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The Position of Naval Engineers.

IT was the late Lord Goschen who, forty years ago, remarked in the House of Commons that "discontent in the public service is a great calamity to the country." Curiously enough, he was then referring to the efforts being made to raise the status of engineer officers in the Royal Navy. Were he alive to-day he would have greater cause to utter the warning, for if ever there was a matter calling for inquiry and remedial measures, it is the discontent which has arisen through the treatment of the engineer officers of to-day, and especially those who have been trained at Osborne and at Dartmouth. These are the officers who, instead of electing to remain on the upper deck and to become navigating, torpedo, and gunnery officers, have specialised in engineering duties and are therefore known as lieutenants 'E' and commanders 'E.' Numbering between two and three hundred, these officers have been promised over and over again that by specialising in engineering their position as executive officers should in no way be jeopardised, and that they should be considered eligible for appointments as admiral superintendents of dockyards and similar posts. They were, in fact, to remain on an absolute equality with the navigating, torpedo, and gunnery officers, except that by becoming engineer officers they abandoned the right to command sea-going ships and, of course, fleets. Of these things there is no shadow of doubt whatever. There never was a clearer case of what was promised and intended, and the officers in question have nothing to fear by the fullest publicity.

The discontent to which we refer is the result of the Fleet Order No. 3241 of last November, an Order which will go down to history as one of the most sinister pieces of internal legislation recorded in any of our public services. Meanly conceived, provocatively worded and aggressively promulgated, that Order has created dissatisfaction throughout the engineering world, and the remonstrance uttered by Sir William Ellis at the recent dinner of the Institution of Naval Architects, when two members of the Board of Admiralty were present, is without precedent in the history of naval affairs. This great Institution was founded in 1860, but we believe a search through its index would fail to find any similar reference to any body of officers employed under the Admiralty, much less to a body of officers who come under the Naval Discipline Act. The remonstrance of Sir William Ellis had been preceded earlier in the day by the speech of the Duke of Northumberland, who, as president of the Institution, voiced the opinion of the council on which serve some of our greatest naval architects, shipbuilders, and engineers, and among whom are Admiralty officers.

We have already, in our article of February 6 on "The Status of the Naval Engineer," given a fair and impartial account of the circumstances leading up to the grant of military status to all engineer officers, and we there referred to the deputation which, with Sir William Ellis as its head, waited upon the First Lord, the Right Hon. W. C. Bridgeman, M.P. Mr. Bridgeman's reply unfortunately revealed no spirit of conciliation or sympathy. He practically told the deputation they had no case, there was nothing in the order derogatory to the position of the engineer officers, and that there was no cause for any feeling of injustice. If Mr. Bridgeman really meant what he said, then he could not have taken the trouble to get down to the bottom of things, while if he simply acted as the mouthpiece of the executive officers on the Board, he was wanting in the first attribute of a statesman.

The further action of the deputation is justified in every respect. It immediately published in full the memorandum which had been handed to Mr. Bridgeman; it stated that Mr. Bridgeman's reply was viewed with grave concern, and it said it would take steps to raise the question in Parliament and the public press. Since then a debate has taken place in the House of Commons in which Mr. Bridgeman treated the matter as of little moment and, among other things, said, "I do not think that those who have raised this question are doing any service to the Engineer Officers in the Navy by trying to magnify what I think is a very trifling irritation," so that which every engineer both inside the Admiralty and outside consider a gross injustice, Mr. Bridgeman regards as a "trifling irritation."

The more one knows of the Order the more one is astonished; and how the distinguished men on the Board could have put their names to such a document is inexplicable. The Order, if it meant anything, meant that it took away the special standing granted to engineer officers by the Selborne Scheme and by the Admiralty action in 1915. The granting of military status to engineers in the Navy was welcomed right throughout the land, but to-day, with the echo of the guns still in our ears, the very Admirals who gained their earldoms and their knighthoods and their grants of public money through the successes which in the first place depended on the efficiency of the engineering branch of the Navy, are content to see the engineers again reduced to the inferior position they occupied for so long.

Were all their eulogies of the engineering department so much lip service? Here is one such eulogy: it was written after the Battle of Jutland. "During action the officers and men of that department perform their most important duties without the incentive which the knowledge of the course of the action gives to those on deck. The qualities of discipline and endurance are taxed to the utmost under these conditions, and they were, as always, most fully maintained throughout the operations under review."

During the War, the Engineer-in-Chief was responsible for a personnel exceeding eighty thousand, and yet to-day his department can be treated as if of little account; an Order adversely affecting the whole of his staff can be drawn up without consulting him, and all the guarantees given can be converted into scraps of paper.

To all this there is no answer. The pages of the engineering press and the columns of the *Times* have recorded again and again the protests of the engineers who have served in the Navy and are of the engineering profession, and though there are some three hundred retired flag officers and some six hundred retired captains, none of them come forward to uphold the Admiralty or to explain the need for the deprivation of the engineers of their military status. Could there be any more significant fact? The Order of last November had as its sole object the belittlement of the engineers, and it was known at the time that the want of military status would load the scale against the engineer on every possible occasion.

It would be a slander to say that the Order of November reflects the general attitude of the executive officers of the fleet toward the engineer officers, for there is plenty of evidence to the contrary. If the Board of Admiralty is resolved not to rescind the Order, it will be the duty of the Engineering Institutions to take the matter higher, for clearly the injustice of the whole thing will inevitably foster that discontent which Lord Goschen stated to be "a great calamity to the country."

Egyptology in Victorian Dress.

Descriptive Sociology: or, Groups of Sociological Facts. Classified and Arranged by Herbert Spencer. Division 1, No. 11: Ancient Egyptians, Compiled and Abstracted upon the Plan organised by Herbert Spencer by Prof. Sir W. Flinders Petrie. Issued by Mr. Spencer's Trustees. Pp. iii + 3 Tables + 79. (London: Williams and Norgate, Ltd., 1925.) 25*s.* net.

"IN preparation for *The Principles of Sociology*, requiring as bases of induction large accumulations of data, fitly arranged for comparison, I, in October 1867, commenced by proxy the collection and organisation of facts presented by societies of different types, past and present: being fortunate enough to secure the services of gentlemen competent

to carry on the process in the way I wished. Though this classified compilation of materials was entered upon solely to facilitate my own work; yet, after having brought the mode of classification to a satisfactory form, and after having had some of the Tables filled up, I decided to have the undertaking executed with a view to publication: the facts collected and arranged for easy reference and convenient study of their relations being so presented, apart from hypothesis, as to aid all students of Social Science in testing such conclusions as they have drawn and in drawing others."

The quotation is from Herbert Spencer's "Provisional Preface" to the second volume in the series which he began to publish under the general title of "Descriptive Sociology," and the date subscribed to it is 1874. Another volume appeared in the same year, and a third in 1876. Fifty years later Sir Flinders Petrie gives us "Ancient Egyptians," and we learn from his preface that two further volumes are in the press, besides a reprint of one of the earlier volumes. Their ultimate purpose is explained in the passage quoted above. The idea of collecting data from all known civilisations (divided into three groups: "uncivilised societies,"—in which ancient Egypt is included!—"civilised societies, recent or decayed," and "civilised societies, present or still flourishing"), analysing their contents, and evolving generalisations from the results, was a colossal conception even for the Victorian Age, when the limits of knowledge in any one sphere were comparatively small.

To-day, no one man would contemplate such an undertaking as an ideal, still less as a practicable possibility. It is now more than twenty years since Spencer died, and the introductory volumes of material, originally intended "solely to facilitate my own work," are still to be completed. What was to be his own work, "The Principles of Sociology," will never appear. In the days when solidity was as essential in furniture as it was in morals and literature, and when to make a book look as much like an office ledger as possible seemed to give it a guarantee of respectability, a book 19½ in. × 12½ in. may well have been considered fitting. But the publishers can scarcely be forgiven for offering their public, in 1926, a work of archaic form and appearance, modelled on the standards of 1850, which for inconvenience of size makes a ledger look almost like a pocket edition! The cover and arrangement of the letterpress within are in keeping, and give the book so antiquated an appearance that one can only suppose it possible that Mr. Spencer's trustees and their publishers are tied up by testamentary red tape in the matter.

If in such a volume the information is considered to have been arranged "for easy reference and convenient study," what should we have had to expect from the great work of which it is only one of the foundation stones?

Yet if we are relieved at our loss, we have to consider that it was essentially the plan that was wrong—and not the purpose. Much in the paragraph quoted at the beginning of the review is strongly reminiscent of the objects for which the Royal Anthropological Institute now exists. The method which Spencer here originated was the method of modern anthropologists. His aim was essentially scientific—to collect all possible data; without which no conclusions were valid. Only, he proposed to do by himself what we now know cannot be done by one man.

In the collection of his material, however, he accepted the principle of specialisation. The bulk of each volume consists in quotations from trustworthy published works, with references, giving all the facts concerning the Society under discussion which can be grouped under the heading sociological. To these were appended tables (generally three or four) giving an analysis of the chronological development of the main sociological factors.

Sir Flinders Petrie began to prepare the volume under consideration in 1910. But, as he points out in his preface, a great deal of our knowledge of ancient Egypt is—and at that time still more was—not yet published in books, but is inherent in the objects in our museums and in the inscribed and painted walls of the buildings of Egypt. Thus, in addition to the extracts from published works (most of which were made by Miss M. A. Murray), a great deal had to be written up by Petrie himself. In this respect it may be noted that, though the work was begun sixteen years ago and its publication only stopped by the War, he has been conscientious in bringing this additional matter of his own up-to-date, at all events in reporting the results of recent excavations. Although in the opinion of the reviewer Petrie is not prepared to give its due to the documentary evidence—on stone inscriptions and papyri—from the ancient Egyptian civilisation, yet no one could deny that we owe a far greater proportion of our knowledge of its sociology to the objects found in the country; and as it was a rich and powerful civilisation which lasted over thousands of years, the variety of those objects is immense.

This has resulted in the production of a book even more of the nature of an encyclopædia than Mr. Spencer's principles necessitate. It is, in fact, a glorified handbook to Egyptology, very thorough in its intention to cover all the ground, but hopelessly inadequate in detail—as it needs must be—on some of the most interesting points. Thus while Herodotus is quoted to prove that gymnastics were practised in honour of a

Greek hero in Panopolis, the inventor of the system of "sequence-dating" has confined his remarks on pottery to two quarter columns which are largely mutually inclusive. But our quarrel here is not with Petrie, for if the work was to be done no one was better qualified for it than he. Rather, the question is: What is the justification for an encyclopædia of this sort? To the specialist in Egyptology it is waste of labour to turn to it. The matter under any given heading is necessarily so general that he already knows it, and the list of reference books, to which he is sent for greater detail, contains nothing with which he is not familiar. In other words, he would go straight to whichever of these works he requires without thinking of consulting "Descriptive Sociology."

For the layman it is more promising—at first sight. For those who have no particular interest in Egypt it may sometimes be necessary to consult Egyptian practice, mainly in connexion with other facts. They have only to refer to the "Contents" of this book, which gives all the headings and sub-headings in the order in which they occur, and takes the place of an index. They can turn up the main facts on the spot and discover where to find a fuller treatment of the subject when they want it. Unfortunately this has been done far better long ago. Erman's "Life in Ancient Egypt" covers all the ground (frequently, of course, in bare detail) and presents a consistent and readable story, efficiently illustrated, and supplies references and bibliography. It does all this in a volume of convenient size for handling, which was quite recently re-edited by Ranke. It is indeed difficult to see how anybody should buy Sir Flinders Petrie's book unless it be that he is anxious to have a complete series of the "Descriptive Sociology."

It is difficult to review the matter, as such, in a compilation of this kind, more particularly when so much of it consists of extracts from other writers. In spite of a large proportion of works by the author—46 out of 158—in the "List of Books," the references are very fairly distributed, and with, on the whole, a very impartial judgment which frequently leads to the juxtaposition of opposite views. It would be strange if there were not details at which to carp. Perhaps the most glaring fault in the text itself is the small space given to the subject headed "Language and Writing." All that we know about the hieroglyphic and cursive writings, and the literature they express, is summarised by Petrie in a single page, and no mention is made of the great Herakleopolitan literary tradition. Such omission, however, is at the worst an error of judgment. There is one point with which criticism must deal far more sternly. It is an old source of bitter complaint amongst Egyptologists, and in a specialist Egyptological journal we should prefer to pass over it. For there, at least, it does no harm, since we are aware of Sir Flinders' idiosyncrasy in the matter. But to those unacquainted with the literature on the subject his introduction to Egyptian chronology will not only be utterly misleading as to the facts themselves, but also prejudicial to the trustworthiness of other writers.

The form of this introduction, consisting of a short list of periods and dates (headed "Periods of Egyptian History"), is familiar to Egyptologists. In these columns are placed respectively a date, the name of the geological period, or later of the dynasty, and the site on which remains of the period have been found. Passing over, as too technical a point for discussion here, the concatenation of two entirely separate flint finds at Badari and in the Fayum Desert under the single description of "Solutrean" (with a correspondingly high date—11000–9500 for both), we come to the crux of the matter in the subdivision of Dynastic dates, headed respectively "By the Egyptians," "By Berlin 1917," and "Berlin 1900." Thus for the 1st Dynasty we get the equation: By the Egyptians, 5500–5300; By Berlin 1917, 4186; Berlin 1900, 3400. If only one Berlin date were given, it might be possible to assume that Sir Flinders Petrie was holding the dating of the Egyptians up to scorn in the light of modern scientific research! As it is, the only conclusion that the uninitiated can draw is that German scholars are so uncertain of their chronological methods that they alter a single date by nearly a millennium in the course of seventeen years' study; hence no reliance is to be placed in them; and that all this is due to the fact that they will not follow the ancient Egyptians' own account of their chronology (as contained in the Palermo Stone, etc.).

This can only be characterised as a very strange presentment indeed of the facts. In the first place, "Berlin 1900" represents the date generally accepted (with very slight variations) by scholars not only on the Continent, but also in Great Britain and in the United States, with only two exceptions, namely, the authors of the systems detailed in Petrie's other two columns, himself and Dr. Borchardt, who is meant by the column "By Berlin 1917," which is still credited by one or two German scholars, in spite of its recent demolition by Prof. Peet. Thus the date proposed by Eduard Meyer (Berlin 1900) has been generally accepted, with but slight modification, ever since. The phrase "By the Egyptians" is equally misleading, suggesting as it does that the German historians must have disregarded the evidence of Egyptian documents. No suggestion could be more inept, for without those

documents it would be impossible to produce any chronology at all. We need not go into the technical points for or against the inclusion of the extra Sothic cycle which is responsible for the difference in dating between Petrie and all other scholars; for it should be clear to all fair-minded persons that unless the rest of the Egyptological world is leagued together to put Petrie in the wrong, regardless of truth, the chances are that the majority is right. We do not, of course, take objection to Sir Flinders Petrie's statement of his own opinions, but to this curious presentation of other people's, more particularly in a book which will by its nature be read (if at all) by the layman, who cannot test the matter, rather than by specialists, who discount what Sir Flinders says on the subject of chronology before the time of the XVIIIth Dynasty.

Timber Pests.

Enemies of Timber: Dry Rot and the Death-Watch Beetle, in which the Origin and Life-History of the two worst Enemies of Timber are given, with a Description of the Damage they cause, and the Methods to be adopted for their Examination. By Ernest G. Blake. Pp. xvii + 206 + 10 plates. (London: Chapman and Hall, Ltd., 1925.) 12*s.* 6*d.* net.

IN these days when there is grave need of sound technical advice designed to decrease private and national waste, and when it is so desirable that the general public shall acquire confidence in the practical value of technological science, it is regrettable that so unsatisfactory a compilation as the book under review should have been published. In the text elementary errors on fundamental matters and details abound, while misleading practical conclusions and unsound advice recur at intervals. A few quotations suffice to justify this condemnation.

"The endogens [monocotyledons] are described as inward growers, because the new tissue is formed annually at the centre of the tree instead of at the outside." "In the hardwoods [dicotyledons] the annual rings are nearly always narrow . . .; the colour of the wood is dark . . .": in the softwoods [conifers] "the annual rings are a good deal wider than in the previous class. . . ."

"Dry rot is caused by the extraction of a portion of the mineral contents by the roots of the fungus." "There are four conditions that are necessary for the successful germination and for the development of the fungus [causing dry rot]; these are darkness . . ."; there is "absolute necessity for the complete stagnation of the air before it [the fungus] can develop to its fullest maturity."

Particularly dangerous as regards its practical results are the misstatement that a fungus causing dry rot "is propagated only by means of spores," and the allegation that fungus-infected wood can be sterilised by "subjecting it to heat . . . in a drying kiln that is raised to . . . about 110 Fahr." Of the many species of fungi causing dry rot the author deals only with three, all of them growing outside as well as inside wood; he never even mentions those species the vegetative growth of which is confined to the interior of the wood. Despite of repeatedly terming dry rot a disease, he fails to see that the most economic treatment should be that suited to the particular fungus present, and regardless of expense he prescribes the same costly treatment for all.

The part of the book dealing with the only two species of wood-attacking insects considered, *Anobium punctatum* and *Xestobium tesselatum*, is perhaps the least unsatisfactory; for the author appears to have made free use of the writings of Dr. Gahan and Prof. Maxwell Lefroy, and provides some excellent figures of the two species and their work. Yet it is truly remarkable that an author setting out to give practical advice on preservation of wood in buildings should be under the impression, and should actually state, that dangerous attacks by Xestobium are more unseen and stealthy than those of termites and fungi causing dry rot. He appears to be unaware that a joist attacked by 'worm' sustains its load years after its surface shows holes made by these insects; whereas a joist hollowed to a mere shell by termites, or thoroughly rotten with internal decay caused by a species of Lenzites, may show no external sign of injury before it crashes. P. G.

British Universities.

The Yearbook of the Universities of the Empire, 1926. Edited by W. H. Dawson. (Published for the Universities Bureau of the British Empire.) Pp. xii + 792. (London: G. Bell and Sons, Ltd., 1926.) 7*s.* 6*d.* net.

THE "Yearbook" was first published in 1914 as a handy substitute for a collection of the calendars of the universities of the British Empire. According to the preface, the aim of the editor was to collect from the calendars information of general interest and value to members of other universities, to public bodies, and to the public generally. This is a task by no means to be underrated, and we may say at once that it has been admirably carried out. The arrangement of the book is conveniently simple and consistent throughout, so that in a few minutes a working knowledge of it can be obtained.

The volume is intended to be used for reference and can scarcely be said generally to be 'readable' in the ordinary sense; nevertheless, the introductions to the sections dealing with the universities of Great Britain and Ireland, of Canada, of Australia, of South Africa and of India, form interesting summaries of the history of university education in the Empire. Under the heading of each university is collected a vast amount of important and useful information as to the institutions, teachers and degrees, together with some account of inter-university co-operation and what may be called extra-mural work, such as public lectures and extension work.

University education is now an integral part of our national life, and the general public can scarcely fail to find interesting the sketch of the work of the universities of the British Empire and the notes showing the developments during the past year.

The appendices, in our opinion, constitute the most valuable part of the work. The sections on individual universities are undoubtedly a great convenience, but would probably be used most extensively by those who already have access to the calendars. The appendices, however, collate information of the utmost value. It is obviously necessary, for parents and teachers especially, to have a concise guide to the professions and careers for which universities can provide preparation, and in this respect the information may be considered adequate. No less valuable is the section dealing with professional schools and subjects of specialised study in the universities of the United Kingdom. Again, information is collected in the appendices as to matriculation examinations and conditions of admission of students from abroad. This alone should assure that the "Yearbook" is ready of access to parents and students, especially to those residing abroad. We have had considerable experience of overseas students, and are certain that much disappointment and expense would be avoided by them if they had a clear idea before they left home as to what the universities require for the purposes of admission. The "Yearbook" information on the subject is by no means exhaustive, but it at least provides an indication as to how to proceed.

Much could be said in commendation of the other appendices, but it will be sufficient in a short notice to express our opinion that the editor has performed a great service by including information about inter-university scholarships and research grants and about foreign universities, since the practice of migrating to other universities at home and abroad for advanced work has now fortunately become well established.

In dealing with a book of this kind it is not unimportant to note that there are complete indexes of names and of colleges as well as a general index. Looking at the "Yearbook" as a whole, it is difficult to see how the material could have been arranged more effectively. It is extraordinary what interest the editor has managed to infuse into a book which, in the manner of directories, must be dull in places. The work, too, must be regarded as one result of the working out of the great aim of the body for whom it is published—the Universities Bureau of the British Empire—namely, to bring into closer touch with each other the universities of the Empire. S. J. W.

Histogenesis of Human Endocrine Organs.

The Histology of the more Important Human Endocrine Organs at Various Ages. By Dr. Eugenia R. A. Cooper. (Oxford Medical Publications.) Pp. xiii +119. (London: Oxford University Press, 1925.) 12*s.* 6*d.* net.

IN this small volume a praiseworthy attempt is made to record the histological appearances of some of the endocrine organs of the human subject at various ages. The author confines her task to the thyroid, parathyroid, pituitary body, suprarenals, and thymus, though recognising that the latter organ has little claim to be considered an internally secreting gland.

For purposes of comparison of the same organ at different ages constant methods of fixation and staining are necessary, and the author has selected the simplest and most commonly employed. Formal infixation has its advantages when the material to be investigated is not available immediately after death; but exact cytology is impossible, and only the grosser changes in structure can be revealed under these conditions. For this reason the work will be of more interest to the pathologist than to the histologist. Another serious difficulty lies in the determination of what is normal and what is pathological in human material. Some of the observations recorded in the book have been made on subjects, presumably healthy, who have died from accidents, but the bulk of human material obtained from the mortuary is more likely to be pathological. The author is aware of this, and quotes Hammar to the effect that "the thymus gland is never found in the normal condition in persons who have died from disease." But bearing this in mind, a real service is undertaken in the description of glands at different ages as revealed by ordinary methods. A knowledge of microscopic structure at various ages in the human subject can only be obtained by the continuous observation of an abundance of carefully selected material. The author has made a good beginning, and it is to be hoped that she will carry on the work.

The pituitary gland is fully described; but it would be better in future to distinguish between the pars intermedia and pars tuberalis, the histological characters of which are quite distinct in the human pituitary. Some interesting observations are made upon the development of the suprarenals, but the employment of special methods is necessary to arrive at their correct interpretation.

The volume would be improved by the addition of the pancreas and gonads to the list of organs described. The condition of the Islets of Langerhans in pathological conditions requires investigation, but more elaborate methods would have to be undertaken if anything is to be made of the 'a' and 'b' cells of these structures.

The photomicrographs are for the most part well chosen and admirably reproduced; an index and useful bibliography are also furnished.

Our Bookshelf.

The Classification of Flowering Plants. By Dr. Alfred Barton Rendle. Vol. 2: Dictoyledons. Pp. xix + 636. (Cambridge: At the University Press, 1925.) 30*s.* net.

AFTER a somewhat long delay, the second and concluding part of this work has appeared, and may be cordially welcomed. Like the first, it follows the system of Engler, but in a general and not in any very close manner, and with considerable alterations in the system that many will think to be great improvements, especially from the point of view of practical usefulness in the study of systematic botany—the purpose for which the work is chiefly designed.

