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Science and the Press.

JUDGING from the Press reports of the Oxford meeting of the British Association, it is obvious that there is a considerable variety of opinion among editors regarding the appreciation of science among their readers. Some pander to the kinema mind and attempt to make the news which they have obtained from a news agency attractive by giving it captious titles such as "Why Mosquitoes Prefer Blondes," "Are Bald Men Brainiest?" "Bobbing Eases the Mind," or seize upon a chance illustration regarding the frayed edge of a collar as a pretext for the assertion that science is rediscovering what every woman knows. Others evidently care for little except the sensational or ultra-controversial subjects, giving the greatest prominence to speculative fields of inquiry and ignoring the substantial advances which have been made in knowledge during the past few years.

It is most gratifying, however, that there are now many editors who have become aware of the increasing demand for accurate presentation of facts as stated by the masters of science, and tend to leave their readers to draw their own deductions from the facts presented. As might be expected, these editors show a nice sense of differentiation between the 'givers' and the 'takers': between those who take every advantage of the facilities afforded at the meeting of the Association to make a wider public acquainted with the recent advances in knowledge, and those who abuse their position by indulging in self-advertisement or putting forth theories which are based upon nothing more substantial than their prejudices and predilections.

Whatever the form in which it is presented, science is now considered good 'copy.' Moreover, it is good copy for all types of journals, from the great national newspapers down to the parish-pump periodical. It may distress some scientific workers that an enterprising reporter of an obscure suburban journal should canvas the local barbers on their views on "What Time hath scanted men in hair, he hath given them in wit," the Shakespearian quotation which Dr. Gunther considered apposite to his thesis on "The Hairlessness of Man." Some may feel that most sections of the Press attached exaggerated importance to the views of Sir Oliver Lodge on the imperishability of the individual spirit of man: others may deplore the reporter's partiality for the easily assimilated contributions to knowledge which are characteristic of such sections as agriculture, education, and geography, or that a broad survey of the recent applications of science to the solution of the pressing problems of industry, public health, and the nation's food supplies and defence, should prove more attractive to editors than

a brilliant analysis of the phenomena of line spectra. Many of those who read papers before the sections of the British Association may feel aggrieved that the substance of their contributions is neglected, while considerable importance is attached to their incidental analogies. Then again, there is the large class of contributors whose papers are ignored altogether in the newspapers, and this is frequently attributed to the reporter's preference for the contributions of scientific workers of well-established reputation, or for those of distinguished laymen.

It is obvious there must be selection. A modest estimate of the average daily output during the Oxford meeting would be sixty papers. To do bare justice to them all, the newspapers would need to devote at least thirty columns daily to science news, and this would involve the employment of a staff of scientific experts for each newspaper, unless all editors were prepared to present to their readers exactly the same copy. But if the public demand for science news were sufficiently great to warrant such wholesale circulation, it is clear that it would also be sufficient to justify the publication of a science daily newspaper.

In existing circumstances, editors will select those items of news which they think will appeal to their particular public. But any author of a paper can help them materially in this process of selection if he will take the trouble to prepare for the official programme of the Association, a summary which is not only written in language intelligible to the average well-educated member of the community, but also calculated to awaken interest either from the newness of its facts or the novelty of their presentation. It is useful if, in addition, one or two copies of his complete paper are available in advance to the reporters in the Press Bureau, as this widens the scope of selection of individual reporters. Attention to such matters as these will usually safeguard an author against misrepresentation of his facts, theories, and opinions. The title given to a paper is also important in this connexion. "The Hygroscopic Relations of Colloidal Fibres" conveys all that is necessary to members of Section A, but is not likely to interest a reporter with limited space and time at his command, who sees, moreover, that there are a dozen other papers with far more attractive titles to be delivered the same day. He is only human in preferring to look to papers on "Intelligence in Rats," the "Psychology of Patriotism," or "The Public Schools and National Life" for his copy.

It is not suggested that scientific workers should aim at providing reporters with 'stunts,' or that the importance of scientific investigations be judged by their immediate value as copy for newspapers or topics of conversation. But it is clearly worth while to present the results of investigation in any one branch of science and theories based upon them, in a form which will enable every scientific worker, as well as the specialist, to appreciate them. Since the general public is also interested in science, there seems every reason why it should be provided with the best of science, and every assistance given to reporters—the channels of communication between science and the public—in the difficult task of selection and presentation. Serious scientific workers are themselves partly to blame for having the patient work of years dismissed in three or four unintelligible lines. They have put a new weapon in the hands of humanity; they have insensibly imposed upon it a new mental outlook; upon them devolves the responsibility of enabling all members of the community to understand the functions, aims, and methods of science, and the essence of the scientific spirit, its fearlessness in facing facts, its determination to resist prejudice, and its constant researches to test the validity of theories or the universality of laws.

If scientific workers will not seriously apply themselves to the task of securing greater and better publicity for their work, other than that which they obtain in the scientific and technical press, and reports of proceedings of learned societies and institutions, they must not complain of the manner of the publicity. They must be prepared for valuable utterances and suggestive discussions to be neglected in favour of the trivial and fantastic contributions made to the proceedings by our scientific entertainers—the terms in which the *Saturday Review* described the press reports of the Oxford meeting of the British Association. Yet there is now less justification for this criticism than formerly, since recently the Press, taken as a whole, has progressively improved its performance in separating the grain from the chaff. Many of the principal newspapers now have at their disposal the services of journalists who are also scientific writers of distinction. The daily reports of the Oxford meeting in the principal London and provincial journals were fuller than ever before, and considering the circumstances in which they were compiled, remarkably fair and accurate. Naturally, newspapers like the *Times* can devote more columns to the proceedings than those in the class typified by the *Daily Express* and the *Daily News*, but little exception could be taken to the reports as a whole. They flattered the intelligence of their readers. Moreover, many of these journals maintained a running fire of comment in leading articles on the more important papers delivered, a striking commentary on the interest in science which the meeting provokes.

There is little doubt that this interest could be sustained. The *Daily Express* published recently a series of articles by eminent scientific workers. Most

of the serious weekly periodicals devote some space to scientific subjects. The day cannot be far distant when the editors of the *Observer* and the *Sunday Times* will make a science page as regular a feature of their papers as their literature, music, and dramatic art pages. It is not improbable that the demand for scientific information is great enough to justify the publication of a science daily newspaper, or at least a sound and popular science weekly, written in a form calculated to appeal to a wider public than NATURE. There are daily and weekly journals devoted to finance, and these are not read solely by professional financiers.

The steps which might be taken by scientific workers to satisfy the public demand for knowledge of their work have already been the subject of comment in these columns. Reference has also been made to what has been done in the United States, by scientific workers themselves, to deal with a like situation. It is obvious that where there is a demand it will be satisfied by somebody. If the scientific community in Great Britain wishes to safeguard itself against the kind of misrepresentation of its endeavours which masquerades in the guise of 'popular science,' if it wishes to safeguard those members of the public interested in science progress against exploitation by enterprising advertisement agencies, there is no time to be lost. The opportunity to give the best of science to the nation exists. Do scientific workers possess the will and energy to take advantage of the present favourable situation?

The Electricity Bill.

