bulletin 40: Hawaiian Mosses. By V. F. Brotherus. Pp. 37+8 plates. 1 dollar. (Honolulu, Hawaii.)

CATALOGUES.

South Africa: Catalogue of Books, Paintings and Drawings, relating to Cape Colony, Transvaal, Orange Free State, Rhodesia, South West Africa, Natal, British Central Africa, Mashonaland, Angola, Matabeleland, Zambesia, etc. (No. 501.) Pp. 45. (London: Francis Edwards, Ltd.)

High-Tension Cable Testing and Fault Locating. Pp. 24. (London: Watson and Sons (Electro-Medical), Ltd.)

Diary of Societies.

SATURDAY, OCTOBER 29.

MINING INSTITUTE OF SCOTLAND (at Heriot Watt College, Edinburgh), at 3.—D. Davidson: The Transport of Injured Persons Underground.—Papers open for discussion:—Experiments concerning the Relationship between Ventilating Pressure and Air Volumes in Mines, and the Effect of Natural Ventilation, by Prof. H. Briggs, Dr. J. M. Williamson, Dr. J. S. Penman, and H. Hyde; Miners' Nystagmus, by Dr. J. S. Haldane and Dr. T. L. Llewellyn; An Improved Face Conveyer, by A. V. Reis.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students' Section) (at Newcastle-upon-Tyne), at 3.—W. S. Rider: Feeding and Treatment of Animals below Ground and Stabling.—Paper open for further discussion:—Variable Speed Gears and their Application for Colliery Purposes, by W. S. Armstrong.

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull), at 7.15.—W. S. Burn: Notes on the Development of an Oil Engine (Lecture).

MONDAY, OCTOBER 31.

INSTITUTE OF ACTUARIES, at 5.—Sir Joseph Burn: The Eighth International Congress of Actuaries.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Institute of Chemistry, Leeds Area Section) (at University, Leeds), at 7.15.—O. C. de C. Ellis: Flame.

UNIVERSITY OF BIRMINGHAM CHEMICAL SOCIETY.—R. S. Tipson: Poisons.

TUESDAY, NOVEMBER 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir John Herbert Parsons: Light and Sight (Tyndall Lectures) (1).

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, at 5.30.—J. N. Langdon and Edna M. Yates: Transfer of Training in Manual Dexterity.

MINERALOGICAL SOCIETY (Anniversary Meeting), at 5.30.—Dr. L. J. Spencer: (*a*) Specific Gravities of Minerals: an Index of Some Recent Determinations; (*b*) South African Occurrences of Willemite. Fluorescence of Willemite and some other Zinc Minerals in Ultra-violet Rays.—Dr. T. V. M. Rao: A Study of Bauxite.—Dr. P. K. Ghosh: On the Biotite-bearing Greenstones and on a Rhyolitic Pumice in the Metamorphic Aureole of the Falmouth Granite.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—F. Martin Duncan: Exhibition of Cinematograph-film of Chimpanzees now in the Society's Collection.—W. N. Blair: Notes on *Hirudo medicinalis*, the Medicinal Leech, as a British Species.—Major R. W. G. Hingston: Field-observations on Spider Mimics.—Miss Mary L. Hett: Some Land Nemerteans from Upolu Island (Samoa), with Notes on the Genus Geonemertes.

INSTITUTION OF CIVIL ENGINEERS, at 6.—E. F. C. Trench: Presidential Inaugural Address.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Midland Hotel, Manchester), at 7.—A. B. Mallinson: Chairman's Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—B. Cox: Some Negatives and why I made them (slides by A. C. Banfield).

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.15.—J. E. Storr: Chairman's Address.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—T. Lewis: The Care of the Eyes in Industry.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—G. Burns: Mechanical Properties of Metals at High Temperatures.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Excavation of a Mousterian Site at Devil's Tower, Gibraltar:—Miss Dorothy Garrod: Archæology and Palæontology.—L. H. Dudley Buxton: Human Remains.—Prof. Elliot Smith: The Endocranial Cast.

WEDNESDAY, NOVEMBER 2.

ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street, W.C.2), at 3.—E. E. Sharp: Time Switches.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Sir Henry Gauvain: Tuberculosis as a Problem of Childhood.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. J. A. Douglas and W. J. Arkell: The Stratigraphical Distribution of the Cornbrash. I. The South-Western Area.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Lt.-Col. A. G. Lee: Chairman's Inaugural Address.

BRITISH PSYCHOLOGICAL SOCIETY (General Meeting, jointly with the Industrial Section) (at Royal Anthropological Institute), at 6.—Dr. W. V. Bingham: Some Individual Differences in Susceptibility to Accidents.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—Major E. G. Beaumont: The Influence of the Automobile User upon the Automobile Engineer (Presidential Address).

ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street, W.C.2), at 7.—W. E. Bush: The Principles of Good Home Lighting.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall, Westminster), at 7.—W. C. Freeman: The Production and Modern Applications of Dissolved Acetylene.

ROYAL SOCIETY OF ARTS, at 8.—Sir Philip Magnus, Bart.: The Royal Society of Arts: its Services to Trade and Training (Inaugural Address).

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.—F. W. Edwards: Narrative of a Collecting Trip to Patagonia and South Chile.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (in Institute of Pathology and Research, St. Mary's Hospital), at 8.15.—Sir William Willcox: The Biological Tests for Blood.—Dr. G. Roche Lynch: The Technique of the Precipitin Test and its Forensic Value.—Dr. F. C. Martley: The Use of the Blood Grouping Reactions in Forensic Investigation.