In a large monographic study, like the great work of Engler and Prantl, one must try to represent as closely as possible what one considers to be the most natural phylogenetic arrangement practical with the knowledge then available. But in ordinary practice, with a reader who is not highly skilled in taxonomy, one may almost say that the more nearly phylogenetic the arrangement, the more difficult does it become to use the system for the everyday purpose of determining the approximate relationships of plants more or less casually encountered. A departure from this method is desirable in the case of a book designed for students, and that is provided here with the restoration of the old group of the Monochlamydeæ. To be able to place a plant at once in one of three, rather than in one of two, divisions of dicotyledons is a great simplification of the labour; instead of having to wade through thirty orders, one has at most only seventeen. Each of the three groups thus made is then grouped in a phylogenetic arrangement, the Dialypetalæ, for example, beginning with the Ranales (now so commonly accepted as the most primitive of all) and working up to the Umbellifloræ, the Monochlamydeæ running from the Salicales to the Centrospermæ. Various alterations are also made in the arrangement of the orders and families, as compared with that adopted by Engler, and a great improvement is the splitting of some of Engler's unwieldy orders, *e.g.* of his Geraniales into Geraniales and Rutales.

Turning to the details of the book, the accounts of the individual families are clear, full, and concise, and at the end of each is given a most useful reference to the two or three most important publications dealing with that family. Finally, a word of praise must be given to the clearly drawn and well-explained figures and diagrams.

Plant and Animal Improvement: a Textbook for Students of Agriculture. By Prof. Elmer Roberts, in consultation with Prof. Eugene Davenport. Pp. xii + 174 + 5 plates. (Boston, New York and London: Ginn and Co., 1925.) 6*s.* net.

THIS modest volume stands distinct among a rather considerable number of books on genetics and breeding which the past few years have brought us. Its aim is "To give the student an intelligent view of the processes involved in the improvement of plants and animals." A simple primer, with no pretensions to being anything else, in letter and in spirit a 'practical man's' book, it seeks not to prove but to relate. Simple language, with plenty of attractive illustrations and clear diagrams, will undoubtedly appeal to the agricultural reader who interests himself in science solely because it may forward his practice.

Although detail is minimised, the exposition of fundamentals appears in general to have that security which brevity may sometimes endanger. The field of the book is naturally limited, but seems wisely chosen. Domestication with the elements of cytology and reproduction in animals and plants make a good introduction. Then come the rudiments of heredity and selection and those interesting theories, like telegony and prepotency, with which the breeder appears almost to be born. An inspiring chapter for the breeder is taken up by the ancestry of domestic animals. At the end is the now inevitable chapter on statistics. This is almost too brief and simple to be safe. But it is not in the brief exposition alone that statistical principles are so presented to the agriculturist as to jeopardise biological soundness. That yield trials should find no adequate place is much to be regretted. In scope and standard the book falls below the requirements of a normal university course for agriculturists. It offers, however, very profitable reading for the beginner and will certainly attract the practitioner.

Plant Forms and their Evolution in South Africa. By Prof. J. W. Bews. Pp. viii + 199. (London: Longmans, Green and Co., 1925.) 12*s.* 6*d.* net.

IN discussing in detail the growth forms of South African species of plants, Prof. Bews has developed in an inspiring way a conception of their ecological evolution. Starting from the idea that a certain number of plant habitats (such as moist tropical forests, stream sides, and swamps) are likely to have persisted little changed for long periods and at least since Cretaceous times, he points out that these primitive types of habitat are on the whole chiefly populated by primitive types of plants. This conclusion holds whether the plants are judged to be primitive either

on their reproductive characters or on their vegetative form. It is, therefore, a corollary of this that, on the whole, the more highly developed types of plants will occur chiefly in the more specialised types of habitat.

The South African flora lends itself very readily to interpretation along these lines. A large element of the flora is assumed to have come from the moist tropical forests to the north, and it is, therefore, not unexpected to find that most of the characteristic endemic forms are xerophytic. Further, if, in line with recent discussions, the tree growth form is regarded as primitive, then it automatically follows that the large number of scrub and grassland species in South Africa are, on the whole, of more recent origin, and the general trend of evolution would thus be towards xerophytic types. Prof. Bews notes that in such sub-tropical areas there is a tendency for a larger number of tropical types to appear as a given succession progresses, and he suggests the possibility of making use of this sequence to obtain some idea of the evolutionary groupings. An interesting observation is credited to General Smuts—that as the South African season develops, the tropical elements become more prominent, to the partial exclusion of the specialised South African types.

Blacks and Pitches. By H. M. Langton. (Oil and Colour Chemistry Monographs.) Pp. xi + 179 + 7 plates. (London: Ernest Benn, Ltd., 1925.) 15*s.* net.

THIS is one of a series of very useful monographs on oil and colour chemistry. The first five chapters deal with the production and properties of black carbonaceous pigments, followed by three chapters on the uses of such pigments in the paint, printing ink, and rubber industries. The following nine chapters deal with pitches, bituminous materials, and so on, the industrial uses in roofing felts, paving materials, paints, japans, etc., being considered in the concluding three chapters. Chapter xviii. is devoted to the weathering and ageing of bituminous materials.

A very wide range has been covered, and it can scarcely be expected that a full treatment of the subject could be condensed into 170 pages. Nevertheless, the volume is very readable and the author is to be congratulated on having done so much in so little space. The general arrangement of the book is good, the chapters following each other in logical sequence. An effort has been made to scan briefly all recent work on the subject, and for the reader seeking more detailed information the references and bibliography will be found very useful.

The author has, of necessity, drawn largely on American sources of information, and it will be clearly apparent to any reader how little favour the subject of blacks and pitches has found with research chemists in Great Britain.

The Table IX. on p. 39, taken from Bulletin 192 U.S. Dept. of the Interior Bureau of Mines, ought to have been reproduced in full scale, since in its present state it needs a lens to read it. Tables X. and XI. suffer from the same defect, and also Fig. 10. In this diagram the explanatory details to which the numbers refer have been omitted.

Visual Education. By F. N. Freeman and others. Pp. viii + 391. (Chicago: University of Chicago Press; London: Cambridge University Press, 1924.) 3.50 dollars.

MANY recent books on juvenile delinquency have suggested that 'the pictures' have an educational influence in the undesirable arts of pilfering and truancy. This book, however, is a comparative study of the value of the moving picture and of other visual and oral methods of presenting the more conventional educational information imparted in schools. It summarises the results of a number of investigations made in the United States with a grant from the Commonwealth Fund. Most of the experiments consisted in teaching the same lesson to parallel classes of children by different methods—the motion picture, the lantern, personal demonstration, and oral presentation—and comparing the subsequent knowledge and achievements of the children.

The results so far obtained are not very conclusive, but suggest that up to the present the chief use of the motion picture is in furnishing an introduction to instruction about moving objects, but even then it should be shown in small lengths. For general purposes, demonstrations and oral lessons, with the accompanying personal emphasis of the teacher, give more satisfactory and lasting results.

Much research is needed, the authors contend, to find all the fields of instruction in which the cinema will be useful, and the form of film best adapted to educational purpose. The interest aroused in this new type of teaching for industrial as well as for scholastic education will undoubtedly ensure that such research will be forthcoming. W. J. G. S.

Left-handedness: a New Interpretation. By Beaufort Sims Parson. Pp. ix + 185. (New York: The Macmillan Co., 1924.) 8*s.* 6*d.* net.

THE interest that has long been felt in the subject of left-handedness is testified to by the forty-seven pages of bibliography at the end of this book, and by the number and variety of theories described in the first chapter. Hereditary transmission, visceral distribution, anatomical inequalities, have all been advanced as possible explanations of left-handedness, but Mr. Parson finds none of these completely satisfactory and therefore offers a new and plausible theory of ocular dominance. His tenet, for which he gives experimental proof, is that man has progressed from pure binocular vision, and now has developed unilateral sighting facility which furnishes clearer vision. From this 'one-eyedness,' 'one handedness' (as opposed to ambidexterity) naturally follows, for the hand on the side of the functioning eye is more convenient for aiming. Habit ensures that this same hand is used for the manufacture and use of all instruments.

Mr. Parson suggests that the right, rather than the left, eye and hand have biological ascendancy from natural selection due to the increased chances of survival of those who used their left hands to protect their hearts, while their right hands were controlling their weapons.

Mr. Parson has devised a manuscope—an instrument for determining the dominant eye, and hence the

probable handedness. He has used it with interesting results with a large group of school children. The theory needs more evidence before it can be accepted, but it is decidedly suggestive and well worthy of future research. W. J. G. S.

Trattato di chimica generale ed applicata all' industria. Per Prof. Dott. Ettore Molinari. Vol. 1: *Chimica inorganica.* Parte Seconda. Quinta edizione riveduta ed ampliata. Pp. viii+681-1351. (Milano: Ulrico Hoepli, 1925.) 45 lire.

THE publication of five editions of a treatise on chemistry of the magnitude of 'Molinari' within the space of twenty years furnishes irrefutable evidence of the cordiality with which the book has been received by Italian chemists. The present volume follows the same general lines as its predecessors and completes volume 1, dealing with inorganic chemistry. Although the bulk of this second part exhibits no great advance beyond that of the corresponding portion of the fourth edition, descriptions of most recent developments of value have been added. Moreover, a number of entirely new sections are included, the most noteworthy being those on the low-temperature carbonisation of coal, decolorising vegetable carbons, pulverised coal, titanium pigments, and the borax industry of Tuscany. The important subjects of electrolytic soda and cement are accorded even more detailed treatment than formerly.

In general, the statistical data which form such a marked feature of the book are brought up-to-date, but in many cases the prices of products are still qualified by the description 'pre-War.' The numerous figures are mostly well reproduced and the printing is good, the rather smaller type, of which considerable use is made—evidently with the object of reducing the proportions of the volume—being not at all irksome to read. The price is fixed at what in Great Britain and nowadays would be a ridiculously low amount, and any chemist with a knowledge of the Italian language would find the book a profitable investment. T. H. P.

The Professor on the Golf Links: some Sidelights on Golf from Modern Science. By Charles W. Bailey. Pp. 91. (London: Silas Birch, Ltd., n.d.) 2*s.* 6*d.* net.

THIS book is by the same author as "The Brain and Golf," which was reviewed in these columns (August 23, 1924, p. 271). It consists of a light-hearted report of the casual conversations of some members of a golf club. The chief talker is known as 'The Professor,' whose topics range from the effect of jazz jumpers for men on their interest in colour and relation to women, to psychological types as reflected on the golf course and even in the owners' golf sticks as well. The author aims at linking golf with mental and physical science in order to interest the average golfer and lower his handicap. It is in lighter vein than the preceding volume, but contains much sound psychology embodied in anecdotal form. He describes golf as the safest safety-valve, because in it the unconscious gets an opportunity for expression in a way socially safe and personally satisfying. One would like to know the incidence of psychoneurosis in golfers: Are the irascible people who let off their irascibility on the links thereby rendered comparatively innocuous and able to bear with equanimity the stresses of ordinary life? The author has yet to give us a more subtle analysis of behaviour on the golf links in terms of modern psychology.

Simen, its Heights and Abysses: a Record of Travel and Sport in Abyssinia, with some Account of the Sacred City of Aksum and the Ruins of Gondar. By Major H. C. Maydon. Pp. 244+12 plates. (London: H. F. and G. Witherby, 1925.) 16*s.* net.

IN setting out on the journey which is described in this book, Major Maydon and his companion, Capt. Blain, had as their objective the barrier of mountains which forms the north-western edge of the great Abyssinian plateau. A preliminary journey of reconnaisance in 1922–23 was followed by a second expedition in 1923–24 in quest of the Walia ibex (*Capra Walie*), the home of which is in Simen, although its existence, as the author says, "was a question of uncertainty." From Simen they went on to Addis Ababa and into the Arusi country in search of mountain inyala. Major Maydon's descriptions of the wonderful hill country of Abyssinia, slashed by precipitous ravines and abysses, conveys a vivid impression to the reader, which is enhanced by some excellent photographs; but he seems to have found, with reason, the natives less attractive than their country. The appendices, in addition to descriptions of the Walia ibex and the inyala, and their habits, give information relating to prices and outfit which will be useful to those who may be inspired by the author to follow in his footsteps.

Practical Pharmacognosy. By T. E. Wallis. Pp. x+115. (London: J. and A. Churchill, 1925.) 7*s.* 6*d.* net.

THIS excellent little book will be of great value to teachers and students requiring an elementary guide to laboratory work in pharmacognosy. The standing of the author, who is lecturer in botany to the Pharmaceutical Society, and the recommendation implied by the contribution of a foreword by Prof. Greenish, are sufficient guarantees of the accuracy of the text, which is arranged in a very clear and practical manner. The ground covered is necessarily familiar, but the chief value of the book lies in the fact that it is essentially a statement of the laboratory work in this subject given at Bloomsbury Square. Part 1 consists of schedules of instructions for the examination of the drugs, each schedule being accompanied by a most useful complement in the form of short notes. Part 2 comprises a description of forty-five medicinal plants and concludes with a scheme for the description of drugs. The book is abundantly illustrated, and special reference must be made to the many skilful line drawings prepared by the author and his wife.

The Pocket Book of British Birds. By Richard Kearton and Howard Bentham. Pp. ix+389. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1925.) 6*s.* net.

MR. KEARTON and Mr. Bentham have produced a pocket guide to British birds. The letterpress consists of a condensed summary of the usual text-book information about each species. The very small reproductions of photographs seem unlikely to be so useful for purposes of identification as the authors suggest.

Letters to the Editor.

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

The Fine Structure of the X-ray Absorption Edge in the *K*-Series of Argon and its Possible Interpretation.

As is well known, X-ray absorption phenomena may be characterised in the following manner: In general the absorption decreases with decreasing wave-length of the X-rays. A sudden increase of absorption, however, takes place at some definite wave-lengths ('absorption edges') characteristic for the absorbing element in question. Each of those absorption edges is connected with the removal of an electron from a corresponding sub-group of electrons in the atom. As for the heavier elements there are one sub-group of electrons in the *K*-shell, three in the *L*-shell, five in *M*-shell, we might expect the existence of one *K*-absorption edge, three *L*-edges, five *M*-edges. Such edges have really been found for several elements by different workers.

More accurate measurements, especially of the workers in Siegbahn's laboratory, have brought to light that the wave-lengths of the absorption edges to a rather small amount still depend on the chemical or physical state of the absorbing element. Besides, in some careful investigations it has been shown that the main absorption edge very often is accompanied by one or two other rather faint edges lying immediately in the neighbourhood and usually to the short wave-length side of the main edge. As has been shown by Miss Chamberlain,[1] at any rate part of this 'fine structure' of the absorption edges must be ascribed to the presence of different chemical compounds in the absorbing screen used in the investigations. As in the case of photographic registration, the time of exposure has to be rather long, it is reasonable to assume that an appreciable amount of the absorbing substance may be decomposed during the exposure by the action of the X-rays. We have, however, several reasons for believing that not all of the fine structure of absorption edges hitherto observed can be explained in the above simple way.

In order to obtain some more conclusive data regarding the fine structure of absorption edges, we have investigated the *K*-absorption spectrum of argon. The use of this substance has several important advantages. The well-known Siegbahn vacuum-spectrograph could be filled with the gas. By varying the pressure of the gas the most favourable condition for getting a sharp absorption edge was easily obtained. Complications due to chemical changes of the absorbing substance as observed by Miss Chamberlain are excluded. Besides, we should expect that an eventual fine structure in the case of a mono-atomic gas would afford less difficulties for a theoretical interpretation.

One of the present writers,[2] and independently Wentzel,[3] have suggested the following explanation of the fine structure of X-ray absorption edges. The main edge in the case of the *K*-absorption corresponds to the transition of one *K*-electron just to the outside of the atom; the other edge or edges lying to the short wave-length side of the main edge should correspond to a simultaneous transition of two electrons connected with one single absorption act. If one of these electrons is the *K*-electron and the other an electron of the outmost sub-group, we should expect the order of magnitude of the energy difference of the main edge and the secondary edge to correspond to about 10 volts, which is just the order of magnitude usually found by experiment.

The absorption edge of argon was exposed with gypsum as the analysing crystal. Though several exposures were tried with argon pressures ranging from 3 mm. to 80 mm., no fine structure at all could be detected on the plates, the edge itself being very sharp and prominent. Using the same gypsum as analysing crystal for the elements chlorine and potassium as absorbers, however, in the same time of exposure (from one to six hours) a very good fine structure was easily obtained. The same thing was tried for other regions of the spectrum where we should expect secondary edges connected with a simultaneous transition to the outside of the atom of a *K*-electron and an electron of one of the other sub-groups of the *M*-shell, or a transition of a *K*-electron and an *L*-electron, or of two *K*-electrons. No such edge could be detected, though in our experiments a sudden change of the total absorption of 1 per cent. should have been easily detected (the total absorption being 95 per cent. of the intensity of the incident rays). From these experiments we may conclude that absorption processes connected with transitions of more than one electron do not contribute to the absorption of X-rays to any appreciable amount, and that such transitions at any rate cannot explain the occurrence of the fine structure of absorption edges.

We may also assume that the fine structure of absorption edges might correspond to transitions to the different optical orbits available for the electron removed from the inside of the atom by an absorption process.[4] Now in the case of a mono-atomic gas such as argon, the fine structure connected with those optical orbits may be easily estimated. If an electron has been transferred from the *K*-shell of argon to an optical orbit of the same atom, this electron moves in a field of force which to a high approximation must be the same as the field of force of the valency electron in the ordinary potassium atom, the difference in nuclear charge of one unit being compensated by the absence of one *K*-electron. If the same selection rules which are applied in the field of optical spectra and of ordinary X-ray spectra also hold for a transition of an electron from an X-ray orbit to an optical orbit, the only optical orbits which in the present case come into consideration are *p*-orbits, as the orbit of the *K*-electron may be compared with an optical *s*-orbit. The largest energy difference between *p*-orbits, *i.e.* the difference between $2p$ and $3p$, corresponds to about 1·4 volts, which is far too small a difference to be separated in our experiments referred to above.

We therefore repeated the experiments with calcite as the analysing crystal and a very narrow slit (0·025 mm.). We really succeeded in obtaining two different absorption edges at about 0·1 mm. apart, separated by a rather sharp black line. Control plates were taken to make sure that the observed structure could not be ascribed to any other cause but the presence of argon in the spectrograph. Measurements of our plates gave for the difference of the observed edges about 1·7 X.U. corresponding to 1·7 volts (with an accuracy of about 20 per cent.). Thus we may state that the difference measured is certainly of the order of magnitude theoretically expected.

[1] Katherine Chamberlain, NATURE, October 7, 1924; *Phys. Review*, 26, 525 (1925).
[2] D. Coster, *Zeitschrift für Physik*, 25, 83 (1924).
[3] G. Wentzel; see Sommerfeld's book, fourth German edition, p. 326.
[4] An analogous suggestion was made for the first time by Kossel, in his earlier work on the classification of X-ray spectra.

With the accuracy hitherto obtained it is, however, impossible to decide with certainty if this difference really must be ascribed to a $2p$ and a $3p$ orbit (the only other energy difference of the potassium spectrum which might come into consideration as being of about the same magnitude is $1s$-$2p$ corresponding to 1·6 volts). Other eventual edges corresponding to higher p-orbits lie too close together to be separated even with calcite.

Experiments are being started with the X-ray absorption spectrum of neon, for which fine structures are expected corresponding to energy differences in the optical spectrum of sodium. As in this case the separation is expected to be much larger than in the case of argon, we hope to be able to decide some questions which still remained unsettled in our experiments with argon.

D. COSTER.
J. H. VAN DER TUUK.

Physical Laboratory, University, Groningen.

Spinning Electrons and the Structure of Spectra.

GOUDSMIT and Uhlenbeck have suggested that the structure of multiple lines in spectra can be made much more comprehensible if it is assumed that the electron itself has a magnetic moment of one Bohr magneton ($eh/4\pi mc$) and an angular momentum of one-half unit ($h/4\pi$), which can orient itself in various ways with respect to the normal to the electron orbits. Goudsmit and Uhlenbeck point out (*Naturwissenschaften*, Nov. 20, 1925) that to obtain such a magnetic moment from the rotation of a Lorentz electron about its axis, there would have to be a peripheral velocity greatly exceeding the speed of light. It can also be easily seen that the magnetic energy with its resulting mass would be much greater than the electrical energy. These difficulties do not seem to be easy to overcome by any small modification of the classical model of the electron. It appears, however, that an entirely different picture of electronic structure, based on the idea of light quanta, is capable of giving a consistent explanation of the energy of the electron, and also of predicting the values of some of the electronic constants.

The author has suggested that the energy in light waves consists of corpuscular quanta which are guided by a virtual field, along Poynting's vector or some similar direction. In general, the direction could not be just that of Poynting's vector, for that does not transform as a velocity under the Lorentz transformation. In the particular case where E and H are equal and at right angles, however, as for a wave in free space, a vector of magnitude c along Poynting's vector may be proved to transform as a velocity, so that for this case it can be taken as the velocity vector of the quanta. A defect in such a scheme was the existence of the constitutive energy of the electrons, which presumably is energy in the field, although otherwise the field was not supposed to carry energy. The present suggestion is that the electron's field itself is virtual, and that its energy consists of a quantum, which is permanently attached to it, revolving about it. To make this consistent with the radiation theory, the path of the electronic quantum should be determined in the same way as the path of a quantum in a radiation field. This can be done; for if we imagine a virtual field, consisting of an electrical point singularity e, and a magnetic doublet singularity $eh/4\pi mc$, there is a circle in the equatorial plane at every point of which Poynting's vector is tangential to the circle and satisfies the particular conditions given above, so that this orbit can be the path of a quantum. The circle has a radius r_0 satisfying the condition that the electric field at this distance, e/r_0^2, should equal in magnitude the magnetic field, $eh/4\pi mcr_0^3$, which gives $r_0 = h/4\pi mc = 1{\cdot}93 \times 10^{-11}$ cm. Evidently at points of this circle the fields are perpendicular to each other, and Poynting's vector is tangential. The picture of the electron is then an energyless field from a point charge and doublet, with the energy and angular momentum located in the quantum travelling with the speed of light in a circle of radius r_0.

We assume the energy of the quantum to be given by the quantum condition for a rotator in its first state, $E = h\nu/2$, where ν is the frequency of rotation. Since the quantum travels with the velocity of light, this frequency is $c/2\pi r_0$. Substituting for r_0, this is $\nu = 2mc^2/h$, giving from the quantum condition $E = h\nu/2 = mc^2$. The mass of this energy is $E/c^2 = m$, so that the quantum carries just the mass of the electron. The angular momentum is equal to mr_0c; again substituting for r_0, this equals $h/4\pi$. Thus we obtain a rational explanation of the half-quantum value of the angular momentum, and of its anomalous ratio to the magnetic moment.

In attempting to work out the dynamics of the paths of quanta, many interesting questions present themselves. It is necessary to consider that there are forces acting on quanta which must operate when the quanta change their direction and hence their momentum. The reactions of these forces on atoms may in some cases be the "quantum forces" which the author has suggested for changing the atom from one stationary state to another in a quantum transition. It is hoped that a further study of these forces will provide more definite information about the dynamics of an electron such as has been here suggested.

J. C. SLATER.

Jefferson Physical Laboratory,
Harvard University,
March 18.

Mercury Helides.

IN a first note (NATURE, December 13, 1924, p. 861) I announced the synthesis of mercury helide. In a second note (NATURE, March 7, 1925) the empirical formula of the compound was given as HgHe, and afterwards (NATURE, June 20, 1925, p. 947) the formula $HgHe_{10}$ was substituted for the earlier one. Details of the methods and apparatus used for synthesizing the compound were given in a paper communicated to the Royal Society last July. The chief points of interest with which that paper dealt may be conveniently enumerated as follows:

1. The formation of the helide is accompanied by a decrease in the pressure of the helium.

2. The maximum decrease in pressure during any synthesis was never greater than 3·3 per cent. of the initial pressure of 6 mm.

