NATURE

SATURDAY, JUNE 27, 1931.

CONTENTS.

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. 3217, Vol. 127]

Professionalism and Science.

ONE of the main features of the development of science during the nineteenth century, as Prof. A. N. Whitehead has pointed out in "Science and the Modern World", is the twin growth of technology and professionalism. Science was then for the first time conceived as a vast mine of ideas for utilisation in practical life, and in the disciplined attack on problems thus encountered in technological developments the scientific worker rapidly passed from amateur to professional status.

The professionalism of science is one aspect of the problem of specialisation which confronts the educationist to-day. It can scarcely be disputed that the complexity of modern science and of industrial technology demand intensive specialisation and tend to encourage the growth of various scientific professions. At the same time, the growth of professional organisations among scientific workers and the marked movement towards registration in post-War Europe, while likely to assist in the participation of scientific workers in public affairs, are not without their own special dangers.

The specialised knowledge and restricted outlook of scientific workers themselves must be recognised as among the factors which have hindered the establishment of right relations between science and leadership. Few scientific specialists could be named whose knowledge and opinions would be accepted as having much weight outside the narrow field in which they have elected to pursue their special studies or researches. In many cases their training has not even equipped them with the powers of expressing the results of their work in forms which facilitate its appreciation and assimilation in the normal life of the community.

It must be admitted that chemists, physicists, and other scientific workers are frequently characterised by a celibacy of intellect which curiously resembles the physical celibacy practised by the learned in the Middle Ages. This celibacy of intellect on the part of individual scientific workers is one of the main causes of the ineffectiveness of their professional organisations, which are rarely able to secure sufficient support from the general body of members for the success of policies originated by a few more fertile minds. If the future of society largely depends on our ability to link administrative power with knowledge of the scientific factors involved in our modern problems, that combination can only be secured when the scientific worker adds to his knowledge the wisdom which is the fruit of a balanced development.

The problem is fundamentally educational. Our present educational system on one hand produces administrators, frequently of a high order of ability, but whose complete ignorance of science renders them incapable of assessing the scientific factors upon which all our modern problems turn. On the other hand, its tendency to excessive and premature specialisation produces a diversity of specialists often devoid of the political or social wisdom essential for the evaluation of the other factors involved.

The problem of education must be faced by professional organisations of scientific workers if they are to assume their responsibilities of leadership. The movement towards professional registration accentuates the importance of educational aspects of professional training. It is essential that a sufficiently high standard of general education should be demanded of all entrants to such professions, that premature specialisation should be discouraged, and that qualification for entry to a profession of science should depend more upon the ability to apply and use knowledge than on the possession of an acquaintanceship with a mass of undigested scientific facts. A danger of undue uniformity may arise, however, if the conditions of entry are too narrowly prescribed in closing a profession by a measure of registration. In his recent book, "Education at the Cross-roads", Lord Eustace Percy has indicated the valuable contribution which the technical schools might make in a considered scheme of professional training.

The technical school provides an important and valuable alternative method of recruiting the scientific and technical staff required by industry which may exercise a vitalising influence on professional policy and opinion out of all proportions to the numbers so recruited. It also makes an important contribution to the solution of a problem which is encountered in every project for the registration of chemists or other scientific workers. The efficient employment of research workers in industry is largely dependent on the existence of an equally or more numerous class of laboratory assistants capable of carrying out the routine testing or analysis and mechanical work. Many such assistants acquire a high degree of experimental technique, although few have the capacity or training to originate experimental work.

The career of laboratory assistant offers, however, very limited prospects. Comparatively few laboratory assistants are able to qualify and enter a scientific profession by one of the recognised channels, nor is industry able to absorb such workers on its technical staff in adequate numbers. Although the normal recruitment of the various scientific professions should not be from the ranks of such assistants, it would be unwise and unfair in any measure of registration to close the door entirely. With proper support and co-operation, the training such assistants can obtain in the technical schools would enable them to attain the necessary standard of technique, and their more varied outlook and training might help to counteract the deadening uniformity which over-rigid conditions of entry tend to stamp upon a profession.

Excessive uniformity is a real danger to professional life to-day. It is fostered by the training which most scientific workers receive, and also by the conditions of industrial research with its emphasis on team work. Nor is the policy of vocational selection without its tendencies in the same direction. Fortunately perhaps, vocational guidance at present appears to exert only a broad influence on those proceeding to the universities, for example, as between arts and science. It would be a serious danger if such methods were applied to guide into relatively narrow fields all intellects of a certain characteristic type and those alone.

Scientific progress depends on more than mere advances in technique. In the perfecting of technique and the evolution of corporate research or team work the professionalism of science has itself largely been developed. Professionalism will, however, defeat its own ends if it succeeds to any great degree in cramping individualism and forcing on scientific workers a mediocre uniformity. Progress depends on the spirit of adventure, and the spirit of science is one of questing and searching in the unknown, with its attendant risks of success and failure.

The more economic necessity forces on scientific workers the development of their professional organisations, the more jealously they must cherish high ideals of craftsmanship and of service, and guard against the sterilising influence of excessive specialisation and uniformity. Moreover, the very security which strong professional organisations ultimately confer on their members may itself be a snare to scientific workers.

Security is but a means to an end, and a first effect of professional organisation should be to improve the conditions of employment of scientific workers, so that they can carry on their investigations without undue financial anxieties. Such security makes for better workmanship by increasing the freedom of the investigator. When, however, it becomes an opiate and the absence

of competition prevents the sharpening of mind on mind, security has outlived its purpose. All powerful professional organisations tend to suffer from a species of inbreeding of intellect, or mental sterilisation, and it is not in an atmosphere of security and uniformity that great discoveries are made or creative ideas conceived.

Specialisation is a necessary evil under modern conditions. Professionalism is essential to maintain and advance high standards of technique and the due status of scientific workers. Vocational guidance must play its part in reducing the wastage of human material in unsuitable occupations. If in such ways the freedom, resources, and efficiency of the scientific worker are increased, it is incumbent upon him to see that there is no dimming of the spirit of adventure, the devotion to truth, the sincerity of purpose which are behind every great discovery of the past and still supply the driving force in the advance of science.

Human Palæontology.

New Discoveries relating to the Antiquity of Man. By Sir Arthur Keith. Pp. 512. (London: Williams and Norgate, Ltd., 1931.) 21*s*. net.

THE last ten years have witnessed a profound change in the aspect of human palæontology. Important fossils of hitherto unknown types of men and an ape (the Taungs Skull) have been found which reveal new and provocative information and add enormously to the range of facts that call for interpretation. Such unexpected types of the human family as Rhodesian Man and 'the Lady of Lloyds'' set new and intriguing problems. The recent discoveries of representatives of *Homo neanderthalensis* in Gibraltar, Italy, Germany, the Crimea, and Palestine have extended the geographical range of this uncouth species and also given welcome corroboration to the generally accepted ideas as to the significance of Neanderthal Man and the part he played in human history. More significant than all these discoveries are the important fossils found in China and the revelation of a new genus of the human family that is more primitive and generalised than any other type at present known. The exceptional value of Peking Man, however, lies in the fact that he provides us with a bond of union between the other early members of the human family, whose fossil remains before the discoveries at Chou Kou Tien seemed to be irreconcilable with one another. At the present moment, with all this new and highly significant information collected from many scattered regions of the earth, there is an urgent need for a critical review of the whole evidence and an attempt to interpret its meaning. The tempting task now for the first time becomes possible of achievement, of creating a solid and coherent foundation for a real science of human palæontology.

For such a task, Sir Arthur Keith has opportunities and qualities such as no other anthropologist enjoys: not merely the diligence to collect the widely scattered data and the literary skill and vivacity of style to make the new information intelligible to the man in the street, but also the freedom from the time-destroying interruptions from which those who hold university positions cannot escape.

If Sir Arthur has not seized this chance in the way that would appeal to the serious student, he has rendered a useful service. For the layman who wants to know what fossils have been discovered and what their meaning is, Sir Arthur has provided a useful and entertaining guide. He begins with a full and well-balanced report on the Taungs Ape, for the rescue and interpretation of which he pays just and generous tribute to Prof. Raymond Dart. Most palæontologists will agree with his verdict. *Australopithecus* is an ape closely akin to the African anthropoids, the chimpanzee and gorilla, and perhaps even nearer to the extinct *Dryopithecus*, which reveals quite definite, if slight, signs in its brain, face, and teeth of a nearer approximation to the human type than any other ape. Obviously, however, the Taungs Skull itself is a relic of the survival into Pliocene or Pleistocene times of a type which must have come into being as early as the Miocene. Hence this individual specimen cannot be regarded as a human ancestor, nor can its discovery in South Africa be regarded as shedding any decisive light upon the place of birth of mankind, since this ape's ancestors may have been, and no doubt were, wandering far and wide during the millions of years of Miocene and Pliocene time.

Sir Arthur Keith adopts the views of Prof. Davidson Black as to the significance of Peking Man, and he gives a clear and instructive report upon the excavations in China and the nature of the evidence provided by the fossils, the importance of which, he admits, it would be difficult to exaggerate. There are, however, some significant omissions in Sir Arthur's commentary: in particular, his neglect to use the illumination its evidence sheds on the Piltdown Skull, to which I shall refer later.

The third major discovery discussed at length is

the Lloyds' Skull, found in the City of London in 1925 during the excavation of the site for the new building of the Corporation of Lloyds', and rescued for scientific investigation by Mr. Warren R. Dawson. Sir Arthur rightly regards this tantalising fragment of highly fossilised skull as a relic of exceptional importance, which deserves exhaustive study and full discussion. (As the custodian of this specimen, I can assure him that during the last two years I have been collecting the material for a monograph on the fossil, for which Miss Dorothy Garrod, Mr. Warren Dawson, and Dr. Matthew Young have written (1928) their valuable contributions.) Later on, I shall refer to Sir Arthur's strange suggestion that this earliest Londoner belongs not to an unknown type of modern man, but to the Piltdown type!

An excellent summary is given of the new discoveries of men of the Neanderthal species and of men of more modern type in South and East Africa, Australia, America, and elsewhere, and some not altogether relevant disquisitions on the archæological work of Mr. Woolley in Sumer and the problems relating to the origin of early civilisation.

Taken as a whole, the survey is useful and illuminating, brightly written, and illustrated with 187 diagrams, most of them excellent, with enough of unexpected and even sensational speculation to titillate the palate of the reader, which might otherwise have become jaded by the richness of anatomical detail. While realising the justice of the appreciations of this book which have appeared in the lay press, it is essential that I should direct attention to aspects of Sir Arthur Keith's treatise which must make the teacher of university students hesitate to recommend it to his class. The major disappointment I experienced in reading the book was that Sir Arthur did not seize the unique opportunity that presents itself at the present moment of building all the wonderful material now available into a coherent foundation of anthropological doctrine, drastically eliminating the errors of the past and the questionable speculations of the present. Instead of doing this, he has introduced a new crop of daringly improbable speculations and retained many old fallacies concerning matters of obvious fact.

So much confusion has already crept into the references to the Lloyds' Skull in the public press, that it seems desirable to explain the real situation with reference to the issue which more than any other focuses the argument of Sir Arthur Keith's book.

Writing in NATURE of Nov. 7, 1925 (p. 678), I discussed the puzzling characters of the fragment of the very ancient skull found in London, which was particularly tantalising in that the most significant parts, front, base, face, and teeth, were missing. I pointed out in what respects it differed from both *Homo sapiens* and *Homo neanderthalensis*, but eventually reached the tentative conclusion (since confirmed by Dr. Matthew Young's statistical analysis), which I expressed more definitely in the *British Medical Journal* (p. 854) of the same date, that 'The Lady of Lloyds'' was "an exceptionally primitive member of the species *sapiens*".

In the course of the discussion in NATURE, however, I mentioned that while the endocranial cast presented a general resemblance to some of the smaller Neanderthal casts (Gibraltar and La Quina), it differed from them in respect of other features, in which it "closely conforms to the type found in *Homo sapiens*, as well as, curiously enough, in the Piltdown cast (*Eoanthropus*)". Sir Arthur Keith seems to have transformed this simple statement into the assumption that the London skull was a link between *Eoanthropus* and *Homo sapiens*! Thus, he says, it does not belong "to an unknown type of modern humanity, but to a recognised type of ancient man, viz., man of the Piltdown type" (p. 32). It is scarcely necessary to say that there is no warrant for this view. Yet if the opinion of Miss Dorothy Garrod is correct—and of that there seems now to be no doubt—that the fossil is at least as old as the beginning of the Mousterian (and not, as my geological advisers claimed in 1925, more recent than the Mousterian), the London skull is vastly older than any known example of the species *sapiens*. Hence it may belong to a hitherto unknown species.

In spite of this possibility, which is even a probability, the lack of the most distinctive parts of the skull suggests that for the present it is wiser to refrain from creating a new species, and regard 'The Lady of Lloyds'' as a very early and primitive representative of *Homo sapiens*. Even if we push back her age to the Early Mousterian (? or to the Acheulean) Age, that would afford no justification for assuming that she was a descendant of (or in any way closely related to) the Piltdown Man, who belongs to a different genus fundamentally distinct in every character. Elsewhere in his book (p. 290) Sir Arthur Keith estimates that 200,000 years (many geologists and physicists would multiply this figure by four) intervene between the age of Piltdown Man and the Mousterian phase of culture. Hence it would impose an unduly heavy strain upon the imagination to bring the Piltdown

Man and the 'London Lady' into the same genus, even if they presented any real likeness to one another. As they do not, we may confidently dismiss this sensational claim as an unwarranted speculation.

Sir Arthur Keith's claim for a certain resemblance of the Lloyds' Skull to the Piltdown Skull is given a spurious plausibility because he still retains his erroneous reconstruction of the Piltdown Skull. Anyone who looks at the Piltdown fossils (or even Mr. Frank Barlow's excellent casts of the separate fragments) can see on the posterior border of the parietal the medial part of the lambdoid suture. Sir Arthur ignores this patent fact and adds about a centimetre to the posterior border of the bone (see his Figs. 95, 154, 155, and 157) to make a hypothetical suture, when the real one is already present on the fossil. To this error, another is added by ignoring the median plane of the skull. The middle line in Sir Arthur's reconstruction is more than half a centimetre to the right of its true place, and the consequent error in the breadth of the skull double that figure, more than a centimetre. Not only so, but these mistakes compel him to dislocate the natural articulation between the parietal and temporal bones and so create an unnatural and monstrous reconstruction. These are not questions of opinion, but of easily checked anatomical facts, to which in 1927 I directed particular attention, with illustrative figures, in my "Evolution of Man" (pp. 70-81, Figs. 17-24). As Sir Arthur tells us he is "throwing sparks into the smouldering fire of the Piltdown Controversy" (p. 32), would it not be wise to abandon claims, the error of which any casual visitor to a museum can detect for himself? I have referred to this matter, however, not because of Sir Arthur's provocative challenge, nor because it disposes of his suggestion to include the Lloyds' Skull within the genus *Eoanthropus*, but also to direct attention to a matter which more than any other is causing confusion in human palæontology.

The widespread suspicion of the authenticity of the Piltdown Man as a valid genus is notorious, and the chief reason for the lack of agreement in human palæontology. Even to-day many Continental anthropologists refuse even to refer to it in treatises on fossil man or, when they do so, brush it aside as being so doubtful that it is best to ignore it. I have been to some trouble to discover the reasons for the persistence of this attitude. It is not simply because the Piltdown jaw is apelike in general form, so much as the claim that the braincase associated with it conforms to the type of *Homo sapiens*. Hence it is particularly unfortunate that in this book Sir Arthur Keith not only persists in exaggerating the size of the braincase and brain, but also states that "the cranial features of Piltdown Man are essentially of the modern type" (p. 32), and "if we had found only the cranial parts of the Piltdown Man we should never have hesitated in regarding him as the direct ancestral type of modern man; the simian features of his lower jaw and of his teeth led us to exclude him from this position" (p. 546). There is no justification for such misleading statements. In my "Evolution of Man" (1927) I showed that the Piltdown skull and jaw are not disharmonious, that the general architecture of the braincase is no less simian in character than the jaw. In a series of comparative diagrams (Fig. 24) I adduced the evidence in substantiation of this opinion.

It is strange that Sir Arthur totally ignores the clear light the evidence of the Peking Skull throws on this aspect of the Piltdown problem. For the peculiar characters of the natural skull of *Sinanthropus*, which is not the result of a reconstruction, reproduce in an even more exaggerated form (especially in the view of the braincase from behind) the peculiar features of the true Piltdown reconstruction to which Sir Arthur has been objecting for seventeen years (see NATURE, Oct. 16 and Nov. 6 and 20, 1913).

In the days when most anthropologists refrained from estimating the antiquity of man in numbers of years, Sir Arthur Keith used to juggle with big figures in his speculations. More recently, when, using the exact methods of physics, the reasonable probability of a figure approaching a million years has been shown to be the sort of date to assign to the beginning of the Pleistocene period, Sir Arthur has cut down his figure to 200,000 years. Many years ago Profs. Joly and Boltwood (1908), among others, suggested the value of radioactive changes in rocks as a geological chronometer. Holmes and Lawson (1927), Kovarik (1930), and von Hevesy (1930) measured the natural disintegration of uranium into lead in the oldest igneous rocks containing radioactive elements and arrived at an estimate of 1,825,000,000 years for the earliest actual sample, or in round numbers about 2,000,000,000 as the possible age. Using the time-scale which geologists have gradually determined since William Smith in 1796 made the first estimate, there is little room for doubt that the end of the Pliocene can be referred to a time which is one two-thousandth of the whole scale—in other words, roughly a million years ago.

Recent researches on this problem have been clearly summarised by Dr. Chester A. Reeds in an article entitled "How Old is the Earth?" in *Natural History* (March–April 1931). Assuming the reality of Pliocene Man, Dr. Reeds suggests that the antiquity of man must be at least 1,500,000 years. Against these results inferred from exact investigation Sir Arthur Keith attempts to justify his estimate of 200,000 (later in the book he makes it 250,000) for the Pleistocene period by the statement: "My reason for reducing the time allowance was based on the results arrived at by students of early man's stone tools, his industries or cultures" (p. 34). But this is sheer guesswork. For who can decide whether Acheulean implements, which are admitted by him to have undergone no change in forty thousand years, might not also have remained under the thraldom of tradition for another forty thousand years?

If Sir Arthur whittles down the time allowance for man's early history, he runs riot in his estimates of the duration of the later phases of culture. Ignoring the general trend of archæological research during the last two decades, he allows eight thousand years for the Neolithic period. He does not explain what precisely he means by the discredited term 'Neolithic', or whether it refers to Britain or the Continent. If the former, eighty would be much nearer the mark than eight thousand —the time it took for the use of bronze to spread from the Continent to England after the people of the former introduced the Neolithic culture in the process of getting tin from Cornwall for bronze-making.

Although Sir Arthur Keith devotes only a page and a diagram to chronology, I have directed particular attention to the important questions at issue because they seem to be of crucial significance in a work bearing the title "Antiquity of Man". It is surprising, therefore, that Sir Arthur while continuing to use this title has ignored the significant work the physicists have been doing to solve the essential problem implicit in his label.

It comes as a relief to find that Sir Arthur has at last abandoned his claims for a high antiquity for the Galley Hill Skull, an opinion that has always played an obtrusive part in shaping his attitude in the reconstruction of human history. The vacant niche in his pantheon of our remote ancestry he now assigns to 'the Lady of Lloyds', the oldest known inhabitant of London. The fact that her skull is truly fossilised and was found in a geological deposit of remote antiquity gives her a very much stronger claim than Galley Hill Man to this honourable place. Yet in abandoning the Galley Hill claims Sir Arthur also seems, at the moment when for the first time there is reasonable evidence in support of it, to have given up one of his favourite slogans—the remoteness of the antiquity of the modern type of man, even repudiating the views of his disciple Mr. Leakey, whom for three years he has encouraged in his theories for assigning extreme antiquity to the human remains and associated cultures in East Africa. Instead of emphasising the fact that although the Lloyds' Skull cannot be brought into strict conformity with either *Homo sapiens* or *Homo neanderthalensis*, it is probably a very ancient and primitive forerunner of *Homo sapiens*, he wants to associate it with the Piltdown Skull and to overcome the burden of incredibility by claiming that *Eoanthropus* is modern in type.

In his writings Sir Arthur Keith has never shown much respect for the commonly accepted principles of biology, in particular those involved in questions of phylogeny. In the present work he provides us with new examples. He suggests that the Australian race (*Homo sapiens*) may have been derived from the genus *Pithecanthropus* (p. 312) and the original owner of the Lloyds' Skull from the genus *Eoanthropus*: yet he seems to regard both the Australian and 'the Lady of Lloyds'' as members of the genus *Homo*! Unfortunately, the diagram that forms the frontispiece does not enlighten us as to the means whereby this miracle was achieved.

It is puzzling to know why Sir Arthur added the last two chapters. They add nothing to our knowledge or the general argument of the book, but suggest rather that he is not serious. His statement that he is going to make endocranial casts "intelligible to those who have not served an apprenticeship to anatomy", is scarcely justified by his conclusion, which is expressed in the words: "I suspect that a large brain was given to man, not that he might understand life, or circumvent difficulties, but simply to enjoy it". Even more surprising is the last chapter. In it he seriously discusses the possibility of an isolated example of a species of man other than *Homo sapiens*—the chapter is entitled "The Discovery of *Homo Gardarensis*—surviving in Greenland in the twelfth century A.D." In the end he admits that the man was suffering from acromegaly—and uses the opportunity once more to suggest that extinct types of the human family were subject to pituitary disturbances, but without being pathological or, in fact, suffering from the usual disabilities of such lesions.

I have directed attention to the weak spots in the book to make it plain why teachers who urgently need a sober presentation of the facts of human palæontology must hesitate to recommend it to their students. Nevertheless, it is full of valuable information and, except in the lapses that I have enumerated, serious argument. It need scarcely be said that the book is vastly entertaining.

G. ELLIOT SMITH.

The New Popular Science.

(1) *Everyday Marvels of Science: a Popular Account of the Scientific Inventions in Daily Use.* By V. H. L. Searle. Pp. 208. (London: Ernest Benn, Ltd., 1930.) 10*s.* 6*d.* net.

(2) *This Scientific Age: Essays in Modern Thought and Achievement.* Edited by Dugald C. Jackson, Jr., and Prof. W. Paul Jones. Pp. vii + 353. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 10*s.* net.

(3) *Master Minds of Modern Science.* By T. C. Bridges and H. Hessell Tiltman. Pp. 278 + 32 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 7*s.* 6*d.* net.

(1) IT may be that, strictly speaking, there is no such thing as popular science, new or otherwise: that science can never, in the strict sense of the term, become popular, and that it is more proper to speak of the popular approach to science. There are, however, many new methods of approach to-day, pleasant paths and by-ways that can be travelled without tears, and these three books bear eloquent witness of this. They also strongly refute the idea that this type of book is apt to disparage the dignity of science or be unworthy the notice of true research workers. For it must be emphasised, in the first place, that any real or imaginary gap between men of science and the people is becoming constantly narrower in several different ways, some of which will be here briefly noted; in the second place, the writing of so-called popular books on science is often very much more difficult and requires qualities of a different and sometimes higher intellectual calibre than does the writing of a professional text-book; and in the third place, they are often of great help to the scientific worker himself.