THE Electricity Bill, after passing its third reading in the House of Commons, is now being considered in the Upper House. As there were twenty-six pages of amendments to be discussed and the bill is of a highly technical nature, the task was no easy one, but it started auspiciously. In the committee stage the bill was discussed from almost every point of view, and so it is unlikely that any serious flaw has been overlooked. Many politicians think that this bill makes a long step in the direction of nationalisation. In the opinion of the Government, however, it will stop nationalisation. It is pointed out that the electric supply industry is on a quite different footing from other industries. In every district of Great Britain electric supply is a monopoly. It is urged, therefore, that the industry should not be deprived of the great benefit that would ensue when co-operation and centralisation replace individual effort. The need for passing the bill at once is imperative, as several schemes for developing electrical supply are being held up pending the new legislation.

The amendment adopted by the Government making it obligatory instead of permissible for the Electricity Board to advance free of interest such sums as might be necessary to enable authorised undertakers or owners to alter their frequency, will probably meet the chief objection of many opponents of the bill.

It will be remembered that the origin of the bill was the desire expressed by many engineers to increase the interconnexion of networks of electricity supply in Great Britain. The primary object of the bill was to increase the efficiency of the supply. It will probably follow that an increase in the retail supply and a lowering in the price of electricity will take place concurrently. In Canada and the United States there are huge supply networks covering many thousands of square miles. The Pacific Gas and South Californian Edison Companies network covers 120,000 square miles and links up 130 stations, which is more than double the area covered by the Government scheme.

The Electricity Commissioners have pointed out that 56 per cent. of the capital of electricity undertakings is locked up in spare plant. If complete interconnexion were established, this could be reduced very considerably. This is one of the principal gains which the promoters of the bill hope to secure. In due time considerable savings will doubtless be effected, and care has been taken to ensure that the consumer will benefit largely by them.

In our opinion this scheme will be a boon to both the country and the industry, provided that no undue delay ensues before it is put into operation. A really forward policy need not involve large expenditure. The Electricity Commissioners' Reports prove conclusively that many of the electricity networks in Great Britain are inadequate and were very expensive to construct. In some cases the cost per unit of maximum demand is about twenty times as great as that of the most efficient stations. The multiplicity and variety of the systems of supply in London, although largely due to early electrical legislation which established two competing companies in each local area, is not creditable to electrical engineers. Figures have proved the great economies that could be effected without even the necessity of scrapping plant the efficiency of which is only fair. A first step in the direction of improvement has been the standardisation of the pressure of supply. Whenever new schemes have been sanctioned or systems changed from direct current to alternating current, or even in those cases where direct current is being retained, the pressure of supply is now 230 volts.

We are glad to see that progress is being made by electrical manufacturers in the direction of cheaper

systems of distribution in rural districts. Every one who has travelled on the continent knows the extensive use that has been made of overhead electrical distribution, particularly in connexion with railways. Whether they spoil the view of the landscape or not, there can be no question but that the use of poles, whether of wood or iron lattice work, is a great boon to the various countries concerned. We hope that the collieries and iron and steel works in Great Britain which do not generate their own electricity will be able to secure a bulk supply at low rates when this bill is passed. We also hope that those firms which can generate from waste heat more than sufficient power to meet their own needs will benefit by being able to sell their excess power to the Electricity Board.

The Mystery of Money.

Wealth, Virtual Wealth, and Debt: the Solution of the Economic Paradox. By Prof. Frederick Soddy. Pp. 320. (London: G. Allen and Unwin, Ltd., 1926.) 10*s.* 6*d.* net

IN childhood many things are hidden from us, but we use money to buy our first sweets at an age which is rarely within the recollection of mature thought. So we take money for granted. We learn by experience that it procures the things we want, and that usually seems to be all we want to know about it. Its origin, its functions, the explanation of the ebb and flow of its command over goods, with an accompanying maldistribution of unearned gain and undeserved loss, are, if not entirely unknown phenomena, at least recondite subjects which are best left alone.

Prof. Soddy is, however, a more adventurous spirit. After achieving a position of distinction in his own sphere which would satisfy the ambition of most men, he has become intrigued with the elusive problem of money. So we have "an attempt, rarely made nowadays, by a specialist in one field of knowledge to solve the problems in another."

Prof. Soddy has produced a volume which contains at one and the same time a penetrating analysis of the ultimate realities of modern banking science and a new theory of money which, despite his assertion that the solution which he brings is "the most ordinary incontrovertible commonsense requiring nothing more than that to prove it," will be rejected by every student of economics.

In the preface the reader is encouraged to read the conclusions in the last chapter before he commences on the arguments in the book. He could economise his time still further by skipping the very interesting but irrelevant matter in the first 100 pages, because it is not until Chapter vi. that the author comes to grips with his first concept of wealth. In this chapter, which bears the heading of "The Two Categories of Wealth," the first section has the sub-title of "The Nature and Definition of Absolute Wealth," and we have to assume, in the absence of any clear indication, that his definition lies in the concluding words, which read: "Wealth as a form, product, or result of a draft upon the flow of available energy consists of the special forms, products, or results which empower and enable human life." After careful study we doubt whether this definition will jump readily to the minds of "all serious readers sincerely anxious to understand the causes of modern unrest." The theme, however, is further developed and two main categories of wealth distinguished. The first includes commodities "which retain part of the energy expended in their production, as an internal store, which, in the consumption of these commodities, is released to serve the purposes of life." The second category includes commodities of which "the energy is expended in overcoming dead resistance, in changing the form or nature of the materials worked upon, and does not remain in the materials as an essential to their use." As examples in the first category we are given food, fuel, explosives, etc., and in the second, clothes, houses, furniture, tools, plant, roads, vehicles, and ships. The difference lies in the relative perishability of those in the first category contrasted with the relative permanence of those in the second. So we reach the distinction, familiar to the economist, between consumers' goods and producers' goods—a distinction which Marshall characterises as "vague and perhaps not of much practical use" ("Principles," II., III., 1).

The meaning of the new term "Virtual Wealth" is not made easy. Prof. Soddy tells us that "the important thing is that this Virtual Wealth does not exist." 'Money,' although nowhere defined, apparently includes gold and silver coins, bank notes and cheques; we assume the latter term to mean all bank balances. Gold in the form of bullion is part of the national wealth; in the form of coins in circulation it is condemned as representing a waste of the community's labour. The system of bank balances is described as a power conferred upon the owners of those balances "not to possess but to be owed wealth." From this it is deduced that money is not wealth, but evidence that the owner of the money has not received the wealth to which he is entitled—wealth which he can demand at his convenience. It follows that "in a community, of necessity, the aggregate money, irrespective of its amount, represents the aggregate value of the wealth which the community prefers to be owed on these terms rather than to own. This negative quantity of wealth I term the *Virtual Wealth* of the community, because the community is obliged . . . to act as though it

possessed this much more wealth than it actually does possess."