3. At ordinary temperatures the helide possesses stability; but on passing the gas over a red-hot platinum spiral it is completely resolved into its components; and as a result of the decomposition the helium is restored to its original volume and pressure.

4. The compound is neither liquefied nor absorbed by charcoal at the temperature of liquid air.

5. In a quantitative analysis of the helide, the total weight of the mercury obtained was 0·00021079 gm.

6. Experiment proved that the helide is most readily formed when the pressure of the helium approximates 6 mm. of mercury.

7. Qualitative experiments made with a Jamin

interferometer having tubes 25 cm. long showed that, as the synthesis progressed, the refractive index of the mixture became somewhat greater than that of the helium alone.

During the past seven or eight months the plans for synthesizing the helide have been modified and the apparatus enlarged. All qualitative experiments made with the new apparatus have clearly indicated the formation of the helide $HgHe_{10}$ and have thus tended to confirm the accuracy of my earlier work. The new apparatus produces a larger quantity of helide, but the maximum percentage found mixed with the helium has never exceeded that obtained in my first experiments.

Using three differently formed synthesizers in series, I have now succeeded in obtaining a second helide of mercury. This also remains gaseous at the temperature of liquid air, and charcoal fails to absorb it.

During the synthesis of the second helide the pressure of the helium was unaffected. Taking the density of helium as 1, that of the mixture of helium and helide, when measured with an Aston microbalance, was found to be 1·150. The helide was decomposed by passing it over a red-hot platinum spiral and the mercury collected. Its weight was 0·0002714 gm. Assuming the formula of the helide to be HgHe, the calculated density of the mixture is 1·148. The close agreement between the measured and calculated values leaves no doubt as to the formula for the helide.

To account for the non-liquefaction of the helides at the temperature of liquid air, I was inclined to regard them as clouds of charged particles. On this point Prof. Soddy has been kind enough to give me his own views. He writes, "I do not think it likely that you have a cloud of solid or liquid particles passing through the liquid air, though it is perhaps a possibility to be borne in mind. . . . My own view is rather that a compound of helium is of a different category from any known chemical compound, as the completed ring of electrons which never act as valency electrons, must be so acting in this case. If so its properties cannot be inferred from those of known gases, and there is therefore no *a priori* reason to expect that it would be condensed by liquid air and charcoal. Its properties must be ascertained *de novo*, and none of them can be inferred from known chemical data." Prof. Soddy regards his views as speculative.

In conclusion, it may be added that experiments made with pure argon yielded results entirely negative. Prof. Soddy has suggested that it would be of interest to repeat the experiments with neon substituted for helium. This I propose doing as soon as I can either purchase or obtain the loan of some 20 c.c. of the pure gas. The presence of helium would obviously be detrimental.

J. J. MANLEY.

Daubeny Laboratory,
Magdalen College, Oxford,
March 25.

Ecotypes of Plants.

IN *Hereditas*, Bd. vi. (1925), which has just come to hand, there is an extremely interesting paper by Göte Turesson on "Plant Species in Relation to Habitat and Climate." This author has grown in Sweden upwards of 10,000 cultures of various types and races of certain widely distributed plants, in order to ascertain the precise nature of the forms inhabiting different environments. Particulars are given concerning about fifteen species, with numerous illustrations.

It is found that the species exhibit parallel "ecotypes," which it is proposed to designate by the names campestris, arenarius, salinus, subalpinus, and alpinus. These names are by themselves sufficient to indicate the nature of the habitat, and an experienced botanist will be able to imagine the character of the adaptive modification. However, these ecotypes are to be understood to include only hereditarily modified forms, and the immediate effects of the environment are placed in another category. It is shown that the several ecotypes are not produced whenever the conditions seem to call for them. They are sorted out from the genotypes which the plant is able to produce. Thus there are four species (of the genera Melandrium, Ranunculus, Rumex, and Geum) which produce "alpinus" ecotypes in Scandinavia, but not in the Swiss Alps, although the very same species exist in Switzerland. It is as if the plant produced the hand of cards, and the environment played the game. The five parallel sorts of ecotypes correspond with five common types of environments into which suitable varieties might enter and in which they prospered.

The author has done his best to correlate the several ecotypes with names already bestowed by botanists. In this he has not been altogether successful, the numerous available varietal names, based on herbarium specimens, being often not precisely applicable in the sense desired. Thus in *Spiræa ulmaria* the "variety denudata" is present in all three ecotypes studied, and although the type specimen of Presl probably belongs to one of them, the restriction of the name to this ecotype would quite contradict the original intention and general usage. It is therefore proposed that previous names shall be discarded in the type of work represented by the paper, and the ecotype names *campestris*, *arenarius*, etc., substituted, no matter what species is concerned. There are, however, numerous minor biotypes not covered in this way, and the author remarks in reference to *Leontodon autumnalis*: "To those, however, for whom the increase and the naming of 'new' biotypes is a particular pleasure, as well as to other intending bidders, I am willing to offer a couple of hundreds hitherto undescribed in a living and exquisite condition."

At this point it may be possible to question the adequacy of the author's methods. The ecotype names certainly have the very great advantage of being intelligible in a general sense, without further explanation. But ought we to be satisfied with this "general sense"? Mr. Turesson himself brings out very clearly the fact that parallel ecotypes of the same species in different regions may not be just alike. Thus, while the ecotype system is highly illuminating, it should not take the place of definite names accompanied by precise descriptions, and supported by type specimens in the herbaria. Also, it is not clear that the most minute analysis of the various biotypes will not after all furnish the necessary materials for an adequate synthesis. Probably the fault to be found with taxonomists is not connected with the minuteness of their analysis, but with the mechanical way in which much of the work has been done, in the absence of guidance from biological theory. We may even believe that the coming years will see the study of biotypes and phenotypes carried to extremes now undreamed of. The work will represent a fascinating game, out of which will emerge from time to time results of high practical and scientific value.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado,
March 12.

The Boskop Skull.

IN criticising Pycraft's paper on the Boskop skull, my whole object was to get a fuller consideration of what I believe to be an extremely important early human skull. Opinions will differ so to the restoration of all imperfect human crania. We have seen how greatly anthropologists have differed in the restoration of the Piltdown man, and it is not surprising that there should be differences about the Boskop man.

Pycraft agrees with Haughton in giving the greatest length as 205 mm. Now the calvaria as preserved certainly measures 205 mm., but much of the lower part of the frontal is lost, and though there was certainly no large supra-orbital eminence, there must have been, from the curve of the anterior part of the frontal preserved, at least a small one, and even Pycraft in his restoration shows a small one. By no possibility can the antero-posterior measurement have been less than 208 mm.: it may have been 212 mm. Dart gives it as 210 mm., and this must be very near to the actual measurement.

Pycraft doubts whether any anthropologist would 'restore' the skull as I have done. Perhaps he is

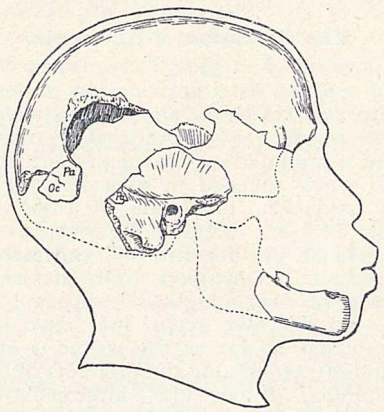

FIG. 1.—Restoration of the Boskop skull, with outline of soft parts as they may have been before the teeth were lost.

right. His own restoration does not differ very greatly from mine. He puts the temporal fragment a little lower than I do, and he has failed to observe the small portion of parietal attached to the temporal. By lowering the temporal fragment he would make the brain still larger than I would. He objects strongly, however, to a brain of 1900 c.c. or more. Elliot Smith, Dart, and Drennen all agree to a brain of 1900 c.c., so that whatever errors I may have made in the restoration I am certainly in as good company as I could desire as to the result.

With regard to the jaw, concerning which Pycraft has nothing to say in his paper, he makes in his letter (NATURE, February 6, p. 196) the following remarkable statement: "All of us who examined this fragment while it was at the British Museum regarded it as of no importance at all!" When I examined the jaw ten years ago, and I have never seen it since, I came to the conclusion, after very careful consideration, that the enlarged socket had held the root of the canine and not the first premolar. I made many drawings of the jaw, which I still have, and even had it X-rayed. Part of the socket, but not all of it, has been eroded by an abscess, but whether this is the socket of the first premolar or of the canine the jaw is still a remarkable one, and it will certainly come as a very great shock to many that a large fragment of the jaw of an extremely ancient and completely fossilised human being—possibly the oldest known 'Neanthropic' type—is regarded by all those who have examined it at the British Museum "as of no importance at all."

Fig. 1 is from a restoration I made ten years ago, and may convince those who are not anthropologists that the skull and even the jaw are of some interest.

R. BROOM.

Douglas, S. Africa.

The Stone Age in Ceylon.

IN *L'Anthropologie* (Nos. 1 and 2, vol. 36) Dr. Fritz Sarasin discusses in a valuable paper (pp. 75-115) the pros and cons of this question. He concludes that there existed a pre-Veddah population in Ceylon—to which the "Cambridge History of India" does not refer—whose culture was analogous to the Aurignacean of Europe.

Dr. Sarasin, however, makes the arresting statements that it is difficult to imagine how men, possessed of only small stone implements incapable of cutting down trees, could exist in forests so humid and full of leeches as those of the Ceylon mountains, and in which they could not find the necessary subsistence, unless, through climateric oscillations, there occurred steppe periods; and that it seems impossible, with the present climate, for these human stations (which he discusses) to have existed in the forests.

May I recall to Dr. Sarasin's memory the conditions under which the Koeboes of Sumatra exist? These people, perhaps the most primitive on the globe and supposedly the most ancient inhabitants of Sumatra, live in isolated communities in several regions of that island. Their abode from time immemorial has been in the vast, sunless, pathless, tiger- and leech-infested and moisture-laden virgin forests, out of which they rarely emerge of their own accord, but through which their sense of direction is 'uncanny.' They make no clearances, having no implements capable of the work, nor do they cultivate a single comestible. They subsist entirely on the inexhaustible products of the woods, especially on durians, jack-fruits, figs, tubers of sorts, wild honey, and even the putrid carcasses they may discover. From time to time, when successful in killing a rhinoceros or a tapir, they gorge themselves until only the bare bones of their feast remain, alongside which are left no signs of human activity. They live as do the beasts, ever in search of the wherewithal to appease their insatiable appetite. Until the intervention of the Dutch authorities, the Koeboes were hunted by Sumatran 'radjahs' and chiefs for enslavement as if they were really wild animals. The Malay so esteemed them when I made acquaintance with these nomads forty-five years ago. They have no true abiding place; they erect temporary wind-screens with palm leaves and branches, more primitive even than the Australian's humpy. Their weapons, all of wood, are pointed, fire-hardened bamboo spears and the deadly accurate blow-pipe. A few among them now possess knives obtained from the Malays by the curious method of silent exchange. Their dead are thrown into some dense thicket, which is ofttimes set on fire, but the body is generally left for any prowling carnivore. This custom accounts for the rarity of their osseous remains—as probably for that of the bones of the Chelleans and Acheuleans—except of those sedentary few groups, partly 'tamed' and half converted to Moslemism, who practise sepulture.

If these a-lithic nomads had discovered stone artifacture, their handiwork would have strewn the forest floor and been found abundantly in the alluvium of the rivers, without any marked climatic oscillations. Their discarded belongings, which in a few months

turn to dust, leave no record of an age-long persistence under their verdant sanctuary. Their life-story, however, affords a highly instructive picture of how generations knowing only wood, of whom no evidence survives, may have succeeded in handing on their race from one millennium to another.

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The Hydrogen Doublet.

IN measuring doublet separations, the Fabry-Perot interferometer can be so adjusted that the fringes of one component fall half-way between those of the other. This eliminates most of the distortion present in other instruments. Using this method, the doublet separations at a pressure of 0·5 mm. and a current density of 0·25 amp. per sq. cm. have been found to be $0{\cdot}316 \pm 0{\cdot}002$ for Hα, $0{\cdot}329 \pm 0{\cdot}005$ for Hβ, and $0{\cdot}353 \pm 0{\cdot}007$ for Hγ. The wave-lengths of each component have also been determined and indicate that $R = 109677{\cdot}70 \pm 0{\cdot}04$, with the use of Sommerfeld's formula.

The doublet separations, however, do not fit Sommerfeld's simple theory with the ordinary principle of choice. They can be explained by assuming that the forbidden components for which $\Delta k = 0$ are present, increase in intensity with an increase in current, and are polarised with the electric vector parallel to the current. These components have always been found in the work on He^+, so that they would naturally be expected in hydrogen. The presence in Hα of the component designated by Sommerfeld as II*c*, will reduce the theoretical separation to the observed value, while the presence of II*b* will not affect it very much. The polarisation of II*c* will produce a smaller doublet separation in the light from the side of the tube than in that from the end. This is found to be the case when the current is heavy enough partly to orient the atoms. The corresponding polarisation of the light from the side is found also at current densities in the neighbourhood of 1·5 amp. per sq. cm. The increase in intensity of these components with an increase in current will produce a greater relative increase in the short wave-length component than in the other. This is found experimentally to be the case.

The intensities predicted by Kramers, upon the assumption of a disturbing field, are much too small to explain the observations if fields small enough to be compatible with the observed width of the lines are used. The results tend to support the suggestions of Uhlenbeck and Goudsmit (NATURE, February 20, p. 264), which in effect replace the principle of choice for azimuthal quantum numbers with the one for inner quantum numbers.

WILLIAM V. HOUSTON,
National Research Fellow.

Norman Bridge Laboratory,
Pasadena, California, March 13.

Domestic Heating.

LETTERS to NATURE have to be short, so every word should carry its full significance. I said in my letter in the issue of March 6 that the peculiar value in glowing coal fires "is either absent or very weak in radiation from anthracite stoves or gas and electric fires." To a careful reader it would be obvious that I had tried the effects of radiation from a gas fire. Prof. Hill (April 3, p. 487) is incorrect in his assumption that I would have got "equally good effects from a *glowing* gas fire." I did *not* get equally good effects from a glowing gas fire. On the contrary, I got markedly inferior effects. Even the best form of gas fire is positively irritating rather than healing to surfaces exposed to it.

Of course, I allow that the bright light of a good electric lamp has some slight beneficial effect, and is better than nothing. Prof. Hill quotes its effect on the iguana. Human physiology, however, is very different from that of an iguana, and however useful evidence may be from animals, first-hand evidence from a sensitive human subject is much more valuable.

Prof. Hill speaks of the coal fire polluting the atmosphere and screening off the sunshine. May I ask him to examine the returns of the tonnage used in domestic fires and note how small it is compared with the millions of tons used by commercial fires? I am entirely with him in claiming that electricity and gas should be used in all factories and for cooking and heating water. Moreover, before condemning the domestic coal fire, Prof. Hill should take into consideration the possibility of its improvement (which I urged upon our Government in 1914). The valuable domestic qualities of coal could be retained and the smokiness and economic loss of by-products be eliminated by the use of partial coking at low temperature.

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The Oxidation of Ammonia.

L. ANDRUSSOW (*Ber.* 59, 458, 1926) has suggested a scheme of reaction for the oxidation of ammonia in which nitroxyl, NOH, is an intermediate product. The scheme put forward by Andrussow, together with many others, were derived by the present writer some years ago when engaged in experimental work on ammonia oxidation, but none of these has been published. It seems desirable, however, to point out that the scheme put forward by Andrussow suffers from the defect that nitroxyl, NOH, if formed as an intermediate product, might be expected to break down to a considerable extent into nitrous oxide, a substance which, so far as the writer is aware, has never been detected among the products of the oxidation of ammonia. A more likely intermediate product would be nitrohydroxylamic acid, which is known to break down with formation of nitric oxide. It is suggested that the oxidation may occur in the following stages, each reaction in which is bimolecular or unimolecular:

(i) $NH_3 + O_2 = NH_3O_2$.
(ii) $2NH_3O_2 = 2NH_2(OH)_2$.
(iii) $2NH_2(OH)_2 = N_2H_2(OH)_2 + 2H_2O$.
(iv) $N_2H_2(OH)_2 + O_2 = N_2H_2O_3 + H_2O$.
(v) $N_2H_2O_3 = 2NO + H_2O$.

The writer had intended to make further experiments on the mechanism of the oxidation of ammonia but has not been able to carry these out. He therefore puts forward the above hypothesis as an alternative to that of Andrussow, since it does not seem open to the objection mentioned above.

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What We Know.

LET this, from Meredith, be my reply to the electrician in my composite friend Sir Oliver Lodge (NATURE, March 27, p. 453).

O sir, the truth, the truth! is't in the skies
Or in the grass or in this heart of ours?
But O the truth, the truth! the many eyes
That look on it! the diverse things they see,
According to their thirst for fruit or flowers!
Pass on: it is the truth seek we.

HENRY E. ARMSTRONG.

Odours and the Sense of Smell.

By Dr. J. H. KENNETH.

FROM year to year the number and extent of specialised investigations of the organs and sense of smell and of odorous substances is steadily increasing. There are few treatises which deal with the subject in a comprehensive manner, and none which could be termed exhaustive. The reasons for this deficiency in scientific literature are many, the main reason being the difficulty of combining, except by means of a symposium, expert knowledge of each of the many different subjects which coalesce in the science of smell. Boyle's "Exercitationes" (1672), Cloquet's "Osphrésiologie" (1821), Zwaardemaker's "Physiologie des Geruchs" (1895), and "L'Odorat" (1925), the presidential address to Section A of the British Association (1898), by Prof. Ayrton; Haycraft on "The Sense of Smell" (1900), Henning's "Der Geruch" (1916), the "Essai d'olfactique physiologique," by Heyninx (1919), and "Smell, Taste, and Allied Senses in the Vertebrates," by G. H. Parker (1922), are some of the outstanding efforts towards an integration of the heterogeneous elements composing the science of smell. This co-ordination of special knowledge comprised in the science of smell (olfactology, *osphrésiologie*, *Geruchslehre*) in its widest interpretation may conveniently be termed 'osmics' (*l'osmique*, *osmica*, *Osmik*).

The subject may be divided into three main and interdependent aspects or foci; morphological, psycho-physiological, and physico-chemical. In addition there would be included all the numerous applications engendered by the science in its different aspects.

The morphological division, again, may be divided into two parts—one dealing with the structure and development of the peripheral and central olfactory apparatus (osphrenes), and the other with the structure of odorous apparatus (osmenes), both in health and disease. There are many anatomical, histological, and embryological data available; for example, accounts of the olfactory mucous membrane of the frog, the olfactory nerve of the goose, the absence of olfactory pigment in albinos, hippocampal abnormalities in epileptics, scent organs of butterflies, and the odorous gland of the chamois, to mention some at random. All these many isolated observations require some sorting out and co-ordination, not merely in order to facilitate knowledge of morphological work already done, but also to stimulate and direct further research and integration of knowledge. Even the comparative histology of the olfactory mucous membrane, or that of the vomero-nasal organ, has yet to be completed, let alone the comparative morphology of osphrenes and osmenes as a whole. Consideration is also due to the connexions between the olfactory apparatus and other parts of the body, such as endocrines and the sexual apparatus. Osmics thus provides a most extensive field of research, not only for the individual morphologist, but for team work.

While noses have an interest all of their own, it is their performances which make a wider and more intensive appeal. From the mysteries of good and evil as represented by fragrances and stinks, to the examination of the psycho-galvanic response to the action of hydrogen sulphide and amyl acetate on the lipoids in the hairs of the olfactory cells, is a far cry, a cry dimly perceived by the osmic as well as by the cosmic philosopher. The general study of reactions to olfactory stimuli is not easily systematised, partly owing to the prolonged courtship between physiology and psychology. However, a discussion of some of the problems requiring elaboration will indicate the scope of the physiological and psychological aspects.

To begin with, the nature of olfactory stimulation is not yet satisfactorily understood. The general opinion would favour the theory that it is induced by some form of solution of the odorous molecule (odorivector, *Geruchsträger*). The minimum number of such odoriferous molecules necessary to produce an olfactory sensation is estimated by Prof. Zwaardemaker to be 20×10^8 in one nasal fossa. The intensity of the sensation would appear to depend on the number of molecules impinging on the olfactory mucous membrane, while the quality of the sensation depends on the molecular structure of the odorivector. According to Heyninx, the quality of the olfactory sensation depends on the wave-length of the molecular vibration, only such wave-lengths being sensed as lie between $0{\cdot}35\mu$ and $0{\cdot}20\mu$. He does not record the inference that this theory would account for the greater liminal range in many animals. Further, following conclusions by Parks which have been quoted by Chwolson, the molecules would form a layer of $0{\cdot}13\mu$ in thickness on the surface of the olfactory membrane. Their vibration would be transmitted to the olfactory hairs and cells. Heyninx suggests that the olfactory pigment functions so as to provide something like resonance. It has occurred to the writer that such 'resonance' may be due to one of the primary functions of the pigment being possibly that of a protective screen against over-stimulation of structures in the corium of the olfactory mucous membrane, by ultra-violet activity.

A considerable amount of work has been done by various observers, chiefly by Zwaardemaker, on the measurement of olfactory acuity (olfactometry) in health and disease. Observations on the senses of the Todas, by Rivers, and experiments on Javanese and Europeans, by Grijns, adumbrate a more extensive investigation of olfactory acuity in the different races of mankind. More quantitative data than are now available on the olfactory acuity of animals are also desirable. Of interest here, too, is the measurement of simple reaction time, which has been carried out by Buccola, Moldenhauer, Vaschide, and requires amplification and comparison with association time. Crude stop-watch experiments tend to show that in a given individual the time required for smell-word association does not seem to differ from that for word-word association; but there is a difference which requires demonstration by more exact methods of experimentation.

Another interesting field for research is the investigation of olfactory reflexes and odour preferences. There are inborn and acquired likes and dislikes, which form

a kind of olfactory syndrome or diathesis characteristic of the individual. Owing to fluctuations in the affective judgment of odours due to changes in metabolic conditions, it would seem probable that an olfactory diathesis would have some diagnostic value, especially if linked with an examination of colour preferences.

Although the history of perfumery gives much information with regard to odour preferences among different peoples, experiments on a large scale are desirable in order to correlate affective judgments with other factors, such as pigmentation, endocrine balance, etc. Quite an appreciable amount of work has been done on the question of smell and sex, but there is room for further investigation. The problem of preferences is intimately related to the examination of olfactory associations. When dealing with familiar odours, the percentage of failures to form ascertainable associations is relatively small, according to recent (1924) experiments only about 15 per cent. The fact that olfactory associations are very largely formed unawares, makes their investigation of some practical importance, especially when linked up with olfactory associations occasionally occurring in dreams. An odour constitutes a more effective characterisation of persons, objects, and places than a verbal description, and the absence of a direct vocabulary of olfactory sensations raises difficulties. However, the images called up by odours are so vivid that there would seem to be a case for their occasional employment in the practice of psycho-analysis. Another suggestion is to employ odours to induce certain 'moods' for therapeutic purposes, and perhaps, in time, the ancient use of burned feathers may develop into a system of osmotherapy based on a wide knowledge of olfactory reactions.

Olfactory fatigue has not been mentioned, nor the problem of a classification of odours, nor methods of educating the sense of smell, nor a tithe of the many problems awaiting co-ordination and further research by the physiologist and psychologist. The plethora of osmics is further indicated by the multitude of problems arising from a consideration of the nature of odorous substances (osmyls).