The greatest minds have never, throughout the world's history, disdained the task of trying to reach the popular ear and heart, and the same is more than ever true to-day. Also, it was never more urgently necessary than now. It is a great and indispensable task.

The distance between the man of science and his fellow-men is rapidly decreasing, and is being replaced by a close relationship more complex, more profound, more significant every day. Science to-day enters more intimately into the daily life of the individual and its achievements meet him at every turn. As Dr. Murray very finely says in his foreword: "The phenomenal advances of science and of its industrial utilisation, its establishment in schools and colleges, and its domestication, so to speak, by wireless sets and the like, have bred in these days a scientific consciousness of a novel and formidable kind". Who can doubt the wondrous growth of this scientific consciousness among the people, and the urgent need for its stimulation and guidance in the right spirit and in the right direction, could we but discern precisely what is right? We may fairly safely claim, then, that the people have risen to a somewhat higher plane in intelligent appreciation of things scientific, and that, again quoting Dr. Murray, the "mild thrills and genteel dilettantism of the Victorian lecture-room have given place to a stronger spirit".

Then again, the gap is narrowed by a change of attitude in the man of science himself. Has he not become more human, possibly even more humble? He may even yet come to realise that he himself, like the rest of mankind, is a wholly insignificant nonentity in a universe growing ever more wonderful, mysterious, and grander as he advances in knowledge, and will be assiduous in passing on this fact to his fellows, as indeed some are already doing. It is far more rational to exert himself to the utmost to invoke the people's interest, help, and sympathies, and, like Mr. Searle, enjoy nothing better than a talk with the man in the street. True, Mr. Searle's excellent book is really intended for the intelligent boy, but in matters of science we are all boys—or girls—and this book may be read and enjoyed by intelligent youngsters up to ninety or more, whether professed men of science or not.

(2) It is a rather surprising fact, though it needs but little reflection to establish it, that much of that which now comes within the category of popular science—the new popular science—is of considerable value to the man of science himself. It will be obvious indeed, in these days of extreme specialism, how very helpful such books can be to the man who, closely and narrowly specialising in one small corner, wishes to know something of the whole world of science in general, and of literature too. Mr. Searle's book, as we have already noted, is intended primarily for the intelligent youth—that

is, in many cases, for the scientific worker in embryo—and though of the 'popular' kind, it will prove extremely stimulating to the student of any branch of science; but this, our second book under review, is of an entirely different sort, and takes a wider range. The editors may perhaps feel that it does not strictly belong to what is commonly understood as 'popular' scientific literature; yet, from what has already been said above, they will assuredly not have any ground for mortification or scent any sort of stigma or degradation.

The work, a collection of essays by eminent thinkers on both sides of the Atlantic, including H. G. Wells, Dean Inge, Sir Richard Gregory, Ray Stannard Baker, Edwin E. Slosson, will provide an intellectual treat for any man, whether scientific worker or layman, and for the specialist it will be a welcome and refreshing diversion. The editors are justified in their hope that the book will meet the needs not only of technical students for whom it is directly intended, but also will appeal to a far wider circle. Sir Richard Gregory writes on "Practical Purpose"—science justified by its works, a favourite theme, with which he deals in a masterly manner; H. G. Wells and others write on specialisation; Ernest Dimmet on the art of reading; Dean Inge on success—one of the most cheerful disquisitions in the book; M. Luckiesh on "Men, Atoms, and Stars", which makes us shrivel into nothingness; and Maurice Holland on the "Voice of Research", which makes us swell into visibility once more. As a combination of great science and great literature, the book is unique, and wonderfully exhilarating.

(3) With "Master Minds of Modern Science" we feel on surer ground, at least, as regards categories and classifications. This is unmistakably a popular science book, rather of the older than the newer type, and describes the work of leading modern scientific workers; but, though fairly comprehensive, it is evident that someone or other is bound to find gaps. It is no doubt a useful contribution to the history and biography of scientific achievement. The chapter on Luther Burbank and his work, the wizard of the garden, is of particular interest, for his work is not perhaps so well known in Great Britain as it should be, especially when we reflect that we are a nation of enthusiastic amateur gardeners. The book has some excellent illustrations, is well printed in large type, and for those who wish to gain a general idea of some of the recent achievements of science it can be thoroughly recommended. W. G. L. C.

Our Bookshelf.

Up and Down in California in 1860–1864: the Journal of William H. Brewer, Professor of Agriculture in the Sheffield Scientific School from 1864 to 1903. Edited by Francis P. Farquhar. (Published on the Foundation established in Memory of Philip Hamilton McMillan of the Class of 1894 Yale College.) Pp. xxx + 601 + 32 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1930.) 27*s.* net.

THE author was the well-known professor of agriculture in the Sheffield Science School of Yale, and sometime president of the National Academy of Sciences. In 1860, as a young man, he joined J. D. Whitney as principal assistant in the new Geological Survey of California, which it was hoped would advise as to the future development of the mining industry, then in dire distress. A second part of the work was to report on the plants and animals, and to Brewer was assigned the former. Whitney, with a love of thoroughness, made it primarily into a topographical survey, upon which the geology could be charted. His action here undoubtedly trained the men and set the standard on which the whole United States was mapped. Brewer led the first field party, and his letters now published show him directing and carrying out every class of work, except botany. This he continued to do until 1865, the survey being continued to 1873, dying itself but giving birth to the Federal Geological Survey Department in 1879.

Brewer was a voluminous letter-writer, and he numbered his letters serially, as he did his plants. He zigzagged across California from south to north, and he always wrote what he saw, seldom what he heard. Consequently, we have an account here of California as it was in 1860–65. It tells of the mountains and valleys, of the mines and of the plantations, of the old Latin civilisation and of the Indian missions, of the Indians themselves and of the westerners, of the animals and of the plants. It is all simple, the life and work of a camping party and of the people they met. There are no striking adventures, no sensational discoveries, merely an account of trails and conditions in a yet unopened country. As an example may be mentioned Brewer's letter on the Yosemite Valley and its waterfall of 2600 feet, a far simpler but more compelling account than any of the numerous, often exaggerated stories of this famous canyon. The letters are a record beyond price to future historians of California; but they are too local to be of general interest, too domestic to allow scope for wider deduction or speculation. They serve their purpose in the history of the United States, and this is further served, for their editor has chosen to illustrate them by contemporary drawings and prints.

The Balancing of Engines. By Prof. W. E. Dalby. Fourth edition. Pp. xii + 321. (London: Edward Arnold and Co., 1929.) 21*s.* net.

THE necessity of balancing steam engines was first felt in connexion with locomotives, and so long ago as 1834 Bodmer patented a method

which was tried with some success about ten years later. Many horizontal marine engines were fitted with balance weights on the cranks, but balancing became of far greater importance with the introduction of fast-running engines for driving electric generators and torpedo craft, and with the construction of very large triple-expansion engines for Atlantic liners. Readers of the life of Sir Alfred Yarrow will recall his experiments on vibration made aboard the *Majestic* during a trip to America in 1890: experiments which led to his collaboration with Dr. Otto Schlick in the introduction of a design of a balanced four-cylinder engine.

Papers on balancing were read to the Institution of Naval Architects and the Institute of Marine Engineers by Schlick, Yarrow, Malloch, McFarlane Gray, and others, and it was to the former Institution Prof. Dalby read his important papers on the balancing of marine engines of 1899, 1901, and 1902. In 1901 he dealt with the balancing of locomotives, in a paper read to the Institution of Mechanical Engineers, and the following year he published the first edition of his well-known text-book. In these papers and text-book he introduced the idea of a reference plane and a schedule by means of which a draughtsman could find the balance weights for a complex system of masses about an engine crank shaft, and his methods have been used all over the world. The work of balancing locomotives has recently assumed a new importance through the experiments of the Bridge Stress Committee, and in view of this, Prof. Dalby in the fourth edition of his text-book has added a chapter dealing with the work of the Committee and at the same time has rewritten the chapter on locomotive balancing. A new chapter written for this edition, on the balancing of internal combustion engines, will be found of great use to those concerned with the design of engines for motor cars, aeroplanes, and motor ships.

Photochemistry. By Dr. D. W. G. Style. (Methuen's Monographs on Physical Subjects.) Pp. vii + 96. (London: Methuen and Co., Ltd., 1930.) 2*s.* 6*d.* net.

THE introduction of a volume on photochemistry into this well-known series of monographs on physical subjects, gives us an indication of the rapid change which has occurred in the study of the chemical action of light by the introduction of the Stark-Einstein law of photochemical equivalence in the primary light process, and of the work of Franck on the interpretation of band spectra and their significance in indicating the process of molecular dissociation. This small volume is well and clearly written and is by no means uncritical. Attention is directed first to the primary light process, and the possible subsequent reactions which the photo-excited molecule may undergo are then discussed in some detail. A little more concerning chemi-luminescence and fluorescence might well have been included in these sections. The fourth chapter is devoted to a consideration of the still debatable problems connected with the dependence of the quantum yield on temperature and wave-length, and the volume concludes with a brief summary of the experimental methods adopted in photochemistry.

Although a rather slender volume, the reviewer can subscribe to Prof. Allmand's introductory remark that the volume can be recommended with confidence to students and research workers. E. K. R.

The Statesman's Year-Book: Statistical and Historical Annual of the States of the World for the Year 1931. Edited by Dr. M. Epstein. Sixty-eighth Annual Publication, revised after Official Returns. Pp. xxxiv + 1462. (London: Macmillan and Co., Ltd., 1931.) 20*s.* net.

THE new issue of this valuable work of reference has again been thoroughly revised in the light of official statistical publications. Many annual returns for 1930 are included, and in some respects the revision is even later. Mention is made of the change of political status in Spain. The year was one of census enumeration in several countries, and new figures are included for the United States, Hungary, Norway, Switzerland, and several other countries. The introductory tables record world production of coal, oil, iron, steel, and some other commodities. An extension of these tables is one of the few improvements that it is possible to suggest. Two coloured maps show respectively the administrative divisions of Yugoslavia and the status of South American boundaries, with the areas that are still in dispute. A welcome feature of this year-book is the small bulk, which is retained from year to year.

Modern Psychotherapy. By Emanuel Miller. (Modern Treatment Series.) Pp. 131. (London: Jonathan Cape, Ltd., 1930.) 5*s.* net.

DR. MILLER is to be congratulated on a very readable and concise work. He does not unduly stress only one aspect of the subject, as so many modern writers do; but provides us with a well-balanced summary of the three main schools of psycho-analytic thought. The author takes a very sensible attitude towards the treatment of the psychoses by psycho-analysis. Although psycho-analytic theory may explain the mechanism of a great many psychotic symptoms, it does not explain their cause and certainly does not supply a useful therapy. The author wisely points out that "full understanding can only come through personal contact with cases and through sympathetic understanding of what are very real and very painful disorders". Psychological medicine is not learnt in the laboratory with the experimental psychologists; but in the infinitely more difficult school of contact with life and its problems.

The Gardener's Year. By Karel Čapek. Pp. 160. (London: George Allen and Unwin, Ltd., 1931.) 3*s.* 6*d.* net.

THIS very entertaining volume with its delightfully humorous pictures should be read by all gardeners. The text is as amusing as the illustrations, and though in no way scientific, much common sense underlies the humour to be found on every page.

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.*]

A Simple Method of Investigating Wireless Echoes of Short Delay.

ONE of the two methods most commonly used in the determination of the equivalent height of the Kennelly-Heaviside layer is that involving the measurement of the time required for a brief wireless signal to travel upwards to the reflecting region and back. This quantity is most conveniently determined by causing an emitting station to send out very short pulses of radio-frequency energy, and measuring, at a point a short distance away, the difference between the times of arrival of a particular signal pulse via the ground and via the upper atmosphere.

Various methods of producing the short pulses required have been used,[1] but in all cases a somewhat elaborate modulating device has been necessary. We

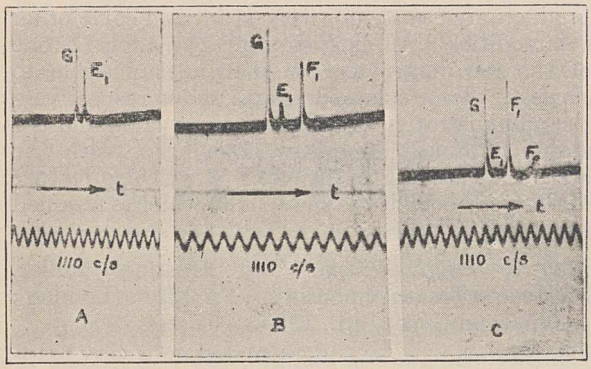


FIG. 1.

have found, however, that it is possible to dispense with any special modulating system for controlling the emission from the oscillator and still obtain pulses of satisfactory type. If the grid leak of an ordinary triode oscillator is increased to a relatively high value, the generator itself produces suitable short pulses of radio-frequency energy alternating between uniform periods of quiescence. By adjusting the grid circuit constants, both the duration of the pulse and the duration of the interval between successive pulses may be controlled. This peculiar property of a triode oscillator working with a high grid leak has been previously investigated in connexion with its use for providing a unidirectional time-scale for cathode-ray oscillography.[2]

Using an emitting station at East London College, London, E.1, working on a wave-length of 80 metres, and emitting pulses of about 0·0003 sec. in duration, spaced 0·02 sec. apart, we have been able to record photographically at King's College, London, W.C.2, 3 miles away, the reception of these pulses and their echoes from the Kennelly-Heaviside layer. A satisfactory arrangement for studying the characteristics of such echoes is to use a dual observational system consisting of a cathode-ray oscillograph and a high-speed recording oscillograph (Duddell type). The received pulses can normally be watched as a recurring image on the cathode ray oscillograph, using a linear time-base of stroke frequency coinciding with the pulse frequency, but, when it is desired to obtain a permanent and more accurate record of any particular combination of echoes, the high-speed oscillograph with a suitable time-scale calibration can immediately be switched into use.

Some specimen records, taken on June 15, between 1800 and 2000 G.M.T. are shown in the accompanying diagrams (Fig. 1). In each case the first impulse (marked G) is that received direct via the ground, the subsequent pulses being due to waves reflected by the upper atmosphere. The records are of interest in confirming results previously obtained in England using the frequency-change method of measuring equivalent heights, in that they indicate reflections from two regions at different heights in the upper atmosphere. Record (*a*), taken at 1830 G.M.T., illustrates a singly-reflected pulse E_1 from the lower of these two regions (Region E). Record (*b*), taken at 1850 G.M.T., shows a singly-reflected pulse E_1 from the lower region and a singly-reflected pulse F_1 from the upper region (Region F). Record (*c*), taken at 1910 G.M.T., shows that, as sunset (2020 G.M.T.) was approached, the singly-reflected pulse E_1 from the lower region was less intense, while that from the upper region F_2 was much more marked. A pulse F_2 indicates double reflection from the upper region.

This work is being carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

E. V. APPLETON.
G. BUILDER.

Wheatstone Laboratory,
King's College, Strand, W.C.2,
June 17.

[1] Breit and Tuve, *Phys. Rev.*, **28**, p. 554; 1926: Tuve and Dahl, *Proc. Inst. Rad. Eng.*, **16**, No. 6, p. 794; 1918: and Goubau, *Phys. Zeit.*, **31**, No. 7, p. 333; 1930.
[2] *Proc. Roy. Soc.*, A, **111**, p. 672; 1926.

The Atomic Weight of Xenon.

BY the kindness of Dr. F. W. Aston, who placed at our disposal 235 c.c. of highly purified xenon, we have been enabled to redetermine the atomic weight of this element.

Using a highly accurate micro-balance, the design of which will be published shortly, we have measured the pressures of xenon and pure oxygen at which the densities of the two gases are equal. This has been done for two different densities, corresponding to pressures of xenon of about 80 and 153 mm. The two ratios PO_2/PXe when all corrections were made were found from two series of very concordant readings to be 4·1035 and 4·1049 respectively at 18° C.

The limiting density is obtained by extrapolating these two ratios linearly to zero pressure, and is 4·1020. At such a low pressure as 80 mm. a linear extrapolation is certainly legitimate, as any curvature would be quite beyond the limit of error of our measurements. Hence the atomic weight of xenon is $4{\cdot}1020 \times 32 = 131{\cdot}26(4)$. The error of measurement does not seem to be greater than $\pm 0{\cdot}005$. This agrees remarkably well with Dr. Aston's value, $131{\cdot}27 \pm 0{\cdot}04$, derived from the measurement of the intensities of the lines of the various isotopes in the mass spectrograph.[1]

The gas supplied to us was originally very pure. It was fractionated a number of times, until further treatment of the heaviest fraction gave no increase in density.

It may be noted that after the first fractionation the difference in balancing pressure between the first and last fractions was only about one part in 900.

R. WHYTLAW-GRAY.
H. S. PATTERSON.
W. CAWOOD.

The University, Leeds,
June 16.

[1] *Proc. Roy. Soc.*, **126**, p. 511; 1930.

The Supposed Resting Stage of *Limnocnida Indica* Annandale.

THE life-history of this fresh-water medusa has been a baffling problem since its discovery twenty years ago.[1] The jelly-fish occurs in certain rivers flowing down the eastern slopes of the Western Ghats of the Bombay Presidency during definite seasons of the year (March to May). What happens to the species during the rest of the year has been more or less a mystery. From the fact that it occurs year after year in certain parts only of these rivers, it has been supposed that there is a fixed asexual hydroid stage in the life-cycle of the animal, which buds off medusæ at the commencement of the hot weather.[2] Although

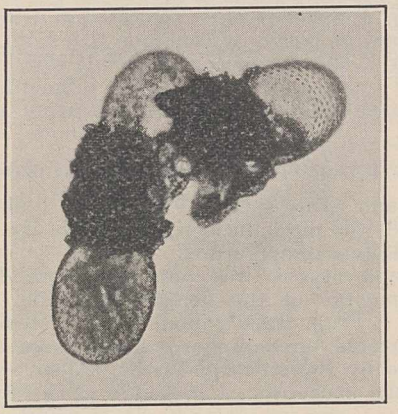


FIG. 1. ×50.

the medusæ were kept under observation in the field, and a careful search for the hydroid stage made on more than one occasion, no clue to the mystery was obtained. Nearly eight years after the discovery of the jelly-fish, the late Dr. Annandale, as a result of further observations, recorded his opinion that the species "must have a fixed or resting stage in its life-history, perhaps with the structure of a minute hydroid, or more probably encysted in a form that would not be recognisable with our present knowledge".[3]

While on a recent tour to Medha (Satara Dt., Bombay), where the species was first discovered, I found certain very minute bodies in great abundance at the bottom of a deep rock pool in the course of the Yenna River, sticking to minute particles of mineral matter (Fig. 1). They are of different sizes (0·15–0·34 mm. in diameter) and in various stages of development, from the presumably early spherical form to the fully developed capsule-like or oblong form, but the latter are much more numerous than the early or intermediate forms. They have a transparent covering of apparently chitinous matter with pits and minute pores on the surface. The cavity of the body is more or less filled with refringent spherical granules in a clear, sticky, viscous fluid. In the early spherical form there are numerous minute elastic and sticky threads issuing through the pores on the surface which serve to anchor it to particles of mineral matter. The more advanced oblong form is, however, attached by a short, stout, elastic stalk which is composed of minute threads of sticky material aggregated together with inclusions of foreign matter between them. The surface of the external covering is distinctly pitted, with traces of minute pores in each pit. In what appear to be the very advanced forms, the granular material forms a few large spherical masses clustered together like a bunch of grapes. It appears probable, from the occurrence of a few empty bodies with their external covering ruptured, that the spherical masses on completion of development within the capsule find their way out.

It will be of interest to add a chance observation which I have made on a small number of medusæ, male and female, from the Koyna River near Karad (Satara Dt., Bombay), kept in a small glass aquarium. At the end of the day of capture, a gravid female discharged its eggs, many of which settled down at the bottom of the aquarium. Examination of the eggs under the binocular microscope showed that they were attached to the bottom by means of minute elastic threads from the surface of the eggs. They were spherical in form, had a thin, transparent, apparently chitinous covering with minute pores, and were filled with a viscous fluid containing numerous refringent granules. The remarkable resemblance between the discharged eggs and the early stages of the so-called resting bodies suggests a clue to the life-history of the jelly-fish. Evidence to prove that the egg passes directly into the resting stage, and that the medusæ have their origin from the resting body without the intervention of a hydroid stage, is still incomplete. It seems probable, however, that the so-called resting bodies lie dormant during the rainy and cold seasons, and discharge their contents at the beginning of March in the form of very minute medusæ, which do not generally rise to the surface until they have attained to a comparatively advanced stage of development, and that a fixed hydroid stage is altogether omitted from the life-cycle.

These resting stages or bodies are still under observation, and a detailed account will be published in due course in the *Records of the Indian Museum*.

H. SRINIVASA RAO.

Zoological Survey of India,
Indian Museum,
Calcutta.

[1] NATURE, **87**, 1911, p. 144; and *Rec. Ind. Mus.*, **7**, 1912, p. 253.
[2] Gravely and Agharkar, *Rec. Ind. Mus.*, **7**, p. 403; 1912.
[3] *Rec. Ind. Mus.*, **16**, pp. 109-112; 1919.

Potential Temperature and the Stratosphere.

THE high coefficients of correlation between the measures of certain meteorological elements at the tropopause and the air-pressure at 9 kilometres cited by L. H. G. Dines in his letter in NATURE of May 30 may be welcomed as a reminder of the intricate but regular associations of the meteorological elements in the sequence of weather-changes which are so vexatiously irregular at the surface.

It is worth noting that, according to the data given by W. H. Dines, the 9 kilometre level is the level at which the relation of pressure to temperature along the horizontal is normally that of the dry adiabatic so that dry air might travel up-gradient or down-gradient, along the horizontal, without exciting any resilience.

I mention this because when Mr. Dines's letter refers to the enormous stability in the stratosphere on account of the isothermal condition in the vertical I am prone to think of resilience, and while allowing

that if I lift air vertically I shall find vigorous resilience, I shall find no resilience in air moving along a surface of equal potential temperature whether the motion be up-gradient or down-gradient, up-hill or down-hill. Along an isentropic surface up-hill coincides with up-gradient above 9 km., but with down-gradient below that level. Consequently, I have no difficulty in visualising an automatic flow of air up-hill or up-gradient provided the isentropic surface shows the way. That is a kind of flow which is almost unthinkable at the earth's surface but possible in the free air, and may bring the high correlations within the sphere of recognised probability.