ROYAL SOCIETY OF MEDICINE (Surgery Section) (at Royal College of Surgeons), at 8.30.—Sir Arthur Keith: Concerning the Origin and Nature of Osteoblasts.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, NOVEMBER 3.

ROYAL SOCIETY, at 4.30.—Prof. Hans Spemann: Organisers in Animal Development (Croonian Lecture).

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. J. F. Gaskell: The Pathology of Pneumonia (Bradshaw Lecture).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Dr. G. Parker: The Early Development of Hospitals (Thomas Vicary Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—H. Clifford Smith: The Furniture and Equipment of the Mediæval House (1).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—A. H. Law and J. P. Chittenden: Higher Steam Pressures and their Application to the Steam Turbine.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at University, Bristol), at 7.30.—H. H. S. Clotworthy: The Manufacture of Viscose Artificial Silk.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Royal Aeronautical Society) (at Royal Society of Arts), at 7.45.—H. B. Taylor: High-Speed Compression—Ignition Engine Research.

CHEMICAL SOCIETY, at 8.—F. G. Mann: The Complex Salts of Nickel with Various Aliphatic Diamines.—T. K. Walker, V. Subramaniam, and P. Challenger: The Mechanism of the Formation of Citric and Oxalic Acids from Sugars by *Aspergillus Niger*.—W. R. Bucknall and W. Wardlaw: The Complex Cyanides of Molybdenum.—F. B. Garner and S. Sugden: The Parachor and Chemical Constitution. Part VI. Some Cases of supposed Ring-chain Tautomerism.

SOCIETY OF DYERS AND COLOURISTS (West Riding Section).—Prof. E. C. C. Baly: The Synthesis of Sugars from Carbonic Acid by Means of Light.

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch).—G. K. Nichol: Surface Condensing Plant.

FRIDAY, NOVEMBER 4.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Geophysical Discussion: Earthquakes. Chairman: Prof. H. H. Turner. Speakers: Dr. H. Jeffreys, R. D. Oldham, Mr. Stoneley, and others.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir William H. Bragg: Application of X-Rays to the Study of the Crystalline Structure of Materials (Thomas Hawksley Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institute of Chemistry (Manchester Section), Society of Dyers and Colourists (Manchester Section), and Manchester Literary and Philosophical Society) (at Blackfriars House, Manchester), at 7.—Prof. A. E. Green: Some New Principles in Chemo-therapy.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Pictorial Group), at 7.—An Evening with W. L. Shand.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—R. Lowe: Engineering Salesmanship.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne).

SATURDAY, NOVEMBER 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—E. Cammaerts: The Main Features of Modern English Literature (1).

GEOLOGISTS' ASSOCIATION (at University College), at 3.—Annual Conversazione.

PUBLIC LECTURES.

SATURDAY, OCTOBER 29.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Nature at Home.

MONDAY, OCTOBER 31.

KING'S COLLEGE, at 5.30.—Prof. E. Cassirer: Die Entwickelung der modernen Wissenschaft und die Grund-Prinzipien des kritischen Idealismus. (Succeeding Lectures (in German) on November 2 and 4.)

TUESDAY, NOVEMBER 1.

ST. MARY'S HOSPITALS, WHITWORTH STREET WEST BRANCH, MANCHESTER, at 4.15.—Dr. H. C. Cameron: The Child in General Practice: a Study both of Temperament and of Disease (Lloyd Roberts Lecture).

GRESHAM COLLEGE, at 6.—W. H. Wagstaff: Geometry. (Succeeding Lectures on November 2, 3, and 4.)

WEDNESDAY, NOVEMBER 2.

UNIVERSITY COLLEGE, at 5.—Dr. R. Hopkins: The Roots of Character.—At 5.30.—Major C. Davenport: Nineteenth Century Methods of Book Illustration.

KING'S COLLEGE, at 5.30.—R. F. Cholmeley: Secondary Education, I.: The Boys' Day School.

LONDON SCHOOL OF ECONOMICS, at 6.—P. T. Lloyd: Office Machinery: The Graphic Method and its Technique.

THURSDAY, NOVEMBER 3.

ROYAL SOCIETY OF MEDICINE (in Barnes Hall), at 5.—Dr. L. Colledge: The Present Position of Laryngectomy for Cancer of the Larynx (Semon Lecture).

UNIVERSITY COLLEGE, at 5.30.—Dr. R. Hopkins: The Use of Literature to Influence Conduct: Some Effects of reading Poetry.

FRIDAY, NOVEMBER 4.

BIRKBECK COLLEGE, at 8.—Public Debate on Humane Slaughtering:—Speakers: A. C. Dewbury and A. C. Knight. Chairman: Prof. F. T. C. Hobday.

SATURDAY, NOVEMBER 5.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Harcourt: Indian Pictures and Problems.

CONGRESSES.

OCTOBER 29.

ANNUAL CONFERENCE OF SOCIOLOGICAL SOCIETY, LEPLAY HOUSE, AND THE TOURS ASSOCIATION (at Royal Society of Arts).
At 11 A.M.—A. Farquharson: Some New Points on Survey Method.—G. Morris: Studies in the Auvergne: The High Pyrenees.
At 3.—Miss Vivian M. Palmer: The Survey of Chicago.
At 5.30.—Field-Studies in Tirol (Speaker from the Leplay House Students' 'Camp,' 1927).

OCTOBER 29 AND 30.

ROUMANIAN CONGRESS OF OTO-RHINO-LARYNGOLOGY (at Bucarest).