The relations between odour and chemical constitution, emphasised by Haycraft, Cohn, Durrans, and others, by the increasing number of investigations carried out in the industry of perfumery and flavouring materials, has been further extended by recent research on phenomena connected with odorous particles. Tyndall's discovery of the absorption of radiant heat has led to the examination of infra-red absorption by Grijns and the ultra-violet absorption bands by Heyninx, and of correlated phenomena. It is not yet possible to draw satisfactory physiological conclusions from these investigations (the interpretations of which are open to criticism), but it can be stated that potential molecular energy may act on the olfactory cells. Zwaardemaker and Hogewind (1920) have pointed out that in homologous series there is an increase in diamagnetism exactly proportional to the number of atoms in the molecule. However, even Zwaardemaker (1925) is obliged to acknowledge that the precise nature of the olfactory stimulus has not yet been satisfactorily explained, but that "il y a de nombreuses perspectives pleines de promesses, qui pourront être dévoilées en continuant la recherche physique." Even this most cursory and incomplete account of some of the innumerable problems tends to show the need for co-ordination and direction of research, not merely in the interests of pure science, but also on account of the numerous applications in everyday life, in industry, and in medicine. There is ample justification for the organisation of the science of smell as a whole, in order that existing data may be integrated and further research may be organised and directed.

The Geological Age of the Earth.[1]

IN delivering the twenty-seventh Robert Boyle lecture last year, Prof. J. Joly returned to his attack on the higher estimates of geological time which have been based on the lead-ratios of uranium-bearing minerals. He favours an estimate of 160 to 240 millions of years for the period that has elapsed since the Archæan, and refers to the lead-ratios of certain thorium minerals and to the sodium method of arriving at the age of the oceans as providing confirmatory evidence. It can, I think, be shown that in both cases the data used are misleading, and that the results from both methods can be readily interpreted to support the very estimates to which Prof. Joly considers they are opposed.

On the assumption of uniformitarianism, the salinity of the ocean points to an age of about 80 to 100 million years. The amount of sodium in the oceans has been determined with sufficient accuracy to justify the method, but this cannot be said of the annual increment of sodium brought down to the sea by the rivers. Denudational statistics show that for all the open drainage areas of the world, the total amount of sodium removed in solution is more than 2·1 per cent of the material mechanically and chemically removed from the lands. On the other hand, the rocks actually exposed to denudation contain on an average only 1·3 per cent. of sodium. Thus it appears that the rocks would have to lose more sodium than they had ever contained in order to supply the amounts alleged to have been added annually to the oceans.

Four partial and independent explanations of this remarkable discrepancy can be suggested. (*a*) To a slight extent the discrepancy is mitigated by the fact that part of the material liberated by denudation remains on the lands and is largely left out of account in the above calculations. (*b*) Many of the analyses of river-waters for sodium have probably been inaccurate; for unless extraordinary precautions had been taken to overcome the difficulties inherent in such analyses the results would usually be too high. (*c*) It is also probable that part of the sodium carried by the rivers is cyclic, and the invariable presence of chlorine in river-waters supports this contention. The amount of chlorine in igneous and other rocks is hopelessly inadequate to provide the quantities found in rivers. Volcanic and other juvenile sources have doubtless served to supply most of the chlorine now accumulated in the oceans, but analyses of rain-water show that volcanic sources cannot be of appreciable importance at the present day. The high relief of the existing

[1] Oxford University Press, 1926, pp. 18. 1s.

lands provides the necessary head for a vigorous circulation of groundwaters. This is an important factor in chemical denudation, and is likely to be responsible for part of the mysterious sodium chloride that finds its way into the rivers. (*d*) Another geologically unusual source of sodium supply is found in the easily eroded glacial deposits with which wide areas are now covered.

Neither of the factors (*c*) and (*d*) can have been operative throughout geological time, and if it be claimed that they suffice to explain away the discrepancy, then it is only at the cost of admitting that present rates of supply are, for the same reasons, abnormally high.

This raises for discussion the fundamental assumption of uniformity of rate. In recent years the assumption has been widely criticised on the following grounds, all converging to show that present rates of denudation are far higher than those that have prevailed during the average conditions of geological time. (*a*) The continents are now more elevated and the lands more extensive than they have generally been, since we are now near the close, or just emerging from, a period of great mountain building and uplift. (*b*) In the past denudation must have repeatedly fallen to an almost negligible value during long periods of quiet peneplanation, and underground waters which are now relatively vigorous must then have become sluggish and relatively ineffective. (*c*) At least since Cambrian times the greater part of the existing lands have, on balance, received sediments rather than supplied them, whereas at present enormous areas are undergoing rapid denudation. (*d*) The presence of widespread glacial deposits facilitates rapid local denudation. (*e*) Finally, human activities have increased the rate by the removal of forests; the tilling of soils; excavations for transport and other purposes; and the addition to the atmosphere of unnatural quantities of acid gases.

A number of geologists have suggested that present rates may easily be from five to fifteen times as high as the average rate for geological time. Moreover, since river analyses for sodium are open to grave suspicion, and the geochemistry of chlorine is still far from being understood, the real income of the oceans in sodium may be less than a third of the amount alleged to be income, which amount is probably partly fictitious, partly capital restored to circulation. It is not unreasonable to combine these sources of underlying error, and to conclude that the age of the oceans may well be twenty times the 80 or 100 million years commonly assigned to it. At least it is certain that the sodium method cannot at present be considered as making any serious contribution to the problem. On its merits the method can be interpreted as pointing to too high an age, and this is a distinct advantage, since it becomes possible, in a way not hitherto allowed for, to admit the probability that the oceans were originally salt, and that additional supplies have since been furnished to them at intervals by juvenile or magmatic waters.

Turning next to the vexed question of the accumulation of lead in thorium minerals, there is no difficulty in demonstrating that the lead-ratios of such minerals are far from leading to concordant or trustworthy results. Thorium minerals of the same geological age give lead-ratios that vary widely among themselves, generally in the direction of lower values than those afforded by uranium minerals. As a type example of this discrepancy, Prof. Joly takes a pitchblende and a thorite from Ceylon. He says, "whereas the uranium-lead ratio indicated 512 millions of years, the thorium-lead ratio gave 130 millions of years." The actual data for these minerals and other analysed thorites from Ceylon are as follows:

Ref. No.	Minerals from Ceylon.	Percentages of			Lead-ratios Pb/(U+0·37 Th.).	Millions of years.
		U.	Th.	Pb.		
1	Pitchblende	71·40	7·86	4·75	0·066	436
2	Thorite .	4·57	62·8	1·28	0·046	304
3	Thorite .	3·50	59·2	0·78	0·030	198
4	Thorite .	1·62	54·4	0·36	0·017	112
5	Thorite .	1·88	65·4	1·71	0·065	429

1. Colonial Reports, Misc. No. 37, Ceylon Cd. 3190, 1906.
2 and 3. Colonial Reports, Misc. No. 87, Ceylon Cd. 7175, 1914.
4. Soddy and Hyman: *Trans. Chem. Soc.*, vol. 105, p. 1404, 1914.
5. Colonial Reports, Misc. No. 74, Ceylon Cd. 5390, 1910.

The ages calculated from Nos. 1 and 4 are lower than those obtained by Prof. Joly because of the adoption of more recent values for the half-periods of uranium and thorium. There is clearly no reason whatsoever for picking out the minimum result given by No. 4 as being in any way more correct than that of the still richer thorium mineral No. 5. The latter gives a ratio practically identical with that of the pitchblende; and when the analyses of the associated thorianites are examined they are found to give ratios varying from 0·048 to 0·075, the average of fourteen ratios being 0·063. The conclusion drawn by Prof. Joly from his comparison of the pitchblende and the thorite No. 4 is based on very limited evidence and is seen to be quite unjustified in the light of the remaining evidence.

The variability of the lead-ratios of thorium minerals suggests that the latter tend to lose lead by the solvent action of percolating waters; and further, that thorium-lead is extracted in preference to uranium-lead. If the lead generated within a uranium mineral forms a highly insoluble uranate, then it is not likely to be easily removed. The lead generated from thorium, however, cannot form a thorate, and within a mineral it is probably present as a comparatively soluble oxide or silicate. Thus there are chemical reasons why one isotope of lead should generally be left while the other is liable to be taken. Atomic weight evidence adds consistent support to this new hypothesis, and for the first time a workable explanation of the long-puzzling discrepancies between uranium and thorium minerals is provided.

If this hypothesis be correct, then the higher lead-ratios of thorium minerals are, like the higher helium-ratios, most likely to approach the true index to age. Thorite No. 5 from Ceylon is likely to give a much more accurate result than No. 4, and, admitting this, there remains no convincing reason for supposing that uranium may have disintegrated more rapidly in the past than we observe it to do to-day. The evidence from pleochroic haloes cannot be accepted as pointing to a declining rate of activity of uranium through geological time, because the part played by the actinium series of elements has not yet been taken into consideration. Thorium haloes reveal no variation of radius with age, thus proving in the most conclusive way

possible that the rate of disintegration of thorium has not varied appreciably in the past. Since the lead-ratios of some thorium minerals are of the same order as those of uranium minerals of the same geological age, it follows equally that the rate of disintegration of uranium must have remained practically constant. It is quite possible that the ages indicated by the lead-ratios of uranium minerals may be a few per cent. too high, but the evidence is overwhelming against Prof. Joly's contention that they may be so much as four times too high. In the state of our existing knowledge and using the most probable modern data, we may safely say that the age of an unaltered primary mineral is given to a first approximation in millions of years by the formula 6600 Pb/(U + 0·37 Th). With Prof. Joly's conclusion we shall all agree: "Kelvin's well-known limitation '20 to 40 millions of years' is gone for ever."

ARTHUR HOLMES.

Fuel Research.[1]

FROM time to time the Fuel Research Board, under the chairmanship of Sir Richard Thelfall, and with Dr. C. H. Lander as director, issues technical reports which have received individual notice in NATURE. It has recently issued a general report on its activities, and this is of great interest, because the whole range of the work engaged upon is traversed, and the progress along the lines laid down at the outset can be gauged therefrom. It is fitting to recall the circumstances of the initiation and development of the Board as recorded in the report.

The decision to establish a Board of Fuel Research was taken on February 6, 1917, presumably because the grave difficulties of that time were found to be accentuated by the inadequacy and want of balance in resources of fuels of different types in Great Britain. It was deemed prudent to embark on an intensified scientific study with the resources of the State so as to diminish, if possible, these difficulties and along two main lines of inquiry. The first was to make a physical and chemical survey of the coal seams of Great Britain and a study of the fundamentals of coal. The second line was to make an effort to meet one of the most clamant needs of the times—a supply of liquid fuel home-produced—and simultaneously to provide a smokeless fuel for domestic and other purposes.

Doubtless with the idea that some result of immediate practical value might thereby be obtained, the second of these lines was given precedence, and for this purpose the Fuel Research Station was erected at Greenwich, where the late Sir George Beilby—the first director, and one might almost say the founder—was able to put to a critical test ideas on smokeless fuel production which he had held for many years. This extensive experimental station, which is elaborately equipped for the handling and treatment of fuels by various processes of industrial importance, is described with plans and illustrations in the report now issued.

The report gives an account of the work done there on carbonisation at low temperatures. It must be confessed that the early hopes placed in coal carbonisation at low temperatures have not yet been realised at Greenwich, but let no one conclude that the effort has been in vain. The difficulties are as much economic as technical. The intensive study of carbonisation at low temperatures, which has been a world movement, has clarified our notions on the carbonisation process in general, and the publication of authentic results has equipped with technical data those attacking the problems to-day immeasurably better than the pioneers of twenty years ago. At the Research Station high hopes are now placed in the use of a suitable vertical retort of metal which has been in operation for some time, but patience will be necessary before assessing its commercial applicability.

Apart from war-time necessities, the return of peace is only serving to emphasise the importance of coal carbonisation, which is very generally regarded as a possible means of increasing the value of coal by exploiting all its potentialities—both thermal and chemical. In order that no obstacle shall prevent the merits of any low-temperature process wherever discovered from receiving recognition, the Fuel Research Station is now empowered to test and report on processes without fee. This service already rendered in two cases (NATURE, February 14, 1925, p. 246, and November 14, 1925, p. 728) is of great public value, for the lack of such impartial tests has led to the dissemination of exaggerated ideas and hopes.

The other main line of work contemplated at the start of the Fuel Research Board was the chemical and physical survey of the coal resources of Great Britain. Now, although much information is in the possession of some consumers as to the relative properties of coals of different origin, there is still a great need for published data of the right kind and extent. It is significant that the only published systematic tests of British gas-making coals are to be found in German technical literature. The tendency of fuel technology is towards increasing refinement of method, and this implies increasing discrimination in the choice of raw material. This tendency is well exemplified by the selection which has to be made in coals for carbonisation in the continuous vertical gas retort. The methods, such as grinding and blending of coals, which are now under experiment and discussion for the production of smokeless domestic fuel, will certainly involve a closer technical control, and therefore a more precise knowledge of the original coals. Such a control may well extend to the composition and character of the ash, which is not without influence on the processes of carbonisation and gasification, and on the behaviour in the boiler furnace. The task of such a survey is a great and protracted one, and eminently suitable for the broad shoulders of a State department. A useful and necessary preliminary step has been to arrange a convention of analytical procedure so that results shall be comparable wherever obtained, and this is already well in hand through the Sampling and Analysis Committee of the Board, which includes members well qualified to speak on such matters. The survey, to be satisfactory, needs to be made with reference to geological and mining conditions, and hence a considerable

[1] Department of Scientific and Industrial Research. Report of the Fuel Research Board for the period ended 31st December 1924; with Report of the Director of Fuel Research. Pp. vi+78+8 plates. (London: H.M. Stationery Office, 1925.) 1s. 6d. net.

amount of decentralisation has been found advisable. Local committees of coal owners and others have been established in those areas where the Survey is already in operation.

The Fuel Research Board was called upon to render an important service in its early years, namely, to advise the Government of the day on the action to be taken in re-establishing the standards for the sale of gas, which had been suspended during the War. It was able, however, to avail itself of the comprehensive experimental study of the efficiency of different grades of gas in use, which had been carried out by the Joint Committee of the Institution of Gas Engineers and the University of Leeds. The recommendations it was finally able to make to the Board of Trade were embodied in the Gas Regulation Act of 1920, establishing the "therm" system of charging, which will undoubtedly in time be regarded as a landmark in the history of fuel industries in Great Britain. It has already had a great influence on the outlook of the British gas industry. The process of "steaming" the charge of vertical retorts came into prominence during the War years as a means of expanding the output of existing gas works plant, and led to much discussion in the gas industry. Eventually the Joint Committee mentioned above investigated the claims made for this process in a series of tests at Uddingston, which showed the uses and limitations of steaming. The Fuel Research Board has since then not only confirmed but also added to these results by the carbonisation with steaming of a variety of coals from different areas—a material contribution to the survey of carbonising coals. Work on the water-gas process has also been carried out at the Fuel Research Station.

The utilisation of fuel in domestic grates is so commonplace a matter that many will learn with surprise that until recently little precise scientific information was available, and some ideas popularly held are fallacious. Much of our quantitative knowledge is based on the experimental work initiated in 1912 by the Manchester Air Pollution Board and carried on under its auspices for ten years—latterly with financial assistance from the Department of Scientific and Industrial Research. In 1922 the work was taken over by the Fuel Research Board, and the reports already issued have thrown much light on this important question.

Peat, steam-raising problems, internal combustion engines, alcohol, oil fuel, have all been the subjects of investigations by the Board. There is scarcely a branch of fuel utilisation which has not received some attention; and, indeed, a good idea of the "present state of the art" and the problems awaiting solution may be gained from a perusal of this report. The field of work is so wide that it is impossible for the research staff even of a national board to cover it in more than a fractional measure. It is gratifying to observe recognition of this in the allocation of financial assistance by the Board to independent workers in the universities and other centres of experiment. H. J. HODSMAN.

Obituary.

DR. W. E. HAWORTH.

DR. WALLACE ELLWOOD HAWORTH, who, as a result of a collision between the motor cycle he was riding and a motor car, sustained fatal injuries at Salisbury, Southern Rhodesia, and died on March 13, furnished an example of a man who, possessing naturally a scientific bent, was able to devote himself wholly to scientific pursuits only somewhat late in life. He was sixty years of age at the time of his death and held the post of a Milner Research Fellow in entomology of the London School of Hygiene and Tropical Medicine, having, in accordance with the arrangement made between the School and the Government of Southern Rhodesia, been sent out to work in collaboration with Dr. G. R. Ross, who is engaged upon an inquiry into the etiology of blackwater fever. Dr. Haworth was responsible for the collection and identification of mosquitoes, and was gathering data showing how the distribution of anophelines coincided with the presence of cases of blackwater.

Dr. Haworth, who was born in New Zealand, had always been interested in zoology, a subject to which he devoted himself when at Canterbury College, Christchurch, from 1882 until 1885. He commenced the study of medicine at the University of Edinburgh in 1886, graduated M.B., Ch.B. in 1892, and then turned his attention to public health, taking his B.Sc. in that subject in 1893. In the same year he was appointed examining officer for ships at Leith during an outbreak of cholera on the Continent. After two voyages to India as a ship's surgeon, he settled in private practice in Southern Rhodesia and was there from 1896 until 1917. Throughout this period his interest in zoology was maintained and he was, to use his own words, constantly observing the life-histories of various insect pests.

From 1917 until 1919, Haworth was on active service with the Rhodesian Native Regiment in Nyasaland, German East Africa, and Portuguese East Africa, and thereafter was employed temporarily in Government service, holding the posts of M.O.H. Tanga, acting director of the Bacteriological Laboratory, Dar-es-Salaam, and Medical Officer of Health at Lindi. Both at Tanga and Lindi his duties included those of Port Health Officer. It was especially at Dar-es-Salaam that he made his interesting and important researches on the breeding of mosquitoes in the tops of coconut palms. The results of his investigations were embodied in a carefully written paper which appeared in the *Transactions of the Royal Society of Tropical Medicine and Hygiene* in October 1924. It is noteworthy that, despite his age, Dr. Haworth himself scaled coconut palms during the course of his observations. These have been the subject of some criticism, but are admittedly of a pioneer nature and were the means of bringing three new species of Aëdes to light.

Dr. Haworth returned to Great Britain in 1924 and then, full of energy and enthusiasm, took a course on systematic entomology under Prof. Ashworth. Thereafter, as has been recorded, he received an appointment at the London School of Hygiene and Tropical Medicine. During the few months he was in Salisbury he worked

with ardour at his special subject, made arrangements for extensive mosquito surveys, and collected a large amount of material. His tragic and untimely death has robbed the School of a zealous and well-trained research worker, and is greatly deplored by all who knew him.

MR. A. R. MCCULLOCH.

BY the death of Allan Riverstone McCulloch, which took place at Honolulu on September 1, 1925, systematic ichthyology lost one of its foremost exponents. He was born at Sydney, New South Wales, on June 20, 1885, and at the early age of thirteen he commenced work at the Australian Museum, Sydney, as an unpaid assistant. Even in those early days young McCulloch was distinguished by his enthusiasm, his ability, and his determination to succeed. Assisted and encouraged by Mr. Edgar R. Waite, then in charge of the vertebrate section of the Australian Museum, he made rapid progress both in the study of zoology and in drawing, and when, in 1906, Waite became Curator of the Canterbury Museum, New Zealand, McCulloch succeeded him, though he was then not quite twenty-one years old. By that time he had definitely resolved to devote himself to the study of fishes, and that became his life-work, though he was skilled in all branches of zoology, and was a recognised authority on decapod crustacea.

Exceedingly versatile, McCulloch was never satisfied with the second best, and became an expert photographer and kinematographer, an accomplished artist and musician, and a delightful lecturer. Although not of robust physique he was active and full of courage, and had made several adventurous trips to the Great Barrier Reef and various Pacific Islands. In 1922, in company with Captain Frank Hurley, he traversed part of Papua, and returned with many valuable specimens and a wealth of observations on the natives and the animals of the island.

At the time of his death, McCulloch was on long leave granted him by the Trustees of the Australian Museum in the hope that his bodily and mental vigour would be restored. He left Australia to attend the Pan-Pacific Fisheries Conference at Honolulu, and, with his accustomed ardour, he took a leading part in the work; but he overworked himself and paid the penalty of enthusiasm in his chosen field of research.

When McCulloch died at the early age of forty years, he left behind a record of accomplishment rarely equalled in the full span of a human life. His work was marked by thoroughness and accuracy. Largely as a result of his numerous contributions, the taxonomy of Australian fishes has been placed on a secure foundation. Most of his work appeared in the *Records of the Australian Museum* or in the official publications of other State Museums in Australia. His most important work, which embodied the results of many years' toil and research, was his "Check List of the Fishes and Fish-like Animals of New South Wales," published by the Royal Zoological Society of New South Wales (*Australian Zoologist*, vol. 1, 1919, pp. 217-227; vol. 2, 1921, pp. 24-68; 1922, pp. 86-130). This fine piece of work was in 1922 issued separately as "Australian Zoological Handbook, No. 1," and forms an enduring monument to the industry and ability of the author.

McCulloch had a most pleasing personality, and was ever ready to assist his colleagues. Many scientific workers, both in Australia and abroad, owed much to his helpful advice and criticism. C. A.

MR. E. K. JORDAN.

ERIC KNIGHT JORDAN, one of the most active and promising among the younger geologists of America, was killed in an automobile accident on March 10. Born in San Francisco on September 27, 1903, the son of David Starr Jordan and Jessie Knight Jordan, he had shown in early boyhood unusual interest in scientific research. Before he entered the university he had made a collection and prepared a manual of the molluscs of California. This MSS., still unpublished, contains much original work, especially on the chitons and the minute snails, Odostomia. His study of the molluscan fauna of Trinidad Head (Calif.) was written when he was fifteen years old, and was published by the U.S. National Museum.

Graduating from Stanford in 1923, with geology as his major subject and zoology as a minor, Jordan made in 1924, under the auspices of Cornell University, a large collection of fishes from Hawaii. Under the direction of the California Academy of Sciences, he took part in a biological and geological survey of the middle portion of Lower California. The reports on the last two expeditions are still unpublished.

A unique combination of heredity and environment made Eric Jordan a perfect specimen of young manhood. Handsome, vigorous, earnest, with a love for his chosen field of science which might be said to approach genius, he was heir also to the personal charm which has endeared his parents to numberless Stanford men and women. But a short month before his death he was married to an accomplished class-mate of his, Elizabeth Roper. The scientific world can but tender its respectful sympathy to one of its masters, so tragically bereaved, and mourn for so fair a promise, never to be fulfilled. ALBERT GUÉRARD.

WE regret to announce the following deaths:

Dr. S. M. Barton, professor of pure mathematics in the University of the South, and a charter member and past president of the Tennessee Academy of Sciences, on January 5, aged sixty-six years.

Prof. L. G. Gouy, of the University of Lyons, distinguished for his contributions to the theory of the propagation of spherical waves, the velocity of light and Brownian movements, on January 27, aged seventy-two years.

Prof. W. J. Lewis, F.R.S., senior Fellow of Oriel College, Oxford, and professor of mineralogy in the University of Cambridge, on April 16, aged seventy-nine years.

Dr. Carlo de Marchesetti, honorary director of the Museo Civico de Storia Naturale and director of the botanic garden, Trieste, on April 2.

Mr H. Kirke Swann, author of a number of important ornithological works, including a "Monograph of British Accipitres," now in course of publication, on April 14.

News and Views.