I may take the opportunity to remark upon the great change of mental attitude towards the general atmospheric problem that is natural to the contemplation of the conditions of the free air. Any time within the past fifty years, judging by what happens at the surface and in the laboratory, I should have had no objection to offer to the suggestion that pressure-gradient means potential energy, which might be sacrificed to produce velocity of air or natural wind; and now, if I think of pressure-gradient as the deformation of an isobaric surface from the horizontal by the shifting of air-mass, as it must be, I find that the energy obtainable by the levelling of a hump must be spent in filling up a hollow, and apart from difference of entropy there is nothing available to produce kinetic energy.

In the upper air, pressure-gradient and wind-velocity automatically increase and decrease together. So pressure-gradient comes to be the mere index of the response of an air-current to the 'centrifugal force' of the earth's rotation, aided or counteracted by any local curvature of the air's path.

In this way, centres of local circulation, whether of low pressure or of high pressure, take quite a different place in the hierarchy of atmospheric influences from that which in the past century they have been supposed to occupy. The real dynamical agents of the free air are the currents which find their cartographical expression as the straight isobars running between high pressure and low pressure, riding 'side-saddle' on the gradient. The high and the low are mere incidents of the relative motion of air-currents of different directions. In the northern hemisphere wherever the passing currents keep the English rule of the road, with opposing traffic on the right, high pressure (and generally fine weather) between them is the inevitable consequence; but wherever the atmosphere adopts the continental rule of keeping the opposing traffic on the left, there a 'low' between them is equally inevitable.

The concentration of attention upon centres of high or low pressure, which are practically points of no motion, instead of upon the air-currents which cause them, is a curious aberration of dynamics. It is to some extent like concentrating attention on the point of contact of a wheel with the rail as the important point of influence in a dynamical system of that character.

There would be little to choose between the importance of the effects on either side of a travelling current if the air kept 'dry'; the real trouble begins when the juxtaposition of the currents from different directions brings the temperature of air below its point of saturation—then an enormous release of energy from its store in the water vapour of the air with little sacrifice of temperature; and in consequence all the dynamical and physical features of the cyclone and the depression.

These conclusions follow from the assumption of an automatic balance between wind-velocity and gradient, under the influence of the earth's rotation, which is not likely to be appreciated by those who fix their attention on the behaviour of air at the surface, but which deserves consideration when the causes of the high correlations of the upper air are being sought.

From this point of view the interactions of air-masses within the regions of cyclonic depressions which the Norwegian school of meteorologists has turned to such profitable use within the past twelve years are the by-play and 'asides' of the main atmospheric drama under the influence of the surface-friction. They are complicated by the release of the energy stored in water-vapour wherever condensation is set up.

NAPIER SHAW.

10 Moreton Gardens, S.W.5,
June 10.

Calculation of the Latent Heat of Fusion of Camphor from Vapour Pressure–Temperature Data.

IT was recently pointed out [1] that of the two available values, namely, 400 and 498, for the molecular depression of freezing point (K) of camphor, the larger figure seemed the more correct, because it had been subjected to an *a posteriori* verification by its discoverer Jouniaux,[2,3] and, secondly, because the smaller value had been drawn from a fusion point diagram [4] of doubtful accuracy.[5]

Briefly, Jouniaux's proof consisted in deducing the latent heat of fusion of camphor (L_f) from his own value for K and comparing the result with the figure obtained by calculation from quite different physical measurements recorded in the literature by other workers. This he accomplished as follows, using the equation $L_f = \frac{T_f}{E}(v_l - v_s)\frac{dP}{dT}$, where p is vapour pressure, v_l and v_s are specific volumes of liquid and of solid, E is the mechanical equivalent of heat, and T is the absolute temperature.

The quantity v_l was obtained from Kuhara's measurements [6] of the density of liquid camphor at 205°. From three vapour pressure–temperature measurements for camphor selected from the data published by Ramsay and Young,[7] Allen,[8] and Vanstone,[9] the constants m, n, and z in the Kirchhoff-Dupré-Rankine [10,11,12] equation: $\log_e p = \frac{m}{T} + n \log_e T + z$ were evaluated as $m = -2108{\cdot}72$, $n = 10{\cdot}1142$, and $z = -51{\cdot}1692$. Putting $T = 451{\cdot}6°$ (melting point of camphor) in this equation, the value of p at the melting point of camphor was found to be 398·7 mm.; also $\frac{dp}{dT} = (nT - m)\frac{p}{T^2}$, whence, by substitution in Clapeyron's equation,

$$L_f = \frac{p(v_l - v_s)(nT_f - m)}{ET_f} = 8{\cdot}23 \text{ cal.}$$

Now taking his previously determined value for K, Jouniaux showed that van 't Hoff's expression $K = 0{\cdot}02T^2/L_f$ yielded a value for L_f equal to 8·24 cal., and thus afforded an elegant check on the correctness of his experimental observations.

Having recently found that the molecular depression constant for camphor lies in the neighbourhood of 395 rather than 498, we have examined more closely the above "vérification *a posteriori*" (*sic*), with the following results.

Jouniaux's calculation contains several arithmetical errors. Using the data chosen by him in this connexion, the values for m, n, and z should be $-362{\cdot}8$, 14·23, and $-80{\cdot}20$ respectively, and not those given above. L_f, therefore, on revision becomes 6·33 cal., neither corresponding with the figure $K_{\text{camphor}} = 495$ nor 400, for which L_f should have been 8·24 and 10·2 respectively.

The reasons underlying these disagreements would appear to be plain. The vapour pressure–temperature measurements utilised by Jouniaux are evidently inaccurate, for, although the Kirchhoff-Dupré-Rankine equation is known to apply, with possible errors of about 3 per cent (Juliusburger [13]), to many organic substances, it becomes apparent by taking other sets of vapour pressure–temperature values from the records referred to by Jouniaux that widely different figures for m, n, and z result. The following two examples illustrate this :

		m	n	z
(1)	$T_1=273°$, $p_1=0{\cdot}06$ mm. $T_2=313°$, $p_2=0{\cdot}60$ mm. $T_3=353°$, $p_3=9{\cdot}15$ mm.	− 3026	64·85	− 355·62
(2)	$T_1=351°$, $p_1=6{\cdot}4$ mm. $T_2=404{\cdot}1$, $p_2=75{\cdot}37$ mm. $T_3=430$, $p_3=181{\cdot}5$ mm.	− 11,950	− 14·31	119·78

(1) From paper of Allen (loc. cit.).
(2) From paper of Vanstone (loc. cit.).

It is therefore obvious that these measurements are not nearly sufficiently reliable to bear the mathematical treatment that Jouniaux attempted to give them. In addition, the value he used for the density of liquid camphor was determined many years ago (Kuhara [6]) and relates not to the melting point (178°) but to 205°. The density for solid camphor at the melting point is quoted as 0·980 without references ; Beilstein gives D_0^0 1·000 ; D_5^5 0·9998 ; D_9^9 0·992.

In conclusion, it is evident that neither as a verification of his own work nor as a means of discrimination between two values of K_{camphor} so widely different as 400 and 498 are such applications of thermodynamic formulæ of much practical use.

R. J. W. LE FÈVRE.
CATHERINE G. TIDEMAN.
The Ralph Forster Laboratories of
Organic Chemistry,
University College, London.

[1] R. J. W. Le Fèvre, NATURE, **126**, 760 ; 1930.
[2] *Bull. Soc. Chim.* [4], **11**, 546, 722, 993 ; 1912.
[3] *Compt. rend.*, **154**, 1593 ; 1912.
[4] Caille, *Compt. rend.*, **148**, 1461 ; 1909.
[5] Le Fèvre and Webb, *Jour. Chem. Soc.*, May 1931.
[6] *Am. Ch. J.*, **11**. 244 ; 1889.
[7] *Phil. Trans.*, **175**, 45 ; 1884.
[8] *Jour. Chem. Soc.*, **77**, 413 ; 1910.
[9] *Jour. Chem. Soc.*, **97**, 429 ; 1910.
[10] *Annalen der Physik*, **104**, 612 ; 1858.
[11] Dupré, " Théorie mécanique de la chaleur ", p. 96.
[12] Rankine, *Phil. Mag.* [4], **31**, 200 ; 1866.
[13] *Annalen der Physik*, **3**, 318 ; 1900.

Prof. Otto Wallach.

As a former student of Prof. Otto Wallach, I would suggest that the obituary notice in NATURE of April 18 scarcely does justice to the immense services which this distinguished investigator rendered to organic chemistry.

Prior to 1880 the utmost confusion existed with regard to the nature of most of the substances contained in essential oils, considerable doubt existed as to the homogeneity of these ' compounds ', and very few determinations of structure or synthesis had been carried out. Wallach's pioneer work, commenced in 1884, quickly produced important results, and in a few years the original chaos gave place to an orderly and greatly simplified arrangement. The distinguishing characteristics of pinene, camphene, limonene, terpinolene, terpinene, and phellandrene were clearly established, and gradually a light was thrown on the inter-relations of most terpene derivatives.

Although other workers, notably Armstrong, von Baeyer, Perkin, Semmler, Tiemann, Tilden, and Wagner have made many noteworthy contributions to this branch of chemistry, its present condition must be regarded as largely due to Wallach. It is interesting, however, that in the first few pages of his book, " Terpene und Campher ", he refers to the valuable work of many of these chemists, including that of Armstrong.

It is gratifying to remember that in 1909 Wallach was awarded the honorary doctorate of science of the University of Manchester. At that time W. H. Perkin, junr., was himself directing a flourishing school of terpene research there, and it is probably not inaccurate to regard Wallach's doctorate as a personal compliment paid by one distinguished chemist to another. Some years later an important communication on stereochemistry was published simultaneously in *Liebig's Annalen* and the *Journal of the Chemical Society* under the joint names of Perkin, Pope, and Wallach. A survey of Wallach's work may, however, be left to the memorial lecture shortly to be delivered before the Chemical Society, and to the exhaustive review of the man and his work which will doubtless be published in the *Berichte* by his German colleagues.

Wallach's students will recall the rather short, spare figure of the Herr Geheimrath, his thin grey hair and beard, his keen eyes and intent look as he passed down the centre of the laboratory to his private room, holding with almost painful care some specimen just obtained from one of his students. They will remember his optimistic " Geht sehr gut ", even when they themselves were by no means satisfied with the progress of the ' Arbeit ', or—when a viscous oil persistently refused to solidify—" Immer noch nicht fest ? Ruhig bis morgen stehen lassen."

The Geheimrath was always pleased when English students came to work with him, he greatly valued his honorary fellowship of the Chemical Society, and he was frankly pleased at his re-election about two years ago. Throughout his tenure of the chair of chemistry in Göttingen, Wallach lived in the old house adjoining the laboratory in Hospitalstrasse with the name ' Friedrich Wöhler ' in letters of gold over the door. He did not understand how a professor could wish to live further from his work than this. There in the large room upstairs was kept his fine collection of water-colours in which he greatly delighted. In 1924 it was my privilege to call upon Wallach, then in the eighth year of his retirement (he retained a room in the laboratory by the courtesy of Prof. Windaus, and long after his eightieth birthday he continued to work there). That was the first visit he had received from an English chemist since 1914, and he did not attempt to disguise the pleasure it gave him, and I am happy to think that several letters have passed between us in the last years of his life.

Wallach was almost the last of the line of great German chemists—Hofmann, Kekule, Victor Meyer, von Baeyer, Fischer, Wislicenus, Hantzsch—who through rigorous discipline and with infinite patience and diligence built up the structure of modern organic chemistry, and his passing marks the close of a romantic chapter of chemical history.

Many chemists in Great Britain who worked with one or other of these giants will remember them with gratitude and admiration. They will recall what they owe to their fellow students, to the many admirable features of German university life, and to the knowledge gained and the friendships formed in the mountains and forests of the Harz or Thüringen or South Germany.

" Nie kehrst du wieder gold'ne Zeit, so frei und ungebunden."

FREDERICK CHALLENGER.
The University, Leeds,
June 1.

Pliny's Water-Mill.

IN connexion with the letter on "Pliny's Water-Mill" in NATURE of June 13, the accompanying photograph (Fig. 1), taken by me at Ching-chong-do, in Korea, in September 1899, may possibly be of interest. It represents a water-actuated 'pestle and mortar' commonly used at that time in the hill country of Korea for hulling rice.

The apparatus consists of a beam, generally the rough trunk of a tree, about fourteen feet long, to one end of which is attached a wooden box capable of holding water, and to the other end a piece of tree trunk about two to three feet long, fixed at right

FIG. 1.—Water-actuated pestle for hulling rice, at Ching-chong-do, Korea. The bucket is shown in the act of spilling its water.

angles to the beam. This last forms the 'pestle'. The rice to be treated is in a wooden or stone 'mortar' beneath it.

The main beam with its appurtenances is balanced on a trestle so that it is free to move up or down like a 'see-saw'.

When the box has filled itself with water from the continuous supply furnished through the wooden trough shown above it in the photograph, the pestle at the other end rises above the mortar, and immediately the tipped box empties its water, causing the pestle to drop with a powerful blow on the rice in the mortar. The box automatically rises to the filling position again, and the sequence is repeated indefinitely. The photograph shows the box in the act of tipping and spilling its water.

The straw-covered hut in the left background of the photograph contains most of the beam, with the pestle and mortar. Its interior was too dark to photograph.

H. GLENDINNING.

Glenalmond,
St. Albans, Herts,
June 15.

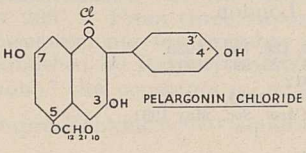
MR. H. P. VOWLES'S account in NATURE of June 13, p. 889, of the Kashgar water-mill is a great help towards the understanding of a hard passage, the difficulty of which is much increased by corruption of Pliny's text. For one false reading Mr. Vowles's *undershot* water-wheel suggests at once the necessary emendation; Rotis etiam quas aqua verset *obiter* et molat: for *obiter*, hitherto unintelligible, read *subter*. I suggest also that in the preceding phrase *ruido pilo* does not at all mean a *roughened* pestle, but is equivalent to *ruente pilo*, and means a *falling* pestle, or drop-hammer—precisely what the sense requires. We may then translate: "In Italy, falling pestles, or drop-hammers, are mostly used; and the grinding is moreover carried on by means of wheels, turned by a stream *flowing underneath*". *Pilum Graecum*, which occurs in a Plautine fragment, "quasi tolleno aut pilum Græcum reciproces", seems to have been the technical name for the pair of alternate hammers, working precisely as in the Kashgar mill.

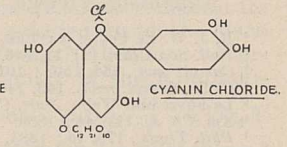
A more curious error lurks in the preceding clause. The pestle, Pliny tells us, is armed with teeth: so that unless the miller keeps a sharp look-out while he is grinding (*nisi intenti pisant*), the grain will be cut or chipped (*concidantur grana*), and the iron-work smashed to bits (*ferrumque frangatur*)! It would surely need rough handling to do so. Now the grain in question was *far*, or spelt; and we know that our miller was not grinding it to flour or meal, but merely cleaning or husking it for groats; and he had to work carefully and use a light hand lest the grain be chipped or broken, and—*ne farreum frangatur*—lest his *groats* be spoiled.

D. W. T.

The Chemical Effect of a Mendelian Factor for Flower Colour.

IN 1914, Willstätter isolated the anthocyanin pelargonin from the flowers of the scarlet *Pelargonium zonale*, and stated that a certain violet-red variety contained cyanin, with a trace of pelargonin. Recently, Robinson and his collaborators have shown that in both these diglucosidal pigments the sugar residue is probably attached at position 5 on the anthocyanidin molecule. If this is so, the only structural difference between these two pigments is the extra hydroxyl group possessed by cyanin at position 3′.





These anthocyanins can easily be distinguished by means of the distinct colour reactions given by their crude dilute hydrochloric acid extracts on addition of excess sodium carbonate solution. Scarlet-red solutions of pelargonin should give an intense violet-red, whilst the cherry-red ones of cyanin turn a pure blue. Extracts containing both pigments give intermediate colours. With the pale-coloured flowers, owing to a higher proportion of flavone pigment in the crude extracts, a green colour may be obtained which masks the true reaction and necessitates a preliminary purification. The presence of even small amounts of pelargonin can also be detected by the characteristic fluorescence given by this pigment when in acid-alcoholic solution.

The genetical basis of the formation of these two pigments is being investigated. The rose-pink variety 'Constance', on selfing by Miss Cranfield, of the John Innes Horticultural Institution, gave seventeen plants resembling the parent and three salmon-pinks, the latter colour being clearly recessive.

On testing, the rose-pink flowers were found to contain cyanin, a slight trace of pelargonin, and an appreciable amount of flavone, while the salmon-pinks contained only pelargonin with a trace of flavone.

The effect of the factor which converts salmon into rose is, therefore, to substitute cyanin almost

completely for pelargonin, the difference being that of a single oxygen atom.

In certain cases in animals a dominant colour factor has been shown to cause the production of a definite oxidising enzyme, and in this case it is not inconceivable that the factor with which we are dealing is in some way concerned in the oxidative processes of the plant.

The close connexion between these two anthocyanins in the *Pelargonium* species is further demonstrated by cases of sporting from one pigment to the other.

It is interesting to note that these pigments are also found side by side in certain varieties of *Dahlia variabilis*, and that the purple-red aster contains both callistephin and asterin, the 3-monoglucosides of pelargonidin and cyanidin respectively.

No Mendelian factor has yet come to light which effects a change in the identity of the anthocyanin pigment by means of an alteration in the nature or position of the glucosidal residue, instead of in the superficial structure of the aglucone, and it is the purpose of this note to invite further evidence as to whether this latter alternative may be the general rule.

R. SCOTT MONCRIEFF.

Sir William Dunn School of Biochemistry,
Cambridge.

Diamagnetism of Liquid Mixtures.

TREW and Spencer [1] have recently reported some very surprising results regarding the magnetic susceptibilities of organic liquid mixtures. They find large deviations from the additive law for many pairs of liquids, and in some cases, for example, mixtures of acetone and chloroform, they even claim to find the mixtures to be paramagnetic over a certain range of composition.

During the past year I have been engaged in the investigation of magnetic susceptibilities of liquid mixtures, and have developed for the purpose a modification of the Quincke method of capillary ascension which has proved very convenient and accurate in practice. Using dark-ground illumination, the alterations produced by a strong magnetic field in the level of the liquids contained in two tubes placed side by side between the poles of an electromagnet are photographed under high magnification on the same plate. One of the tubes contains benzene, which serves as a standard of comparison, and the other contains the liquid mixture under investigation. The plates when measured give results which are reproducible to within one part in a thousand.

The results obtained by me do not confirm the work of Trew and Spencer. For example, with mixtures of benzene and carbon tetrachloride, for which they report large deviations from the additive relation, I find that the graph connecting susceptibility with composition is a perfect straight line. In the case of mixtures of acetone and chloroform, I find that there is a definite departure from the additive law, which is most pronounced at the concentration at which the density of the mixture shows the largest abnormality. But the deviation is very small, being nowhere greater than three per cent of the observed value, and is incomparably smaller than that reported by Trew and Spencer.

From a theoretical point of view, there is reason to expect that molecular association in liquids may influence diamagnetic behaviour to a slight extent; but the results of Trew and Spencer seem wholly outside the range of theoretical possibility. It will be noticed that the susceptibilities as measured by them for the pure liquids show large deviations from the accepted values.

S. P. RANGANADHAM.

210 Bow Bazar Street,
Calcutta, India,
May 16.

[1] *Proc. Roy. Soc.*, **131**, 209; 1931.

A Simplified Lecture Demonstration of the Thomson Effect.

ELEMENTARY theory represents the Thomson effect as an absorption of heat by a current traversing a temperature gradient in one direction, and an evolution of heat in the other direction. In other words, when a current passes over a temperature peak, the originally symmetrical temperature distribution becomes asymmetrical, one side becoming steeper than the other.

The converse effect, the production of a potential difference by an asymmetrical temperature distribution, is easily demonstrable. Connect a piece of steel wire across the terminals of a sensitive galvanometer and heat to redness any part of the wire by means of a bunsen flame. So long as the flame is kept steady there is nothing unusual; but move the flame slowly in one direction along the wire, and the galvanometer gives a decided deflection, which is reversed on reversing the direction of motion of the flame. The order of the effect is several microvolts, and can also be shown on a potentiometer. Nickel wires also give good results, though copper, of course, conducts too highly.

Apparently the motion of the flame produces an asymmetry of the temperature in the wire, a steep gradient where the flame approaches, and a slow gradient behind the flame. According to modern statistical theory,[1] the Thomson potential is produced by a temperature gradient, not by a temperature difference; thus, although in this circuit the temperature differences may balance out, there is a greater gradient on one side than the other, and on the balance a potential difference remains.

The phenomenon is very much more convenient for demonstration in a lecture than is the more usual method, where the heat absorbed by passing a current along a steep temperature gradient is detected. In fact, the whole thing is so simple that I doubt very much whether it has not been noticed before, even though there seems nothing about it in the literature of the subject.

WILLIAM BAND.

Physics Department, Yenching University,
Peking, China.

[1] Sommerfeld and Frank, "Reviews of Modern Physics", Jan. 1931.

Plankton Changes on the Coast of Ecuador.

MR. G. SHEPHERD directs attention in NATURE of April 25 to the masses of yellowish brown plankton matter seen off the coast of Ecuador. Some years ago the Chilian coast experienced a similar visitation, with much resulting trouble to locomotive boilers and condensing plant. I had some of the water with the brown contents sent home and forwarded for examination to the Marine Biological Laboratory at Plymouth, where it was investigated and the results were kindly communicated to me.

A diatom *Grammatophora* (probably *Maina*) was superabundant and was the chief cause of the trouble. Other diatoms, *Lyomphora* (sp.) and *Thalassiosira* (sp.), were also common. *Infusorians*, *Ceratium*, *Peridinium*, and *Pyzophacus* were frequent.

DAVID WILSON-BARKER.

Some Notable Women of Science.

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

A CENTURY ago, on June 27, 1831, the eminent French woman mathematician, Sophie Germain, died in Paris at the age of fifty-five years, and a few days later was buried in the Père Lachaise cemetery. Her great women contemporaries were Mary Somerville (1780–1872) and Caroline Herschel (1750–1848), to whose names might be added, perhaps, that of Mrs. Marcet (1769–1858), whose "Conversations on Chemistry" was the means of awaking the interest of Faraday in science. Of the careers of Caroline Herschel, the devoted assistant of Sir William Herschel, and of Mrs. Somerville, whose "Mechanism of the Heavens" and "The Connexion of the Physical Sciences" gave her a world-wide reputation, everyone has heard, but Sophie Germain's story is little known. Yet she and Mrs. Somerville had much in common, and their minds were cast in the same mould. When Mary Somerville, amidst the duties of her London home, was finding time to study the works of Lacroix, Biot, Euler, and Laplace, Sophie Germain was corresponding with Lagrange and Gauss, investigating the motion of the sand on Chladni's vibrating plates, and writing memoirs which gained for her the respect and admiration of both mathematicians and physicists. Her place in history is that of the foremost of all French women of science.