The trained student, to say nothing of the ordinary reader, will not find the argument very lucid, especially when he reads, on a later page, that "Virtual Wealth has, in fact, very little to do with the quantity of money." The author does not seem to realise that both in their private and business lives people retain floating balances of money (in the house, office, or bank) because it is a convenience to do so. The custom rests upon an economic basis; balances so kept perform a useful service. But the real object of Prof. Soddy's attack is the creation of bank money, which proceeds from the mechanism of banking operating through the extension of credit resting upon a gold basis. With an increase in 'cash balances' of 100*l.* and a cash ratio of 15 per cent., it is possible, he notes, to create deposits to the extent of 666*l.* 13*s.* 4*d.*, this liability being balanced on the assets side by the 100*l.* of original cash plus 566*l.* 13*s.* 4*d.* of advances. In this manner additional purchasing power is created, and Prof. Soddy says that if the total advances tend steadily to increase, people are undoubtedly "empowered by the banks to acquire wealth temporarily from the community to which they were not entitled and for which the whole community paid."

The author asserts that the financial device of the cheque for economising the use of currency means that a complete and unsuspected alteration has come over the nature of money. It may be complete, but it is surely going too far to imply that it is unsuspected by any one familiar with monetary science. In the ordinary course the growth of credit is small and gradual. It is controlled in all communities using the gold standard by that standard. Viewed impartially, the cheque system joined with the expansion of credit has been a blessing and not a curse. On the other hand, the multiplication of credit by the banking system during the War years, and immediately afterwards through the increase in the cash basis provided by the withdrawal of gold from circulation and the substitution therefor of Treasury notes, did bring into being a mass of purchasing power which was acquired from the community as a whole through the depreciation in sterling. In one word, we had inflation, and undoubtedly inflation was profitable not only to manufacturers, merchants, and traders, but also to the bankers. Views may differ as to the necessity of this operation, but few will now be found to hope that it is possible, as Prof. Soddy would wish, to put the clock back.

Prof. Soddy contends that "something of the order of two thousand million pounds have been created by the banks," which at 5 per cent. brings them in a revenue of a hundred million. His remedy is that the State should "buy back in the open market £M2000 of War Loan with genuine new money to replace that created by the banks." It is not clear how this money is to be issued. In one place we are told it is unnecessary to issue this quantity of Treasury notes and put them in circulation; three pages later we learn that this new money has in future to be held by the banks. Debtors to the banks in respect of present advances must, under this scheme, either sell their securities or find some one who has fresh money to lend them in order that they may repay the banks, which in future are to be required to lend only genuine deposits and are to be forbidden to extend credit upon the principle of keeping only in their tills a safe proportion of deposits.

The precise manner in which these proposals are to be executed is not specified. If contact and trust can be established between repaid National Debt holders and debtors to the banks so that the former lend to the latter sufficient to repay the banks, this part of the scheme might work in theory. The hypothesis, unfortunately, rests upon unexpounded assumptions which will not bear a moment's examination. The new money would unquestionably be paid into the banks, to the credit of the repaid National Debt holders as depositors. Now the banks are in future to keep pound for pound against deposits. We are at a loss to understand how they can do so and still "lend money at interest as before." If they keep cash pound for pound against deposits, they can earn no interest, and the whole credit structure, with all the assistance it renders to industry, will be brought to the ground. Further, how are the debt holders who are to be penalised by the redemption of their stock in new currency to be selected? If impartially, then the innumerable changes that have taken place in the ownership of debt holdings necessitate nothing less than a capital levy. In truth, Prof. Soddy's real plea is for the nationalisation of banking. But just as he shirks the issue of a capital levy, so he omits to carry his other proposals to their logical conclusion.

In the latter half of his book the author concentrates on the problems of the monetary factor in relation to production, and argues in favour of a stable price level controlled through the medium of a national statistical office. Control of currency is, however, to be in the hands of the State. As production increases, new money is to be printed and issued to the consuming public, by meeting Government expenditure therewith instead of by taxation. We are told that the correct quantity of money is that which is sufficient at the stable level of prices to purchase the total stocks of finished wealth in and outside the industrial system. No attention is given to the special circumstances of

Great Britain as an exporting country. We are left wondering how we are to have a stable price level—presumably upon a gold basis—kept in proper relation to the price levels of other countries upon a like basis, if the export trades optimistically expand their output despite the absence of foreign buyers at the prices current, and if floods of new currency are issued by the State *pari passu* with the optimism of the producer.

While we have every sympathy with the difficulties that Prof. Soddy has found in the full comprehension of our present monetary system, we fear that his remedies would involve evils and difficulties far worse than those from which we at present suffer.

W. H. COATES.

Venereal Disease.

Proceedings of the Imperial Social Hygiene Congress, Wembly, Oct. 1925. Pp. iv+301. (British Social Hygiene Council, Carteret St., London, S.W.1.) 4*s*.

THE report of the Imperial Hygiene Congress deals exclusively with venereal diseases. Formerly all diseases were regarded as 'trials,' or as 'punishments for sin.' To-day only venereal diseases are so regarded, and only by the least civilised. It is known that they are caused by microbes, and that microbes do not discriminate between the just and the unjust. Nevertheless, even in England, and even so lately as during the War, after lectures compulsorily attended by soldiers, the jest that "It cannot, then, be sinful to have intercourse with virgins and respectable married women" was not uncommon. The silliness of these lectures is realised when it is borne in mind that among the sufferers are millions of infants.

Diseases may be prevented, or they may be cured. Cure is not an hygienic measure of importance. At any rate, the prevalence of no disease has been reduced appreciably by mere cure. Hygiene *is* prevention, which implies some effective form of cleanliness. Thus, diseases of the alimentary tract (*e.g.* cholera, typhoid, and dysentery) are prevented by attention to the food and water supplies. Insect-borne diseases (*e.g.* malaria, typhus, yellow fever, and bubonic plague) are prevented by destroying the insect carriers. Contagious diseases, such as most skin complaints, can be prevented only by personal hygiene.

The venereal diseases are strictly contagious. They have certain peculiarities. In the vast majority of infections, man is the carrier for woman and woman for man; that is, if they be prevented for one sex, they are automatically prevented for the other. As a very general rule, infection occurs only on particular occasions and on particular parts of the body. The microbes are very delicate, and therefore destructible by ordinary disinfectants if the latter be employed soon after the danger has been incurred, while the microbes are yet on the surface of the body. The male is much more easily disinfected than the female—so easily that a child might perform the operation which consists in no more than the swabbing of a few inches of very accessible skin. Lastly, the venereal diseases are the only maladies with which morality is now concerned.

Two methods of prevention are in vogue: exhortations to morality, and the use of chemical disinfectants. No one has objected to the exhortations; but the use of disinfectants has been much opposed. It has been forgotten that cleanliness is next to godliness. Exhortations to sexual morality, though used for many centuries, have not been very effective at any time. A point of psychology is involved. The sexual inclination is an instinct—a mental impulse to action which is awakened by experience, but not created by it. Thus no one *learns* to be hungry, or thirsty, or to suck. All human instincts are the same for all races of men. On the other hand, morals differ with time and place. They are learned. They constitute the rules by which men restrain their instincts and play the game of society. Almost invariably they are acquired at a particular age and in a particular way—during childhood and by imitation. A little child is 'plastic' (*i.e.* imitative), and therefore tends to copy the emotional convictions of its associates.