On April 14 Sir James G. Frazer, O.M., was officially invested by M. de Fleurian at the French Embassy in London with the most distinguished title of Commandeur de la Légion d'Honneur, which had recently been conferred on him by the French Government. This rank in the Legion of Honour is, we believe, the highest which is conferred upon a private individual, and is a fitting recognition of one who for many years has held an outstanding position in the field of thought and scientific investigation. It is a little more than a year ago that Sir James Frazer's contributions to the study of the development of human consciousness as manifested in the religious beliefs and social organisation of primitive and early man received the signal recognition of the Order of Merit. This testimony to his pre-eminence among scientific workers in Great Britain is now supplemented by an honour which will serve to remind his fellow-countrymen, should such reminder be needed, that his reputation stands equally high on the Continent, and that his lectures in France and translations of his works have made the name of the author of "The Golden Bough" almost equally familiar on both sides of the Channel. We offer Sir James Frazer our sincere congratulations on this latest honour.

In our issue of November 21, p. 758, in commenting upon the recent very successful visit of Sir Ernest Rutherford to the capital cities of Australia, we expressed a desire to know whether the Australian universities which arranged this visit meditated plans for making such invitations at regular intervals. A correspondent informs us that in 1922, at the Australian Universities' Conference in Melbourne, Prof. Darnley Naylor, of Adelaide, suggested that Prof. John Mackail, the well-known classical scholar, should be invited to deliver lectures in certain of the cities in 1923. The interest taken by the public in these lectures led to the appointment in the University of Melbourne of a small body, known as the Overseas Lecturers' Committee, to make arrangements each year, in consultation with the sister universities, for the visit of a distinguished authority from overseas. No restrictions as to subject were laid down. In 1924 Prof. John Adams accepted an invitation, and his addresses on educational theory and practice were greatly appreciated. Last year Sir Ernest Rutherford visited nearly all the States. The lectures are usually given late in August or in September, and a lecturer is able to return to England a few weeks after the commencement of the Michaelmas term. Unfortunately, Australia cannot offer the financial inducements which attract many British leaders to the United States on similar missions. Moreover, the physical strain of a tour extending from Perth to Brisbane may be considerable. But perhaps the exceedingly hearty appreciation of Australian universities and public audiences, and the sense of most valuable work accomplished in forming "a real net-work of thought and action among British universities," may serve to make it easy for Australia each year to obtain the services of an outstanding scholar from the mother country.

At the present time the changing of generating stations into substations is one which interests electrical engineers. The working, therefore, of the new substations at Ilford is being watched by all those interested in supply. The authorities at Ilford were informed by the Electricity Commissioners so far back as 1920 that no further extensions of their generating plant would be permitted. If they required extra current they would have to take it from a neighbouring generating station. At that time the only suitable station which could supply them was at West Ham, and it is from this station that the supply for the substations at Ilford is obtained. In the future, it is probable that West Ham itself will be a substation, as it is not on the list of the 'selected stations.' This, however, will not affect the supply. These substations, especially when fully automatic, will want regular inspection by a competent staff. Although automatic devices can be looked after by a much smaller staff, yet they must be highly technical. The rapid growth of the supply when the price is reduced will increase the demand for technical inspectors, and we do not think that electricians need fear loss of work or loss of status. The introduction of machinery greatly increases the output, but it does not decrease the number of workers required. One of the substations at Ilford only operates when the load reaches a certain value. Automatic switches actuated by relays then start a rotary converter. Another substation is simply a kiosk built of steel containing high-tension switches which operate a transformer. The rapid extension of fully automatic machinery in substations, both for electric power supply and in telephony, will probably soon be accelerated.

For his Friday evening discourse at the Royal Institution, delivered on April 16, Dr. A. W. Hill took as his title "The Quest for Economic Plants." The quest for spices, drugs and herbs has caused men from the days of the remote past to wander far and wide. In Dr. Hill's opinion the available evidence points to South America as the original home of the banana, coconut, and of the ground nut, and possibly of the oil palm, but when and how they were first transported is and will ever be something of a mystery. Turning to the more recent history of plant introductions, the ill-fated voyage of the *Bounty* may first claim attention. This voyage, undertaken in 1787–1789 for the purpose of conveying the bread fruit—Artocarpus—from the South Sea Islands to the West Indies, is of interest not only because of the mutiny and from the fact that David Nelson, a Kew gardener, was appointed by Sir Joseph Banks to look after the plants, but also because a plan of the ship showing the arrangement for the storing and packing of the pots of plants is given. This may be regarded as the first definite attempt in historic times at plant introduction, on a large scale, of an economic product from one part of the world to another.

THE invention by Nathaniel Bagshaw Ward, examiner to the Society of Apothecaries from 1836 until 1854, of Wardian cases, which are in effect miniature green-houses, made possible the introduction of tea from China to India in 1848 by Robert Fortune, curator of the Chelsea Physic Garden. This was followed by the introduction of Cinchona, the source of quinine, from the Andes of northern South America to Kew by Sir Clements Markham in 1861, and thence to India; and by the introduction of Para rubber, *Hevea brasiliensis*, in 1876, by Sir Henry Wickham and others from Brazil through Kew to the East. The quest for economic plants has since assumed a new aspect. It is now very largely one of finding plants resistant to the diseases which everywhere are manifest, such as the Panama disease of bananas, the withertip of limes, the leaf disease of Para rubber which is causing so much trouble in South America, and so on. There are also modern problems of great complexity relating to the yield of latex from Para rubber, the improvement in type of the oil palm and genetical work in connexion with cotton, rice, sugar and bananas, besides problems relating to soil and climatic conditions which tend to keep alive the romance of economic botany.

THE report of the Council of the Linen Industry Research Association for the year ended September 30, 1925, was presented to the members, on March 23, at a meeting at the Research Institute, at Lambeg, close to Belfast. The Association has been six years in existence, under the direction of Dr. J. Vargas Eyre, who has been most successful in discovering the problems and meeting the needs of the industry—so much so, that those who at the beginning had little use for science are now not merely warm admirers of the work the staff has done for the industry, but persuaded that such a Research Institute is an indispensable accessory. Success is due to the fact that the director has kept practical requirements always to the fore. Commencing with the seed, a large amount has now been raised (more than a ton from a single seed of Russian origin he selected fifteen years ago), which is calculated to yield a plant of even growth, affording a flax of superior quality. The development of the seed has been most carefully studied, not forgetting its value as a source of oil. The retting process has been so thoroughly investigated that a "controlled process" appears to be well within sight. The preparation of flax for spinning has been a subject of the most searching inquiry, and there would seem to be promise of no slight simplification of spinning operations. The very difficult problems of bleaching and dyeing have also received much attention, with a view to diminishing the excessive loss in weight and alterations which affect dyeing properties.

THESE are but some of the co-ordinated activities of the research staff of the Linen Industry Research Association, which has loyally co-operated to a common purpose, with unusual regard of a practical end. The example set should be of no slight value. It is matter for congratulation, that the Council is able to report that the efforts to finance the Association for a second period of five years have, to a large extent, been successful. Congratulations are due to the chairman, Mr. J. G. Crawford, upon the work he and his Council have done in promoting the introduction of the scientific spirit into their industry. It is age-old and at a critical stage but courageous and clearly marked out for a new and invigorated life of usefulness and prosperity. The feature of the meeting at Lambeg was a most feeling account given by Dr. Eyre of his stewardship. To his and the Council's great regret, he is severing his connexion with the Institute. The Association, therefore, is in need of a suitable successor. The post is one of no slight difficulty, as a man is required who has not only sufficient knowledge to have feeling for chemical, botanical, physical and engineering problems, but is also practical in outlook and gifted with tact and organising ability.

THE explorations in Derbyshire caves carried out by Mr. E. C. R. Armstrong, under the auspices of a joint committee of the British Association and the Royal Anthropological Institute during the last two or three years, have produced, and may be expected to continue to produce, important evidence bearing upon the extent and epoch of early man's occupation of the northern Derbyshire area. What may prove an important addition to our knowledge of the archæology of the Peak district, should subsequent investigation confirm and extend present conclusions, has been made by a discovery in a previously unknown cave in the Manifold Valley. The cave was found by the Rev. G. H. Wilson of Bakewell, a well-known local archæologist. According to a statement in the *Times* of April 15 he has found in a stalagmite matrix which lies below limestone boulders at the end of the cave a skull and skeletal remains of the rare pleistocene lynx *Felis borealis*. Remains of wolf, polecat, small ox, red deer and reindeer were also found in a lower chamber of the cave. Beneath the stratum containing reindeer was a layer of charcoal, which Mr. Wilson believes to point to the presence of man.

THE April issue of the *Fortnightly Review* contains an article by Mr. Lancelot Lawton entitled "The Coal Report: No Solution." The title is interesting because it would seem to imply that Mr. Lawton thought that the Royal Commission would be able to find a solution for the difficulties of the industry. If that really was his belief, it need only be said that his optimism was not shared by any one familiar with the position of the industry, because it has long been evident to those acquainted with the facts that the solution must come from within the industry itself, and can be reached only slowly by hard work, sacrifices, and an earnest determination to co-operate for the welfare of the industry on the part of all concerned therein. Few will agree with Mr. Lawton "that the Coal Commission has been a lamentable waste of time and an altogether needless proceeding"; the Coal Commission has done admirable service in putting together the facts of the industry clearly and authoritatively, so that all interested can make themselves definitely acquainted therewith, and that there is no

longer any excuse for the public ignorance that prevails as to many of the conditions under which coal mining is carried on. The Coal Commission's report shows unmistakably that the trouble with the British coal industry is that the coal costs too much when it reaches the consumer. If Mr. Lawton had grasped this fact, he would scarcely have put forward the solution of the difficulty, which he finds in low temperature carbonisation! It is obvious to any one, even without expert knowledge, that the use which the consumer makes of the coal after he has received it is no remedy for the fact that the cost of British coal to him is too high.

SIR WILLIAM BRAGG is to deliver three lectures at the Royal Institution on April 29, May 6 and 13, at 5.15 P.M., on "The Imperfect Crystallisation of Common Things." Whereas some solid bodies are single crystals, and some are not crystalline at all, a large number consist of aggregates of small crystals, and their properties are dependent both upon the nature of the crystals and the nature of their aggregation. In metals that have been drawn, rolled, or worked in any way, the crystals tend to orientate in special directions, and a large amount of work has been done in recent years on the connexion between these peculiarities of crystalline arrangement, the treatment to which the metal has been subjected, and the consequent changes in physical properties. So also in natural structures, such as wool, cotton, and other fibres, in animal growths such as spines, bones, and teeth, there are peculiarities in the arrangement of their minute crystalline contents, which are often associated with the manner of their growth. The methods of X-ray analysis have been lately applied to the study of such cases, and a new field has been opened up which may well prove to be of great importance in the study of the properties of all rigid structures, both natural and artificial. Sir William Bragg's three lectures will deal with the methods which have been employed in this field, and examples will be given of the results already achieved.

PROF. H. NAGAOKA has now occupied the chair of physics in the Tokyo Imperial University for close on thirty years. In 1921 a committee of his friends and former students undertook the compilation of a volume of original papers in celebration of the twenty-fifth anniversary of his appointment (Tokyo: Publishing Committee of the Nagaoka Anniversary Volume, Tokyo Imperial University, 1925). This has recently been published, and seven hundred and fifty copies have been distributed to physicists and institutions all over the world. The delay is mainly attributable to the great earthquake of 1923, in which at least one of the contributors lost his life. It is a handsome volume of more than four hundred pages, including some forty papers relating to a great variety of problems in physics, mathematics, meteorology and astronomy. The very wide field covered precludes any attempt to review the subject-matter; at the same time it is an appropriate reminder of the remarkable range of Prof. Nagaoka's own interests and researches. The committee is to be congratulated on the production of a notable *Festschrift*.

THE issue of the *Journal of the British Science Guild* for March contains some valuable suggestions for the method of procedure at conferences called to settle important questions on which action by the State is necessary or desirable. The Ministry concerned should first constitute an agenda committee, on which each interest should be represented, to draw up a statement of the points at issue. This should be circulated to each of the interested parties, and each is to make a preliminary reply to all the points at issue. The preliminary replies are to be circulated to all the parties, which are then to send in final replies to replace the preliminary ones. The Ministry then collates statements and replies and shows the points of agreement, if such exist, and the real differences. The actual conference is then constituted by the Minister to discuss the issues as summarised and to make recommendations. This procedure is so scientific and orderly that it might with advantage be adopted at all conferences whether under the auspices of the State or not, and much time and temper saved.

THE Report of the Clifton College Scientific Society, for the years 1924–25, is a record of much useful work and many-sided activities on the part of its members. The weather report for the two years under review is summarised by means of three interesting graphs in which the records are compared with those for the period 1881–1915. Among the natural history notes mention must be made of the record of a nesting Great Grey Shrike, which is of special interest in view of Coward's remarks on this species, in his "Birds of the British Isles." The exact locality is, wisely, not mentioned, though doubtless adequate account of it has been preserved in the School records. As is usually the case with school societies, the Lepidoptera command the larger share of attention among the insect groups, but we are glad to note the plea made that other orders of insects should not be neglected. A start has been made with the Coleoptera, and this excellent example will doubtless be extended to other groups. We cordially endorse the advice given to members of this Society—to study the living insect and its habits, and to collect as sparingly as possible. This is in the best traditions of the naturalist and of the very essence of field work. The members of the Society who are interested in entomology may be advised to explore the possibilities of the Bristol Museum as an aid to the classification of their captures.

WE have received the first number of a new quarterly publication entitled *Health and Empire*, the official journal of the British Social Hygiene Council (London: Constable and Co., Ltd., 10*s*. per annum). The subject-matter consists of editorial comments, articles, reviews of books, summaries of official publications, and notes on the Council's activities. Among the articles, Prof. Cyril Burt writes on the "Contribution of Psychology to Social Hygiene." He has much to

say on sex delinquency, and his conclusions are hopeful for the future. He believes that many of the amorous adventures of youth of either sex in civilised life are attributable, not solely to the sex instinct, but also in part to the hunting instinct: the youth prowling after the girl, the girl promenading after an attractive youth, are simply stalking each other, because the streets of the modern city provide no other animal to chase. Much misbehaviour, too, is really based upon the so-called maternal or protective instinct. Prostitution, he believes, will slowly vanish, just as the organised robberies, fighting, and duelling of former times have been mastered. "The main force of the sexual instinct will in the near future be controlled, ennobled and refined." Altogether, a critical and illuminating article! Prof. Percy Nunn contributes an article on the "Influence of Education and Tradition in Social Hygiene," in which he indicts science-teaching in schools. "In our secondary schools for boys, 'science' means scarcely anything beyond physics and chemistry. . . . My conviction is, and has long been, that progress towards national enlightenment in social hygiene must remain slow and disappointing until we rectify these grave defects in our school programmes. We must seek, through genuine, if simple, biological teaching in the elementary and even more in the secondary schools, to correct the orientation of the national mind." Other articles are by Mr. C. J. Bond and Dr. L. Findlay.

MAJOR J. HALL-EDWARDS, a pioneer worker in X-ray therapy whose name is widely known, has been elected an honorary member by the council of the British Medical Association in recognition of his services to medicine.

PROF. E. G. COKER, University College, London, has been awarded the Louis Edward Levy Medal of the Franklin Institute, Philadelphia, for his paper on "Photo-Elasticity" appearing in the March 1925 issue of the *Journal of the Franklin Institute*. The medal was "founded for the recognition of papers contributed to the Journal of the Institute, descriptive of the author's researches in physical science or of his engineering achievements, which have added largely to the sum of knowledge or aided greatly the well-being of mankind."

DR. W. E. GYE has been awarded the Walker Prize of 100*l*. of the Royal College of Surgeons of England in recognition of his work in advancing the knowledge of the pathology and therapeutics of cancer during the past five years. The Committee appointed to advise the council of the College in the matter stated that the work suggests "new and hopeful lines of attack upon the problem of the cause of malignant disease."

THE following have been elected to honorary membership of the American Museum of Natural History, New York City: Captain J. B. L. Noel, in appreciation of his valuable contributions to the science of geography through his explorations in the Himalayas, and especially in his remarkable ascent of Mount Everest; Kunwar Dillipat Shah Rai Bahadur, for the generous assistance which he extended to the Faunthorpe-Vernay Expedition, which has been so successful in securing for the American Museum of Natural History splendid examples of the Plains animals of India.

THE Museum of Practical Geology, Jermyn Street, London, S.W.1, is now open to the public at the following times: Week days (except Saturdays), 10 A.M. to 6 P.M.; Saturdays, 10 A.M. to 9.30 P.M.; Sundays, 2.30 P.M. to 6 P.M. The Library will be open from 10 A.M. to 5 P.M. on week days.

THE *Transactions of the Faraday Society*, which have hitherto appeared three times a year, will in future be published bi-monthly in order to expedite the publication of papers. In addition to the six bi-monthly parts, reports of two general discussions will be published annually, one in the spring and one in the autumn. The new arrangement begins with Vol. 22, 1926. The Publication Committee of the Society will be glad to consider papers on any branch of pure or applied physical chemistry, and under the new arrangement rapid publication will be ensured. Communications should be addressed to the Secretary and Editor, 90 Great Russell Street, London, W.C.1.

A GENERAL discussion on "Explosive Reactions in Gaseous Media" is being organised by the Faraday Society to take place on Thursday, May 13, at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. The proceedings will be divided into two sessions. The first, from 2.30 to 6.30, will deal with the subject generally, and Prof. H. B. Dixon will preside. An introductory survey will be given by Dr. W. E. Garner, and papers initiating discussion will be presented by Prof. Dixon, Prof. W. T. David, Dr. S. W. Saunders, Dr. R. V. Wheeler, Prof. W. A. Bone, and Dr. C. Campbell. The second session, 7.45 to 10, will deal with explosive reactions considered in reference to internal combustion engines. Sir Dugald Clerk will preside, and he will give an introductory survey, being followed by Prof. David and Mr. H. T. Tizard. A dinner will be held between the sessions at the St. Ermin's Hotel. A full programme can be obtained from Mr. F. S. Spiers, 90 Great Russell Street, London, W.C.1.

THE Geodetic Survey of Canada and the United States Coast and Geodetic Survey have recently completed a joint circuit of 1860 miles of triangulation in Eastern Canada and New England. The 1300 miles in Canada extends from the international frontier south of Montreal along the St. Lawrence to Anticosti Island, then round the Gaspé Peninsula and the coast of New Brunswick to the head of the Bay of Fundy. There begins the 560 miles of the American net which extends via Albany northward to the point on the frontier south of Montreal. The circuit closed with an error of only 42 feet, which averages about one-quarter of an inch per mile.

THE United States Department of Agriculture Library has just issued No. 11 of its Bibliographical Contributions, in the form of a list of manuscript

bibliographies and indexes in the Department, including serial mimeographed lists of current literature. The bibliographies are classified by subject, 202 entries being divided under 35 headings, and a comprehensive index with cross-references is of valuable assistance in tracing items in greater detail. The entry relating to each bibliography is descriptive, indicating its source of origin and giving a brief account of the ground covered by the material catalogued. The list has been made as comprehensive as possible, the assistance of the librarian and chief clerks of the various bureaux having been secured to attain this end.

MESSRS. J. and A. Churchill will publish at an early date a translation, by Dr. E. Fyleman, of Dr. B. Waeser's "The Atmospheric Nitrogen Industry," "The Chemistry of the Proteins," by Dr. Dorothy Jordan Lloyd, and an addition to the "Recent Advances" series, entitled "Recent Advances in Biochemistry," by Dr. J. Pryde.

THE Cambridge University Press will shortly publish Vol. 2 of Prof. F. O. Bower's "The Ferns (Filicales)," dealing with the Eusporangiatae and other relatively primitive ferns. The same house will also issue "The Southern New Hebrides: an Ethnological Record," by C. B. Humphreys, being an account of the ethnological conditions of the five southern islands of the New Hebrides: Tanna, Anaiteum, Futuna, Aniwa, and Eromanga.

APPLICATIONS are invited for the following appointments, on or before the date mentioned:—A scientific officer for research in connexion with electrical ignition appliances—The Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (May 15, quoting Ref. A.81). Civilian education officers (Grade IV.), Royal Air Force, with good academic and practical qualifications for teaching engineering subjects—The Secretary, Air Ministry, Adastral House, Kingsway, W.C.2. A research physicist, with experience in research—The Director, Research Laboratories of the General Electric Co., Ltd., Wembley. A museum attendant, with knowledge of preparing and mounting specimens—The Curator of the Museum, University College Hospital Medical School, University Street, W.C.1.

ERRATA.—NATURE of April 10, p. 516, end of penultimate paragraph in Col. 1; *for* "standard deviation, 74·7" *read* "standard deviation, 7·47."

NATURE of April 17, p. 557, Col. 1. The total power of the electrical machinery in the machinery hall of the Rugby Wireless Station is 1800 kilowatts and not 800 kilowatts as stated. The insulation referred to at the end of paragraph 3 as being designed for a quarter of a million volts is the insulation between antenna and earth.

Our Astronomical Column.

MAGNETIC 'STORM,' AURORA, AND SOLAR DISTURBANCE.—A considerable magnetic disturbance was recorded at Greenwich on April 14, commencing with a sudden deflexion of the needles at 11 hr., and continuing until 11 hr. on the following day. The extreme range shown by the Declination trace was $1\frac{1}{4}°$, and by the North Force trace 350γ. The disturbance thus ranks as 'great.' In this connexion, a letter received from Mr. Charles Leaf of Cambridge is of interest, in which he records a fairly well-marked display of the aurora borealis seen on April 14 between $21^h\ 20^m$ and $21^h\ 50^m$ G.M.T., after which clouds made further observations impossible. The aurora was seen as a moderately strong greenish glow exhibiting a marked 'pulsation' of intensity; no streamers were visible. Mr. C. P. Butler of the Solar Physics Observatory, Cambridge, also observed the aurora. He noted its greenish colour and that the auroral line λ5577 was fairly bright.

At the time of these phenomena there were no large spots on the sun, although there were three comparatively small ones, and several areas of faculæ. One of the spots at the time of the commencement of the magnetic storm was 9° of solar longitude (or 0·7 day) east of the sun's central meridian. Although much diminished in size, this spot was the fourth recurrence of one of a very large pair of spots seen last December. Its earlier history has been outlined in these columns as the naked-eye spot, Nos. 1 and 4 (NATURE, January 9, 30, February 27). When near the sun's central meridian on January 22 a moderate magnetic disturbance took place, but no marked movements of the needles were noted at the time of its two subsequent transits of the central meridian about February 19 and March 18.

Mr. A. M. Newbegin, of Sutton, Surrey, has observed that the longitudinal zone of the sun containing this spot has produced a large prominence, which he saw with his spectroscope at the sun's limb on February 25, March 10, and March 23-24.

THE HAMBURG OBSERVATORY, BERGEDORF.—The report of the Director of this Observatory, Prof. R. Schorr, for 1924 has lately come to hand; it contains a record of numerous researches. The transit circle is being used for the re-observation of stars observed by Rümker. The 60-cm. refractor has been used by Dr. Graff for charting the stars surrounding 150 eclipsing variables, determining both their magnitude and their colour.

Dr. Baade used the reflecting telescope for photographic observations of several faint comets and interesting minor planets, including Ganymed, which he discovered. He also obtained photographs of several clusters and nebulæ. He has now temporarily left Bergedorf on a visit to some of the North American observatories. Dr. Kruse has used the 26-cm. equatorial for photometric observations of variable stars, also for comets and minor planets. The Lippert astrograph was used by Prof. Schwassmann and Dr. Haas for obtaining photographs and spectrograms of the Kapteyn selected areas. The exposures for the spectrograms ranged from half-an-hour to 5 hours. Dr. Haas also determined the spectral types of several faint stars for which sensible parallaxes have been found. They are mostly of late types, G to M, but B.D. +42° 3917 is of type A 3.