Mary Somerville, Caroline Herschel, and Sophie Germain were not, however, the first women in modern times to devote themselves to scientific studies. Even in the seventeenth century, and amidst the disasters and miseries of the Thirty Years' War, we hear of the German astronomer Maria Cunitz, with the assistance of her husband, compiling new astronomical tables, which, after much delay, were published at Frankfort in 1654. Maria Cunitz died in 1664. To the seventeenth century also belongs the work of Jeanne Dumée, the French authoress of an unpublished memoir on the views of Copernicus, and of Elizabeth Koopmann, the wife of Hevelius, the celebrated astronomer of Dantzig. Hevelius died in 1687, but for ten years his wife had been his ablest assistant, and after his death she published the two works, "Prodomus astronomiæ" and "Uranographia, seu firmamentum Sobescianum". Another German astronomer of the seventeenth century, George Eimmart, found in his daughter, Marie Claire, a valuable co-worker, and for him she made some hundreds of drawings of sunspots, comets, and eclipses.

Among the women of science of the eighteenth century, one name, that of the Italian mathematician, Maria Gaetana Agnesi (1718–1799), stands out clearly. When only eleven years of age she knew eight languages, and in her twentieth year she published a collection of ninety-one theses she had previously defended. Her "Instituzioni Analitiche", published in 1748, long continued a valued text-book on the calculus, and is regarded as the first important mathematical work by a woman. This work had been preceded in 1740 by the "Institutions de physique" of the remarkable Frenchwoman, Gabrielle-Émilie Chastelet (1706–1749), the friend of Voltaire, and to her we also owe a translation into French of the "Principia" of Newton. This was not published until after her death. While the names of these two distinguished women belong to the history of mathematics, those of Margarete Winckelmann (1670–1720), the wife of Gottfried Kirch, and of Nicole-Reine Étable de la Brière (1723–1788), the wife of Jean André Lepaute, belong to astronomy. Madame Kirch, the wife of one astronomer and the mother of another, while at Berlin discovered a comet and made observations on the Aurora Borealis, and, after she became a widow, she published in 1712 a paper on the approaching conjunction of Jupiter and Saturn. Madame Lepaute from an early age had displayed a taste for science, and when at the age of twenty-five years she married the celebrated horologist she at once became his collaborator. She was also the friend of Clairaut and Lalande, and assisted them in the calculations on Halley's comet. Her own observations are contained in the "Connaissance des temps", 1759–1774. The last years of her life were devoted to her husband, who was struck down with sickness, and she died at Saint Cloud a few months before him. Another woman of science of the eighteenth century was Dorothea Erxleben (1715–1762), who in 1742 published a work on the cultivation of science by women, and in 1754 was made a doctor by the University of Halle.

Though to-day women are found working at every branch of science, it has been mainly in the realm of astronomy they have hitherto done their most notable work. Following in the footsteps of Mary Somerville and Caroline Herschel, during the nineteenth century a succession of women made their mark either as observers or as writers on astronomy. Maria Mitchell (1818–1889) was long the professor of astronomy and director of the observatory at Vassar College in the United States. She was provided by the women of America with a large equatorial, and the observatory at Nantucket, now under the direction of Miss Margaret Harwood, was erected in her honour. Two other American women, Anna Winlock, who died in 1904, and Mrs. Williamina Fleming (1857–1911), were connected with Harvard University. Especially important were the writings of Miss Agnes Mary Clerke, who was born in County Cork in 1842 and died in London in 1907. Her sound judgment and her wide acquaintance with astronomical literature made her "History of Astronomy during the 19th Century" a most valuable book of reference. This work first appeared in 1885, and was followed by her "System of the Stars", 1890, and "Problems in Astrophysics", 1903. Her most eminent woman contemporary in England was Margaret Murray, who in 1875 married Sir William

Huggins. Like Caroline Herschel, Mary Somerville, Anne Sheepshanks, Miss Clerke, and Mrs. Fleming, Lady Huggins enjoyed the distinction of being elected an honorary member of the Royal Astronomical Society.

In other branches of science, mention may be made of the Russian mathematician, Sophie Kovalevsky (1850–1891), who studied under Weierstrass at Berlin, and in 1884 was made professor of higher mathematics in the University of Stockholm; Mrs. Ayrton, the first woman member of the Institution of Electrical Engineers, and who was proposed for admission into the Royal Society; Marie Sklodowska, better known as Madame Curie, famous for all time as the discoverer of radium; and Dorothea Klumpke, who in 1893 was the first woman to obtain the doctor's degree in the mathematical sciences at the Sorbonne. Her thesis was a study of the rings of Saturn. It was when granting her the degree that M. Darboux said that her work gave her a place beside Maria Agnesi, Sophie Kovalevsky, and Sophie Germain. To this short sketch of some women of science other names might be added, but from what has been said it will be seen that France, England, Switzerland, Russia, Italy, Germany, and America are all represented, showing that the women of science, like science itself, have been confined to no one country or age.

Diet and the Teeth.*

AS a result of numerous experiments, Mrs. Mellanby has shown that there is an intimate relationship between the structure of the teeth in dogs and the composition of the diet, more especially its vitamin D content (see NATURE, vol. 125, p. 604; 1930). In further work she has now demonstrated a relation between diet and the structure of the teeth in rabbits and rats, as well as one between diet and certain forms of dental disease in dogs and other animals.

Defects of structure similar to those observed in the teeth of imperfectly fed dogs are common in other animals and have been found in horses, monkeys, rabbits, and ferrets. A common defect is the presence of interglobular spaces in the dentine: in fact, these spaces are so common that it is only their absence from teeth with smooth white enamel and their presence in large numbers in obviously imperfectly calcified teeth that has enabled one to say that they are abnormal structures and that their presence in a tooth otherwise well calcified indicates a certain degree of imperfect development or hypoplasia.

The dentition of rabbits and rats differs considerably from that of the dog: in the former, the permanent dentition shows continuous growth throughout life; in the latter, there is no temporary dentition, and the incisors grow from persistent pulps as in the rabbit, but the molars cease growing after eruption, as in dogs. Young rabbits, about eight weeks old, were used for the experiments: they were placed on a diet containing four parts of oats to one part of bran with 1·5 per cent calcium carbonate; 6 c.c. decitrated lemon juice were also given daily. Without the latter, the animals developed scurvy, and without the calcium carbonate, good growth and health were not maintained. The condition of the teeth on this basal diet was worse than when the calcium carbonate was omitted, since growth was better. Except when vegetables were included, it was necessary to supply water also.

The defects produced by this diet were as follows: the enamel was thin and irregular and stained deeply with carmine; the dentine was thin and easily stained and contained many interglobular spaces; the odontogenetic zone was wide and irregular: the jawbone was poorly calcified, consisting largely of osteoid tissue or osteoporotic bone.

The addition to the diet of materials rich in vitamin D, such as cod liver oil, egg yolk, and irradiated ergosterol, induced good calcification of the teeth: the two former, however, were not well-borne, death following after 7-8 weeks. Smaller doses of cod liver oil, for example, 0·5 c.c. instead of 1-2 c.c. daily, with a supplement of 20 gm. or more of cabbage, markedly improved general health and growth, and calcification was excellent. Vegetables alone exerted only a small calcifying effect, although improving general health: dandelion and clover were fairly effective, cabbage had little influence unless fed in large quantities, the allowance of oats and bran being at the same time reduced: summer but not winter grass, was comparable to cabbage. Swede-turnip, carrot, potato, and white turnip had little or no calcifying power. As might be expected, irradiation of the animals with the mercury vapour lamp also improved the structure of the teeth.

The amount of calcium and phosphorus in the diet and the calcium/phosphorus ratio are only of importance when the vitamin D intake is low. In the basal diet, the ratio is 1 : 0·81 and the actual percentages of these elements relatively high. It is of interest to note that rats fed on similar quantities of calcium and phosphorus have normally calcified bones. When the calcium carbonate was replaced by phosphate the rabbits grew as well, but the calcification was much improved.

The experiments on rats indicated that the defects of structure caused by a deficient intake of vitamin D were very similar to those found in rabbits, and that supplying this factor in the diet resulted in the development of perfect teeth.

Although it has not been found possible to produce caries satisfactorily in the teeth of experimental animals, it has been shown that the development of the periodontal tissues in dogs and their subsequent liability to disease can be controlled by the diet. On a perfect diet the gingival region of the jaw is comparatively thin: the subgingival epithelium is

* Medical Research Council. Special Report Series, No. 153: Diet and the Teeth: an Experimental Study. Part 2: A. Diet and Dental Disease; B. Diet and Dental Structure in Mammals other than the Dog. By May Mellanby. Pp. 94+28 plates. (London: H.M. Stationery Office, 1931.) 2s. 6d. net.

thin and regular and the corium is composed of connective tissue only. The alveolar bone is compact. On a diet deficient in vitamins A and D the gingival region is thick, the epithelium is hypertrophied and finger-like processes extend down into the corium, in which varying degrees of cell infiltration are present: the alveolar bone is poorly calcified and consists in part of osteoid tissue. Experiments proved conclusively that, whereas vitamin D controls the calcification of the jawbone, vitamin A is responsible for the perfect development of the soft tissues. The gingival epithelium is thus comparable to epithelia in other regions which are abnormally developed in the absence of vitamin A. The distinction between the effects of the two vitamins was clearly seen when vitamin A was supplied to one animal as mammalian liver oil (which contains no vitamin D) and vitamin D to its litter mate as irradiated ergosterol.

Periodontal disease does not develop when the animals are fed on a diet containing abundant fat soluble vitamins, even though it is soft and pappy throughout life. For prevention it is essential that the puppy be fed on a good diet for the first months after weaning: if the intake of vitamins A and D is low at this period, a certain amount of disease almost invariably develops even although the diet is good for the rest of life. When the tissues are properly developed owing to an adequate vitamin intake, very considerable resistance to disease is shown in later life even though the diet is incomplete for long periods. After the disease has once appeared, further progress can be arrested by administration of large amounts of vitamins A and D, but a complete cure was not observed. It may be concluded that diet acts primarily by controlling the developmental structure of the periodontal tissues and not by any direct or indirect effects concerned with bacterial decomposition in the mouth. Prevention appears to be all-important: once the tissues have developed abnormally, prevention of disease becomes extremely difficult.

Caries has been observed only occasionally in the teeth of dogs, rabbits, rats, and monkeys, and attempts at its experimental production have usually failed. Even when micro-organisms were fed for a long period, they were rarely found in the teeth. In rabbits, however, softening of the exposed dentine on the occlusional surface of the molars was fairly frequent, especially when the animal had been fed on a defective diet, and organisms were found in the dentinal tubules in the majority of such teeth.

When an erupted tooth is attacked by disease or suffers injury, it reacts by the production of secondary dentine. Mrs. Mellanby has shown that the structure of this new dentine, both in dogs and rats, depends on the amount of vitamin D in the diet, in the same way as that of the primary dentine. The reaction only occurs in a living tooth. As secondary dentine was not always found when the teeth were worn down by natural attrition, its production was stimulated artificially by filing the teeth and extracting them after this treatment had been carried out for six weeks. It was found that perfect dentine was laid down when there was abundant vitamin D in the diet, that oatmeal interfered with the action of the vitamin, and that when the diet contained little, little or no secondary dentine, or dentine with many interglobular spaces, was produced.

This experimental study has indicated certain lines of investigation in the problem of the arrest and prevention of caries in human beings; the conclusions reached will be described in Part 3 of this series.

Magnetographs obtained by Amundsen, 1903–1906.*

WHEN Captain Roald Amundsen started his voyage in the *Gjoa* through the North-west Passage in 1903, his first aim was the accomplishment of this great feat of exploration, and his second was the investigation of the magnetic conditions at and near the magnetic pole. After his return from these successful enterprises, he published an account of his voyage, "The North-west Passage", in 1907, but his scientific material for a long time lay stored in the Historical Museum, pending its publication by a board of editors. State grants were made at various intervals between 1908 and 1923 towards the preparation and publication of the results, and the preparation of the terrestrial magnetic data was finished in 1923; at that time further funds for the publication became difficult to obtain, but by restricting the scale of the work the funds were finally obtained for publication by the Geophysical Commission of the Norwegian Academy of Science at Oslo in its regular volumes. Part 1 is to deal with astronomy and meteorology, and Parts 2 and 3 with terrestrial magnetism. The first to appear is Part 3, which consists of a reproduction of all the magnetographs obtained by the expedition, with only sufficient text (17 pages) to explain their nature. It is "assumed that in some way or another funds will be obtained for the publication of Parts 1 and 2"—an assumption which geophysicists will earnestly hope to see confirmed.

Amundsen occupied Gjoahavn on King William's Land (68° 37′ N., 95° 53′ W.) from Sept. 12, 1903, to Aug. 13, 1905, and King Point on the coast of Alaska (69° 6′ N., 138° 8′ W.) from Sept. 3, 1905, to July 11, 1906. At Gjoahavn the variometer house was constructed out of the packing-cases of the expedition (specially prepared free from iron for this purpose) and the instruments were set up by Oct. 31, 1903, and continued working until June 1, 1905; at King Point the dates were Oct. 17, 1905, to Mar. 31, 1906, the variometer house there being constructed of drift timber. The houses at both places were partly dug into the ground, and covered over with sand; even so, the temperature inside them underwent great changes, at Gjoahavn from

* Geofysiske Publikasjoner, vol. 8, pp. 17+191 plates. (Oslo, 1930.) 20.00 kr.

5° C. in summer to −26° C. in winter, with a daily range of about 1° C.; at King Point they were still greater, the daily range being 6° or 7° C. Unfortunately, the registering instruments were not well compensated for temperature.

The data have been prepared under the editorship of Nils Russeltvedt and Aage Graarud, and the difficulty of their task must have been very considerable, in inferring temperature coefficients, base line values (frequently altered), and scale values. In stating the latter, they do not indicate in what unit the ordinates are measured, but it appears to be 1 mm. The scale values (per mm.) of the three instruments, which were of Eschenhagen pattern, all registering on one drum, were for declination (in force units) 17γ, in horizontal force 12γ, and for vertical force 5γ until about September 1904, and thereafter 22γ; at King Point the corresponding values were about 20γ, 12γ, and 23γ. In the vertical force record, 1° change of temperature made an apparent change of 140γ in the force. The normal time scale was 20 mm. per hour; in quick runs it was twelve times as great.

The magnetographs show records and base lines for the three magnetic elements and for the temperature. Before reproduction the times were marked on the hour lines automatically registered across the sheets, the date was written on, and the various traces were indicated by letters at one end. It is to be regretted that on sheets which show disturbance, when some of the traces often crossed one another, the letters were not added elsewhere also; in the reproductions it is often not easy to be sure of the identity of each trace on such days, while on the originals the difficulty is likely to have been much less.

The sheets are reduced on reproduction in the ratio 3·46 to 1, so that four can be got on to a quarto page; the reproduction is very good, and the collection should be of great value to those who wish to make intercomparisons between the changes of the earth's field near the auroral zone and elsewhere. The curves indicate the presence from time to time, in the neighbourhood of these stations, of intense overhead currents, usually somewhat to the south, and sometimes flowing eastwards, at others westwards. This would suggest that both stations are within the auroral zones, and it will be of interest to learn later, from Part 1 or 2, whether auroræ usually appeared to the south.

The magnetic results of the Amundsen expedition would have been of still greater value had they coincided in time with Birkeland's magnetic and auroral expeditions of 1902–3, the results of which were published by him in 1908 and 1913. Though this was unfortunately not so, their value will enhance, and be enhanced by, Birkeland's data, and they will form an important link in the chain of evidence which will lead to the elucidation of the very difficult problems presented by magnetic disturbance.

Obituary.

Mr. C. T. Heycock, F.R.S.

THE death of Mr. Charles Thomas Heycock, on June 3, removes from among us one who had gained the affection of generations of Cambridge men and who was a pioneer in an important branch of inorganic chemistry. Heycock was the younger son of Frederick Heycock of Braunstone, Oakham, and was born on August 21, 1858; he received his early education at the Grammar Schools of Bedford and Oakham, and entered King's College, Cambridge, as an exhibitioner in 1877, taking the Natural Sciences Tripos in 1880. For many years he taught chemistry, physics, and mineralogy for the Cambridge examinations, and in 1895 he was elected to a fellowship at King's College, becoming a college lecturer and natural sciences tutor in the following year. He was elected a fellow of the Royal Society in 1895, and was awarded the Davy Medal in 1920 for his work on alloys. His original work on the metals attracted the attention of the Goldsmiths' Company, who endowed a readership in metallurgy at Cambridge; he was appointed to this office in 1908 and held it until his retirement in 1928. He was admitted to the Livery of the Goldsmiths' Company in 1909 and to the Court in 1913; he acted as Prime Warden during the year 1922–1923, and took a keen interest in the work of the Company's Assay Office.

Notwithstanding the exacting character of his work as a Cambridge coach, Heycock joined with his lifelong friend, F. H. Neville, in a comprehensive study of the metals and their alloys; this partnership, which was only dissolved by the death of Neville in 1915, led to a remarkable series of papers in which novel directions of investigation were mapped out and developed. The first of these joint papers was published in 1889 and dealt with the depression of the freezing points of metals brought about by others dissolved therein; in this and later papers it was shown that the addition of small amounts of a second metal depresses the freezing point of the first to an extent (1) directly proportionate to the weight of metal added and (2) inversely proportionate to the atomic or molecular weight of the added metal. Raoult's law for ordinary solutions was thus extended to alloys, and a method indicated for calculating the latent heat of fusion of a metal by the application to the freezing point depressions of the now well-known van't Hoff equation. At the outset, mercury thermometers were used in the temperature measurements and only alloys of low melting points could be studied; the introduction by H. L. Callendar of the platinum resistance pyrometer made it possible to extend the scope of the investigation to metals of high melting point. This was done with the assistance of Dr. E. H. Griffiths. During the carrying out of the programme thus extended, the melting points of many of the metals in the pure state were determined; later observers have confirmed the

substantial accuracy of most of the melting points given by Heycock and Neville.

The study of the melting points of dilute solutions of one metal in another led naturally to the determination of the melting points of mixtures of metals in all proportions; a technique was developed by which the results, interpreted by means of the phase rules of Willard Gibbs and Roozeboom, were supplemented by the microscopic examination and photography of polished and etched sections of the solidified alloys. The most detailed piece of work done on these lines was that on the copper-tin alloys, which formed the subject of the Bakerian Lecture before the Royal Society in 1903; the two collaborators also made a minute study of many other binary and ternary alloys. They had already shown in 1897 that X-ray photographs of thin sections of alloys could provide valuable information as to the physical state of the component metals.

The major part of Heycock and Neville's experimental work was carried out in a small laboratory in Sidney Sussex College and, owing to the many other duties which fell upon the two partners, much of it had to be done late at night and in the early hours of the morning. It may seem surprising that such a quantity of data of enduring value could be collected under such conditions: but both men were enthusiasts, both possessed an exquisite sense of technique, and both were meticulous in their striving after accuracy.

Heycock was an excellent lecturer; his whimsical mode of addressing a class sustained an interest in inorganic chemistry during a period when that subject seemed in danger of eclipse by the rapid advance of organic chemistry. He had few equals as a teacher in the laboratory; his deliberate method of working and his sarcastic denunciation of slovenliness inspired respect and awakened the spirit of emulation. Much of the work of organising and planning the numerous extensions of the University chemical laboratories during the last twenty-five years fell upon him, and he carried it out with characteristic care and thoroughness. His physical vigour found further expression in his devotion to the Volunteer movement from quite early days, and during the War he was appointed Lieutenant-Colonel of the Cambridgeshire Regiment.

In his domestic life, Heycock was thoroughly happy; his house was the meeting place of undergraduates and seniors alike, and its cheerful hospitality is a delightful remembrance to vast numbers. With his death we have lost a scientific man of the old type who would spare no pains or time in eliminating error from an experimental observation; many of us have also lost a shrewd and wise counsellor and one of the most staunch and loyal of friends.

W. J. POPE.

DR. A. T. MACCONKEY.

DR. ALFRED THEODORE MACCONKEY, who died on May 17 at the age of seventy years, was known to bacteriologists in all parts of the world as the originator of the medium which bears his name. After taking his medical degrees in 1889, he settled in practice for some years, but relinquished it in consequence of an illness, and decided to devote himself to research work in bacteriology.

MacConkey was associated for a time with Washbourn and Eyre in the laboratories of Guy's Hospital, his old school, and afterwards with Boyce in the Thompson-Yates laboratories in Liverpool. His appointment about this time as assistant bacteriologist to the Royal Commission on Sewage Disposal, the working headquarters of which were at Leeds, determined the trend of his researches during the early years of the century. The problems that called for solution fascinated him, and his interests were soon deeply engaged in the technical part of the work. During the period 1900–9, he published a number of papers, which embody his pioneer studies upon the classification of the lactose-fermenting bacteria of intestinal origin, and upon the differential criteria of this group and their significance as contaminants of water, milk, and foodstuffs.

The introduction of MacConkey's bile-salt medium put into the hands of bacteriologists a simple and effective tool for the separation of the typhoid-dysentery group of bacilli. Bile-salts had been added to media so early as 1889, and MacConkey's first experiments with them were made in 1897; in 1900 he was using bile-salt lactose agar for the purpose of isolating *B. typhosus* and *B. coli communis*. In 1902, Grünbaum and Hume suggested the addition of neutral red as a colour indicator for colonies that either do or do not ferment lactose, and MacConkey adopted this improvement in the method. He was one of the first to appreciate the importance of noting and comparing the biochemical activities of the intestinal group of bacilli with the object of defining their specific characters and their relationships. Thus, he based a useful classification of the coliform group upon the ability of its members to ferment saccharose and dulcitol.

In November 1901, MacConkey joined the staff of the Lister Institute, London, as an assistant in the bacteriological department. His transference soon afterwards to the serum department of the Institute at Elstree, then under the charge of the late Prof. George Dean, directed his energies to the solution of the problems which surround the preparation of toxins and antitoxins. In April 1906, he became the head of the department, and he remained at Elstree until his retirement in April 1926, at the age of sixty-five years. He continued the early work of his colleague, Dr. J. C. G. Ledingham, on serum concentration, and developed the technical processes for refining and concentrating antitoxic sera. There are workers in many countries who owe their practical knowledge of the subject to the information which MacConkey freely put at their disposal. In 1912 he contributed to the reports of the Plague Research Commission in India an interesting paper on the production and titration of anti-plague serum, in which he showed that the specific antitoxin can be concentrated by the usual methods, and that it is associated with the

pseudo-globulin fraction of the serum proteins. He had previously made a comparative study of the antigenic relationships of the plague bacillus and the pseudo-tubercle bacillus and was able to confirm the close kinship of these bacteria, as judged by the results of precipitin and immunity tests.

In 1912, MacConkey published a remarkable paper which indicated a seasonal change in the potency of diphtheria toxin when produced in regular weekly batches. His curves certainly seem to show a significant increase of toxicity during the winter months as compared with the level attained in the summer. Moreover, he directed attention to the close correspondence of the toxin curve with that of the prevalence of diphtheria in London and elsewhere. These observations are unique, and the present writer is disposed to believe that they are related to variations in the health and susceptibility to infection of the stock of guinea-pigs from which the test animals were drawn.