Consequently, a child can learn with sincere and unquestioning belief the tenets of any religion and its associated system of morals. In later life this power of learning through imitation becomes greatly enfeebled. The adult learns more through evidence; or what he supposes is evidence, for his judgment is often warped by preconceptions acquired during youth. Thus, while the child of ardent Mohammedans or Hindoos may be brought up in any religion and system of morality, it is usually impossible to change the opinions of the parents. In Christendom, and especially among English-speaking peoples, it is remarkable that exhortations to sexual morality are usually delivered by adults only to adults. Consequently, children learn their sentiments from other children among whom a knowledge of sex is traditional. It follows that exhortations to sexual morality delivered to adults are usually very ineffective—as any reader of NATURE may judge from his own feelings. Would any amount of preaching alter his present sentiments?

Prevention by means of chemical disinfectants has been practised for many years, and on a large scale during, and since, the War. During the War, precise statistics, every item of which could be checked from

official records, were available. It was demonstrated that in many instances, under many and diverse conditions, in many parts of the world, high venereal rates had been reduced almost to the vanishing point by means of immediate disinfection practised by the endangered persons themselves. These facts were unpalatable to people whose principal concern was sexual morality. They could not bring themselves to believe, and sought to create unbelief. But the evidence has been examined by several committees of inquiry, and found unassailable—for example, Lord Trevethin's committee. To-day the only people who insist that personal disinfection is valueless are those who, on moral grounds, have refused to advise it, and therefore have no experience of it.

During the proceedings of the Imperial Hygiene Congress there seems to have been general agreement on two points: public sexual immorality had increased, and the prevalence of venereal disease had diminished during recent years. The conclusion to which we are driven is very obvious. Exhortation has had little influence and disinfection much.

The opening address of the Congress was delivered by Mr. Amery, Secretary of State for the Dominions and Colonies, who stated:

"Now we are dealing in this Congress more particularly with a certain aspect of health, and with certain types of diseases. We are dealing here with a problem that is at once one of the most serious and one of the most hopeful to which any body of public workers or reformers can devote themselves. Most serious, because I think it is becoming increasingly realised how wide-spread, how appalling in the misery, suffering, waste of human life, strength and ability they cause, are the consequences, direct and indirect, of venereal diseases. On the other hand, hopeful, because from the medical point of view there can be no doubt that under the conditions of modern science there is no range of diseases which is more obviously and definitely capable of being dealt with, of being cured, and, indeed, if public opinion was strong enough, capable of being extirpated."

In effect, the only reference to chemical disinfection was made by Surgeon-Commander Thomas Shaw, professor of hygiene in the Royal Naval Medical School, Greenwich, who declared:

"As stated by Trotter one hundred years ago, the best means of preventing venereal disease, if promiscuous sexual intercourse is indulged in, is immediate disinfection of the parts. The part played by suitable and immediate prophylaxis is no longer disputed by any responsible person, and as promiscuous sexual intercourse will still continue to be practised by certain people in spite of all efforts to the contrary, our only hope of eventually exterminating venereal disease altogether is by a wider application of this measure. Whilst we all recognise the great importance of social measures in combating venereal diseases, we shall never exterminate them by these means alone."

The remainder of the volume recording the proceedings is occupied with accounts of the prevalence of venereal diseases in the British Empire, with descriptions of measures taken to cure people already infected, and of narrations of attempts to preserve sailors and other plastic types from the sirens of the streets.

The word hygiene does not accurately describe the Congress.

The Biology of the Protozoa.

The Biology of the Protozoa. By Prof. Gary N. Calkins. Pp. 623. (London: Baillière, Tindall and Cox, 1926.) 35*s*. net.

ALTHOUGH during the last quarter of a century the study of protozoa has been vigorously pursued by many students in many lands, yet the bringing together of the results so obtained, and the critical analysis of often discrepant results, is long overdue. The well-known text-books by Minchin and Doflein to a certain extent fill this need, but one is largely concerned with parasitic forms of protozoa, while the other is not available to those not conversant with the German language.

Moreover, as Prof. Calkins says in his introduction, "protozoology as a branch of the biological sciences has meant little more than the application of biological or zoological methods to a definite but limited group of organisms, the Protozoa." The author has therefore tried to weave the many aspects of protozoological research into a common whole, with the hope of so founding a science of protozoology. The underlying principle of the work is the irritability of protoplasm, combined with protoplasmic organisation. Keeping this fundamental fact in view, the various characteristics of these unicellular animals, namely, metabolic activities, asexual and sexual reproduction, reorganisation and restoration of organisation, etc., are considered.

The word 'unicellular,' as applied to these animals, reminds one of the much-debated point as to whether 'non-cellular' is not a better designation. Prof. Calkins points out that, whereas a single protozoon is to be compared structurally with a single isolated tissue cell of a metazoon, it is a different unit physiologically, and as such should be compared with a complete organism, as was pointed out by Whitman, and later by Gurwitsch, and Dobell.

The book is divided into twelve chapters, covering a wide range of the subject; the first five chapters treat of the general organisation of the protozoan body, nuclei and kinetic elements, structural differentiations, general physiology, and reproduction. This is followed by chapters dealing with each of the big

subphyla of the protozoa: Mastigophora, Sarcodina, Infusoria, and Sporozoa. The classes of each of these groups are described and useful keys to the common genera are given. The concluding three chapters are perhaps the most interesting, for the author discusses such questions as vitality, fertilisation, and the origin of variations.

In a book of only about six hundred pages it is obviously impossible to treat exhaustively this subject matter, and the author has been wise in concentrating more upon free-living protozoa, to the exclusion of the parasitic types, as for example in the chapter on structural differentiations. Here little or no mention is made of the many curious adaptations incident upon the adoption of parasitism; since, however, these have already been well described, the account given by Prof. Calkins of the modifications found in free-living protozoa is particularly welcome.

Under the heading nuclei and kinetic elements, the author has grouped together, in a clear and interesting way, the various organs and cellular elements associated with movements, together with a description of the different configurations grouped together under the term nucleus. To the general biologist the section devoted to kinetic elements will probably appeal most strongly, for it is comparatively few who realise how complex is such a seemingly simple structure as a flagellum or cilium; added to this the reader is introduced to the numerous cytoplasmic granules known as endobasal bodies, centrioles, blepharoplasts, parabasal bodies, etc., all of which appear to play some part in the physiology of movement.

Particular attention may also be directed to the advances recently made towards elucidating the question of co-ordination in protozoa. Sharp, Yocom, McDonald, and others have been able to show that a definite conducting system of fibrils exists in many species of ciliates and that this system emanates from a common mass of protoplasm—the motorium—constituting with the fibrils a 'neuromotor' apparatus. Fig. 57 of Calkins' book illustrates this apparatus in *Euplotes patella* and goes far to substantiate the view that a single protozoon must be regarded as physiologically comparable with a whole metazoon individual.

The chapter on general physiology does not attain the high character of the rest of the book. This is unfortunate, since the title of the volume would suggest that physiology was particularly stressed; and, moreover, there is no modern book dealing with this branch of protozoology which can be recommended to the student. Prof. Calkins' book does help to fill this need, but not completely. In a future edition he would probably be well advised to expand this section to two or three times its present dimensions, even at the expense of some of the other material. The author has evidently been at pains to keep his book within reasonable limits, with the result that sometimes his treatment is a little sketchy; thus little space is given to the questions concerning the response to various stimuli, and little or no mention is made of the reactions brought about by changed environmental conditions or adaptation to new conditions. Again, the important phenomena of encystation and excystation are not adequately discussed. The author has committed himself to the view that external conditions do not play a predominant part in causing the former reaction—a view to which most students of protozoa will subscribe—but the results of the many modern experiments are not given.