Progress is also being made with the "Geschichte des Fixsternhimmels" and the "Eigenbewegungs-Lexicon," which are extremely useful works of reference.

The work of detecting faint minor planets and periodic comets on their return to perihelion has been very successfully pursued.

Research Items.

BLOOD CHARACTERISTICS AND RACE.—The first number (Jan.-Feb.) of vol. 36 of *Natural History*, the publication of the American Museum of Natural History, is devoted to the study of the present races of man, and contains, in addition to descriptive articles of primitive peoples, several papers dealing with anthropological questions of more general bearing. Among these is a review by Mr. R. Ottenburg of the present position of the study of the characteristics of the blood as a test of race relationship. The suggestion put forward by Dr. Hirschfeld and his wife in 1918 that the constituents known as A and B originated in Europe and Asia respectively, no longer holds good in the light of further and more extended observation. It is found that there are races in Africa, Asia, Australia, and America which show as high a proportion of A to B as do the North Europeans, the supposed exceptionally high proportion of A in the last named being the basis of Hirschfeld's conclusion. Six fundamental types are to be recognised according to the proportion of the three more common blood-groups. The European type is characterised by a relatively high proportion of Blood-group II., while two of the Asiatic types, the Indo-Manchurian and the Afro-South Asiatic on the fringes of the Indian Ocean, have more of Blood-group III. The Pacific American type, consisting almost entirely of Australian and American Indians, shows an enormous preponderance of Blood-group I. The Hunan type is remarkable in that it shows an unusual proportion of Group IV., which in every other type is the lowest. The figures seem to indicate the existence of transition races formed by the mingling of two adjacent races. The Jews apparently do not form a homogeneous group, but tend to assimilate to a local group, *e.g.* Berlin Jews to German, Spanish Jews to Arab, Rumanian Jews to Hungarian, and so on. The gypsies, however, correspond to the Indo-Manchurian type, which seems significant in view of their tradition of non-intermarriage and Central Indian origin.

AN 'EOLITH' FACTORY.—A sequel to the now famous study of the 'eoliths' produced in the course of the manufacture of cement at Mantes, which was made by Prof. M. Boule in 1905, appears in Nos. 1-2 of vol. 36 of *L'Anthropologie*. In 1924 Mr. Etienne Patte, at the suggestion of Prof. Boule, examined flints similarly produced by a cement factory at Beaumont-sur-Oise, and found them to be identical in form with the implements found in the pliocene of East Anglia for which a human origin is claimed. The method pursued in selection was identical with that followed by those who accept the Pliocene specimens as artefacts; that is, a process of repeated classification, selection, and rejection which ends in the assembly of a relatively small number bearing what are said to be indubitable traces of human purposive working. In this case the causes are mechanical; but the chipping is identical, and the result a collection of characteristic types, rostro-carinates, etc. More remarkable still, a crushing machine which consisted of two 'jaws' shod with iron, the lower being fixed, produced flakes, some of which showed an apparent secondary chipping and might have been taken for scrapers of an Upper Palæolithic or even Neolithic culture.

THE MARINE FISHES OF PANAMA.—The second part of this monograph, by Mr. S. E. Meek and Mr. S. F. Hildebrand (*Field Museum of Natural History*, Zool. Ser., vol. 15, 1925), includes the teleost fishes from the families Carangidæ to Pomacentridæ. Nine new species and subspecies are described, and in many cases a detailed study of Atlantic and Pacific forms has demonstrated differences of sufficient importance to warrant the institution of new species. The report is well illustrated, and the authors have not neglected to supply well-produced figures of hitherto inadequately figured forms. Useful working keys to the genera and species continue to form a prominent feature of the work, and, when completed, it should be an indispensable guide to the fishes of this region and yield valuable information for a detailed comparison of species and genera on both coasts of Central America.

FLUCTUATIONS IN FISHERIES.—We quite agree with Mr. B. Storrow (*Trans. Nat. Hist. Soc. Northumberland*, Nov. 1925) that to trace to their cause the fluctuations to which statistics show that all fisheries are subject, is one of the most important problems in fishery investigations, if not indeed the central problem on which all remedial measures depend. These fluctuations are seen by comparing the total landings year by year, or the catch per unit of power in unit of time. The latter is obviously the most accurate method, but boats themselves as units of power fluctuate so greatly, leaving out of all account the skill of their crews, that its measure of accuracy is not great. In any case, it cannot be applied to herring or any fish which is not distributed relatively evenly over the bottom or the surface of the sea where trawl or drift fisheries are regularly pursued. In writing on any fishery question there is always the personal factor which must come in, even in interpreting rigid facts, as exemplified by figures of catch of different areas as shown by Mr. Storrow to his readers in numerous graphs. The thesis here is that migrations of fish have more to do with fluctuations than any other factors, such as bad spawning or hatching, greater or less vitality of the young, or extraordinary occurrences causing the death of fish in vast numbers. As examples the herring, cod, haddock and mackerel are considered. Graphs are given either to show average catch per day's absence for each month, or the total catches year by year for a number of years in several areas, superimposed for each year upon one another. These should be similar if the same causes operate in all areas, but it is clearly brought out that peaks in some graphs so commonly overlie depressions in others that, if all were added together, the result would be so smoothed down that the facts would be hidden. To put it in another way, the total catch does not vary much year by year, while the catch in areas shows large fluctuations. There are great periodic changes in the flow of Atlantic waters besides minor fluctuations and, coinciding with these, are supposed to be wholesale movements of the fish themselves. Of these, statistics alone cannot give proof, which can only come by the identification of the areas from which the fish came, by markings or otherwise on the fish themselves.

CARABID BEETLES FROM THE KUMAON-TIBETAN FRONTIER.—In the *Entomologist's Monthly Magazine* for March 1926, Mr. H. E. Andrews contributes a paper on the Carabidæ obtained by Mr. H. G. Champion in the north of Kumaon and over the Tibetan frontier. During the expedition much new country was traversed at a great elevation, and the Tibetan frontier was reached near Shelshel and Laptel at about 15,000 ft. The species and varieties of Carabidæ enumerated number sixty-six, and twelve

new species are described. Most of the species inhabiting the higher regions of the Himalaya are, as would be expected, palæarctic genera, and this appears to be the southern limit, at least in Asia, for a good many of them. A few, such as Dioryche and Colpodes, occur in tropical Asia and reach their northern limit in the Himalaya. Others, such as Tachys and Bembedium, are nearly world-wide. Sixteen species extend their range outside the Himalayan tract, occurring, in some instances, in Indo-China, Formosa, and the Malay Islands. One species, *Anchomenus quadripunctatus*, is holarctic in its range and extends into England.

EXPERIMENTS ON DAPHNIA.—M. Ramult records (*Bull. Internat. Acad. Polonaise Sci. et Lettres*, No. 1, 2B, Jan.-Feb. 1925) observations on the effects of sodium chloride solutions, including Ringer and Van 't Hoff's solutions, on Daphnia and other Cladocera. These solutions restrain the passing of the parthenogenetic eggs into the brood-pouch; such restraining action begins to appear in N/30 sodium chloride, and in concentrations above N/10 is total. While the restraining action appears in individuals before the weakening of their other vital functions, the author thinks it may be assumed to be due to the enfeebling action of the solution on the egg-producing female. N/30 and higher concentrations exercise a restraining influence on the development of the egg, which is especially sensitive to such solutions in the membraneless condition, but after the formation of the membrane can develop in solutions up to N/16 to N/6. The eggs of the succeeding broods of the same female living in the saline solution show a decreasing resistance, probably corresponding to a lessening vitality. The different eggs of the same brood living in the solution exhibit differences in their power of development. Animals which passed through their whole development in the solution attained their maturity in the same period of time as, sometimes even earlier than, those from the normal culture. In the third generation bred in the solution (not stronger than N/15) both the period of embryonal development and of the attaining of maturity are as long as in the second generation, and the number of eggs produced by the females in the solution is not reduced. The eggs of the second generation are able to pass through their normal development in a concentration slightly higher than those of the first generation—this applies to solutions not stronger than N/20.

INTESTINAL FLAGELLATES IN TROPICAL AMERICA.—Prof. R. W. Hegner (*Amer. Journ. Trop. Med.*, 5, May 1925) records the results of examination of stools made by him during the summer of 1924 in Honduras and in Colombia. The incidence of infection with *Trichomonas hominis* was 20·6 per cent., with *Chilomastix mesnili* 7·7 per cent., and with *Giardia lamblia* 2·1 per cent. The author accounts for the high incidence in the case of the first two (1) by the high temperature and moist climate of tropical America, which are favourable for the transmission of these flagellates; (2) by the insanitary habits of the natives, which also favour transmission; and (3) the diet, which is largely vegetable, of the general population. Prof. Hegner has previously shown that these flagellates grow and multiply rapidly in hosts that live on a vegetable diet, but they are largely eliminated from hosts that live on a meat diet. Comparison of these results with those of Miss Jepps from the Federated Malay States and of Boeck and Stiles from the United States indicates a definite relation among human beings between a meat diet and the lower incidence of infection with these flagellates, especially Trichomonas.

THE PERIOD REQUIRED FOR MITOSIS.—Modern methods of tissue culture permit observations on the process of mitosis and of the duration of the various phases. In view of the discrepancy in the times recorded by Levi (1916) and by Lewis and Lewis (1917), G. P. Wright (*Journ. R. Micr. Soc.*, Dec. 1925) has made observations on tissue from the heart of chick embryos of the 9th to the 12th day, cultivated in Pannett and Compton's saline medium to which embryonic extract had been added. Assuming that the telophase period lasts 5 min., and on this there seems to be fairly close agreement, the early prophase takes 8 min., the spireme 6½ min., the metaphase 5 min., the anaphase 4 min., the telophase 5 min., and the reconstruction 5 min.—a total of about 34 min. This is almost identical with Strangeways' record of 35 min. as the period of division of the choroidal cells of the chick, and it falls midway between the two limits, 25 min. to 45 min., found by Lambert and Hanes to be the time of division for the connective tissue cells of the rat.

A TAXONOMIC STUDY IN EVOLUTION.—From this general point of view, Mr. Francis W. Pennell examines the taxonomy of the genus Afzelia of the Scrophulariaceæ in *Proc. Acad. Nat. Sci. Philadelphia*, vol. 77, pp. 335-373, 1925. He concludes that the genus shows transition from the campanulate to rotate corolla, with a change from longitudinal to pore dehiscence in the anther of the stamen, with which change also runs a modification of the staminal filament from a broad flat hairy structure to a type with a slender, terete, glabrous distal region. Thus the flower, viewed as an organ to ensure pollination, has been so changed as to function in a new manner. Studying the distribution of the species in this genus, Mr. Pennell concludes that they show a striking disagreement with the "Age and Area" hypothesis of Dr. Willis. In Afzelia, the most modified and recent species appear to be the most widespread.

REGENERATION OF FERN PROTHALLI.—In the *Biologisches Centralblatt*, vol. 46, pp. 80-96, 1926, K. Linsbauer describes some interesting experiments on the regeneration of isolated cell groups obtained by cutting pieces out of fern prothalli. He finds that very small cell groups, which normally would have finally ceased to grow and divide, when isolated in this manner, may again begin to grow vigorously and practically give rise to prothalli. He concludes that this revival of growth cannot be traced to growth-promoting substances from the wounded cells, but to the accumulation of assimilates in the isolated prothallial fragments which normally would have been passed on to nourish the growing apical region.

CURRENTS IN THE RED SEA.—An account of current-meter measurements made during the hydrographic cruise in the Red Sea of the *Ammiraglio Magnaghi* in 1923–1924 is published by Prof. F. Vercelli, with numerous diagrams and illustrations (*Armati Hydrografici*, vol. 11). The recorded horizontal movement of the upper layers was found on analysis to be the sum of a to-and-fro tidal stream and a drift current, the latter varying with the monsoon season. The tidal streams persist throughout all depths, whereas the drift current decreases down to a depth of 100 metres in the channel off Bab-el-Mandeb, below which it reverses in direction. From the harmonic components of the tidal stream, derived from an analysis of the observed data, and the drift current, the calculated velocity of the upper layers is tabulated for every hour throughout a year. Accurate computations of the currents which will

be met with by vessels navigating the Red Sea are likely to be of particular value in view of the difficulty often experienced in that neighbourhood in obtaining reliable 'sights' during the day owing to refraction.

RAINFALL IN THE NETHERLAND INDIES.—The Royal Magnetical and Meteorological Observatory of Batavia in *Verhandelingen*, No. 14, vol. 1, publishes the mean rainfall figures for 2715 rainfall stations in the Netherland East Indies, calculated from observations made during the period 1879–1922, by Dr. J. Boerema. The present publication contains nothing besides a mass of tables without a word of text. Very few of the stations are for the whole period of forty-four years, but the number of years over which the observations extend are given with each station, and the height of each station above sea-level is stated. In addition to the mean rainfall for each month and the year, the mean number of rainy days is also given, but what constitutes a rainy day does not appear to be stated; the results are in mm. The mean maximum daily rainfall is also given for each month and for the year; it might perhaps have been more useful to give the absolute maximum rainfall for each month and year. A single entry of the absolute fall is given without reference to when it refers.

SEASONAL WEATHER FORECASTING.—Remarks on the influence of the currents in the waters about Denmark upon the climate of Denmark and neighbouring countries by A. C. Johansen and A. J. C. Jensen, reprints from Physiological Papers, have recently been published in Copenhagen. The strength of the inflow into the Kattegat varies much from time to time, and a strong outgoing current in the surface layer is followed by a strong ingoing current in the lower layer. The authors have examined the correlation between the salinity of the bottom water of the Kattegat and the salinity and temperature of the surface water, also the correlation between the salinity of the bottom water in the Kattegat in the spring months and the air temperature in Denmark and neighbouring countries in the summer months. It is found that a high salinity in the lower layer of the northern Kattegat in April–May is normally followed by a low air temperature in June and July, and a low salinity is normally followed by a high air temperature. There is probably also a positive correlation between the salinity of the bottom water of the Kattegat in the spring months and the rainfall in Denmark in the early summer.

LEAKAGE OF CARBON DIOXIDE FROM SHIPS' HOLDS.—Special Report No. 24 of the Food Investigation Board, by Mr. A. J. Smith, describes leakage tests on two vessels (London: H.M.S.O., 1925; 9*d*. net). Carbon dioxide was introduced into the empty holds, and, by analysing the gas from day to day, the amount of leakage was determined. The rate of leakage in port was increased to more than ten times its original value by opening the thermometer tubes. The leakage when the vessel was at sea was higher than when at rest in port.

TRANSMUTATION OF MERCURY INTO GOLD.—A further contribution to this question is made by Piutti and Boggio-Lera, whose results are published in the September-December issue of the *Rendiconti dell' Accademia delle Scienze Fisiche e Matematiche* (*Naples*). The mercury employed was purified by repeated distillation in a vacuum, the two final operations being carried out in Jena glass apparatus under a pressure of the order 0·001 mm. This purified mercury was treated in three different ways: (1) A spark discharge was passed between electrodes of the metal in a highly evacuated tube; (2) an arc was passed between two very fine jets of the mercury in a vessel kept filled with hydrogen to prevent oxidation; (3) a fine stream of the mercury was allowed to fall through the arc passing between two specially pure carbon electrodes, also in an atmosphere of hydrogen. In no case was any formation of gold detectable, even by Stammreich's method of testing, which responds to so little as one one-millionth of a milligram of gold per kilogram of mercury. The view that mercury may undergo spontaneous transmutation into gold in Nature is suggested by the invariable presence of gold in commercial mercury, and it is possible that useful information on this phase of the subject might be acquired by the examination of deposits of cinnabar of different geological ages.

THE GLOW OF PHOSPHORUS TRIOXIDE.—Thorpe and Tutton, the discoverers of phosphorus trioxide, showed that this substance is oxidised with emission of light, and it has been suggested that the glow of phosphorus is really due to that of phosphorus trioxide formed in a preliminary reaction. It has also been suggested that in moist oxygen an intermediate substance, probably phosphine, is formed from phosphorus trioxide, and that the glow is due to this. An interesting account of the glow of phosphorus trioxide is given by Christina Cruickshank Miller in the *Proceedings of the Royal Society of Edinburgh*, 1925–6, vol. 46, part 1. It was shown that the glow depends on the presence of moisture and ceases in the absence of water. It was found that phosphine and other hydrides of phosphorus are produced, and the glow is attributed to the oxidation of these. The results throw much light on the still obscure problem of the glow of phosphorus itself.

MEASUREMENT OF HUMIDITY IN CLOSED SPACES.—Special Report No. 8 of the Engineering Committee of the Food Investigation Board contains an account of experimental work in hygrometry carried out at the National Physical Laboratory by Dr. Ezer Griffiths (London: H.M.S.O., 1925; 2*s*. net). The primary object of the investigation was to study apparatus for making humidity measurements, and a description is given of numerous forms of hygrometers devised to meet special requirements. The supreme importance of exposing the wet bulb of the wet and dry bulb hygrometer to moving air is emphasised. The special forms of this hygrometer described are: (*a*) a direct reading instrument; (*b*) instruments to enable readings to be taken without entering the enclosure; (*c*) a distant reading form. The dew-point hygrometer is particularly suitable for use as a standard of reference in calibration work. Several industrial forms of dew-point apparatus are described. The hair hygrometer was given detailed study. It was found that the hair hygrometer showed a tendency to give high readings with lapse of time. The instruments which behaved most satisfactorily were those in which the tension force was small and the bearings and pivots of which were so well made that friction was reduced to a minimum. A distant reading type of hair hygrometer was constructed on the Wheatstone's bridge principle. The other instruments of this type that might be mentioned are (*a*) the form adapted for insertion into fruit cases; (*b*) the combined hair and dew-point apparatus. A hygrometer was constructed utilising a discovery of Orme Masson that dry cotton-wool when exposed to a damp atmosphere generates heat. The instrument was constructed in the form of a differential resistance thermometer, one coil being covered with cotton and the other by non-hygroscopic material. This type of hygrometer has certain inherent defects due to hysteresis.

Exhibits at the Optical Convention, 1926.

THE Optical Convention, 1926, was held at the Imperial College of Science and Technology, South Kensington, during the week April 12-17, under the presidency of the Astronomer Royal, supported by representatives of all branches of the optical industry and profession. An important part of the Convention was the exhibition of optical instruments and apparatus organised to demonstrate the advances that have been made in optics in Great Britain since 1912, the date of the previous Convention. During the week, more than 8000 visitors, in addition to members of the Convention, attended the exhibition. Many were attracted, no doubt, by the various entertainments and performances incorporating interesting optical illusions, but many also were attracted by a desire to study the concrete evidences of recent developments and the most modern products of British opticians, many of which, as the Prime Minister pointed out during the opening ceremony, are recognised the world over as achieving the high water-mark of technical perfection.

Considerable development might be expected in an industry during a period of fourteen years. When it is remembered that during part of that period, development was quickened by the urgency of war-time requirements, and later by the necessity of meeting fierce competition arising from depreciated foreign exchange rates, and also of keeping pace with rapid advances in science, it can easily be imagined that the manufacturer had a wide range from which to choose his exhibits.

Optical glass, the most important of the optician's raw materials, was exhibited in the rough lump and in the form of moulded slabs, disks and prisms by Messrs. Chance Bros. and Co., Ltd., and by Messrs. Parsons' Optical Glass Co. The latter firm exhibited a disk of hard crown glass, 32 in. in diameter, suitable for use in a 30-in. aperture telescope object-glass. Specimens of dense barium crown glass shown by Messrs. Chance Bros., illustrated the improvement in quality, particularly in regard to freedom from colour and bubbles, which has been effected in recent years in the production of this difficult glass. This firm now makes more than 100 different types of glass suitable for optical purposes, many of which were not manufactured before the War.

Some of the uses to which these new glasses have been put were well illustrated by the extensive range of new types of photographic lenses exhibited. The Ross Xpres and the Taylor-Hobson Aviar lenses were designed and produced during the War to meet the demand for large-aperture lenses giving the high quality of definition required in air photography. Further developments in the direction of the production of rapid anastigmats were represented by Messrs. Taylor, Taylor and Hobson's f/2·5 lens, suitable for reflex cameras, and also their f/2 anastigmat, which has a covering power of 55° and represents the limit so far reached in the production of wide angle, large-aperture lenses. Another exhibit by the same firm was a series of f/3·5 telephoto lenses, which marks an important advance in telephoto construction. This advance has been shared by the Teleros lenses of Messrs. Ross, Ltd., who had on view a 40-in. lens of that series fitted to a Ross Sports camera. Telephoto lenses of recent design were also exhibited by Messrs. J. H. Dallmeyer, Ltd., and by Messrs. Wray (Optical Works), Ltd.

The remarkable developments that have been effected in British-made surveying instruments were well shown in the various types of theodolites and levels exhibited by Messrs. C. F. Casella and Co., Ltd., Messrs. Cooke, Troughton and Simms, Ltd., Messrs. W. Ottway and Co., Ltd., and Messrs. E. R. Watts and Son, Ltd. These improvements have been largely directed towards securing optical perfection, reduction in dimensions and weight, greater rigidity, more effective guarding of vulnerable parts, and the introduction of means for saving time and labour in the making of observations. In the precise levels exhibited by these firms, the telescope with the attached bubble can be tilted independently of the vertical axis, which greatly facilitates and expedites field work. Provision is also made on many of the instruments for reading the bubble, the compass bearing, and the staff, from the telescope-end position, without change of position on the part of the observer. Messrs. Cooke, Troughton and Simms and Messrs. Watts exhibited levels embodying reversible bubbles, the use of which simplifies the adjustment of the instrument. Further simplification in the use of Messrs. Watts' instruments have been effected by the introduction of their "constant" bubble, which is so constructed that changes of temperature within the range 0° to 130° F. produce no change in the length of the air bell. Thus, when the instrument is being set it is necessary to observe only one end of the bubble.

With the exception of a few standard instruments or parts of instruments, the microscope apparatus exhibited by Messrs. C. Baker, Messrs. R. and J. Beck, Ltd., Messrs. Negretti and Zambra, Messrs. Ogilvy and Co., Messrs. James Swift and Son, Ltd., and Messrs. W. Watson and Sons, Ltd., represented an entirely new series of instruments and appliances for microscopical work computed and designed since the last Convention, and including all types of microscopes and microscope accessories such as are required for students' use, for industrial processes, for scientific investigations and for all classes of laboratory and research work. The modifications that have been introduced involve many important changes in mechanical design and construction, and also improvements in optical properties. One of the most striking alterations in mechanical design is that shown in the Beck Radial microscope. The general design is that of a small optical bench so arranged that as the inclination is changed from the vertical to the horizontal, or any intermediate position, the centre of rotation remains in the optic axis. The advantage of this arrangement is specially apparent in metallurgical work when a vertical illuminator is used. The adjustment, being once set, is not altered by the inclination of the instrument or by the focussing.

Of the many important instruments exhibited by Messrs. Adam Hilger, Ltd., the most outstanding were the Hilger interferometers, including those for demonstration purposes and for the examination of prisms and lenses, and the latest model, the Universal camera lens interferometer, which permits of the examination of all ordinary photographic lenses up to a clear aperture of 5½ in., and from 4 in. up to about 33 in. focal length, as well as lenses of the telephoto type, process lenses, complete telescopes up to a total length of 12 in., and eyepieces. On this firm's stand were also a complete range of Hilger wave-length spectrometers; a permanent adjustment quartz spectrograph giving a spectrum from 2100 Å.U. to 8000 Å.U.; a vacuum spectrograph for the study of the furthest ultra-violet region, in which a concave diffraction grating of 2 metres radius is used; and the Hilger ultra-violet spectroscope provided with a fluorescent screen from which the wave-length may

be directly determined. Messrs. Bellingham and Stanley, Ltd., also exhibited quartz spectrographs and a range of polarimeters and spectrometers, including a compact instrument for the examination of the entire spectrum giving readings directly in wave-lengths.