During the years of the War, MacConkey put his energies without stint into the task of enlarging and organising his department to meet the increasing demands made upon it by the army authorities for tetanus antitoxin, antidysentery serum, and antimeningococcus serum. He took a keen interest in the prophylaxis and treatment of tetanus by means of antitoxin, and he published several papers on the subject; in some of them he reviewed the observations of workers in many countries, and in others he gave an account of experimental work carried out by himself and his colleagues. He served as a member of the War Office Committee for the investigation of tetanus. In his published articles he put forward a strong plea for devoting special attention to the early signs and symptoms of tetanus, on the ground that the antitoxin is likely to influence the disease only when administered as soon as the symptoms are recognisable. The limited response to his appeal and the scanty information which came to hand disappointed him, but it is probable that he had not sufficiently appreciated the difficulty of discriminating between the premonitory subjective symptoms of tetanus and those which were attributable to sepsis and to the nervous strain from which the patients were suffering.

MacConkey, as the writer has good reason to know, was essentially a man of a kindly disposition. His sense of duty was so strong that, during the trying years of the War, he suffered from the strain to an extent which weakened his resistance and laid the foundation of a cardiac disability from which he never really recovered. G. F. P.

MR. E. TORDAY.

THE death, at the age of fifty-six years, of Emil Torday, which occurred on May 9, at his London home, removes one of the most distinguished of African ethnologists. A Hungarian, his adventurous spirit led him to the heart of the Dark Continent some thirty years ago. He there acquired a great affection for its savage native inhabitants, and by his personality inspired in them an equal affection for himself.

Deeply interested in native manners and customs, Torday made these his life's study. To this end his wonderful linguistic talents helped very considerably. He spoke seven European languages and eight of the tongues of Central Africa. His works on the ethnography of the Negro, written in collaboration with Capt. T. A. Joyce of the British Museum and published by the Belgian Government in French, "Les Bushongo" and "Peuplades de la forêt et Peuplades des prairies", are surely models to be followed by future students of native life. In lighter vein, but scarcely less informative to the general reader, is his "Causeries congolaises", published in Brussels in 1925. In English he published "On the Trail of the Bushongo" and "Camp and Tramp in African Wilds", besides contributing numerous articles and reviews on African ethnology to the *Journal of the Royal Anthropological Institute*, *Man*, and *Africa*. Only just before his death he had completed his monumental volume on "African Races" for the series of works upon descriptive sociology founded by Herbert Spencer, which was reviewed in NATURE of May 2, p. 655.

Of Torday's personal courage a word must be said. Upon one occasion he stepped in between a party of defenceless children and the warriors of a hostile tribe who had their bows already drawn to annihilate the children of their national enemies. Torday, unarmed, stepped in between the warriors and their victims, and, by his utter disregard of personal safety, saved the lives of innocents and the commencement of an inter-tribal feud which would probably have lasted to this day.

The loss of Torday, could it be made known to them, would most certainly be regretted by many tribes in Central Africa. It will as certainly be regretted by scientific workers in Europe. One who was privileged to accompany him for two years upon his last great Central African journey mourns his loss not least of all.

M. W. HILTON-SIMPSON.

MR. TORDAY'S contribution to the science of African ethnology was twofold. His publications have already been mentioned; they constitute a record of the highest importance. But he was also distinguished as a practical field-worker; and the ethnographical collections from the Belgian Congo, all carefully documented, with which he enriched the British Museum between 1907 and 1910, are of outstanding excellence. Both in quantity and quality they are unrivalled among our African collections, and it is not too much to say that the study of them is essential for anyone who would understand the high level of refinement in decorative and textile arts of which the Bantu are capable. In performing this signal service to the nation, Torday has incidentally achieved a fitting memorial to himself and his labours, which will increase in value with the passage of time. He worked for some years in an unofficial capacity at the British

Museum, arranging and labelling his own and other collections, and his deep knowledge of African matters was always placed freely at the disposal of the staff.

Mr. Torday was also one of the most active members of the Royal Anthropological Institute, attending its Council meetings regularly, helping in the improvement of the library, reading papers, and rendering invaluable and unselfish service in a variety of ways. In 1929 the Institute awarded him the Rivers Memorial Medal for anthropological work in the field. Torday was also a Chevalier of the Order of the Crown of Belgium, and by his own country he was awarded the Great Gold Medal for Literature and Science, a rare distinction.

By his death African ethnology loses one of its most brilliant, sincere, and devoted students, and his friends the privilege of a delightful and stimulating personality. H. J. BRAUNHOLTZ.

News and Views.

IT was a remark of Lord Oxford's, that the business of biography is the vivid delineation of a person, and that for its success one of its obvious conditions is that the person delineated should have the power of permanently interesting his fellow-men. Of all men of science, Faraday assuredly was such a person, his rare mental qualities, combined with a singularly refined moral nature, making him as worthy a subject for the biographer as a Pasteur or a Lister. Some of the characteristics of Faraday were admirably brought out by Dr. R. L. Mond, who on June 11 delivered the Second Spiers Memorial Lecture to the Faraday Society. Referring to the approaching celebrations of the centenary "of one of the most fruitful conceptions of the human mind", Faraday's discovery of electro-magnetic induction, he said many, well qualified, will comment on the origin of this conception, its development and application, but there is one aspect of this triumph of the human mind which deserves special consideration, namely, the study of the conditions and of their influence on the individuality which makes the conception a possibility. This naturally led Dr. Mond to refer to Faraday's early environment. One dominating influence was his association with the Sandemanian form of belief, which combines (like that of the Quakers and Unitarians) a great simplicity of mind with exemplary conduct and love and esteem for your fellow-members. Next came the influence of books; the writings of Bacon, of Dr. Watts, of articles in the Encyclopædia Britannica, and of Mrs. Marcet's book on chemistry. Faraday also found both assistance and inspiration by his association with the ardent spirits of the City Philosophical Society; and then came the turning-point in his career when he was engaged by Davy, a step which in turn led to his memorable tour on the Continent, "a high school of incomparable value".

"BUT", said Dr. Mond, "what can we learn from Faraday's career, that we can usefully apply both to the search for new knowledge, the Perfection of what we all possess, and the Perfectibility of those who are devoting themselves to this research?" This question led to the examination of Faraday's views on education. Giving evidence before the Public School Commission in 1862, Faraday said, "I do think that the study of natural science is so glorious a school for the mind that, with the laws impressed on all these things by the Creator, and the wonderful unity and stability of matter, and the forces of matter, there cannot be a better school for the education of the mind". Reverence for the beauties of Nature and the laws which control them, in Faraday was combined with a reverence for great thinkers and the truths they were unfolding. One of the problems of to-day is how to guide the footsteps of those whom we hope will emulate our great prototype, and the task often is "how to bring the great pupil to the great teacher". Modern civilisation has evolved an intellectual machine which, from heterogeneous raw materials, attempts to produce a uniform product, but we shall have to provide opportunities where the young mind can develop, untrammelled by any hard and fast system, under the ægis of a wise and kind direction, and where every suitable aid to self-development and facilities for scientific research are amply provided.

THE English Channel was crossed for the first time by a British-built glider with a British pilot, Mr. Lissant Beardmore, on June 19. The pilot, having been towed by an aeroplane to a height of about 14,000 ft. above Lympne, at 4.30 P.M. released his machine and glided in a continuously falling path, landing at St. Inglevert aerodrome just after 6 P.M. It is unfortunate that he will not be officially recognised as being the first person to glide the Channel, since he was prevented from applying to the British Gliding Association for the proper observation of his performance by the anomaly that he did not hold the most advanced of the certificates awarded to glider pilots, and was therefore not judged competent to undertake the feat. Herr Kronfeld, on a German-built machine, accomplished the same flight, in a similar manner, under official observation, on June 20. He flew from France to England, and thus becomes the holder of the official distinction. He afterwards made a return glide from Dover to St. Inglevert, being again raised to the required height by an aeroplane that had accompanied him, and qualified for the *Daily Mail* prize for the first glide across the Channel in both directions on the same day.

THE executive committee of the Committee on Intellectual Co-operation of the League of Nations at its April meeting considered a request from the Chinese Government for co-operation with the League organisations in the intellectual and scientific field. The principal suggestion related to the exchange of university professors. The Chinese Government proposed to send to Europe students, writers, philosophers, historians, and archæologists, and invited the League to organise tours in China for specialists in medical,

political and natural science, and legal questions. A request was also made for professors of geography and geology for the University of Nanking, particularly of English, Austrian, Scandinavian, or Swiss nationality, who could give instruction in English. A further request for co-operation considered at the same executive committee meeting related to the better utilisation of leisure—a problem which is assuming ever greater importance as a result both of the reduction in hours of work and of the tendency to mechanisation and specialisation of labour. The request was received from the International Labour Office, and the Committee authorised the director of the Institute to accept the offer of the International Labour Office and assist in the study of the conditions of popular arts and public libraries in various countries, their resources, and accessibility to the workers, by collecting complete information on these subjects in relation to the problem of workers' leisure as a basis for comparison, conclusions, and appropriate action.

SINCE the old days of driving sheep from the Argentine to the southern sheep stations of Patagonia, no drive can compare, for duration and extent, with the reindeer movement now in progress in Canada. In 1929, 3000 reindeer were purchased in Alaska by the Canadian Department of the Interior, and in December of that year the work of herding the animals from the west coast of Alaska to the eastern side of the Mackenzie River was begun. In the spring of 1930, the herd had reached the Hunt River in the Kotzebue Sound area, where a halt was made for the fawning season. During the summer the herd, with its 2000 fawns, remained in this region, until the second stage of the drive began late in 1930. The movement was then continued in a north-easterly direction toward the pass leading to the Colville River. It was reckoned that the second fawning season on this long trek would be passed in the delta of that river, so that probably only about 400 miles now separate the herd from its new range to the east of the Mackenzie delta. Here it is expected to arrive during the winter of 1931–32.

THE *Quarterly Bulletin* of the Imperial Bureau of Animal Genetics, vol. 2, No. 2, just issued, contains a useful summary of recent developments in fur production and reindeer breeding. Since the first fox farms were established in Prince Edward Island, this industry has grown largely in Canada, and attempts, not very successful, have been made to domesticate other species. Questions of fur production from many animals are discussed, and it is pointed out that the most important fur-bearer in the world is the rabbit, because it breeds rapidly and well in captivity and can be produced genetically in a great variety of colours. The reports of the Porsild brothers on the possibilities of reindeer breeding in Arctic Canada and the problems of reindeer husbandry are considered at some length. The Mackenzie delta and Great Bear Lake regions are found to be capable of supporting large herds, hence the reindeer movement. Experiments are already being made in crossing the reindeer with the large woodland caribou of Newfoundland. Other items in this bulletin are a list of literature on reindeer, reviews of books on fur farming and rabbit breeding, and notes on the domestication of mink. A bibliography on fur breeding will shortly be ready and obtainable from the Bureau in Edinburgh for 1*s*. One on the biology of the fleece has already been published at 2*s*. 6*d*., and another on the genetics of the rabbit is in preparation.

GERMAN oilfield developments have been prominent in the press lately, consequent on the Royal Dutch Shell Company's active interest in the operations, of which a report appeared in the *Times* of May 22. For some time past, both German and American companies have been engaged on exploratory work, but the results have scarcely justified the claims originally made as to resources, though there would seem to be evidence of petroleum occurrence over a wide area in the north-west. From a technical point of view, one of the best recent accounts of the fields is given by Von E. Krenkel in the April number of *Die Naturwissenschaften*. For all practical purposes, the chief developments have been in the Hanover region within a radius of some fifty kilometres from that city, and the features of geologic interest are the Zechstein salt bodies. This region includes the Oelheim, Hänigsen and Wietze fields among others, from which there has been a steady though not spectacular production; the prospective total for this year for the region as a whole is estimated at 200,000 tons. Unproved areas lie to the north (Oldenburg) and elsewhere in the Hanover province, already noted for the famous Limmer and Vorwohle rock-asphalt deposits. It is clear that although comparable salt-structures with those of certain other oilfields are known in this part of Germany, they are not, in the present state of our knowledge, significant of the existence of oilpools of magnitude.

A LARGE proportion of the current issue of *Africa* (vol. 4, pt. 2) is devoted to the consideration of matters of practical import. Instructions for missionaries who have opportunities for extended ethnographical observation, which have been prepared by Dr. Westermann, and suggestions for the teaching of hygiene to women, by Miss Mary Blacklock, have a grasp of the problems in their respective fields which gives them a claim to careful consideration. There are, however, two other communications which call for more than passing mention, as illustrating the principles, recently discussed by Prof. Malinowski and others in the pages of *Africa*, which bear on the value of scientific study of native institutions in relation to practical problems. It was urged that in a changing Africa neither an academic nor an antiquarian interpretation of the field of inquiry is likely to have any practical effect, but that what is needed is a study of the functioning of existing institutions as integral parts of a culture considered as a whole.

IN the first of the two communications to which we refer, Mrs. A. W. Hoernle, in considering the native conception of education in Africa, points out the

significance of age and sex in determining occupation, the function of the family as a social unit, and the place of initiation in ensuring tribal continuity of tradition through the instruction given in the initiation schools, and discusses the bearing of these factors upon the problem of educating the native in present conditions. Mr. D. S. Knak, in his study of the influence of European civilisation on African family life, deals with native marriage on similar lines, referring particularly to native as opposed to European forms in marriage and the difficult problem of polygamy. The two papers may be commended to the attention of those who are prepared to consider impartially the respective claims of the scientific student and of the 'man on the spot' with practical experience but unbacked by specialist knowledge, to speak with authority on native problems which call for solution both now and in the immediate future.

IN his presidential address to the Devonshire Association on June 23, the Bishop of Plymouth gave an admirable, but necessarily brief, survey of the history of religious houses in Devonshire. Unfortunately, Devonshire had no chronicler in its monasteries to emulate, even *longo intervallo*, Jocelin of Brakelond, and, as Dr. Masterman was constrained to admit, the actual history of most Devonshire religious houses has passed into oblivion. Yet for five centuries they played a large part in the religious and social world of Devonshire, if we may judge from the contemporary evidence of a writer whom the Bishop quoted, even though he dealt with another county. It would appear that the monks dealt paternally with their tenants, if less efficiently than the landlords who succeeded them, and it is significant that among the demands of the Cornish and Devon rebels of 1549 one was that two of the chief abbeys in each county should be re-established. At the time of their abolition, the number of religious houses in Devonshire ranked sixth among the English counties, ten being included among the greater monasteries, that is, monasteries of which the income exceeded £200 (about £3000 in modern currency). The suppression seems to have been carried out by peaceful negotiation. In nearly every case the abbot and his brethren received pensions. Of Devonian monasticism one relic remains in 'the Abbot's Way', the rough track across Dartmoor which once linked Buckfast and Plympton with Buckland and Tavistock, marked by broken crosses set up to guard the traveller from the pixies that haunt the moor.

THE advantage of short over long wave transmission for broadcasting is that it is much less affected by atmospherics and fading. In some parts of the world, for example, in Central and South America, these causes prevent reception of long wave stations sometimes for months at a time. This probably accounts for the great popularity of short wave broadcasting in America. At present, according to *World-Radio* for June 12, there are thirty-seven firms engaged in the manufacture of short wave receivers. These receivers range from the one valve to the thirteen valve set. Home-built sets are almost a thing of the past; manufacturers are now competing with one another and the prices are very reasonable. Combination receivers which allow the listener to tune in at all wavelengths between 14 and 550, the latter being the upper limit of the American broadcast band, are the most popular. At present there are twelve operating short wave broadcasting stations in the United States and a few in Canada and Mexico. All relay musical programmes and can be heard in the United States. Distant reception is also to be had from all parts of the world. The Rome station on 25·4 metres is heard best in the eastern portion of the country, and the station at Saigon, in French Indo-China, in the western section. It is noticed that the Rome station does not fade so early in the evening as stations farther north. Many new stations are being built, broadcasting on short wave-lengths only.

IT is interesting to notice that when the London United Tramways were faced with the necessity of a heavy expenditure in connexion with their tram track and vehicles, for about seventeen miles of their tramway system in Surrey they decided to adopt trolley bus working. The first trolley bus service in London started on May 16 and has given satisfaction. This type of transport is common in many towns both in Great Britain and abroad, and the number of trolley buses in operation is increasing very rapidly. In the *English Electric Journal* for June an account is given of various types of 'English Electric' trolley buses. They run smoothly and quietly, and are capable of rapid acceleration and powerful braking. When fully loaded they are capable of a speed of about thirty miles per hour on the level and eighteen miles per hour on a five per cent gradient. The maximum operating acceleration is three feet per second per second, which allows twenty miles per hour to be attained in ten seconds, in a distance of about sixty yards. In the Twickenham-Teddington route the vehicles are double-decked 56-seaters. They are fitted with an 80-horse-power 500-volt motor, and the speed control is effected by a pedal which actuates an electric controller. Three braking systems are provided, hand, rheostatic, and vacuum, the two latter being operated in succession from one pedal. Retardation can be effected at eight feet per second per second for ordinary stops, and at twelve feet per second per second for emergency stops, these rates being uniformly maintained until the vehicle comes to rest. Thus in an emergency a bus that is running at thirty miles an hour can be brought to a standstill in about eighty feet.

WHEN the last estimate for the Reichskuratorium für Wirtschaftlichkeit was passed by the Reichstag, a recommendation was put forward that in all investigations on rationalisation carried out at the public expense the human factor should receive special study. An official conference to discuss rationalisation and the human factor was held in Berlin on Feb. 27 and 28, the conference being opened by the president of the Board of Trade and a representative of the Ministry of Labour. The programme was divided

into two sections, the first, on the optimum organisation of labour, being opened by papers on recent discoveries in the field of labour psychology (Dr. Lipmann); practical investigations to ascertain the optimum organisation of labour (Dr. Ascher); and measures taken by employers to introduce the optimum organisation of labour. The discussion was unusually animated, and was guided by the Reichskuratorium by means of statements, opposing statements, and syntheses of the communal and individual points of view. The second section was concerned with vocational selection and training. The discussion in both sections indicated the divergent views held on rationalisation, and also the ease with which the gap could be bridged by eliminating misunderstandings due to differences of language and definition, and by concentrating on views common to all parties. The Reichskuratorium is following up the conference by a closer study of the special fields, and their investigation by the central organ of the German rationalisation movement should ensure that they are studied less from the personal than from an unbiased scientific point of view.

IN his address on "Industrial Administration" before the Association of Technical Institutions, Mr. A. S. Comyns Carr referred to the scant attention which industrial administration had received from the majority of those engaged in industry, in spite of its necessity in every industrial enterprise. This want the Institute of Industrial Administration is endeavouring to supply. Regarding industrial administration as the co-ordination and control of all the activities of an industrial enterprise, from the purchase of the raw material to delivery of the finished product, the Institute seeks to provide the industrial administrator or general manager with sound information on the principles which his experts should follow. The effort to establish industrial administration among the recognised professions is already leading to the recognition that management occupies a unique position in industry. That position involves responsibility not merely to the proprietors of the business but to those employed by it, and also towards the public.

THE Institute of Industrial Administration sets as its first aim the establishment of industrial management as a responsible profession. The promotion of research into the principles of management is a further main line of advance, particularly in Great Britain, where the spirit of secrecy has greatly hindered the interchange of information on management methods and principles, which is a first step towards raising the general standard of administration. Referring to the educational work of the Institute, Mr. Comyns Carr asserted the importance of teaching the principles of administration. Once these are understood, the appropriate system for meeting with a given set of conditions will easily be developed. In discussions on the need of first-class administrators for industry loose references to the importance of personality tend to obscure the need for training. Personality is not a substitute for training, and the Institute of Industrial Administration insists that management requires real qualifications and not the accidents of financial interests or family relationships.

IN view of the great development of the work of the Long Ashton Research Station of the University of Bristol, the governing body of the Station has recently formulated a new scheme of membership of the Station. This scheme provides for three classes of members, on a basis of varying rates of annual subscription to the Station, the privileges of the members in the three classes being graded according to these rates. Class A, on a subscription of £1 1*s*., allows the member to consult the staff without fee; to purchase at preferential rates any material of the nature of buds, grafts, cuttings, or plants of any varieties of fruit; to submit, without charge for examination, not more than six samples of cider and perry annually; and to have priority over non-subscribers in respect of any advisory services. Class B, entailing a subscription of £2 2*s*., includes all the privileges of Class A, also to receive one copy of reprints of papers published by the staff, and to participate in the seedling distribution scheme, which has been adopted after consultation with the Ministry of Agriculture and Fisheries and the Horticultural Trades' Association. Class C, for which the subscription is £5 5*s*., differs from Class B only in the seedling distribution scheme.

THE original air maps of the United States, which were first published a few years ago, were known as strip maps, because, individually or in series, they covered strips of territory 80 miles wide between one air port and another. Of the 42 sheets planned, 22 are now completed and 7 are in hand. The Annual Report of the United States Coast and Geodetic Survey for the year ending June 30, 1930, announces a new project in air maps. Since 80 per cent of flying is now over routes which do not follow the airways provided with strip maps, it has become necessary to have a map covering the whole country. This will be provided in 92 sheets, excluding Alaska. It will be based on the United States topographic map, which, however, is available for only about 40 per cent of the country. The Report announces also that financial resources have now been provided for the completion of the topographic map in some twelve years' time. This will allow the air map to follow rapidly.

AT a meeting of the Royal Society of Arts on May 6, the Earl of Crawford and Balcarres made a strong plea for the retention of the natural and artificial beauties of England, in an address upon "The Preservation of the Country-side". The appositeness of the speaker's remarks and the need for his criticism of many tendencies of present-day development were emphasised by a series of lantern pictures of England spoilt and unspoilt. The text of the address was "orderliness, tidiness, and discipline", and the illustrations showed how much could be accomplished by the application of these qualities, none of which was incompatible with the picturesque and the inspiring. Amongst the special points dealt with were the litter nuisance, the choice of building materials, ribbon

development of building (a serious and very important issue), and the value of trees. The address and the comments made upon it by various speakers, including Mr. Cass Gilbert, the architect of the Woolworth Building in New York, appear in the *Journal* of the Society for June 5.

As announced in NATURE for March 7, the 'Dechema' (Deutsche Gesellschaft für chemisches Apparatewesen) held its general meeting in Vienna on May 28 and 29 at the same time as did the Verein deutscher Chemiker. The scientific proceedings were well attended, and the papers which were communicated on "The Separation of Liquids and Solids" aroused wide interest. In all, twelve papers were communicated dealing with filtration in the laboratory and on the technical scale, the latter being naturally in the majority. We are informed that this interesting series of lectures will shortly be published in volume form of the 'Dechema' Monographs. On May 30 those taking part in the general meeting were able to visit the almost completed new Institute of Chemical Technology of Inorganic Compounds, a part of the Vienna Technical High School. This Institute provides an almost ideal solution of the problem of enabling the students to work with apparatus which corresponds to factory scale conditions.