A similar criticism may be made against the treatment of nutrition, for, while certain aspects of it are well described, it is a surprise to find such a fascinating subject as choice of food dismissed quite summarily, without even mention being made of the work of such men as Oehler, to give only one example.

Probably the chapters to which all biologists will at once turn are those dealing with vitality; the author means by this term "the sum total of actions, reactions, and interactions between and amongst the substances making up the organisation of protoplasm, and between these and the environment." As is well known, Prof. Calkins, as a result of many years' research, has arrived at conclusions regarding the significance of conjugation and the part it plays in the life cycle of ciliates different from those of other distinguished observers.

The experiments on which these views are founded are well recounted; and to-day Prof. Calkins maintains the following conclusion: "To my mind the phenomena in these forms lead to the conclusion that Protozoa and Metazoa are fundamentally alike in respect to protoplasmic continuity and protoplasmic death, the difference between them is bound up with our definitions of the individual. So far as immortality of Protozoa is concerned, Hertwig's (1914) conclusions appear to sum up the situation: 'However these investigations may turn out, one may say this now, that the doctrine of the immortality of the Protozoa in the form established by Weismann, at a time when we did not know anything of the fertilisation processes of the Protozoa, cannot be retained.'"

The author must be congratulated upon the production of an exceedingly useful and interesting book; and in conclusion the hope may be expressed that at a future date he will furnish us with a more extended account of the general biology and physiology of that group of animals to which he has given thirty years' research.

D. WARD CUTLER.

Our Bookshelf.

Cotton and its Production. By W. H. Johnson. Pp. xxvii + 536 + 16 plates. (London: Macmillan and Co., Ltd., 1926.) 30*s.* net.

THE author has evidently utilised his very extensive experience of cotton-growing in most parts of the world to guide him in compiling this substantial volume from documentary sources. The result is a useful addition to the books about cotton, for besides being well up-to-date it is well balanced and exceptionally free from errors of fact. The author's first-hand knowledge puts his treatment on a higher level than mere compilation, but it is in no sense a critical treatment, and only attempts to present the known or reputed state of affairs. He deals with cotton production throughout the world, taking the information available with discretion.

The general level of the agricultural chapters which deal with the different countries is very fairly maintained in the others. Such subjects as the history and botany of the crop, its manufacture and by-products, its pests and diseases, all receive a chapter each, and these chapters are not likely to mislead the student, but will serve as useful introductions to further study.

Seeing that the scope of the book is such as will serve for reference purposes as well as for general information, it is regrettable that the system of references is very irregular. The "bibliography of cotton" which figures in the table of contents only contains some fifty items, apart from lists of journals and reports; some of these few are merely of casual interest, while others have not been used in the text. Conversely, there is internal evidence for the use of many publications which are not cited, as in the chapter on manufacture. Having regard to the skill with which the author has built up these citations into readable matter, and the great number of sources from which he has drawn them, it is to be hoped that the next edition will be lavishly provided with footnotes. An alternative course would be to issue a thin supplement volume of such references.

The details open to criticism are unimportant, and in most cases are due to the authority cited, for which the author has become responsible; thus the paragraph concerning the reputed depreciation in length of Sakel is very misleading, and the possibilities of rain-grown cotton in the Sudan, as regards quantity, are neglected more than the descriptive treatment warrants. W. L. B.

Dairy Cattle: Selection, Feeding and Management. By Prof. William Wodin Yapp and Prof. William Barbour Nevens. (Wiley Farm Series.) Pp. xvii + 378. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 11*s.* net.

THIS book deals with the selection, feeding and management of dairy cattle on the lines which the authors consider suitable for vocational-school students and dairy farmers in the United States. The subject matter of the different chapters is generally well known to the writers and workers in dairy husbandry in Great Britain and does not require special mention, but the method of study recommended in each chapter is novel and characteristic of the organisation and attention to detail which is possible in agricultural educational work when there is a staff sufficiently large to permit of the division of each subject into numerous sections.

The method adopted by the authors is that of stating clearly at the commencement of each chapter the practical operations involved; thus in the chapter on "Improving the Dairy Herd" the operations specified are: (1) Eliminating the low-producing cows; (2) choosing the proper sire; (3) practising rigid selection.

Each operation is then considered and the procedure to be followed is set out concisely in appropriately headed paragraphs. This method appears excellent, and has the merit of at once attracting the attention of the reader to the main points which the writers wish to emphasise. At the end of each chapter is given a list of American text-books and bulletins to which the reader may refer for further information; also a series of questions is set out, and the student is advised to obtain answers for himself by visiting a number of dairy farms. The advice given throughout is excellent, but amid so much attention to detail it is strange that the fundamental dairy farm operation of milking is passed over in a few words, and that in taking composite samples of milk for fat testing no mention is made of the need for the amount of the sample to be proportionate to the quantity of milk from which it is taken.

The book will be interesting and helpful to the lecturer in dairy husbandry in Great Britain who does not already possess an American text-book, but its value to the British student and farmer is limited because the numerous breeds of dairy cattle and kinds of feeding stuffs common in England but little known in the United States are not referred to by the authors.

Les mollusques d'eau douce. Par Prof. E. Chemin. (Encyclopédie pratique du naturaliste, Tome 24.) Pp. viii + 186 + 15 planches. (Paris: Paul Lechevalier, 1926.) 25 francs.

THIS little manual is one of a kind common in France, but only too rare in England, in which a circumscribed portion of some branch of natural history is treated by itself, be it from an elementary or from an advanced point of view. As a matter of fact, this one is more restricted than usual, for while its title would lead one to expect a complete account of the freshwater molluscs, at all events of France, the author announces in his preface that such is far from his intention. He writes, he says, merely for those who are interested in the natural sciences and the marvels of Nature, and his method is to select a common, characteristic form from each genus and describe its salient features, external and anatomical, so far as they can be explored without serious dissection. Comparisons are drawn between these genera, and their relationships to the bigger groups which they represent are outlined.

All this is admirably done, and the explanations are thoroughly clear and as good as any we have seen. On the other hand, in common with many who rest in the biological stage and are incapable of developing into the higher one of zoologists, the author gives vent to his contempt for the systematic side of his subject, and his sole contribution is to append to each generic description brief remarks on, or sometimes only the names of,

the species he includes under it. He has evidently no first-hand knowledge of this branch of the subject, and his statements are antiquated and sometimes erroneous, as for example when the names of *Unio pictorum* and *U. tumidus* are interchanged. Fifteen plates depicting these species are appended to complete the book. Four are in gaudy, unnatural colours, the remainder in bistre half-tone, based principally, it would seem, on photographs, and for the most part devoid of their characteristic surface-markings or sculpturing.

Animal Husbandry. By H. J. Waters and F. G. King. Pp. viii+546. (Boston, New York and London: Ginn and Co., 1925.) 7*s.* 6*d.* net.