The ophthalmic section of the industry was well represented by about twenty-five different exhibitors. Many new types of spectacle lenses, eyeglass mounts and spectacle frames were shown. The ophthalmic instruments on view illustrated the development of apparatus for the detection of pathological conditions of the eye, as well as those for the mechanical measurement of visual errors. Among these may be mentioned the self-registering perimeters exhibited by several firms; the photographic ophthalmoscope, exhibited by the Cambridge Instrument Co., Ltd., by means of which it is possible to obtain photographs of the fundus showing both the optic disk and the macula lutea on one plate; and the combined corneal microscope and slit lamp, exhibited by Messrs. Clement Clarke, Ltd., in which both the illuminating system and the microscope are mounted on an arc which has its centre of curvature at the focus of the illuminating beam.

It is, of course, quite impossible in an article of reasonable length to give anything approaching a full list of the various interesting pieces of apparatus on view and described in the 320-page catalogue prepared for the use of the members of the Convention. In the preceding paragraphs reference has been made to only a few of the items on the stands of a few of the trade exhibitors, and many important items in important groups of instruments have had to be omitted.

The educative value of the exhibition was enhanced by the inclusion of a section devoted to optical instruments and apparatus designed by research workers for use in scientific investigations. These included an instructive collection of apparatus exhibited by the National Physical Laboratory, Teddington; the Technical Optics Department of the Imperial College of Science and Technology, South Kensington; the Department of Applied Optics, Northampton Polytechnic Institute, London; the Refraction Hospital, London; and by other institutions and scientific workers. Mention should be made of the selenium apparatus designed by Dr. E. E. Fournier d'Albe and E. O. Symonds for registering mechanically the passage of interference fringes; the Clarendon photoelectric photometer, exhibited by Prof. F. A. Lindemann and Dr. G. M. B. Dobson, by means of which very small areas, such as spectral lines on a photographic plate, can be measured to a high degree of accuracy; and the series of instruments exhibited by the Cambridge Instrument Co., Ltd., in which the stylus-on-celluoid method is used for recording various physical phenomena.

The historical section of the exhibition contained a valuable loan collection of more than 350 items of great historical importance, illustrating the evolution and development of various types of optical instruments and indicating the types actually made and in use at different periods. Our admiration for the many highly developed and finished products of modern science in the adjoining sections did not in any way detract from our admiration for these optical treasures of past generations; for did not each one represent a modest though none the less distinctive landmark along the path of optical progress? The magnificent and impressive display of present-day apparatus, instruments and methods which formed the Optical Convention 1926 Exhibition marks the farthest point yet reached along that path.

The Intermittent Theory of Radiation.

AN important paper on "The Intermittence of Electric Force" was read by Sir J. J. Thomson to the Royal Society of Edinburgh on December 21. We now know that the atom is made up of electrons and positive charges, and that the number of electrons in the atom of an element is equal to the atomic number of the element. We also know the masses of the electrons and the positive charges. If, therefore, they obeyed the ordinary laws of electrostatics, we could calculate by the laws of dynamics the behaviour of the atom. The behaviour predicted in this way is not in accord with experiment. The reason of this discrepancy is doubtless that in the atom we are concerned with effects which occur in times and in distances very much shorter than those which occurred in the experiments by which the laws of electric force were discovered or tested.

Sir Joseph directs attention to the possibility of the electric force being intermittent in its action. The intermittence is so rapid that its effects are only apparent when we are dealing with events which occur in intervals as short as those in the atom. He illustrates this point by considering the properties of gases. So long as we test these properties on an 'engineering scale' they are completely explained by supposing that the gas exerts a continuous pressure on the walls of the containing vessel and that it obeys the hydrodynamical laws for a continuous fluid. It is known, however, that the pressure is not really continuous but consists of a succession of isolated blows following each other irregularly at very small intervals of time. By the methods now available for producing very high vacua we can get the gas in a state where it is impossible to explain its behaviour by the hypothesis of continuity. The gas has a structure in time, the fineness of which is determined by the interval between the collisions. The fineness of the structure for a given gas varies with the pressure, being coarse at low pressure and fine at high pressure.

Sir Joseph supposes that the electric field has a structure in time, so that instead of the electric force being a continuous effect consisting of a continuous flow of momentum into the body under its action, it is really discontinuous and consists of finite increments of momentum separated by finite intervals of time. This discontinuity in the nature of the force readily explains the occasional spontaneous dissociation of a system. It also gives a reasonable hypothesis to explain why a system sometimes radiates away its surplus energy as Röntgen rays.

The assumption of the intermittence of electric force leads to startling results when applied to light waves. The mathematical proofs given indicate that there can be no unlimited propagation of light waves diverging from a source. The waves must ultimately reach a region where they are reflected back.

It will thus be seen that the hypothesis demands a corpuscular theory of light. The energy of the light must be done up into batches which retain their energy undiminished as they travel out into space. This does not exclude, in fact it requires, the presence of electrical waves of Maxwell's type. We must picture the light unit as a central quantum vibrating with the period of the light and emitting electrical waves. None, however, is allowed to escape, and the energy lost by the quantum in radiation is restored to it.

Light, therefore, has a dual character. It consists of electrical waves and the quantum. The electrical waves give rise to interference effects and the quantum to photo-electric effects. The energy in the electrical waves surrounding the quantum does not alter as the system travels through space, and so the ratio of the energy in these waves and that in the quantum remain invariable. The mathematical proofs based on the theory of probability given in this paper are very neat and very easy to understand.

In a paper read before the Royal Society of Edinburgh on February 8, Prof. E. T. Whittaker follows up Sir J. J. Thomson's paper and shows that the Maxwell-Lorentz equations can easily be modified so as to represent Sir Joseph's ideas regarding light. What distinguishes Thomson's theory from the work of all other writers on the subject is that he pictures the structure of the light-quanta in terms of tubes of electric force. When light is generated he invites us to picture a closed part of a loop in a tube of electric force to become detached and go off as a closed ring. This ring soon becomes circular and travels with the velocity of light in a direction at right angles to its plane, like a circular vortex ring. The energy of the ring remains constant until the ring is broken. It is known, for example, that if cathode rays fall on a metallic plate and generate X-rays which fall on a second metallic plate, electrons are ejected from the second plate and their energy is of the same order as that of the electrons in the primary cathode rays and is independent of the distance of the plates.

The only explanation seems to be that the energy of the X-rays is contained in compact parcels between the plates. This phenomenon has led Einstein and other physicists to advocate corpuscular theories of light. In Thomson's theory we picture something similar to a procession of rings of cigarette smoke, moving forward through the air in front of the mouth of a smoker. As the group moves through space, it sweeps over the interior of an infinitely long, straight cylinder, the axis of which is in the direction of propagation. Everywhere outside this cylinder the field is permanently null.

Sir Joseph points out that it is not necessary to suppose that light consists exclusively of a procession of 'electric vortex rings.' He considers that it consists of rings of electric force accompanied by Maxwellian waves. These rings sometimes vibrate and produce waves of the type ordinarily considered. Whittaker gives a justification of Thomson's hypothesis and a verification of the quantum relation.

Salient Features in the Stratigraphy, Tectonic Structure, and Physiography of the Commonwealth of Australia.[1]

A BRIEF summary of the salient features of the stratigraphy of the Commonwealth is essential for understanding its tectonic structure. Pre-Cambrian rocks are developed in Western, Central, and South Australia. The Proterozoic rocks of Northern Australia are partly formed of thick dolomites, possibly a forerunner of the Great Barrier Reef of to-day. Basic lavas and tuffs, 3000 feet thick, preceded a great ice-age in late Proterozoic or early Cambrian time. Marine Cambrian strata occur chiefly in Northern and Central Australia and South Australia, with patches in Victoria, Tasmania, and Queensland. Ordovician rocks attain a thickness of 40,000 feet in Victoria and Central Australia. Igneous intrusions and unconformity separate the Ordovician rocks from the Silurian. In the Devonian rocks of Queensland, coralline limestone, 7000 feet thick, is probably another ancestor of the Great Barrier Reef. In Carboniferous time a south-eastern shore of 'the Tethys Sea' is well defined in the north-west of Western Australia. Carboniferous and Devonian time were periods of granitic intrusions and effusive rocks. In Permo-Carboniferous time half Australia was under ice. This was the chief coal-forming epoch, followed by more coal (in Triassic and in Jurassic times) developed in immense epi-continental lakes in eastern and central Australia, near which carnivorous deinosaurs existed.

Marine Jurassic strata in Australia are only found in 'the Tethys Sea' of Western Australia. The great dolerite-sills (comparable with the Karroo dolerites) of Tasmania possibly closed Jurassic time. Cretaceous time witnessed great peripheral and central marine transgressions. The Neocomian Sea was probably cold, and epeirogenic uplift in east Central Australia replaced marine by lacustrine conditions; this uplift was probably accompanied by small local glaciation. In Western Australia the last of 'the Tethys Sea' is represented by the Lower Santonian with Uintacrinus (comparable with the Arriloor Beds of Southern India). Cretaceous strata were slightly folded in pre-Oligocene time. Eocene marine deposits are mostly wanting except, perhaps, in New Guinea, but the Winton series may be partly Eocene.

Oligocene time was one of very extensive peneplanation, which was prolonged into the Miocene, and in places into early Pliocene time. A rock-crust, or 'petroderm' ('Hartrinde' of Walther) formed over the more arid parts of this peneplain. Marine transgressions occurred all along the southern coast of Australia, mostly following on the eruptions of the 'older basalts.'

In Miocene time there were warm seas with large foraminifera (Lepidocyclina) and reef-forming corals, even in Tasmania. The earliest marsupials are found there in the Miocene beds. Miocene brown-coal deposits up to 800 feet thick, formed partly of Fagus and Banksia, occur in Victoria. 'Deep leads' of gold and tin were formed inland. In New Guinea the oil-belt was developed during the Miocene Period.

In Pliocene time the whole peneplain underwent differential movement which was strongest in eastern Australia. Alkaline lavas were erupted from tensional fault-planes in the old peneplain. Epeirogenic uplift (during the 'Kosciusko epoch' of E. C. Andrews) now followed, and became accelerated in a late Pliocene epoch. The Rift Valley of Australia formed mostly during this uplift. This later movement was accompanied by widespread eruptions of basalts with some andesites. The Great Barrier Reef was already forming, and possibly commenced to develop even earlier.

The southern edge of the Lake Eyre peneplain became tilted northwards, and that of Western Australia eastwards, bringing about interior drainage and local aridity. The Pleistocene ice-age followed, together with a pluvial epoch, when Lake Eyre once more drained seawards. Crocodiles and gigantic marsupials were then abundant in Central Australia. The Tasmanian aborigines arrived in Tasmania by way of the Malay Bridge, possibly during a eustatic negative movement of the sea. As the Ice Age ended, the sea-level rose, drowning the coastal valleys. The rainfall decreased. Lastly, the Australian aborigines

[1] Substance of a lecture delivered by Sir T. W. Edgeworth David, K.B.E., F.R.S., before the Geological Society of London on March 29.

arrived, perhaps bringing with them the dingo. In the last few thousands of years the sea-level has fallen by about 15 feet.

The salient features in the tectonic structure were briefly discussed, with especial reference to Suess's views as to the arrangement of the Australian arcs, and the physiographic features, chiefly with reference to the phenomena of arid erosion. The origin of the inland sand-hills of Central Australia is attributed to the disintegration of the widespread Permo-Carboniferous sandstones, for the later seas of that period transgressed over large areas of Australia, possibly in part through a eustatic rise of sea-level following on the melting of the great Permo-Carboniferous ice-sheets.

Ventilation and Comfort.

THE Medical Research Council has published a report on the "Methods of Investigating Ventilation and its Effects," by H. M. Vernon and others (Special Report Series, No. 100: Methods of Investigating Ventilation and its Effects. London: H.M. Stationery Office, 1926, 2s. net). Part 1 contains descriptions of two new instruments for the measurement of variations (*a*) in the velocity and (*b*) in the temperature of air currents. For the former purpose a new form of hot-wire anemometer was constructed which is very sensitive to changes of air velocity, while influenced little by changes in temperature. For the latter purpose a suitable thermopile was devised which was unaffected by changes in velocity. The combined use of these two instruments has thrown further light on the relative importance of temperature and air movement in ventilation. In Part 2 the results of a further calibration of Leonard Hill's kata-thermometer are given, which allow low-air velocities found in ordinary rooms to be measured with far greater accuracy.

Part 3 consists of an investigation of the extent to which objective indications of the kata-thermometer correspond with actual sensations of comfort. Acclimatisation is shown to have an important influence. It is concluded that the cooling power of 6, fixed as the minimum for sedentary workers in Great Britain by Leonard Hill, may reasonably be 5 for people acclimatised to summer weather, and 7 for people acclimatised to winter weather. "It was found that the various degrees of 'stagnancy' experienced in factory air were due to differences in the air temperature, whilst the various degrees of 'freshness' were due chiefly to differences in air velocity. The cooling power of the kata-thermometer combines these two variables better than any other known measure, and the correlation ratio of cooling power on air sensation was found to be ·703 in summer and ·790 in winter."

In Part 4, Dr. Vernon has studied the rate of cooling of the human body, as shown by fall of mouth and rectal temperatures, naked and clothed, after being warmed up by previous exercise, and has in this way thrown further light on the relative importance of air temperature, clothing, and air movements. The results tend to show that in order to induce cooling of men engaged in hot and heavy work, it is of most importance to reduce temperature and next clothing, small increase of velocity of air having comparatively little effect.

Work now in progress in the new wind tunnel built at the National Institute for Medical Research shows, however, that velocity can have a very great effect on warmly clad men, when it is sufficient to drive air through and so ventilate the clothing. By means of wind sufficient to evaporate the sweat effectively, men can be kept much more comfortable, and will in consequence work better, in hot atmospheres.

University and Educational Intelligence.

LONDON.—A University chair of bacteriology and immunology, tenable at the London School of Hygiene and Tropical Medicine, and a University chair of epidemiology and vital statistics, tenable at the London School of Hygiene and Tropical Medicine, have been instituted.

The following courses of free public lectures are announced: "The Influence of Water on Vital Processes," by Prof. J. B. Collingwood, at University College, on April 26, May 3, 10, 17, 24, and 31, at 5.30; "The Integration of the Circulation," by Prof. R. J. S. McDowall, at King's College, on April 27, May 4, 11, and 18, at 4.30; and "The Nature and Functions of the Fasciæ of the Human Body," by Prof. J. Kay Jamieson, at King's College, on April 30, May 7 and 14, at 5.30.

Applications for grants from the Dixon Fund for assisting scientific investigations, accompanied by the names and addresses of two references, must be made to the Academic Registrar, University of London, South Kensington, S.W.7, before May 15, and those for grants from the Thomas Smythe Hughes Fund for assisting Medical Research, accompanied by the names and addresses of two references, not later than June 15.

APPLICATIONS are invited by the Ministry of Agriculture and Fisheries for not more than five agricultural scholarships tenable for two years and annually of the value of not more than 200*l*., plus, possibly, extra allowances for travelling and subsistence whilst the scholars are abroad. The application form, A.189/T.E., must be returned to the Secretary of the Ministry, 10 Whitehall Place, S.W.1, by June 30 at latest.

IT was stated in the House of Commons last week by Lord Eustace Percy, President of the Board of Education, that the Government is in general agreement with the recommendations of the Departmental Committee on the University of London, and that it is proposed to introduce legislation for the purpose of setting up a statutory Commission for the University accordingly.

THE presentation portrait of the late Sir Sydney Russell-Wells, painted by his nephew, Mr. John Wells, R.I., will be unveiled in the staff room of the Dreadnought Hospital, Greenwich, by Sir Humphry Rolleston, Bart., at 3 o'clock on Tuesday, May 4. The portrait, which has been subscribed for by the friends and colleagues of the late Sir Sydney Russell-Wells, represents Sir Sydney in his robes as Vice-Chancellor of the University of London. Those desiring to be present at the ceremony may obtain cards of invitation on application to Prof. R. Tanner Hewlett at the Seamen's Hospital, Greenwich.

THE Court of the Worshipful Company of Poulters has agreed to offer a scholarship of 60*l*. per annum for two years tenable at the Harper Adams Agricultural College, for the training of persons to be instructors in the practice and science of poultry husbandry. Candidates must be British-born and not less than sixteen years of age on October 1, 1926. They must produce satisfactory certificates of character and physical fitness, and should have passed an examination of matriculation standard. The successful candidate will be required to take an approved course of study leading to the National Diploma in Poultry Husbandry. The award will be made on the recommendation of the Principal of the Harper Adams Agricultural College, to whom all inquiries should be addressed.

Contemporary Birthdays.

April 25, 1862. Viscount Grey of Fallodon, K.G., F.R.S.
April 25, 1859. Mr. Henry R. A. Mallock, F.R.S.
April 25, 1874. Senatore Marconi, Hon. G.C.V.O.
April 26, 1879. Prof. Owen W. Richardson, F.R.S.
April 27, 1845. Dr. Douglas W. Freshfield.
April 28, 1856. Mr. Charles E. Stromeyer, M.Inst.C.E.

VISCOUNT GREY was educated at Winchester and Balliol College. A former president of Armstrong College, Newcastle, he was, until eyesight disabilities intervened, interested in most departments of natural history pursuits, to one of which he contributed a useful work, "Fly-Fishing" (1899).

SENATORE MARCONI was born at Griffone, near Bologna. His first and tentative experiments in wireless telegraphy were made in Italy in 1895. Coming to England in the following year, with an introduction to Sir William Preece, F.R.S., who was then engineer to the Post Office, Marconi received marked encouragement at his hands at a crucial period, as also from Prof. J. A. Fleming, F.R.S. In 1899 he was able to establish wireless communication across the English Channel, later (1901) between a station at Poldhu, Cornwall, and Newfoundland. The story is continued in a stream of later improvements, inventions and researches of various kinds, of which perhaps the most distinctive practical application (in alliance with other minds) is broadcasting. In 1909 Senatore Marconi shared the Nobel prize in physics with Prof. Braun.

Prof. RICHARDSON, one of the Royal Society's Yarrow research professors in physical science, was born at Dewsbury. He was educated at Batley Grammar School and Trinity College, Cambridge. Formerly professor of physics in Princeton University, U.S.A., he returned to become Wheatstone professor of physics in the University of London (King's College). Prof. Richardson received the Hughes medal of the Royal Society in 1920 for his work in experimental physics, and especially thermionics. In the following year he was president of Section A of the British Association.

Dr. DOUGLAS FRESHFIELD, the distinguished geographer and mountaineer, a former president of the Royal Geographical Society and one of the staunchest supporters of that institution, was educated at Eton, and graduated at University College, Oxford. His interest in mountain-climbing was already established more than fifty years ago, for it was in 1872 that he undertook for a considerable span the editorship of the *Alpine Journal*. "I have always tried," he once said, "to prevent mountaineering from becoming a mere form of sport. By precept and example I have done my best to persuade my comrades to keep their eyes open to all the interest, historical, scientific, and artistic, in which the mountains abound." Dr. Freshfield received the founder's gold medal of the Royal Geographical Society in 1903, and it is interesting to recall that Dr. Sven Hedin received a medal at the same time. Apart from contributions to physical geography in the Caucasus, Dr. Freshfield's valuable work in promoting geographical education was the subject of special comment. He is the author of a life of Horace Benedict de Saussure.

Mr. C. E. STROMEYER, for many years engineer to the Manchester Steam Users' Association, was born at Sutton. His book, "Marine Boiler Management and Construction," is a standard of reference.

Societies and Academies.

LONDON.

Linnean Society, March 18.—J. L. **Sager**: Phyllody of the corolla in *Primula vulgaris* Huds. The specimens come from a plant growing in a garden in Exeter, all flowers of which show this monstrosity. The petals are like the foliage leaves in all respects except size. The revolute venation characteristic of the leaf shows well in these petals. Calyx, stamens, and pistil appear normal. Mr. Samuel E. Steer found this plant growing in a disused burial-ground at Lympstone, South Devon, in March 1925. He transferred it to his garden, where it has increased in size, and is now bearing about twelve flowers, all abnormal.—R. T. **Gunther**: An account of the early manuscript herbal of *Apuleius Barbarus*, which has been stated to have been written in A.D. 1100 and illustrated in the monastery of Bury St. Edmunds; it may therefore be the oldest-known English botanical work.—G. P. **Farran**: Biscayan plankton collected during a cruise of H.M.S. *Research*, 1900. (Pt. XIV.) The Copepoda. The Copepoda collected in deep water off the Bay of Biscay were mainly taken in numerous horizontal hauls with open tow-nets by day and night down to 100 fathoms, and by vertical hauls with closing nets by day down to 2000 fathoms. The horizontal hauls show a marked difference between day and night distribution, the population above 100 fathoms being approximately doubled by night by the upward migration, in large numbers, chiefly of *Metridia lucens*, *Pleuromamma robusta*, and *Pleuromamma gracilis*. In the vertical hauls the maximum number of species was found between 500 and 700 fathoms, and of specimens between 150 and 250 fathoms. The average number of specimens per 100 fathoms vertical haul between 1500 and 2000 fathoms was only 4·6, and not all of them alive, as against 781 specimens between 150 and 250 fathoms. Helena **Bandulska**: On the cuticles of some fossil and recent Lauraceæ. The possibility is demonstrated of interpreting certain elements of the floras of the past by a comparative study of their cuticles with those of recent forms. By this means the Lauraceæ have been found to be the most abundant fossils with cuticle preserved in the Bournemouth Eocene; many have lanceolate leaves with pinnate venation and strong midrib. Three species of Aniba and various species of Neolitsea, Litsea, and Lindera have been discovered. The physiological characters of the fossil Lamaceous cuticles described are such as at the present time are associated with the need for controlling transpiration, and may be of assistance in the interpretation of the nature of the flora and the climate of Middle Eocene time.

The Physical Society, March 26.—Ivor **Backhurst**: Obliquity corrections in radium estimation. Formulæ are given for obliquity corrections in radium estimation applicable to sources of the shapes most frequently occurring in practice. The effect of scattered radiation is considered, and some experimental results obtained are shown graphically and compared with theory.—Albert **Griffiths** and P. C. **Vincent**: Viscosity of water at low rates of flow determined comparatively by a method of thermal convection. A method is described of determining the coefficient of viscosity of water by measuring the rate of convective flow in a long capillary tube, the driving head being obtained by the difference in density due to a difference of temperature between two vertical columns of water. The results show that the viscosity of water at low

rates of shear in glass tubes is apparently no different from that at high rates. Novel features are (1) the method of obtaining the driving head; (2) the new method of introducing a coloured index in a closed capillary circuit, and an improved method of reading its position; (3) the almost complete elimination of what may be called the thermometric effect as distinct from the convective effect; (4) the elimination of the small residual thermometric effect from the final calculations.

PARIS.