IN connexion with the International Illumination Congress which is being held in Great Britain next September, the General Council of the Congress has issued a booklet on the origin, organisation, and work of the International Commission on Illumination, under the auspices of which the Congress is being held (International Illumination Congress, 1931, 32 Victoria Street, London, S.W.1). Its object is the provision of an international forum for all matters relating to the science and art of illumination, and the International Commission at the present time has national committees in Austria, Belgium, Czechoslovakia, France, Germany, Great Britain, Holland, Hungary, Italy, Japan, Sweden, Switzerland, and the United States. Meetings of the Commission are held every three years, the last being held in the United States in 1928. This meeting was attended by 71 delegates from nine countries, while the Congress held just previously was attended by 514 delegates. Among the more important work of the future is that of securing international agreement on the fundamental bases of illumination, the standardisation of illumination materials, and international agreement on illumination legislation. Added to this, is the necessity for research and the education of public opinion to the value of good lighting. The booklet includes an article on "The International Commission on Photometry", the names of the officers of the Commission, and lists of the papers read in 1921, 1924, 1927, and 1928.

THE Report on the work of the Department of Petroleum Technology of the Sir John Cass Technical Institute for the session 1930–1931 is to hand, and, as in the past, shows a creditable record of progress. This constitutes the tenth session during which provision has been made for instruction in petroleum technology, and it is significant of the farsightedness of the sponsors of the courses involved that little material departure from original schedule has been found necessary during that time. Students are drawn principally from the clerical, distributive, and technical branches of the industry, and the average number per session, taken over the whole decade, who have profited by the teaching at the Institute, is one hundred. During last session, courses were provided on general technology of petroleum, on internal combustion engines and lubrication, on chemical and physical properties of petroleum and its examination, on the applications of engineering to industry, and on construction of works. The past session was also marked by a striking increase of the number of student hours, from 2876 previously to 4144, a testimony to the keenness of the members of these classes and a source of gratification to the teaching staff.

AN important congress of naval architects will be held in Paris on June 29–July 4 at which papers will be read dealing with shipbuilding, marine engineering, and civil aviation. The meeting will be confined to members of the Institution of Naval Architects (London) and members of the Association Technique Maritime et Aéronautique.

THE United States Government sets a good example in the matter of industrial statistics. Much of interest can be culled from even the dry bones of such documents as "The Coke and By-Product Tables for 1929", compiled by the U.S. Bureau of Mines, Coal Division (Washington, D.C.). It throws interesting light on the immense American carbonising industry. In 1929, nearly sixty million tons of coke were produced —an increase of 50 per cent on the figures of 1915, but the proportion made in by-product ovens had grown in that period from one third to 90 per cent of the total. The coke is mainly used as metallurgical fuel, but an increasing proportion is going into the domestic 'furnace'. The immense quantities of tar cannot be absorbed for manufacturing purposes, and more than one-half is consumed as fuel, mainly in the steel works, the average price being 5 cents a gallon. The surplus gas is used mainly as industrial fuel and commands an average price of 16 cents a thousand cub. ft., but up to 29 cents for use as town's gas. These figures are instructive in indicating the limits set by economic circumstances to the extension of coal carbonisation.

THE observatory of De Bilt lies about 40 miles east of the Hague. The seismological section, founded in 1904, possesses a pair of Galitzin's horizontal seismographs and his vertical seismograph with the usual magnetic damping and galvanometric registration, one of Wiechert's astatic horizontal pendulums, and a pair of Bosch horizontal pendulums. The first number of the *Seismische Registrierungen* contains the records for part of 1904 and for the interval April 1908–1913. Since then, the numbers have been published annually. We have recently received the sixteenth number, that for the year 1928, compiled by Dr. G. van Dijk, the director of the seismological section. It contains the records of

433 earthquakes, giving, as usual, the epoch, period, and amplitude of the various phases, and, with very few exceptions, the approximate position of the origin.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—Two chief assistants in the department of psychological medicine of St. Thomas's Hospital—The Secretary and Clerk to the Governors, St. Thomas's Hospital, S.E.1 (June 30). A labour superintendent at the ordnance factories of the Royal Arsenal, Woolwich, with workshop training in an engineering establishment—The Under-Secretary of State (C. 5), War Office, S.W.1 (July 3). A Sir Ernest Cassel reader in commerce at the London School of Economics—The Academic Registrar, University of London, S.W.7 (July 6). A lecturer in agriculture under the Hertfordshire County Council—The Clerk of the Hertfordshire County Council, 28 Castle Street, Hertford (July 7). A head of the engineering department, a lecturer in mechanical engineering and drawing, and a graduate lecturer in electrical engineering (with physics and mathematics as subsidiary subjects) in the engineering department of the Merchant Venturers' Technical College, Bristol ; also a head of the building department, a lecturer in building construction and building subjects, and a graduate lecturer in chemistry and physics (with mathematics as subsidiary subject) in the building department of the Merchant Venturers' Technical College, Bristol — The Superintendent, Merchant Venturers' Technical College, Bristol (July 7). A full-time lecturer to take charge of the electrical engineering department of the Chesterfield Technical College—The Principal, Technical College, Chesterfield (July 11). A pathologist at the National Hospital for Diseases of the Heart—The Secretary, National Hospital for Diseases of the Heart, Westmoreland Street, W.1 (July 11). An assistant master, to teach mainly science subjects in the junior technical school and engineering departments of the Bolton Municipal Technical College—The Director of Education, Education Offices, Nelson Square, Bolton (July 11). A lecturer in chemistry at the Technical College, Sunderland—The Chief Education Officer, 15 John Street, Sunderland (July 11). An assistant lecturer in physics in the University College of Wales, Aberystwyth—The Secretary, University College of Wales, Aberystwyth (July 11). A lecturer in philosophy at Jesus College, Oxford—The Principal, Jesus College, Oxford (July 11). A lecturer in physics at the Northampton Polytechnic Institute—The Principal, Northampton Polytechnic Institute, St. John Street, E.C.1 (July 13). An assistant lecturer in physics at University College, London—The Secretary, University College, Gower Street, W.C.1 (July 13). An assistant lecturer in chemistry in the University of Sheffield—The Registrar, University, Sheffield (July 13). A demonstrator in civil engineering and surveying at the City and Guilds (Engineering) College—The Secretary to the Delegacy, City and Guilds (Engineering) College, Exhibition Road, S.W.7 (July 15). A woman professor of mathematics at the Huguenot University College, Wellington, South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand, W.C.2 (July 31). A Savilian professor of astronomy in the University of Oxford—The Registrar, Old Clarendon Buildings, Oxford (Oct. 10). A director of research of the British Launderers' Research Association—The Secretary, British Launderers' Research Association, 17 Lancaster Gate, W.2.

Our Astronomical Column.

Tempel's Comet 1866 I.—This is the comet associated with the November meteors ; it has a period of about 33 years, but was not recovered at its return in 1899. In the hope of facilitating its recovery at the forthcoming return, the computing section of the British Astronomical Association undertook the computation of the perturbations from 1366 (when a comet, believed to be the same, was observed) to 1866 and onward to 1933 ; the results are published in the April number of the *Journal* of the Association, and were supplemented by a further statement at the meeting on May 27. The deduced orbit for the next return is found to be nearer the earth's orbit by half a million miles than it was in 1899, which gives hopes of a better display of meteors. The most hopeful dates for meteors are 1932 Nov. 16·5 and 1933 Dec. 16·8, but search should also be made on 1931 Nov. 17·3.

The first rough date announced for the comet's perihelion passage was 1933 May 4 ; but revision of the work has made this some three months earlier, or the end of January ; in 1866 perihelion was on Jan. 11, so if the date is only slightly later than this, there will be good hope of observing the comet. There is still uncertainty of a month or more either way in the predicted date, but before the investigation the uncertainty was quite two years, so that it has been notably reduced. The recovery of the comet is highly desirable ; it would make possible the accurate study of its motion in the past, and would verify, or otherwise, the conjecture of Le Verrier that the comet and meteors owed their introduction into their present orbit to the action of Uranus in A.D. 126. Some textbooks refer to this conjecture as an established fact, but it is not so ; however, the near approach of the comet's orbit to that of Uranus makes it likely that there was a close appulse of the two bodies at some epoch.

The Distance of the Galactic Centre.—*Astr. Jour.*, No. 957, contains articles by P. van de Kamp on the distance of the galactic centre and the thickness of the galactic absorbing layer. He notes that the existence of this layer, first announced by Trumpler, has been further confirmed by Schalen, Ohman, Miss Slocum, and himself. Hubble's work on the spiral nebulæ gives further support, as he finds an irregular zone of avoidance of such nebulæ along the Milky Way, while their distribution elsewhere is fairly uniform. The thickness of the layer is given as 210 parsecs, with a probable error of 40.

The distance of the centre of the galaxy is found from (1) the centre of the system of globular clusters, (2) from a study of cluster-type variables in a Milky Way field, (3) from the constants of galactic rotation. The extreme values of the distance of the centre in parsecs are 16,700 and 7000. He suggests 12,000 as a mean (say 40,000 light-years). This implies an absorption intermediate between Trumpler's value and that of Bottlinger and Schneller ; it would be somewhat over a magnitude at 1000 parsecs.

Research Items.

An Aboriginal Tasmanian Skeleton.—In *Man* for June, Mr. Gilbert Rigg describes human bones forming part of a skeleton, which was found in a shelter at the head of the Mersey river. The skull lacks the lower jaw and the incisors and canines of the upper. The bones show considerable weathering and are stained a light to dark brown. The specimen is a male, judging from the pelvis; and the teeth are greatly worn on the crowns, so that it would appear that he was not a young man. The sutures of the skull are unclosed. He was, therefore, probably under middle age. The teeth show no sign of caries, but an abscess has corroded the roots of the first and second molars on the right and has eaten well into the jaw. The wear of the teeth is partly due to the nature of the food, which included a large proportion of shell-fish. Sand doubtless found its way into the food. The principal measurements of the skull are: *Max. length*, glabella to occiput, 185·5 mm.; *Width*, across parietal bones, 135 mm., across temporal lines, 97·5 mm.; *Max. zygomatic width*, 134 mm.; *Height*, above earholes, 116 mm.; *Cephalic Index* 72·8; *Cranial capacity* (Pearson and Lee's formula), 1368 c.c., (shot) 1340 c.c.; *Palatal width*, across the outer borders of the second molars, 69·8 mm.; length (by estimate) 63·3 mm. The measurements bring out the great size of the teeth, a characteristic of Tasmanian aboriginals. Among the other bones the atlas is present and six dorsal and lumbar vertebræ. One scapula only is present, the left, and only the right humerus. The left half of the pelvis is missing. Both femora are present, but only one tibia.

The Hares of Japan.—Yoshio Abe has followed up his researches upon the seasonal changes of colour in the variable hare of Japan by making a systematic study of the species. He regards it as differing from any of the northern varying hares and designates it a new variety, *Lepus brachyurus etigo* (*Jour. Sci. Hiroshima University*, Ser. B, Zoology, March 1931). The mixture of elements which make up the present fauna of Japan, derived partly from Saghalien in the north and partly from Japanese-Corean forms and more southern forms, travellers across former land bridges, makes the resolution of the hare species no easy matter, and Abe is inclined to differ on several points from previous workers. He recognises nine Japanese species and races, and in addition to the Etigo hare mentioned above, describes as a new race of the variable hare, the Saghalien hare *Lepus timidus saghaliensis*.

Ancestral Peculiarities in Lower Jaw of Elephant.—In the course of a detailed examination of the anatomy of three fœtal elephants, Dr. Nellie B. Eales has found, in the form and set of the mandible, traces of an ancestral character (*Proc. Zoo. Soc. Lond.*, April 1931). In an adult elephant, the mandible is deflected and the pre-alveolar border is useless, a unique condition. In the fœtal specimen examined, however, the deflection was greater than in adults, and the mandibles were of longirostrine type, in this respect suggesting some of the extinct forms of proboscidians. During early post-natal development, the jaws shorten, and gradually become like those of their parents. Dr. Eales looks upon the modification as an embryonic repetition of the phylogeny of the race.

Birds of Hispaniola.—In an account of the "Birds of Haiti and the Dominican Republic", Alexander Wetmore and Bradshaw H. Swales discuss the most interesting avifauna in the West Indies; for the island of Hispaniola, so named by Columbus on its discovery, has preserved in its high mountainous tracks remnants of an ancient fauna which has elsewhere disappeared in the archipelago (*U.S. Nat. Museum Bull.* 155, 1931). Though the island has from time to time yielded many peculiar forms, it is only within recent years that the significance of the fauna as a key to the problems of distribution in the Antilles has been understood. The resident forms fall into two principal groups, one of species found on the coastal plain or foot-hills of the interior, and the other a much smaller body confined to the high mountains of the interior. The former series contains members which range at large over the entire main island and may extend even through the adjacent Greater Antillean islands. It has a few peculiar species, elsewhere unknown, like the flat-billed vireo (*Lawrencia nana*) and the palm-chat (*Dulus dominicus*). The high mountain series, including such as the crossbill (*Loxia megaplaga*), several thrushes, a warbler, and others, are highly peculiar in occurrence and seem to represent remnants of an ancient fauna of general distribution, which has since disappeared except on the mountain ranges of the island, the most extensive area of elevated land in the West Indies.

Kidney Worm of Pigs.—I. Clunies Ross (Jour. Council Sci. Ind. Res. Commonwealth Australia, vol. 4, No. 1) records observations on *Stephanurus dentatus*, the kidney worm of pigs, which is found when mature in small fibrous capsules opening into the pelvis of the kidney, while larval stages and immature adults are found also in the liver, lungs, thoracic cavity and sub-lumbar muscles. This parasite is firmly established in the north-east coastal region of Australia but is scarce south of Sydney. The eggs of the worm pass out with the urine and hatch in a minimum period of 16 to 24 hours. The microscopic larvæ develop in mud, and in about five days, having undergone two ecdyses, are able to infest pigs. They may survive for five months under suitable conditions of heat and moisture. The larvæ may be swallowed by the pig or may enter through its skin (this is confirmed by Dr. Kauzal), and in either case reach the liver, where they grow rapidly while wandering in the liver tissue and causing great destruction thereof. Only after five or six months' development do the worms, now adult but immature, take up their final position in the vicinity of the kidney or ureter, where their presence gives rise to the formation of the fibrous sacs in which the male and female worms are found. The author points out that in well-drained and clean sites or in sanitary yards it is possible to decrease the danger of infestation and even to effect complete eradication of the worm.

Notes on Ostracods.—Mr. A. G. Lowndes, in his paper "Some Rare and Little-Known British Freshwater Ostracods", published in the last Report of the Marlborough College Natural History Society (No. 79), records a number of species of ostracods, mostly from the Marlborough district, two of which are new to the British Isles. Detailed descriptions are given, and the paper is illustrated by microphotographs and by line drawings. In a second paper by the same author, "On Entomostraca from the New Hebrides collected by Dr. J. R. Baker" (*Proceedings* of the Zoological Society of London, 1930, published January 1931), some interesting observations are made, especially on the ostracod *Stenocypris malcomsoni* Brady, well known from tropical countries. The material is from a large lake on the island of

Gaua, two samples of dried mud also being collected, from one of which, taken in shallow water, a good culture of *Stenocypris* was obtained. The male is unknown and all the culture specimens obtained were from parthenogenetic females. A good deal of variation is found among the individuals in a culture, especially in the armature of the caudal furca, and good figures are given showing the differences.

Eradication of Prickly Pear in South Africa.—Although not yet such serious pests as they have proved in Australia, various species of *Opuntia*, indigenous to America and possibly introduced in the first place in cultivation, are now spreading in South Africa. C. R. van der Merwe, in *Science Bulletin* No. 93, issued by the Department of South Africa, gives some account of the spread of these species in the Cape Province particularly, and discusses possible methods of eradication, in the light of the extensive Australian experiments in this direction at the Dulacca Prickly Pear Experiment Station and of recent South African experiments at Uitenhage, which have been designed to test Australian methods under South African conditions and against the species particularly rampant in South Africa. These, which are described, are given as *O. monacantha*, *O. maxima*, *O. megacantha*, and *O. aurantiaca*. Where dense stands of prickly pear are encountered, it is concluded that the methods of eradication which seem most effective require a combination of spraying and injection with soluble arsenical compounds.

Electricity in Horticulture.—Electricity is at present little used in horticulture, but since market gardening is usually carried out on intensive lines and in concentrated areas, there seem better prospects of its proving an asset in this industry than in farming. In a recent article (*Jour. Min. Agric.*, **38**, p. 132), C. A. Cameron Brown shows that a considerable amount of experimental work on this question is being undertaken, some of which seems suitable for development on a large scale. Electricity as a source of bottom heat appears to be particularly promising. Electric hot-beds are already employed successfully on the Continent, and it is not improbable that an extension of this system would lead eventually to some replacement of the usual manure hot-bed with its obvious disadvantages. The investigations regarding the use of power for cultivation, and electric light for increasing plant growth are less far advanced. Various cultivation implements have been designed, notably in France, but their cost of production is at present too high to merit their use on a commercial scale. Extension of the length of day by artificial lighting has been definitely shown to improve the growth of plants, but more experiments are required before it is certain that such treatment can be considered an economic proposition.

New Zealand Glaciation.—A report on evidences of past glaciation in New Zealand and Australia by Dr. P. Marshall is given in the *Report* of the twentieth meeting of the Australian and New Zealand Association for the Advancement of Science (Brisbane, 1931). The work was the result of a research committee appointed at the previous meeting. There is held to be no evidence of Silurian or of any other glaciation previous to the considerable extension of the present glaciers in late Pleistocene to recent times. Even that extension would appear to be of much smaller extent than was previously supposed. Large accumulations of gravels in several areas in Central Otago are now ascribed to fluviatile origin previous to the development of glaciation. In the North Island there seems to have been no glacial development on the high volcanoes or on the central mountains from Cape Runaway to Cook Strait. The report also summarises the evidence for glaciation in Cretaceous times in New South Wales and in Permo-Carboniferous times in Western Australia and Victoria.

The Structure of Incandescent Carbon.—In a recent *Scientific Paper* (No. 299) from the Tokyo Institute of Physical and Chemical Research, M. Hirata has given an account of an X-ray study of carbon. The specimens were mounted as poles of an arc, and the X-ray diffraction patterns produced by them photographed both with no current passing and with the carbons kept incandescent by having the arc burning. The main object was to find if the surface of either pole became liquid at the high temperatures reached (4000° C.), but although part of the pattern due to the position pole could be accounted for in this way, the results were inconclusive. From the change in spacing of the diffraction rings between room temperature and incandescence, it has been shown that the expansion of the graphite occurs almost completely in a direction perpendicular to the most closely packed plane, the average value of the expansion coefficient being $4 \cdot 10^{-5}$ per degree, which is much larger than the expansion coefficient at lower temperatures.

The Electrical Failure of Crystals.—It is known that if potential surges of short duration are applied to crystals discharge tracks appear in the solid which are not unlike Lichtenberg figures in form, and follow definite crystal axes. The extension of these observations to the practical case of failure of crystals under prolonged electric stress is described by J. Lasz in the *Zeitschrift für Physik* for May 12. Asymmetrical fields were applied between point and plane electrodes in rock-salt, fluorspar, gypsum, and calcspar. When the temperature was not too high the channel formed by the spark followed directions defined by the crystal axes, being usually built up of a number of straight sections, and not following the shortest line from point to plane; when a track forked, each branch made its own channel on similar lines. The effect of the spark appeared to consist in a plastic deformation of its immediate neighbourhood, followed later by local shattering and fusion. At higher temperature the directing effect of the crystal axes disappeared and the spark passed in the region of greatest field strength. It is remarkable that the average field needed for the disruptive discharge is much smaller than has been calculated theoretically by Rogowski.

Rare Earth Metal Amalgams.—Of the sixteen rare earth metals, only six have been obtained in the free state (Y, Ce, La, Nd, Sm, Eu), and only two (Ce, La) in a high state of purity. Audrieth, Jukkola, and Meints, working in collaboration with Prof. Hopkins, of Illinois, describe some interesting experiments in the May number of the *Journal of the American Chemical Society* which show that it is possible to prepare rare earth amalgams electrolytically not only from aqueous but also from absolute alcoholic solutions. The paper deals with the amalgams of lanthanum and neodymium; work on other amalgams, and the separation of the metals from them, is contemplated. The amalgams are extremely reactive and undergo ready decomposition. By heating the neodymium amalgam in vacuo much of the mercury was removed, but some remained even at the temperature at which pyrex glass begins to melt. The product thus obtained was a black powder which readily takes fire in air. By heating this powder in a tungsten boat in a high vacuum furnace the remaining mercury was eliminated, and the neodymium metal could even be volatilised with the deposition of an extremely reactive film of the element.

Canadian Coal.

BY A CANADIAN CORRESPONDENT.*

AMONG the most abundant of Canada's natural resources, coal is near the head of the list. A comparatively recent estimate placed the coal reserves of the Dominion at more than 1,234,000,000,000 metric tons, or about 16 per cent of the world's coal reserves.

The principal coalfields of Canada are in Nova Scotia, Alberta, and British Columbia, while the chief centres of industry and population are in Ontario and Quebec —2000 miles to the east and 1000 miles to the west. The great coalfields of the eastern United States lie only 300-500 miles to the south of the southern boundaries of Ontario and Quebec, and from those fields these two provinces import most of their coal, because it is more economical to do so. For the past thirty years Canada has imported from 50 to 60 per cent of its total coal requirements from the United States.

Ever since Confederation in 1867, it has been the aim of every government to make it possible for Canadian mines to obtain a larger proportion of the total coal business. Until recently, efforts in this direction have been confined to the imposition of protective tariffs, but lately this has been supplemented by more direct forms of assistance, such as by the Dominion Government paying a share of the freight rates on coal from western and eastern mines in Canada to points in Ontario, Quebec, and Manitoba; also by extending some monetary aid under the Domestic Fuel Act of 1927 to by-product coking plants.

Nine years ago, an organisation known as the Dominion Fuel Board came into being by government regulation. It was formed to make a thorough study of the underlying causes of recurring coal shortages and of the methods by which they might be counteracted. Since then the Board has been largely instrumental in stimulating the provision of fuels alternative to American coal for Ontario and Quebec, and is chiefly responsible for the greatly increased importations of British anthracite in the last three years.

Of the Canadian coal production in 1930, amounting to 14,799,000 tons, less than 750,000 tons was exported, and it does not appear that there is much likelihood of the export market being increased. The possibility of extending the home market by supplanting American coal with the Canadian product has been engaging the attention of the Fuel Board. To the end of 1930, government assistance in the form of subventions and the operation of the Dominion Fuel Act have resulted in the placing of 900,000 tons of Canadian coal and coke in markets previously held by foreign coal.

The character of the mining problems presented in the coalfields of the maritime Provinces indicates that the present production of between six and seven million tons cannot be increased more than perhaps 50 per cent above present figures. If this were accomplished, the total production of these fields would still fall short of supplying the present requirements of Canada, east of Ottawa and Kingston, by from one to two million tons per annum.