No phase of agriculture has made more distinct advance within the last century than that which relates to the care and management of domestic animals. Certainly no other makes quite so attractive an appeal to human nature. This may explain the numerous text-books on this subject which appear from time to time. In one of the latest of these, by means of a judicious interweaving of theoretical principles and sound practical instruction, Messrs. Waters and King have succeeded in promoting that degree of co-ordination which should exist between the science and practice of stock farming.

A well-marked feature of the book is the attention devoted to the improvement in live-stock production, emphasis being laid on the attainment of the breeder's ideal through years of judicious selection and the vigorous culling of the scrub animal. It is pleasing to see that a few chapters are devoted to the encouragement of boys' and girls' clubs. This movement originated in the United States and has now assumed very large dimensions; doubtless it has been a factor of considerable importance in the general advancement in live-stock production. Useful hints are given regarding the formation of such clubs and what should be the ideals of club members.

We are of the opinion that the sections relating to the nutrition of the farm animal might have contained somewhat more detail. However, considering the size of the volume, the authors appear to have covered the ground with remarkable thoroughness.

The whole work is well produced (there are many beautifully reproduced photographs to illustrate the text), and should serve as an introductory or intermediate text-book for rural economy classes in schools and colleges.

Bibliographia Genetica. Onder redactie van Dr. J. P. Lotsy en Dr. H. N. Kooiman. Deel 1. Pp. v+462. ('s-Gravenhage: Martinus Nijhoff, 1925.) 25 guilders.

Dr. Lotsy and Dr. Kooiman have undertaken the task of editing this work, the first volume of which appeared last year. In a series of volumes, contributed to by geneticists from all over the world, it is intended to summarise the whole field of modern genetics. The enormous and rapid development of genetics, which began in 1900 and is still going on at an increasing pace, makes such a series of summaries very valuable to workers in this field and to those who wish to know the present state of the subject without looking up the original papers. Each author covers the field in which his own contributions figure most prominently.

Thus in the present volume of 460 pages we find Fritz von Wettstein summarising—in 38 pages—the genetical work on mosses, including his own important work on polyploidy in these forms. Similarly, Punnett takes up the genetics of the sweet pea, giving a chromosome map of the various linkage groups; Castle deals with rabbits and guinea-pigs, with illustrations of the more important types; Fruwirth sets forth in 48 pages the genetic results on the potato, and Lehmann in 56 pages those with Epilobium.

Of somewhat different character is Haecker's "Aufgaben und Ergebnisse der Phänogenetik," which occupies 222 pages and is divided into eight chapters, dealing with such topics as size and its inheritance, asymmetry, pigmentation, skull shape, etc., in a comparative way.

Each contribution ends with a list of literature and an index which places all the information in the most available form. The volumes are well bound and should find a place in every productive biological library. R. R. G.

A Course of Geometrical Analysis. By Dr. Haridas Bagchi. Pp. xi+562. (Calcutta: Chuckervertty, Chatterji and Co., Ltd., 1926.) 20 rupees.

It is evident from this book, which is concerned with differential geometry, that Dr. Bagchi knows a great deal of mathematics and that he is a charming man, but it is equally clear that he would have been well advised not to publish this work in its present form. It consists of a kind of commentary or gloss on Forsyth's "Differential Geometry," to which the author makes handsome acknowledgments—see in particular on p. 228 the disarming way in which he ventures to point out a misprint. He deals at great length with rather elementary and trivial points, referring to Forsyth for the serious algebra and for the explanation of his terms, so that the book is unintelligible by itself. There are long digressions on such matters as homogeneous functions and Jacobians, in which the author has really nothing to say which should not be well known to any one beginning the subject. In fact, the book would be intolerably prolix and quite unreadable were it not for the delightfully quaint turns of speech which are to be found on every other page, but from which, in spite of the temptation, we refrain from quoting. Twenty rupees is a large sum to pay for this kind of amusement; after all, Mr. Anstey has done it quite as well long ago. It is a great pity, because Dr. Bagchi is undoubtedly capable of doing good work in mathematics, if he would not spread himself so much.

Kleines Praktikum der Vegetationskunde. Von Dr. Friedrich Markgraf. (Biologische Studienbücher, 4.) Pp. v+64. (Berlin: Julius Springer, 1926.) 4·20 gold marks.

Dr. Markgraf's introduction to the practical study of vegetation is chiefly of interest because of a somewhat detailed consideration of the use of the quadrat method in the field, illustrated especially by reference to bogs and woodlands. This occupies nearly half the volume and, by comparison, the second section dealing with methods of investigating the features of the habitat appears all too brief, even for a beginner.

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 Continuous Spectrum of Mercury.

IN recent papers I have discussed the continuous spectrum of mercury and its association with the resonance line λ 2537. Prof. R. W. Wood showed in 1909 that the green visual fluorescence of mercury vapour with continuous spectrum was destroyed by a red heat. I have recently studied the effect of heat on a stream of mercury vapour, showing the continuous spectrum as it distilled away from the electric discharge in which it originated. The visual glow disappeared, as might be anticipated from Wood's result. I thought it very probable that this was to be explained by the dissociation of mercury molecules which give rise to the (apparently) continuous spectrum. It was of interest to see whether the resonance line due to the atom would survive.

Photographs of the ultra-violet spectrum taken with these ideas in view gave a very surprising result. The resonance line *did* survive, but with it was the strong part of the continuous spectrum in the region λ 3300, little if at all affected by the heat. This surviving part of the continuous spectrum is separated by an intervening minimum from the visual region which *is* extinguished by the heat.

There is much more to do. I limit myself for the moment to announcing the above, which has been thoroughly confirmed.

RAYLEIGH.

Terling Place, Chelmsford,
November 14.

The Golgi Origin of Fatty Yolk in the Light of Parat's Work.

DURING the last few years evidence has been steadily accumulating that the Golgi rings or crescents of certain eggs give rise to fatty yolk. As this conclusion has been challenged by certain authors (for example, Harvey, *Quart. Journ. Micr. Sci.*, 1925), it seems to me desirable to set forth briefly the evidence in favour of the above view in the light of Parat's work, which lends strong support to it.

To the best of my knowledge, Hirschler (*Zeit. f. Wiss. mikr. u. tech.*, 1915) was the first worker to describe, in the eggs of ascidians, a swelling of the Golgi elements and their fusion with the swollen mitochondria to give rise to compound yolk bodies. This conclusion has been recently supported by Parat and Bhattacharya (*Comptes rendus*, 1926), who have studied the eggs of Ciona by means of Vital dyes. The greater bulk of evidence in support of the Golgi origin of fatty yolk, however, has been furnished by Gatenby and his pupils, and more recently by myself. In the egg of Saccocirrus (Gatenby, *Quart. Journ. Micr. Sci.*, 1922) the juxta-nuclear Golgi apparatus spreads out and proliferates with the growth of the egg, and probably gives rise to granules which are fatty in nature. A similar process has been described by me (*Proc. Camb. Phil. Soc.*, Biol. Sci., 1924) in the eggs of Lithobius, in which the granules that arise from the proliferation of the Golgi apparatus grow to a considerable size and form fatty yolk which comes up in the centrifuged eggs exactly like the fatty yolk of Saccocirrus. In Helix (Brambell, *Brit. Jour. Exp. Biol.*, 1924) some of the Golgi elements are directly metamorphosed into fatty yolk which occupies the upper pole in centrifuged eggs. In Patella, Ludford (*Jour. Roy. Micr. Soc.*, 1921) and Gatenby and Woodger (*Jour. Roy. Micr. Soc.*, 1920) give a very circumstantial and convincing account of the origin of fatty yolk from the Golgi elements which has more recently been confirmed by Brambell (*Brit. Jour. Exp. Biol.*, 1924), who shows that the fatty yolk occupies the upper pole in centrifuged eggs as is the case in Saccocirrus, Lithobius, and Helix.