Academy of Sciences, March 15.—H. **Deslandres**: The aurora borealis and magnetic perturbation of March 9, 1926, at the Meudon Observatory. A bright aurora borealis was observed at Meudon on March 9; its duration was short and coincided with a marked deviation of the magnetic declination registered on the magnetograph.—A. **Cotton**: An observation of the aurora borealis on March 9; observed at Sèvres. A magnetic disturbance was recorded at the Val Joyeux Observatory.—B. **Baillaud**: Remarks on the Catalogue of Fundamental Stars of the Paris Observatory.—Pierre **Copel**: A property of skew curves and its application to the demonstration of Beltrami's theorem.—Nicolas **Kryloff**: A method of approximate integration containing as particular cases the method of W. Ritz and that of least squares.—Leonida **Tonelli**: The method of adjunction in the calculus of variations.— — **Hadamard**: Remarks on the preceding communication.—Joseph **Pérès**: A theorem concerning the movement with two parameters of a solid. — — **Rogoff**: A rectangular plate supporting a load P concentrated at its centre.—Louis **Roy**: The propagation of waves on the elastic line with four parameters.—L. **Dunoyer**: A condensation pump working with a moderate primary vacuum. A description, with diagram, of a glass mercury vapour pump. Starting with a water-pump vacuum (10 to 30 mm. mercury), the pump is working within four minutes of lighting the burner.—Jean **Dubief**: The law of viscosity of fluids as a function of the density. Its relations with the equation of state.—Y. **Rocard**: The diffusion of light in liquids.—Mlle. O. **Jasse**: The structure of the bands 4511 and 4123 of the carbon monoxide spectrum. These bands have a more complex structure than Hulthén's band, but belong to the same class.—G. **Lejeune**: Contribution to the study of the oxidisability of organic substances.—Jean **Cournot**: The cementation of ferrous alloys with aluminium. The cementation of mild steel with aluminium is best carried out by heating in a muffle with finely powdered ferro-aluminium containing a little ammonium chloride.—T. **Karantassis**: Double decompositions between the halogenides of tin, arsenic, antimony, bismuth, silicon, titanium.—Maurice **Delaville** and Paul **Carlier**: The estimation of small quantities of potassium. The metal is precipitated as cobaltinitrite, and the cobalt determined by nitroso-β-naphthol. Working with quantities of potassium of the order of 1 mgm., the error is less than 3 per cent.—V. **Hasenfratz** and R. **Sutra**: The oxidation of harmaline and of bromoharmaline.—R. **Lantz** and A. **Wahl**: A new synthesis of phenylrosinduline.—H. **Arsandaux**: The eruptive origin of the basic gneiss of Djabataouré (Togo).—Auguste **Loubière**: The flora and relative level of middle coal measures of Gages (Aveyron).—P. **Choux**: Some new Sapindaceæ of Madagascar.—A. **Guilliermond**: The action of the methods of silver impregnation on plant cells and on the relations of the vacuome and Golgi's apparatus.—Albert **Petit**: Contribution to the cytological and taxonomic study of Bacteria.—L. **Hackspill** and A. P. **Rollet** and Maurice **Nicloux**: The argon in the blood. From the results of the experiments cited, the authors conclude that argon, like nitrogen, is found in defibrinated blood in quantity corresponding to its solubility and to its partial pressure in air. The blood clot, dried in a vacuum, and burnt in the presence of copper oxide, gives no argon.—L. **Fage** and R. **Legendre**: The swarming and lunar rhythm of *Eulalia punctifera*.—P. **Sédallian** and J. **Loiseleur**: The fractionation of serum proteids and the freeing of antidiphtheric serum from albumen. The method is based on the gradual addition of sodium chloride, starting with serum of pH 4·7.—S. **Posternak**: The distribution of phosphorus in the serum and red blood corpuscles of the blood.—Louis **Léger**: A new Microsporidia with spiny spore cases.—S. **Metalnikov** and V. **Chorine**: The part played by Hymenoptera in the infection of *Galleria mellonella*.

March 22.—H. **Deslandres**: The magnetic disturbance of March 5, 1926, and the disturbances of the first months of the year. A magnetic storm was recorded by the apparatus at the Meudon Observatory, and at the same time auroral lights were noted at two different places—Grainville and Neauphlette. It is shown that there is a definite relation between the periods of these magnetic storms, since the intervals of time between the storms are multiples of the time of synodic rotation R.—Henry Le **Chatelier**: The theory of the furnace.—André **Blondel**: The measurement of the photometric yield of optical apparatus (objectives, telescopes, etc.).—G. **Friedel**: The radiograms of mixed crystals. Mixed crystals obtained by isomorphous crystallisation give radiograms which do not differ from those which would be given by a simple crystal of the mean parameter. From this it is generally admitted that the mixed crystal will be like the pure crystal, governed by a strictly defined period, the mean of the pure constituent crystals. This view is adversely criticised, and it is shown that there is a serious limitation to the power of penetration of radiographic analysis, especially in cases where there may be isomorphous mixtures or pseudo-paramorph structures.—L. **Cuénot**: Description of a Tardigrade new to French fauna. This is intermediate between the uncovered Oreella and armoured Echinisci, and is a type of a new genus Parechiniscus, to which is given the specific name of Chitonides.—Jean Charcot was elected a free Academician in succession to the late E. **Tisserand**.—A. **Sainte-Laguë**: Unicursal and bicursal networks.—E. **Grynaeus**: The differential geometry of Euclidian space with constant curvature.—E. **Vessiot**: Conformal geometry of surfaces.—Maurice **Gevrey**: The analytical nature and prolongation of solutions of non-linear equations of elliptic and parabolic types with one variable.—J. **Favard**: Nearly periodic harmonic functions.—Boris **Grinberg** and Maurice **Paschoud**: The torsion of a hollow cylinder the section of which is limited by two excentric circles.—Pierre **Henry**: The velocity of deformation of metals at high temperatures.—Charles **Platrier**: Periodic winds and critical wind squalls for the flexion of pillars.—A. **Chatillon**: The different magnetic states of cobalt chloride.—V. **Posejpal**: The quantitative experimental control of the resonance absorption of X-rays.—Louis **Longchambon**: The rotatory dispersion of camphor. A criticism of the conclusions arrived at by applying the formula of Lowry and Cutter to the experimental results of the rotatory power of camphor in acetone.—Miramond de **Laroquette**: The ionometric measurement of X-rays incident per unit surface and X-rays absorbed per unit volume.—Pierre **Auger**: The amount of fluorescence in the X-ray region.—H. **Colin**

and Mlle. A. **Chaudun**: The variations of the constant of hydrolysis with the concentration of sugar. The experiments are not in agreement with the hypothesis that the hydrogen ions alone produce the reaction; the nature of the acid and the viscosity of the solution also intervene.—H. **Forestier** and G. **Chaudron**: The thermomagnetic study of some ferrites. Ferrites of the general formula Fe_2O_3.MO have been prepared, where M may be nickel, copper, lead, barium, calcium, cadmium, or zinc, and the variations of the magnetisation coefficient with temperature determined.—M. **Holweck**: The critical *K* potentials of light atoms. Reply to a note of A. Dauvillier.—Marcel **Laporte**: The mobility of the ions in gases. The author's experiments are not in agreement with the view that for a given gas the ions have one mobility only: the hypothesis that there may be several ion mobilities is discussed.—Jules **Ventre** and Emile **Bouffard**: The influence of sugar on the estimation of ammonia in grape must.—J. **Bougault**: An example of an oxide ether of a ketone hydrate.—Marcel **Bouis**: The synthesis of ethylallene C_2H_5. CH : C : CH_2.—F. **Salmon-Legagneur**: Mixed ketones derived from the α-mononitrile of camphoric acid.—A. **Demay**: The genesis of the granulitic gneiss of the Pilat massif, near Saint-Etienne.—L. **Petitjean**: New researches on the displacement of (meteorological) discontinuities.—Louis **Besson**: The influence of the temperature of one month on that of the following month. According to A. Angot, the temperature of any one month has no influence on that of the following month. A statistical study of 100 years' observations made at the astronomical and Montsouris Observatories does not confirm this view. A warm January is followed by a February with a temperature above the normal 13 times out of 19 at one observatory and 8 times out of 12 at the other. Similarly a cold February is followed by March with a temperature below the normal.—Mme. P. **Lemoine** and G. **Delepine**: Discovery of the genus Solenopora in the Jurassic of France.—Lucien **Daniel**: New researches on the heredity acquired by grafting on *Helianthus Dangeardi*.—M. and Mme. **Fernand Moreau**: Sexual reproduction in lichens of the genus Collema and the theory of Stahl. Observations opposed to the Stahl theory of sexual reproduction in Collema.—— **Averseng**,—**Jaloustre**, and—**Maurin**: The development of *Recinus communis* in a culture medium rendered radioactive by the addition of thorium-*X*. Thorium-*X* in small doses (10 micrograms every fifteen days) improved the general development of the castor oil plant, the increase in the number and quality of the seeds being especially marked.—Antonin **Nemec** and Mihovil **Gracanin**: The influence of light on the absorption of phosphoric acid and potash by plants.—— **Parat**: The constitution of the Golgi apparatus and of the idiozome; true and false dictyosomes.—Boris **Ephrussi**: The unequal acceleration of the different phases of cell division by rise of temperature.—M. **Bridel** and C. **Béguin**: The biochemical synthesis, with the aid of emulsion from almonds, of α-ethyl-*b*-arabinoside.

ROME.

Royal Academy of the Lincei, February 7.—F. **Cavara** and A. **Chistoni**: Hybridisation of *Papaver somniferum* L. in relation to the morphine content of the opium. By hybridisation of the white and black varieties of *Papaver somniferum* L., it is possible to raise both the morphine content and the yield of the opium.—E. **Bompiani**: Projective invariants of contact between plane curves.—Harry **Levy**: Certain properties of the spaces for which Riemann's symbols with five indices are annulled.—Bruno **Finzi**: Vertical space motions in correspondence with uniform translations.—Francesco **Sbrana**: Dynamic effect of a fluid circulating round two cylinders with parallel axes.—Giorgio **Abetti**: The altitude of the solar chromosphere.—Enrico **Fermi**: The quantisation of the perfect monatomic gas.—A. **Pontremoli**: The duration of emission of monochromatic radiations and the mean life of the stationary states.—Pietro **Saccardi**: A colour reaction of the skin relative to the genesis of the melanins. The colour reactions obtained with *p*-phenylazoxycarbonamide confirm the epidermal origin of the cutaneous pigment and indicate that the ability to produce the colourless pro-pigment which generates melanin is a specific and autochthonous property of the Malpighian layer.—Ugo **De Castro**: Physico-biological conditions and determinism of Kottmann's reaction.—C. **Sibilia**: The action of certain enzymes of Fusarium. The actions produced by the amylase and pectinase of *F. echinosporum* and *F. fuliginosporum* are described.

VIENNA.

Academy of Sciences, March 4.—F. **Urbach** (Communication from the Radium Institute, No. 185): On luminescence and absorption particularly that of sylvine subjected to Becquerel radiation. Sylvine shows radio-luminescence and after Becquerel-radiation thermo-luminescence and phosphorescence.—J. **Zellner** and colleagues: Contributions to comparative vegetable chemistry (xii.). Chemistry of barks. Barks of privet, beech, elder, and alder have been examined. Phytosterin, ceryl alcohol, and several other substances have been found.—R. **Klapholz** and J. **Zellner**: Contributions to comparative vegetable chemistry; *Œnothera biennis*.—J. **Pollak** and E. **Gebauer-Fülnegg**: The action of chlorosulphonic acid on phenols.—E. **Gebauer-Fülnegg** and F. **Riesenfeld**: Studies on aryl-sulpho-chlorides.—K. **Federhofer**: The construction for the centre of curvature of plane curves.—L. **Waldmann**: The geological structure of the Moldau-Danube primitive rocks on the survey sheet Gmünd II.

March 11.—H. **Spandl** communicated his work, prepared in part with the assistance of the Academy, on the fauna of subterranean waters (Wien, Verlag Speläologisches Institut, 1926).

Official Publications Received.

Annuaire de l'Observatoire Royal de Belgique. 94me année, 1927. Par P. Stroobant. Pp. iii+192. (Bruxelles.)

Bureau of Science, Manila. Publication No. 19: Geology and Mineral Resources of the Philippine Islands. By Warren D. Smith. Pp. 559+39 plates. (Manila: Bureau of Printing.)

Instituts scientifiques de Buitenzorg. "'s Lands Plantentuin." Treubia: Recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 6, Livraison 3-4, Décembre 1925. Pp. 221-502+24 plates. 5f. Vol. 7, Livraison 2, Février 1926. Pp. 85. 2.50f. Vol. 8, Livraison 1-2, Janvier 1926. Pp. 198. 5f. (Batavia: Landsdrukkerij.)

The Optical Convention 1926. Catalogue of Optical and General Scientific Instruments. Pp. x+326. (London: 1 Lowther Gardens, S.W.7.)

State of Connecticut. Public Document No. 24: Forty-eighth Report of the Connecticut Agricultural Experiment Station, New Haven, Conn., for the Year 1924. Pp. ix+583+34T+xvi+39 plates. (New Haven, Conn.)

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1925. Pp. ii+16. (Cape Town.)

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 561: Surface Water Supply of the United States, 1923. Part 1: North Atlantic Slope Drainage Basins. Pp. vi+294+3 plates. 35 cents. Bulletin 767: Geology and Coal Resources of the Gallup-Zuni Basin, New Mexico. By Julian D. Sears. Pp. v+53+17 plates. 50 cents. Bulletin 780-B: Geology of a part of Western Texas and Southeastern New Mexico, with Special Reference to Salt and Potash. By H. W. Hoots. (Contributions to Economic Geology, 1925, Part 1.) Pp. v+33-126+plates 3-17. Bulletin 780-C: Platinum near Centennial, Wyoming. By Frank L. Hess. (Contributions to Economic Geology, 1925, Part 1.) Pp. ii+127-135. Professional Paper 140-F: Correlation of the Basal Cretaceous Beds of the Southeastern States. By Wythe Cooke. (Shorter Contributions to General Geology, 1925.) Pp. 137-143+iii. (Washington, D.C.: Government Printing Office.)

The Carnegie United Kingdom Trust. Twelfth Annual Report (for the Year ending 31st December 1925) submitted by the Executive Committee to the Trustees on Friday, 12th March 1926. Pp. ii+109. (East Port, Dunfermline.)

Proceedings of the California Academy of Sciences. Fourth Series, Vol. 15, No. 1: Expedition to the Revillagigedo Islands, Mexico, in 1925. General Report. By G. Dallas Hanna. Pp. 113 (10 plates). (San Francisco, Cal.)

The North of Scotland College of Agriculture. Bulletin No. 30: Report on Grass Seed Mixtures, 1907–13. Second edition (enlarged) with some Observations regarding more Recent Trials. By Wm. M. Findlay. Pp. 75. (Aberdeen.)

Proceedings of the United States National Museum. Vol. 67, Art. 25: Foraminifera of the Genera Siphogenerina and Pavonina. By Joseph A. Cushman. Pp. 24+6 plates. Vol. 68, Art. 12: A Classification of the Toothlike Fossils, Conodonts, with Descriptions of American Devonian and Mississippian Species. By E. O. Ulrich and R. S. Bassler. Pp. 63+11 plates. (Washington, D.C.: Government Printing Office.)

Abstract-Bulletin of Nela Research Laboratory, Incandescent Lamp Department, of General Electric Company, Cleveland, Ohio. Vol. 1, No. 4, December 1925. Pp. x+523-746+8 plates. (Cleveland, Ohio.)

Classified List of Smithsonian Publications available for Distribution, March 15, 1925. Compiled by Helen Munroe. (Publication 2866.) Pp. v+30. (Washington, D.C.: Smithsonian Institution.)

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 26: Statistics of Land-Grant Colleges, Year ended June 30, 1924. By Walter J. Greenleaf. Pp. v+51. 10 cents. Bulletin, 1925, No. 33: Education Pays the State. By Merle A. Foster. Pp. 27. 5 cents. (Washington, D.C.: Government Printing Office.)

Diary of Societies.

SATURDAY, APRIL 24.

ROYAL SANITARY INSTITUTE (at Guildhall, Hull), at 2.30.—H. Edridge: The Economic Collection of Town Refuse.—W. Nicholson: The Present Position with regard to Smoke Prevention.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Neville Hall, Newcastle-upon-Tyne), at 3.—J. G. Taylor: Coal and its Banded Constituents.—Discussion on Paper by F. J. Johnston on The Use of Breathing Apparatus in Mines.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. T. Calman: The Shipworm (2).

MONDAY, APRIL 26.

ROYAL IRISH ACADEMY (Dublin), at 4.15.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. Dr. H. U. W. Stanton: The Qur'an and its Doctrine of God.

INSTITUTE OF ACTUARIES, at 5.—Notes concerning Some Practical Points that arise in the Valuation of Widows' Funds.

INSTITUTION OF STRUCTURAL ENGINEERS (Students' Meeting) (at Abbey House, Westminster), at 6.—E. S. Andrews and others: Discussion on Theory *versus* Practice.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne) (Annual General Meeting), at 7.—B. A. Robinson: Modern Methods of Measurement (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.

RAILWAY CLUB (at 65 Belgrave Road, S.W.), at 7.30.—L. Hiller: The Principles of Signalling.

ROYAL SOCIETY OF ARTS, at 8.—C. R. Peers: Ornament in Britain (Cantor Lectures) (2).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—W. Warwick James: Do Epithelial Odontomes increase in Size by their own Tension?—Dr. E. W. Fish: The Circulation of Lymph in Dentine, with some Observations on the Metabolism of this Tissue.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—C. F. Rey: A Recent Journey to Gudru and Gojam (Abyssinia).

TUESDAY, APRIL 27.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Barcroft: Organs of Multiple Function (3): Feathers.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: Report on the Additions to the Society's Menagerie during the month of March, 1926.—Dr. J. Beattie: Exhibition of Radiographs of a young *Macacus rhesus*.—Prof. G. Elliot Smith: On the Brain of Cænolestes.—Dr. R. Broom: (*a*) On the Organ of Jacobson and some other Structures in the Nose of Cænolestes; (*b*) On a Nearly Complete Skeleton of a New Eosuchian Reptile.—J. W. Low: Contributions to the Development of the Pelvic Girdle. I. The Pelvic Girdle of *Menopoma alleghaniense* Harlan.—O. M. B. Bulman and W. F. Whittard: On Branchiosaurus and Allied Genera.

INSTITUTION OF CIVIL ENGINEERS, at 6.—H. R. Lupton: The Triple-Expansion Steam-Engine, as applied to the Pumping of Water; with Special Reference to the Plant at Lea Bridge.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Refrigeration.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7.—W. Vinten: International Standardisation of Kinematograph Standards.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-on-Tyne), at 7.30.—Annual General Meeting.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—C. W. Brown: Stone Implements from North-West Peru.

WEDNESDAY, APRIL 28.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at 17 Fleet Street), at 5.30.—Comdr. A. D. Turnbull: The Stevens Family—Engineers and Inventors.

RADIO SOCIETY OF GREAT BRITAIN (at Institution of Electrical Engineers), at 6.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Manchester College of Technology), at 7.30.—G. Rushton: The L.G.O.C. Methods of Omnibus Repair (Lecture).

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications of the Microscope Section), at 7.20.—R. and J. Beck, Ltd.: Exhibition of the Swan Photomicrographic Apparatus for Workshop Use and Radial Metallurgical Microscope.—H. Wrighton: Demonstration of the Preparation of Metallic Micro-Specimens.—At 8.—J. H. G. Monypenny: Some Micro-Structural Features of Modern Rustless Steels.

ROYAL SOCIETY OF ARTS, at 8.—J. Paterson: Horse Traction and Motor Traction.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Medical Society of London, 11 Chandos Street, W.1), at 8.30.—Dr. N. H. M. Burke: What is a Mental Illness?

THURSDAY, APRIL 29.

BRITISH SCIENCE GUILD (Annual Meeting) (at Mansion House), at 4.30.—Sir Richard Redmayne: The Future of the Coal Mining Industry.—Dr. E. F. Armstrong: Dyestuffs.—Capt. P. P. Eckersley: Broadcasting and Electrical Industry.

ROYAL SOCIETY, at 4.30.—C. H. Best, Dr. H. H. Dale, J. P. Hoet, and H. P. Marks: Oxidation and Storage of Glucose under the Action of Insulin.—C. H. Best, J. P. Hoet, and H. P. Marks: The Fate of the Sugar disappearing under the Action of Insulin.—J. P. Hoet and H. P. Marks: Observations on the Onset of Rigor mortis.—J. C. Mottram, G. M. Scott and Prof. S. Russ: On the Effects of Beta Rays from Radium upon Division and Growth of Cancer Cells.

INSTITUTE OF PATHOLOGY AND RESEARCH (ST. MARY'S HOSPITAL, W.2), at 5.—Sir Almroth E. Wright: The General Outcome of Thirty-six Years' Work on Immunisation (Lecture).

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Miss H. P. Hudson: Linear Dependence of the Schur Quadrics of a Cubic Surface.—Prof. G. N. Watson: On an Expansion Due to Abel.—B. A. Edwards: On Periodic (2-2) Correspondences between Two Planes.—C. G. F. James: On Scrolls in a Linear Congruence.—A. C. Dixon: The Solving Nuclei of Certain Integral Equations whose Nuclei are Homogeneous r of Degree -1.—M. Hanna: Algebraicability of Integrals.—R. G. Cooke: Gibbs's Phenomenon in Fourier Bessel Series and Integrals.—J. Brill: On the Motion of an Ideal System referred to Natural Co-ordinates.—Prof. G. H. Hardy and J. E. Littlewood: (i) On the Strong Summability of a Fourier Series; (ii) On Parseval's Theorem.—S. Bochner and Prof. G. H. Hardy: Note on Two Theorems of N. Wiener.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: The Imperfect Crystallisation of Common Things (1).

CHEMICAL SOCIETY, at 6.—Prof. W. E. S. Turner: Additive Relationships in the Properties of Glasses (Informal Lecture).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 5.30.—Annual Meeting.—At 6.—A. Farquharson: Homeland Survey for Children (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—B. S. Cohen, A. J. Aldridge, and W. West: The Frequency Characteristics of Telephone Systems, and Audio-Frequency Apparatus and their Measurement.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 7.—Dr. J. Kerr and others: Discussion on School Lighting (Modern Requirements and Recent Progress).

INSTITUTE OF CHEMISTRY STUDENTS' ASSOCIATION (London), at 8.—Open Evening.

FRIDAY, APRIL 30.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—C. W. J. Taffs and others: Marine Oil-Engines in Practice.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Y.M.C.A. Hall, Dundee), at 7.30.—Capt. P. P. Eckersley: The Past, Present, and Future Development of Wireless Telephony (Lecture).

JUNIOR INSTITUTION OF ENGINEERS (at Royal United Service Institution), at 7.30.—Air Vice-Marshal Sir W. Sefton Brancker: Air Transport (Gustave Canet Memorial Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. W. H. Eccles: Wireless in the Empire.

SATURDAY, MAY 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. P. C. Buck: The Song Form in England as represented by Stanford.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—Annual Meeting.

PUBLIC LECTURES.

MONDAY, APRIL 26.

UNIVERSITY COLLEGE, at 5.30.—Prof. J. B. Collingwood: The Influence of Water on Vital Processes. (Succeeding Lectures on May 3, 10, 17, 24, and 31.)

TUESDAY, APRIL 27.

KING'S COLLEGE, at 4.30.—Prof. R. J. S. McDowall: The Integration of the Circulation. (Succeeding Lectures on May 4, 11, and 18.)

THURSDAY, APRIL 29.

UNIVERSITY COLLEGE, at 5.—Prof. E. A. Gardner: History of Ancient Sculpture.

FRIDAY, APRIL 30.

KING'S COLLEGE, at 5.30.—Prof. J. Kay Jamieson: The Nature and Functions of the Fasciæ of the Human Body. (Succeeding Lectures on May 7 and 14.)

UNIVERSITY COLLEGE, at 5.30.—Sir Jagadis C. Bose: he Nervous Mechanism of Plants.