At the present time, maritime coals supply approximately seven million tons out of a total consumption of eleven and a half million tons. It is evident, therefore, that eastern Canada must look to other countries for a considerable part of its needs.

In the west, the capacity of existing mines is far in excess of present needs. Total requirements of the western provinces are about ten and a quarter million tons. About half a million tons are imported from the United States, chiefly to Manitoba. British Columbia in past times had a good export market to California, but this has diminished greatly. Total exports of Canadian coal from the western fields are now only about 400,000 tons.

The lack of coal resources in Ontario and Quebec has been compensated to a large degree by the development of the abundant water powers of these provinces. There is now approximately six million horse-power developed. In terms of coal, this is the equivalent of eighteen million tons, an amount more than the total Canadian coal production.

The use of fuel oil is increasing rapidly. In 1929, the latest year for which complete figures are as yet available, the total consumption of fuel oil in the Dominion outside the refineries was more than 413,000,000 gallons—an 18 per cent increase over 1928. The consumption of fuel oil in 1930 is expected to show a small increase. The coal equivalent of the present consumption is approximately three million tons. The competition of fuel oil is being particularly keenly felt in British Columbia coal mines. Cheap oils from California and Peru have replaced nearly one million tons of coal in British Columbia. The bulk of this oil is used by the railways.

In 1930, Canada imported 17,728,991 tons of coal, of which 13,463,601 were bituminous and 4,265,390 anthracite. Of the total imports of bituminous coal, 13,217,369 tons were from the United States and 146,232 tons from Great Britain. Of the anthracite imported, 2,965,254 tons were from the United States, 996,127 from Great Britain, 292,529 from Russia, and 11,480 from Germany.

Last year, Canada consumed 31,870 tons of coal and 3,385,000 tons of coke—a decrease of 3,000,000 tons from the average consumption of the previous two years. Central Ontario consumed approximately thirteen million tons, Quebec five millions, Alberta four and a half millions, and Nova Scotia three and three-quarter millions.

Of the total Canadian coal production last year, the mines in Nova Scotia accounted for 6,247,761 tons; New Brunswick, 208,405; Saskatchewan, 571,632; Alberta, 5,682,487; and British Columbia, 2,089,052; a total of 14,799,337 tons valued at £10,600,000. The coal mining industry in Canada represented at the end of 1929 a capital investment of £28,400,000. There were at that time 29,739 employés in the industry, whose salaries and wages bill totalled for the year £8,475,000, or about £285 per employé.

As a step towards the more economical utilisation of domestic fuel supplies, pamphlets have been published dealing with the advantages to be gained through proper insulation of houses and factories, and the maintenance of adequate humidity in them. The question of proper humidity in houses subject to a Canadian winter climate is one which closely affects standards of health as well as fuel economy, and investigations on these subjects are being continued.

Canadians are fully aware of the advantages to be gained through the development of a national fuel policy, which will assure to them the fullest possible use of their own fuel resources consistent with reasonable economy in the distribution of them. Where factors of transportation prohibit the realisation of this aim, effort is concentrated in finding a source of supply within the British Empire. That these aims have met with a measure of success is evidenced by the increasing imports from Great Britain.

* This article is based upon information derived from various official documents and the records of the Department of Mines, Ottawa.

Annual Assembly at Rothamsted Experimental Station.

THE annual assembly of subscribers to the Rothamsted Experimental Station took place on June 18, when demonstrations of the field experiments and of the work going on in the various laboratories were given. As the time available for the inspection of the fields was short, only a limited number of the trials were inspected; these included the classical experiments on the Park Grass begun in 1856, and the one on the famous Broadbalk wheat field started in 1843. The first was designed to show the effect of different fertiliser treatments on the yield and character of the herbage, and to-day it forms a very striking illustration of the way in which the farmer can affect the nature of his pasture by varying the plant nutrients supplied. The second experiment was originally intended to show the effect of nitrogen, potash, and phosphorus on the growth of the wheat plant; the action of these three substances is now well known, but the experiment is still yielding valuable information: for example, a few years ago a study of the yields from the various plots, with the weather records, enabled the statistical department of the station to deduce valuable correlations between rainfall at different seasons of the year and the yield. More recently, by studying the average yield of the plots, the physics department has been led to the study of certain soil characteristics.

The average yield of the plot receiving a full annual dressing of artificial manure has been very close to that of the plot receiving farmyard manure; but the economic value of the two crops has not been equal, since the dunged plot has yielded relatively more in unfavourable seasons, when prices were higher. It is a matter of great importance to discover why the yields on the dunged plot have been less at the mercy of the vagaries of our climate. The increased microbiological activity induced by the addition of organic matter is undoubtedly the primary reason, and it influences the yield partly by the production of soluble chemical nutrients and partly through the formation of humus, which gives a more open structure to the soil and, incidentally, gives it the black colour characteristic of a 'rich' soil. The problem of ascertaining just how the presence of humic matter affects yields is bound up with the wider question of how the nature of the soil and the cultivation treatment it receives influences the growth of the crop and its response to manuring. Work, therefore, on the stability of soil crumbs formed in the field under different systems of cultivation, and by sheep treading, is being followed up in the laboratory, where an attempt is being made to discover the nature of the forces which bind soil particles together. The prosecution of this inquiry has involved excursions into pure science, particularly colloid physics and physical chemistry.

These problems are part of the general one of land utilisation. In many soil surveys only qualitative tests have been applied, owing to the large amount of time and money needed in using the existing laboratory methods. Several new ways of determining the physical properties of a soil have been worked out at Rothamsted. These are quantitative and, at the same time, very rapid. In their development the needs of those responsible for irrigation projects in salty areas have been particularly kept in view.

In addition, however, to the old classical experiments, more modern ones, designed to meet the needs of modern agricultural conditions, have been devised. As an example, the six-course rotation in Long Hoos field and the forage crop in Little Hoos may be cited.

The main object of the six-course rotation is to obtain data by means of which the influence of climatic conditions in different seasons on the response of crop yield to artificial fertilisers may be studied. The rotation is: barley, clover, hay, wheat, potatoes, a forage mixture (rye, beans, and vetches) and sugar-beet, and each crop is grown every year. Sulphate of ammonia, superphosphate, and muriate of potash are used, and there is a range of five intensities of manuring for each fertiliser.

The nature of the problems to be investigated in these experiments necessitates continuance over a long period of years, but the immediate results will be of interest. A feature of the experiment is that the number of years required for a cycle of crops differs from the number required for a cycle of manurial treatments, so that the defect from which older rotation experiments suffered, that the same crop constantly recurred with the same manurial treatment on the same plot throughout the period of experiment, is avoided. It is thus possible to eliminate the effects of permanent differences in fertility between the plots.

The large experiment of 144 plots, arranged as a Latin square, in Little Hoos field, is designed to investigate the effect of different fertilisers on the yield and chemical composition of forage crops, consisting of mixtures of cereals and legumes. The manuring of such crops presents difficulties which are not encountered when a single crop is grown, since the ability of one constituent to compete with the others in the mixture may be altered by manuring, and the composition and nutritive value of the produce so changed. The main problem is to discover by what system of treatment with artificial fertilisers the yield of protein per acre may be increased. Four different mixtures are used, consisting of: winter oats, vetches, beans; wheat, vetches, beans; winter oats, peas, beans; and wheat, peas, beans. The twelve fertiliser treatments include sulphate of ammonia, nitrate of soda, potassium chloride, and superphosphate, separately and in combination.

Chemical investigations are being carried out on these crops, which should yield interesting information. In 1930 ammonium sulphate increased the amount of cereal straw and depressed that of leguminous plants in mixed forage crops to such an extent that the large increase in total yield was not accompanied by any increase in the yield of protein per acre. Calcium cyanamide generally gives similar results to ammonium sulphate, but under less favourable soil conditions it interferes with the normal nitrification process.

In the afternoon the laboratories were inspected. In the bacteriology department, the investigations made on the nitrogen-fixing bacteria forming nodules on lucerne were explained. In the past this work has led to a large increase in the area of ground on which lucerne can be grown, and special attention is being paid to the reaction of the organism to the host-plant. This is usually one of mutual benefit; the plant supplying the bacteria with carbohydrates, and receiving in return a supply of nitrogen compounds. If the supply of carbohydrates to the nodule is checked, as by growing the plant in the dark, the bacteria become actively parasitic and destroy the cells of the host.

The entry of the bacteria into the root is in some way assisted by root secretions of the host-plant, although the manner in which these act is still uncertain.

In the chemistry department, the barley crop is studied in great detail, because its value varies more strikingly than that of any other farm crop with the

conditions of growth. The amounts of the principal nitrogenous constituents are closely related to the nitrogen contents for a given variety of barley, irrespective of the soil, season, and manuring. Further, many of the properties recognised as important in brewing may be deduced from simple analyses on the original barley, and it should therefore soon become possible to place the valuation of barleys on a more rigid and objective basis. In the course of the work, a successful laboratory technique for small-scale brewings has been developed.

Interesting exhibits were shown by the department of mycology, illustrating racial differentiation and behaviour in fungal species, 'immune' potato varieties infected with wart disease, and the relation of fungal and host nutrition to potato diseases. There were also demonstrations of the structure and life-history of *Bacterium malvacearum* and cotton-plants growing in chambers under controlled environmental conditions. In the Empire Marketing Board virus glass-houses, plants were exhibited showing different types of virus diseases; and the physiological, cytological, and entomological aspects of virus research were shown.

In the entomology department, the exhibits illustrated the means of control of Cecidomycidæ (gall midges) affecting osier willows, clover, wheat, and other plants; and experiments dealing with the chemotrophic responses of these insects and the extent to which they govern the selection of the host-plants. The field trials and laboratory observations designed to determine the amount of natural destruction exercised by parasites upon the frit-fly and other agricultural pests were also demonstrated.

The demonstrations gave the visitors some idea of the scope of the work carried on at Rothamsted, although the time at their disposal precluded an exhaustive tour of the fields and the laboratories.

University and Educational Intelligence.

BELFAST.—The Senate has appointed Dr. T. Thomson Flynn to the chair of zoology from Oct. 1, 1931. Dr. Flynn is at present Ralston professor of biology in the University of Tasmania.

CAMBRIDGE.—The Vice-Chancellor gives notice that the Quick professorship of biology will become vacant on Nov. 1 by the retirement of Dr. Nuttall. A meeting of the electors will be held on July 17. The regulations provide *inter alia* that it shall be the duty of the Professor to devote himself to the study of the biology of the cell and generally to promote that branch of science by research and by the superintendence of a laboratory and otherwise. Candidates are requested to send in their applications to the Vice-Chancellor on or before July 10.

The Council of the Senate has put forward recommendations for the three John Humphrey Plummer professorships. The chairs are those of mathematical physics, inorganic chemistry, and colloid science.

In the case of the chair of mathematical physics, it is recommended that it shall be the duty of the professor to promote the study of theoretical physics in connexion with the Department of Physics and the Faculty of Mathematics, with special responsibilities towards research students in the Department of Physics. At the first election, preference shall be given to candidates whose work is connected with atomic physics. Before each election to the professorship after the first, the General Board shall consult the Council of the School of the Physical Sciences as to the needs of teaching and research in theoretical physics, particularly in connexion with the Department of Physics, and, if the Board think fit, it shall be specified in the notice to candidates that preference will be given to those whose work is connected with some particular branch or branches of theoretical physics.

Mr. W. H. Mills, Jesus College, has been elected reader in stereo-chemistry.

GLASGOW.—The honorary degree of LL.D. was conferred on Sir F. G. Hopkins, president of the Royal Society, and on Prof. C. U. Ariëns Kappers, professor at the Central Institute for Brain Research, Amsterdam, at the graduation ceremony held on June 17. At the same graduation, the degree of D.Sc. was conferred on Dr. G. W. Tyrrell for a thesis entitled "The Geology of Arran".

LONDON.—Prof. W. W. Jameson, professor of public health in the London School of Hygiene and Tropical Medicine, has been appointed dean of the School, in succession to the late director, Sir Andrew Balfour.

The following appointments to University Chairs have been made by the Senate: Philosophy (King's College), Dr. H. F. Hallett, since 1919 lecturer in philosophy in the University of Leeds; Medical Industrial Psychology (London School of Hygiene and Tropical Medicine), Dr. Millais Culpin.

The title of Reader has been conferred upon Mr. Sydney Barratt, physical chemistry, University College; Dr. L. F. Bates, physics, University College; and Dr. E. A. Spaul, zoology, Birkbeck College.

University postgraduate travelling studentships of the value of £275 for one year have been awarded to John Stuart Anderson and Eric Gwynne Jones. Mr. Anderson proposes to continue research in the chemistry of the metal carbonyl compounds and related substances at Heidelberg. Mr. Jones proposes to carry on spectroscopic research at the astrophysical observatory at Potsdam.

OXFORD.—Applications are invited from members of Magdalen College for the Edward Chapman research prize value £20, for a published piece of original research in physics or chemistry, including the sciences of astronomy, meteorology, mineralogy and geology, zoology and botany, treated from the morphological, palæontological, physiological, or pathological point of view. Further particulars are obtainable from Prof. H. L. Bowman, Magdalen College. Competing essays must be received by, at latest, Oct. 10.

THE Foreign Work Committee of Leplay House announces that during the coming August vacation there will be a visit to Poland, including a fortnight in the Carpathians and a few days in Poznan, Cracow, and Warsaw, for historical, geographical, and sociological studies. The studies will be under the direction of Mr. R. E. Dickenson. A meeting will also be held in the Cantal, with Rocamadour and Le Lioran as the centres, under the direction of Mr. D. L. Linton. A students' camp will be held in Yugoslavia. Full particulars may be obtained from Miss Margaret Tatton, Leplay House, 65 Belgrave Road, Westminster, S.W.1.

THE tenth Unity History School will be held this year in Stockholm, under the direction of Mr. F. S. Marvin. The general subject will be "The World at Peace: A Survey of Post-War Developments". Both English and Swedish lecturers will be taking part, among them being Prof. Herbert Dingle, of the Imperial College of Science, who will trace recent progress in the physical sciences; Mr. Hartley Withers, who will deal with financial and economic problems; Mr. Unden, rector of Uppsala and ex-Minister of Foreign Affairs, on international law; and Archbishop Söderblom, to whom the Nobel

Peace Prize was recently awarded. The date of departure from London is Aug. 5. Full particulars can be obtained from the Hon. Secretary, Mrs. Innes, 29 High Oaks Road, Welwyn Garden City.

Birthdays and Research Centres.

June 29, 1868.—Dr. G. E. HALE, For.Mem.R.S., honorary director of the Mount Wilson Observatory, Pasadena, California.

The spectrohelioscope, spectroheliograph, and spectrograph of my solar laboratory are being used in several combinations for visual and photographic observations of the atmosphere and magnetic fields of the sun. A standard form of spectrohelioscope will soon be in operation at twenty-five or more observatories distributed around the earth. A plan of co-operative research will deal primarily with the question whether auroræ, magnetic storms, and other geophysical phenomena are caused by solar eruptions, as certain observations and theories suggest.

The Astrophysical Observatory and Laboratory of the California Institute, conducted in close co-operation with the Mount Wilson Observatory, are in process of development. Experiments in manufacturing large mirror discs for the 200-inch telescope are under way, with good prospects of ultimate success. New auxiliary instruments, including correcting lenses, spectrograph objectives, and radiometers, when tested with the 60-inch and 100-inch reflectors on Mount Wilson, have greatly increased the efficiency and range of these telescopes.

June 29, 1885.—Prof. W. C. MCCULLAGH LEWIS, F.R.S., professor of physical chemistry in the University of Liverpool.

The work which has been carried out for some years now in this laboratory belongs, in the main, to the field of bio-colloid chemistry, a branch of chemistry which is receiving considerable attention in various research centres. So far as our own programme is concerned, it may be said to include four lines of investigation: (1) The kinetics and energetics of coagulation or aggregation of typical colloid and other finely dispersed systems; (2) the physico-chemical aspects of denaturation of proteins; (3) the capillary behaviour of finely dispersed systems of biochemical importance, for example, the lipoids and proteins; (4) the kinetics and energetics of enzyme processes. In addition to the bio-colloid work, research in photochemistry and electro-chemistry is likewise being carried out by members of the staff.

July 2, 1862.—Sir WILLIAM BRAGG, O.M., K.B.E., F.R.S., director of the Royal Institution of Great Britain.

The determination of the crystal structure of organic substances is the chief object of research of my colleagues and myself in the Davy-Faraday Laboratory. Our particular object for the moment is the improvement of the apparatus and of the interpretation of the results. It seems that advance in the future will depend on observations of the relative intensities of the pencils of X-rays diffracted by a crystal. The crystals to be examined are generally very small, weighing only a fraction of a milligram. We have therefore been constructing powerful X-ray tubes which should give results plainly, accurately, and quickly.

At the same time various interesting crystals are under examination, and, in particular, the long chain compounds. The new X-ray tubes make it easy to observe certain remarkable effects as the substances are heated until they melt.

Societies and Academies.

LONDON.

Royal Meteorological Society, June 17.—**S. Chapman**: A theory of upper-atmospheric ozone. The paper consists of a discussion of the daily and annual variations of the ozone content of the atmosphere in any latitude up to about 50°. The ozone is treated as if it were uniformly spread through a layer of air 10 km. thick, having the same density as the air at the level of maximum ozone density. Convection and diffusion of ozone are neglected. The thermal decomposition of ozone ($2O_3 = 3O_2$) is discussed, and estimated to be negligible, except possibly in connexion with an eleven-year (sunspot) variation of ozone.—**C. K. M. Douglas**: On the relation between temperature and pressure in the troposphere. It is shown that the high correlation coefficients between pressure and temperature high up in the troposphere are closely related to the constancy of the lapse-rate of temperature. The correlations between the mean temperature of the column up to 9 km. and the temperatures at 3 and 6 km. are very high. Some factors tending to produce a constant lapse-rate are discussed. Groups of extreme cases show that when the barometer at sea level is very low or very high the troposphere contributes about half the deviation from the mean. Both cyclones and anticyclones can be grouped into systems largely confined to the troposphere, and systems extending to the stratosphere. The argument in favour of an advectional theory is developed.

PARIS.

Academy of Sciences, May 4.—**A. Cotton**: The optical properties of a liquid placed in a magnetic field and traversed by a beam polarised in any direction. Remarks concerning the work of G. Dupouy and M. Schérer; with special reference to the installation.—**Charles Nicolle**: Distemper in dogs can be experimentally transmitted to man without apparent symptoms. Although man can act as a carrier of the distemper virus, no reaction of temperature or otherwise could be detected.—**A. Fraenkel**: An essential alternation of the axiom of choice.—**W. Tartakowsky**: The totality of numbers representable by a general quadratic or cubic indefinite form.—**Mandelbrojt**: Functions, holomorph and limited in a semi-plane.—**Henri Cartan**: A remarkable class of domains.—**M. Pichot** and **P. Dupin**: The distribution of the velocities of colloidal solutions presenting anomalies of viscosity. The flow of water and of a 0·7 per cent gelatine solution between parallel planes has been studied by the Camichel chronophotographic method, and curves are given showing the velocity as a function of the distance from the walls for each of these liquids. These curves prove the existence of a central portion flowing *en bloc* in the case of the gelatine solution.—**Hènri Mineur**: Remarks on the mechanics of variable masses.—**E. Huguenard**: A method of mechanical inscription applicable to the recording and reproduction of sounds.—**M. Pauthenier** and **Mme. M. Moreau-Hanot**: The cylindrical ionised field and the duration of the path of the ions.—**V. Dolejšek**: The ultra-soft X-rays. A modification of Osgood's method was used. The most intense line obtained was a doublet with an approximate wavelength of 480° A.—**G. Dupouy** and **M. Schérer**: The combination of the simultaneous optical effects of magnetic rotary polarisation and magnetic double refraction in a liquid.—**Jean Becquerel** and **Louis Matout**: The combined effects of the internal electric field of a uniaxial crystal and of a magnetic field normal to the optic axis. Variations of the

components of the absorption bands of the ordinary spectrum according to the relative orientations of the incident vibration, of the binary axes, and of the magnetic field. Circular polarisation and magneto-electric rotary power.—**R. Gibrat**: The optics of uniaxial heterogeneous structures.—**Guichard, Clausmann, Billon, and Lanthony**: New data relating to the independence of the hardness and hydrogen content of electrolytic metals. Reply to criticisms by L. Guillet and J. Cournot: Fresh experimental evidence is given in support of the authors' views.—**Augustin Boutaric and Maurice Doladilhe**: The adsorption of colouring matters by the granules of a hydrosol.—**Georges Fournier and Marcel Guillot**: The absorption of the β-rays by matter.—**Mme. Irène Curie**: The complexity of the α radiation of radio-actinium.—**F. Joliot**: The phenomenon of recoil and the conservation of the quantity of motion. The author has repeated Akiyama's experiment and has obtained similar phenomena, but considers unnecessary the hypothesis of an emission of a γ radiation of very great energy.—**L. Bert and R. Annequin**: The action of phosphorus pentachloride upon ω-chlorallyl benzene derivatives. The action of phosphorus pentachloride upon compounds of the type $R . C_6H_4 . CH_2 . CH : CHCl$ furnishes a good method for obtaining $C_6H_5 . CH_2 . CHCl . CHCl_2$ and its homologues.—**Sébastien Tabetay**: On $\omega . \omega'$-dichloroparaxylene, p-diethylolbenzene, and p-divinylbenzene.—**Mlle. M. Montagne**: The action of organomagnesium compounds on N-diethylacetamide.—**C. Gaudefroy**: The orientation of crystals, and of quartz in particular, with the aid of corrosion figures.—**F. Holweck and P. Lejay**: Improvements in a transportable instrument for the rapid measurement of gravity. The portable type of instrument described and illustrated is an improved form of one described in an earlier communication. After being carried 2000 kilometres in a motor car, without special precautions, its accuracy was unaffected.—**Ladislas Gorczynski**: Some measurements of the diffused solar radiation obtained with solarimeters in the Maritime Alps.—**Chung-Hwang Chow**: The development of the carpophore in *Coprinus tormentosus*.—**M. Bridel and R. Lavieille**: The sweet principle of the leaves of Kaá-hê-é (*Stevia Rebaudiana*). The dry leaves contain 6 per cent of the glucoside, stevioside. This is very sweet, about 300 times as sweet as cane-sugar. It is not hydrolysed by emulsin, rhamnodiastase, yeast or by powdered *Aspergillus niger*, but 5 per cent sulphuric acid acting for three hours at 100° C. gives α-glucose and a substance, steviol.—**F. Fouraire**: A new myxosporidium of the genus *Chloromyxum* observed in the carp.—**P. Lépine**: The separation of the antagonistic sexual hormones in extracts of the anterior lobe of the hypophysis.—**A. Leulier and B. Drevon**: The action of the blood serum on morphine chlorhydrate in the presence of hydrogen peroxide. Oxydimorphine has been proved to be formed under these conditions.—**Ch. Dhéré and M. Fontaine**: The fluorescence spectra of the phycochromoproteids studied in solution and in a living alga.—**J. Magrou, Mme. M. Magrou, and E. Roubaud**: The stimulating action at a distance exercised by certain bacterial suspensions, through quartz, on the eclosion of the mosquito of yellow fever.—**J. Parrod**: The formation of α-arabinotetroxybutyl-4-imidazol at a low temperature, starting with glucose and with levulose in a solution of ammoniacal cupric hydroxide.—**Armand Dehorne**: New observations on the generalised plasmodium and the merozoite cysts of *Sabellaria spinulosa*.—**Ugo Lumbroso and Mlle. H. Van Sant**: New strains of bacteria isolated from north African cases of trachoma following Noguchi's technique. Three strains of bacteria have been isolated, A, B, and C. Of these, type A differ essentially from the *B. granulosum* of Noguchi in the appearance of the colonies, their consistence, their golden yellow pigment, and the absence of fermenting power towards certain sugars attacked by *B. granulosum*. Type B, and especially type C, show still greater differences.—**C. Levaditi, J. Bardet, A. Tchakirian, and A. Vaisman**: *Gallium*, its therapeutic properties in syphilis and the experimental trypanosomiases. *Gallium* has a marked preventive and curative action in syphilis and certain trypanosomiases.