During 1924 and 1925 Parat and his collaborators (*Comptes rendus des Séances de l'Académie des Sciences* and *Comptes rendus des Séances de la Société de Biologie*) have published a large number of small papers giving the results of their study of the Golgi apparatus in the genital and somatic cells of both invertebrates and vertebrates. This is not the place for a full discussion of Parat's view. According to Parat, the Golgi elements exist in the form of vacuoles in all vertebrate and invertebrate cells. This he has proved by the use of the Vital stain, neutral red, the crystals of which precipitate in the vacuoles while the mitochondria remain quite colourless. These latter, however, can be stained by the application of Janus green. Vacuole-like or ring-like Golgi elements are of course very common even in fixed preparations of all the cells of invertebrates and the genital cells of vertebrates. The important contribution, however, that Parat has made is that even the network-like Golgi apparatus of the somatic cells of vertebrates really consists of vacuoles. The reticular appearance of the Golgi apparatus is, according to Parat, an artefact produced by the precipitation of metallic silver or osmium in the interior, or at the periphery, or between these vacuoles.

As the somatic cells arise by differentiation from the germ cells, and as undoubtedly the Golgi elements of a particular cell are roughly distributed to the two daughter cells during mitosis, it has been so far difficult to explain how the Golgi crescents or rings of the germ cells could give rise to a network found in the somatic cells of vertebrates. As to the contents of the vacuoles, Parat insists that they are not lipoidal, because osmic acid is the test for fats and not for lipoids. The content is mostly a liquid and its reaction is acidic; hence the affinity of vacuoles for the basic neutral red. The absence of coagulum leads us to think that we have to deal in the majority of cases with the solution of crystalloids. But it is a fact that certain colloids not miscible with protoplasm can accumulate in the vacuoles, like aleurone grains in the vegetable cells. Final judgment on the chemical nature of the Golgi apparatus, however, can be delivered only when we are able to analyse it chemically, as has been done in the case of nucleo-proteins, but the view that the Golgi apparatus really consists of vacuoles in all animal cells lends strong support to the view of Guilliermond, Mangenot, Bensley, and others, that the plant cell vacuole is the homologue of the animal Golgi apparatus.

The above view of Parat also lends very strong support to the opinion that fatty yolk may arise from the Golgi elements. In spiders (Nath, unpublished), in Scolopendra (Nath and Hussain, unpublished), and in the firefly Luciola (Nath and Metha, unpublished), the juxta-nuclear Golgi apparatus consists, in Mann-Kopsch preparations, of rings which may also be appropriately described as vacuoles with a sharp chromophilic rim and a central chromophobic area. With the growth of the eggs, the Golgi rings proliferate and swell up and give rise to fatty yolk spheres by the

deposition inside them of free unsaturated fat which is stained black even by the osmic acid in Flemming-without-acetic. The most interesting point, however, is that when these osmicated fatty yolk spheres which appear solid are treated with turpentine, they show a chromophilic rim and a chromophobic central substance, exactly like the Golgi elements. On further decolorisation the yolk spheres appear like clear vacuoles, which give a frothy appearance to the whole egg.

Recently Miss S. D. King (*Proc. Roy. Soc.*, June 1926) has given convincing arguments in favour of the Golgi origin of fatty yolk in the eggs of Oniscus exactly as in the eggs of Lithobius. It seems to me that there is no justification for the attacks that have been made on the above view of Gatenby and his pupils. My line of argument is perfectly simple. Golgi rings look like vacuoles, and fat spheres are certainly vacuolar in nature. It seems clear that the vacuole-like Golgi elements give rise to vacuole-like fatty yolk spheres, by a process of deposition in their interior of free fat not miscible with the general cytoplasm.

VISHWA NATH.

Bhupendra Research Laboratory,
Mohindra College,
Patiala, India,
October 7.

Anthropology and Administration.

ALL anthropologists will feel grateful to Mr. Ormsby-Gore, as well as to NATURE, for the vigorous pleading on behalf of the Imperial importance of our science by the Under Secretary of State for the Colonies, and for the interesting leading articles in the issues of October 30 and November 6. The passage from the Under Secretary's report quoted in NATURE is of special value for the right appreciation of anthropological methods. Mr. Ormsby-Gore sees clearly that "personal contact" is not enough. A "scientific study of their [the natives'] mental and moral characteristics, of native law and customs, of native history, language, and tradition" is indispensable. As is pointed out in the leading article, "There is now a wealth of accumulated experience and knowledge at our command in our schools of anthropology." I should like to add a few concrete suggestions as to how anthropology should be studied in order to be of direct use to the administrator.

The official in a Crown Colony has to legislate and to administer justice to his subjects; he has to regulate relations between white settler and native—relations which are predominantly of an economic or judicial nature—and he has to deal in various ways with local custom and belief. Three lines of anthropological approach are therefore of extreme importance to the future Colonial administrator: early economics, the psychology of native races, and, above all, the theory of primitive jurisprudence. Remarkably enough, two of these branches of learning, economics and jurisprudence, have been almost entirely neglected until recently. Text-books of anthropology, and even of social organisation, as well as most records of field-work, ignore them or deal with them inadequately or one-sidedly. Yet both primitive production and consumption of wealth, as well as the principles of justice and its administration, are fruitful subjects of observation in the field, as I have proved from my own experience and have shown in my published work. When trying to co-operate with the Colonial authorities in the utilisation of native labour, and the preservation of native culture, it seems of paramount importance to insist from the onset that our science can and will assist directly the authorities in what they need most.

There is, moreover, no practical difficulty in the way of such teaching in Great Britain, for it has been provided for by two or three universities, including that of London, where anthropology is taught in several of its colleges. At the London School of Economics a chair of ethnology has been in existence since 1913—and afterwards a readership in social anthropology—while later on the teaching of this subject was also established at University College and Bedford College. In the Department of Ethnology of the London School of Economics, under the direction of Prof. Seligman, the study of the early economic systems, the principle of native law and of savage mentality has been carried on for the last fifteen years. With field-workers of the measure of Prof. Seligman and Prof. Westermarck, with sociologists such as Prof. Hobhouse and Prof. Graham Wallas, with jurisprudents specially interested in anthropology such as Prof. Jenks, the teaching of our science has gone hand in hand with that of comparative law, comparative sociology, and economic history.