CAPE TOWN.

Royal Society of South Africa, Mar. 18.—**R. A. Dart and Nino del Grande**: The ancient iron-smelting cavern at Mumbwa.—**R. S. Adamson**: On a new species of *Aristea*.—**H. Zwarenstein and I. Schrire**: The effect of castration upon protein metabolism. Total castration of male rabbits leads to an increase in weight and to a 25-40 per cent increase in creatinine excretion 3 months after operation. Grafting of testes caused a return to normal within a fortnight. The creatinine excretion of a female rabbit showed a 20 per cent decrease 3 months after removal of the ovaries.—**M. Fortes**: Perceptual tests of general intelligence for international use.—**Sir Thomas Muir**: (*a*) Note on equalities connecting two sums of squares. (*b*) Note on a special alternant of three variables.—**J. F. V. Phillips**: A sketch of the floral regions of Tanganyika Territory.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 18, 1930).—**N. Zelinsky and M. Rakuzin**: A new simplified procedure for the manufacture of sulphuric acid from plaster of Paris. Calcium sulphate can be converted, by boiling with ammonium carbonate, into ammonium sulphate and the latter electrolysed to produce sulphuric acid.—**A. Arkhangelskii and E. Salmanson**: A note on the diagenesis of the marine argillaceous deposits. The chemical side of the processes connected with the interaction of particles of soil and the sea water is discussed.—**L. Broude and V. Gulevitch**: The use of Buchner's press for the studies of animal extractive substances. The press can be applied successfully in qualitative studies on extractive substances from muscles, but the amount of the extract is never complete and the method cannot be recommended for quantitative studies.—**V. Nikolaev and S. Kosmann**: On the boracic acid of the Tchokrak salt lake. Analyses of the lake water.—**N. Achyeser**: (1) On certain polynoms of minimum deviation. (2) On the extremal proprieties of certain fractional functions.

SYDNEY.

Linnean Society of New South Wales, Mar. 25.—**Germaine A. Joplin**: Petrology of the Hartley District. (1) The plutonic and associated rocks. The plutonic rocks at Hartley occur as a portion of a large bathylith, and in two stocks, each of which is about one mile in diameter. Hypabyssal rocks occur in the form of dykes and apophyses associated with the bathylith. A number of different types, ranging from ultra-acid to ultra-basic, have been described, and mineralogical and chemical evidence points to consanguinity among them. The complex forms a typical calcic, or sub-alkaline suite, and is comparable to one of similar age at Moruya. It is probable that the various types have been developed as a result of fractional crystallisation in an intercrustal reservoir, followed by separate injections of the fractions, and differentiation *in situ*. The plutonic rocks are intrusive into Upper Devonian sediments, and are overlain by Permo-Carboniferous Upper Marine beds.

The series is comparable to other complexes of Devonian age, and, therefore, probably belongs to the Kainmbla epoch of igneous intrusion.—**G. H. Cunningham**: The Gasteromycetes of Australasia: (10) The Phallales. (1) Following a discussion concerning the morphology of the order, an account is given of the development of three representatives of the genera, *Mutinus*, *Ithyphallus*, and *Dictyophora* respectively. A key to the genera is given, and the species occurring in this biologic region (five in all) are discussed in detail. Critical notes are appended as to the generic limits and to the specific characters of the Australian representatives of this family. A complete synonymy of the species and genera under discussion is appended.—**J. R. Malloch**: Notes on Australian Diptera (27). This paper contains a complete catalogue of the described Australian species of the family Chloropidæ, with a generic key to the subfamily Chloropinæ and descriptions of thirteen new species, with notes on several described species, a survey of the characters of the family Milichidæ, with a key to the Australian species of the genus *Milichiella* and descriptions of two new species, and some notes on three recently described species of the genus *Rutilia* of the family Tachinidæ.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 17, No. 2, Feb. 15).—**Henry Borsook and Howard M. Winegarden**: On the specific dynamic action of protein. A survey of recent experimental work, with reference to the literature. It is suggested that the specific dynamic action of protein parallels the course of nitrogen excretion and results from at least two processes, the work imposed on the kidney and the metabolism of the nitrogen and the carbon, the latter being the specific dynamic action proper.—**Perry Byerly**: The California earthquakes of Nov. 28, 1929, and the surface layers of the earth in California. These two earthquakes were recorded by several observatories near the epicentre. Both the direct and indirect *P* waves were identified, and a method allowing of the accurate calculation of the depth of focus was used. The epicentre was at lat. 37° 31′ N., long. 119° 2′ W., the focus was at a depth of 5 km., and the granitic layer in the region is 20–25 km.—**Clyde E. Keeler**: The independence of dominant spotting and recessive spotting (' piebald ') in the house mouse.—**H. C. Ramsperger and G. Waddington**: The interpretation of the thermal decomposition of nitrous oxide. Data of all known unimolecular actions are included.—**Wilder D. Bancroft and J. E. Rutzler, jr.**: Reversible coagulation in living tissue (1). Intravenous injections of sodium thiocyanate solutions bring rabbits out of the unconsciousness due to ether, amytal, or morphine more rapidly than is normal, can prevent death from strychnine or histamine, and can prevent anaphylactic shock in rabbits sensitised with egg-white sol. Potassium salts cannot safely be substituted for sodium salts, because of their greater toxic action. It is considered that since sodium thiocyanate peptises proteins, its effect is to counteract disturbances due to coagulation of nerve proteins; this supports Claude Bernard's view that anæsthesia is due to coagulation of nerve colloids.—**Tracy Yerkes Thomas**: On the unified field theory (4). A consideration of the so-called geodesics of zero length which give the light tracks in the Einstein theory of gravitation.—**Leonard Carlitz**: The arithmetic of polynomials in a Galois field.—**Hassler Whitney**: (1) On the colouring of graphs.—(2) Non-separable and planar graphs.—**Francis D. Murnaghan**: The principle of Maupertuis.—**A. D. Michal**: Notes on scalar extensions of tensors and properties of local co-ordinates.

Official Publications Received.

BRITISH.

Ministry of Agriculture and Fisheries. Marketing Leaflet No. 30: Litter Testing and Pig Recording; Interim Report by the Pig Industry Council. Pp. 8. (London: Ministry of Agriculture and Fisheries.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 4 (New Series), No. 4, April. Abstracts Nos. 585-747. Pp. 107-146. (London: H.M. Stationery Office.) 9*d*. net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1361 (E. 43—I.C.E. 761, 790): Carburettor Fuel Metering Characteristics. By W. C. Clothier. Pp. 12+15 plates. (London: H.M. Stationery Office.) 9*d*. net.

Proceedings of the Royal Irish Academy. Vol. 40, Section B. No. 2: Contributions to the Fungus Flora of Ulster. By Arthur E. Muskett, E. Norman Carrothers and Hugh Cairns. Pp. 37-55. 6*d*. Vol. 40, Section B, No. 3: Further Studies in the Pigment of the Berry of the Elder (*Sambucus nigra* Linn.). By Thomas J. Nolan and Hyacinth M. T. Casey. Pp. 56-66. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1931, Vol. 43, No. 4, May. Pp. 157-202+xlii. (London.)

Journal of the Chemical Society. May. Pp. iv+1033-1314+x. (London.)

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 42, Part 1, May 28th. Pp. 85. (London: Edward Stanford, Ltd.) 5*s*.

The International Commission on Illumination. The Origin, Organisation and Work (with Appendices). Pp. 24. (London: The International Illumination Congress.)

The University of Sheffield. Report on Research Work carried out in the Departments of Mining and Fuel Technology during the Session 1929-30. Pp. 14. (Sheffield.)

City of Birmingham: Education Committee. Selection of Skilled Apprentices for the Engineering Trades: Report of Research. By E. Patricia Allen and Percival Smith. Pp. iv+35. (Birmingham.)

The British South Africa Company. Publication No. 1: The South African Citrus Thrips in Southern Rhodesia. By Dr. W. J. Hall. Pp. 56+8 plates. (London and Salisbury: The British South Africa Co.)

Paleontologiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 1, Stuk 2: Die Krytfauna van Soeloeland. 2: Voorlopige Beskrywing von enige Soeloelandse Ammoniete. 1. Lophoceras, Rhytidoceras, Drepanoceras en Deiradoceras. Deur Dr. Ir E. C. N. Van Hoepen. Pp. 39-54. (Bloemfontein.)

Mines Department: Safety in Mines Research Board. Paper No. 66: Haulage Accidents in Coal Mines. Report of the Haulage Committee of the Safety in Mines Research Board. Pp. 20. (London: H.M. Stationery Office.) 6*d*. net.

Ten Years of Research for the Metal Industries: a Brief Record of Progress made by the British Non-Ferrous Metals Research Association, 1920–1930. Pp. 30. (London.)

The League of Science (The Science Party). Report on Preliminary Work and Activities from 11th November 1929 to 1st May 1931. Pp. 8. (London.)

Brighter Biochemistry: being the Illustrated Journal of the Biochemical Laboratory, Cambridge. No. 8, May. Pp. 38. (Cambridge.) 2*s*.

National Health Insurance. Memorandum on Certification of Incapacity for Work, giving the Results of Recent Investigations as to the Causes of Increase of Claims to Sickness and Disablement Benefit. (Memo. 329/I.C.) Pp. 31. (London: Ministry of Health.)

Navy: Hydrographer's Report. Report on Admiralty Surveys for the Year 1930 by the Hydrographer of the Navy. Pp. v-x. (London: Admiralty.)

The Quarterly Journal of the Geological Society of London. No. 346, Vol. 87, Part 2, May 29th. Pp. 179-375+lxiv. (London: Longmans, Green and Co., Ltd.) 7*s*. 6*d*.

Empire Cotton Growing Corporation. Report of the Tenth Annual General Meeting. Pp. 16. (London.)

Proceedings of the Royal Society. Series A, Vol. 131, No. A818, June 3. Pp. 517-703+xxx. (London: Harrison and Sons, Ltd.) 10*s*.

Apia Observatory, Apia, Western Samoa. Report for 1927. Pp. 86. (Wellington, N.Z.: W. A. G. Skinner.)

Records of the Botanical Survey of India. Vol. 13, No. 2: A Census of Indian Mosses, with Analytical Keys to the Genera referred to in the Census as well as all the Genera dealt with in the second edition of Prof. Brotherus' account of the Musci Veri in Engler and Prantl's "Pflanzenfamilien". By P. Bruhl. Pp. v+152. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s*.

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1931 June 6. Pp. 17. (Greenwich.)

Imperial Bureau of Plant Genetics (for Crops other than Herbage). Papers on Plant Genetics received from January to June 1930. Pp. 23. Papers on Plant Genetics, Vol. 1, No. 2. Pp. 36. Plant Breeding Abstracts, Vol. 1, No. 3. Pp. 52. (Cambridge: School of Agriculture.)

Canada: Department of Mines: Mines Branch. The Mining Laws of Canada: a Digest of Dominion and Provincial Laws affecting Mining. (No. 713.) Revised edition. Pp. v+98. 25 cents. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories) 1929. (No. 720.) Pp. ii+208. (Ottawa: F. A. Acland.)

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the Year 1930. Pp. 9. (Cape of Good Hope.)

County Borough of Halifax. Bankfield Museum Notes, Second Series, No. 12: Methods of Hand Spinning in Egypt and the Sudan. By Grace M. Crowfoot. Pp. 51+44 plates. (Halifax.) 3*s*.

Ministry of Agriculture and Fisheries: Department of Agriculture for Scotland, and Ministry of Agriculture for Northern Ireland. Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1929–1930. Pp. 280. (London: Ministry of Agriculture and Fisheries.) 1*s*. net.

FOREIGN.

Известия тихоокеанского научного института рыбного хозяйства (Bulletins of the Pacific Scientific Fisheries Institute). Vol. 4, Part 2: Очерк водорослевого пояса приморского побережья в связи с некоторыми общими вопросами его использования (Eine Übersicht des Tangguertels des Kustengebietes im Zusamn enhang mit einigen allgemeinen Fragen seiner Ausbeutung). Von Harry Gail. Pp. 46. 50 коп. Vol. 5: Обзор рыб дальневосточных морей (A Review of the Fishes of the Seas of the Far East). By Prof. V. K. Soldatov and Prof. G. J. Lindberg. Pp. xlvii+576. 6 руб. Vol. 6: Сельдь (*Clupea harengus* Palassi C.V.) залива петра великого, биологический очерк (The Herring *Clupea harengus* Pallasi C.V.) of Peter the Great Bay, a Biological Sketch. By A. I. Ambroz. Pp. viii+313. 5 руб. (Vladivostock.)

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 281: Mechanism of the Atomization of Liquids. By R. A. Castleman, Jr. Pp. 369-376+3 plates. 5 cents. Research Paper No. 289: Extension of the Standard Visibility Function to Intervals of 1 Millimicron by Third-Difference Osculatory Interpolation. By Deane B. Judd. Pp. 465-471. 5 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the Colorado Museum of Natural History. Vol. 10, No. 2: Prehistoric Flaked Points from Colorado and neighboring Districts. By E. B. Renaud. Pp. 22+3 plates. (Denver, Colo.)

University of Illinois Engineering Experiment Station. Bulletin No. 226: Laboratory Tests of Reinforced Concrete Arches with Decks. By Prof. Wilbur M. Wilson. Pp. 97. 50 cents. Bulletin No. 227: The Effect of Smelter Atmospheres on the Quality of Dry Process Enamels for Cast Iron. A Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in coöperation with the Utilities Research Commission. By Prof. Andrew I. Andrews and Horace W. Alexander. Pp. 16. 10 cents. (Urbana, Ill.)

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 620: Geology and Ground-Water Resources of Western Sandoval County, New Mexico. By B. Coleman Renick. Pp. vi+117+10 plates. 35 cents. Water-Supply Paper 641: Surface Water Supply of the United States, 1927. Part 1: North Atlantic Slope Drainage Basins. Pp. vii+188. 35 cents. Water-Supply Paper 643: Surface Water Supply of the United States, 1927. Part 3: Ohio River Basin. Pp. vii+216. 35 cents. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture. Circular No. 157: Fig Insects in California. By Perez Simmons, W. D. Reed and E. A. McGregor. Pp. 72. (Washington, D.C.: Government Printing Office.) 20 cents.

The Bashford Dean Memorial Volume. Archaic Fishes. Edited by Eugene Willis Gudger. Article 2: The Segmentation of the Egg of the Myxinoid, *Bdellostoma stouti*, based on the Drawings of the late Bashford Dean. By Eugene Willis Gudger and Prof. Bertram G. Smith. Pp. 43-62+2 plates. (New York: American Museum of Natural History.)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 9, Part 1, March. Pp. 114+27 plates. (Tôkyô: Iwanami Shoten.) 1.66 yen.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 6, No. 5, May, R.P. Nos. 303-313. Pp. 765-916. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 78, Art. 2: Catalogue of Human Crania in the United States National Museum Collections. By Aleš Hrdlička. (No. 2845.) Pp. 95. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: Freer Gallery of Art. Yaksas. Part 2. By Ananda K. Coomaraswamy. (Publication 3059.) Pp. 84+50 plates. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Bulletin 100: Contributions to the Biology of the Philippine Archipelago and adjacent Regions. The Fishes of the Families Pseudochromidae, Lobotidae, Pempheridae, Priacanthidae, Lutjanidae, Pomadasyidae and Teraponidae, collected by the United States Bureau of Fisheries Steamer *Albatross*, chiefly in Philippine Seas and adjacent Waters. By Henry W. Fowler. Pp. xi+388. (Washington, D.C.: Government Printing Office.) 60 cents.

Les observatoires astronomiques et les astronomes. Par P. Stroobant, J. Delvosal, E. Delporte et F. Moreau. Pp. 315. (Uccle: Observatoire Royal.) 14 Belgas.

Suomen Geodeettisen Laitoksen Julkaisuja (Veröffentlichungen des Finnischen Geodätischen Institutes). No. 15: Der Einfluss der den Pendel umgebenden Luft auf die Schwingungszeit beim V. Sterneckschen Pendelapparat. Von M. Franssila. Pp. 23. No. 16: Ergebnisse der astronomischen Ortobestimmungen auf den Finnischen Dreieckspunkten. Von Y. Leinberg. Pp. 162. (Helsinki.)

The University of Colorado Studies. Vol. 18, No. 3, April. Pp. 119-176. (Boulder, Colo.)

Proceedings of the Imperial Academy. Vol. 7, No. 4, April. Pp. ix-x+129-178. (Tokyo.)

The Carnegie Foundation for the Advancement of Teaching. Bulletin No. 26: Current Developments in American College Sport. By Howard J. Savage, John T. McGovern, Harold W. Bentley. Pp. iv+58. (New York City.) Free.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 83. A new East African Francolin. By W. Wedgwood Bowen. Pp. 301-303. (Philadelphia.)

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 20, No. 1: Geographic Variation in the Richardson Grouse. By Harry S. Swarth. Pp. 7. (San Francisco.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 68: Stresses under Tension in a Plate with a Heterogeneous Insertion. By Katsutada Sezawa and Genrokuro Nishimura. Pp. 25-43. 0.18 yen. No. 69: On the Buckling under Edge Thrusts of a Rectangular Plate clamped at Four Edges. By Katsutada Sezawa. Pp. 45-59. 0.15 yen. No. 70: On the Lateral Vibration of a Rectangular Plate clamped at Four Edges. By Katsutada Sezawa. Pp. 61-70. 0.11 yen. No. 71: Atomic Heat at Constant Pressure of Crystalline Substances. By Yositosi Endô. Pp. 71-82. 0.12 yen. (Tôkyô: Koseikai Publishing House.)

Japanese Journal of Astronomy and Geophysics. Transactions and Abstracts, Vol. 8, No. 3. Pp. 4+67-207+11-44. (Tokyo: National Research Council of Japan.)

CATALOGUES.

A Catalogue of Publications in Medicine and Science. Pp. xiv+66. (London: Baillière, Tindall and Cox.)

Leitz Epidiascopes. Pp. 26. (Wetzlar and London: Ernst Leitz.)

Diary of Societies.

FRIDAY, JUNE 26.

ROYAL SOCIETY OF ARTS, at 4.30.—W. L. Stampe: The Ganges Canal Hydro-Electric Scheme: A System of Rural Electrification.

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Queen's College, Oxford), at 2.—Dr. W. T. Hillier: The Lateral Line of Sense Organs. —At 5.—E. A. Peters: (*a*) A Test for Maximum Tuning Fork Hearing; (*b*) A Case of Cerebellar Abscess Drained Anterior to the Lateral Sinus.—Demonstration:—Dr. M. Macnaughton Jones: Models Illustrating the Physiology of the Ear.

SATURDAY, JUNE 27.

BRITISH PSYCHOLOGICAL SOCIETY (at Reading University), at 3.15.—Papers on Oscillation:—Miss M. I. Dunsdon: Reversible Perspective and the Effect of Conation.—Mrs. H. W. Oldham: Oscillation in Sounds of Low Intensity.—Demonstrations of Apparatus by D. F. Vincent: (*a*) A Mirror Tachistoscope Without Moving Parts; (*b*) An Apparatus for Producing Sounds of Predetermined Wave-form.

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Queen's College, Oxford), at 10.30 A.M.—Discussions: The Physics of Sound and the Physiology of Hearing, and on the Questionnaire of the Otosclerosis Committee.

TUESDAY, JUNE 30.

ROYAL ANTHROPOLOGICAL INSTITUTE (Annual General Meeting), at 8.30. —Presidential Address.

FRIDAY, JULY 3.

ASSOCIATION OF ECONOMIC BIOLOGISTS (Summer Meeting) (at Farnham House Parasite Laboratory, Farnham Royal).

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section) (at Bath).

PUBLIC LECTURE.

FRIDAY, JUNE 26.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir Thomas Legge: Industrial Poisonings.

CONGRESSES.

JUNE 29 TO JULY 4.

INTERNATIONAL CONGRESS OF THE HISTORY OF SCIENCE AND TECHNOLOGY.

Monday, June 29, at 3 (at Royal Geographical Society).—Dr. C. Singer: Presidential Address.

At 4.30.—Reception (at Science Museum) by Sir Henry Lyons and Lady Lyons.

At 9.—Reception (at Royal Society of Medicine) by the President and Mrs. Singer.

Tuesday, June 30, at 9.30 A.M. (at Science Museum).—The Sciences as an Integral Part of General Historical Study, and The Teaching of the History of Science.

At 4.30.—Reception (at Royal Society) by Sir Frederick Hopkins and Lady Hopkins.

At 9.—Reception (at Royal Institution) by the Managers.

Wednesday, July 1 (at Cambridge).

Thursday, July 2, at 10 A.M. (at Science Museum).—Historical and Contemporary Inter-relationship of the Physical and Biological Sciences.

At 4.30.—Reception (at Institute of Historical Research) by the Director and Committee.

At 9.—Reception (at Royal College of Physicians) by Lord Dawson of Penn.

Friday, July 3, at 10 A.M. (at Science Museum).—Interdependence of Pure and Applied Science.

Saturday, July 4 (at Oxford).

JUNE 29 TO JULY 4.

CONGRESS OF NAVAL ARCHITECTS (Institution of Naval Architects and Association Technique Maritime et Aéronautique) (at Paris).

Papers on—
Shipbuilding.
Marine Engineering.
Civil Aviation.

JULY 4 TO 11.

ROYAL SANITARY INSTITUTE (at Glasgow).—Subjects for Discussion:—
The Rôle of the Hospital Relative to the Development of Preventive Medicine.
The Proposals of the British Medical Association for a General Medical Service, from the Standpoint of Preventive Medicine, in Relation to National Health Insurance.
Development of the National Health Insurance Scheme.
Administration of the Local Government Act, 1929.
Eugenic Sterilisation.
Health Certificates before Marriage.
Pregnancy and Tuberculosis.
Maternity and Child Welfare Work.