Recently also chairs of international relations and international history have been set up at the London School of Economics, and are held by Prof. Baker and Prof. Arnold Toynbee respectively. A wide scope is given to the study of the subject, and problems of inter-racial relations; the mutual influences of western and oriental culture; and the diffusion of European civilisation among simpler peoples fall within the sphere of these two chairs.

To such studies the background of appropriate anthropological theory is indispensable. The anthropologist is able first to supply the dispassionate attitude of mind so necessary to the discussion of inter-racial problems. His methods, especially if he is trained in field-work, tend to develop that sympathy with each specific culture based on understanding, which is perhaps the best antidote to political bias or false sentimentalism.

At the University of London we have also perhaps the biggest school of comparative linguistics extant, the School of Oriental Studies. I believe that any serious attempt to train future settlers and officials in the anthropological outlook must include linguistic teaching both of a theoretical and practical nature. It is to be hoped that the already existing co-operation between the London School of Economics and University College will soon be extended, also the School of Oriental Studies, and that with the assistance and advice of the Colonial Office, some such scheme of training will be devised as that already in force in the universities of Holland, above all at Leyden. This scheme has proved invaluable to the Dutch Colonial authorities.

There is, then, a definite field for anthropological research which can be made practically useful to the Colonial authorities. By cultivating it more intensively than is done at present, anthropology can also be brought in touch with realities and be able empirically to verify some of its theories.

Nothing is so salutary to a new science as a pragmatic contact with facts. Without in any way swerving from the pursuit of purely theoretical ends, anthropology needs at present to be deflected from the curio-hunting sensation-mongering interest which had been its curse in the past. There is a useful as well as a useless anthropology.

B. MALINOWSKI.

Department of Ethnology,
London School of Economics,
University of London.

The Recurrence of Magnetic Storms.

A FEW remarks seem expedient on Dr. Deslandres' letter in NATURE of October 30. Various recurrence phenomena, including pulsations with periods of a few seconds or minutes, have attracted the attention of magneticians, but my original letter referred only to the recurrence of magnetic storms, that is, large disturbances of considerable duration experienced simultaneously all over the earth. The various members of a recurring series of storms do not seem to bear any special family resemblance to one another. The methods I have employed have demonstrated recurrence after intervals of 27 days or multiples thereof, but not in shorter intervals. I am uncertain whether Dr. Deslandres agrees that these large prolonged disturbances show only the 27-day interval T, or whether he believes that they also tend to recur to a lesser extent in intervals $iT/6$, where i is integral, and that the failure to show these shorter intervals is the fault either of my data or of my methods. He refers to doubts entertained respecting the international character figures. So far as I am aware, the only criticism passed on these is that any particular character figure, for example, 1·5, is not an absolute measure of disturbance, but may signify different amounts of disturbance in quiet and disturbed years. This criticism is one I have made myself, but the defect does not prejudice the use of the figures for discriminating between disturbance on consecutive days, the only purpose for which the figures have been used in the present connexion.

Dr. Deslandres also seems to suggest that the use of mean data from a number of years may obscure real recurrence intervals prominent in individual years. If, however, mean data from a number of years reduce to insignificance a period prominent in one or two years, it implies a remarkable deficiency of recurrences with this period in the other years, a phenomenon difficult to explain unless the prominence during the one or two years was a matter of pure chance.

As a matter of fact, the results which I gave from the international character figures did not represent an 11-year period, as Dr. Deslandres seems to suppose. Two separate periods, one of six years, 1906 to 1911, and one of five years, 1920 to 1924, were dealt with separately, and neither showed the intervals $iT/6$. The 11-year period 1890 to 1900 which I dealt with preceded the existence of international figures. The results for it were based on Kew data alone, the criterion of disturbance being the absolute daily range of the horizontal force. No trace of a period a submultiple of T appeared in that case either.

As regards the suggestions which Dr. Deslandres has made for the better utilisation of the international character figures, the employment of 14 instead of 5 selected days a month has two rather obvious drawbacks. It entails nearly three times as much arithmetic, and it largely waters down the amplitude of the primary pulse. There is admittedly no special virtue in the number 5; it merely happens to be the number of quiet or disturbed days internationally selected for each month. But long experience has shown that in disturbed months it is difficult to secure more than 5 reasonably quiet days, while in quiet months it is sometimes difficult to get so many as 5 reasonably disturbed days. The suggestion to consider individual cases individually embodies the procedure which I originally followed after Mr. Maunder's investigations directed my attention to the subject. When following this procedure I did not succeed in arriving at any conclusions from which I felt assured that the influence of personal bias had been excluded. For ascertaining definitely the cause of the phenomenon the consideration of individual cases may be essential. It has of course special attractions for astronomers like Dr. Deslandres or the late Rev. A. L. Cortie, S.J., who have corresponding solar data immediately available.

C. CHREE.

75 Church Road, Richmond, Surrey.

THE letter on the above subject by Dr. Deslandres in NATURE of October 30, contains a reference to some preliminary investigations made by me some fourteen years ago.

From Dr. Deslandres' remarks I gather that he regrets that I should have confined myself in these investigations to 10 spots, and I wish to correct this impression, inasmuch as I have subjected all spots which appeared during the years 1912–14, that is, three years, to the identical examination, but the space available permitted only of the publication of one specimen table. The result in all the many other tabulations was the same, but when the material I worked upon gave out, I certainly came to a standstill. However, by an odd coincidence, on the very day I read Dr. Deslandres' communication, I received a letter from Stonyhurst offering to provide me with all the required data on similar lines as those the *Observatory* used to provide so very suitably. Therefore I intend to take the matter up again, and desire at this juncture already to express my thanks to both Dr. Deslandres and the Stonyhurst Observatory officials for their kind encouragement.

I wish to add that I am equally delighted to read that Dr. Deslandres has also found the presence of the D_3 helium-line over merely faculic areas, an observational fact of many years' standing with me, and to which I have often referred in lectures and papers.

ALBERT ALFRED BUSS.

22 Egerton Road, Chorlton-cum-Hardy,
near Manchester,
November 8.

Post-Cretaceous Igneous Activity in Western India.

THE discovery of nepheline-syenite and monchiquite in Girnar, Kathiawar, announced by Dr. J. W. Evans in 1901 has, after a lapse of a quarter of a century, been followed by detailed petrographical and field investigations published in recent issues of the *Records of the Geological Survey of India* and the *Journal of Geology* respectively. The central mountain forms a dome of plutonic rocks intruded into the overlying Trap. Further investigations in Gujrat and Kathiawar have revealed a fascinating chapter in the history of post-Cretaceous igneous activity in India which is not dissimilar from the Tertiary igneous activity of Scotland. They acquire a special interest in view of the recent theory of magmatic cycles and its application by Dr. G. W. Tyrrell to the British Isles.

The plateau basalt which was presumably erupted from long fissures is, as a rule, free from evidence of explosive activity and the mode of its extravasation needs no description. This was followed in India by laccolithic intrusions, of which the Girnar and Barda hills are better known than others. A large circular dyke, corresponding to the ring-dykes of the Scottish intrusions, occurs round the central intrusion of Girnar (*Journal of Geology*, Vol. 34, No. 4). The long dykes which follow an approximately elliptical course east of Girnar and are so conspicuous in the Gir Range and near Gondal are, likewise, to be explained as

a result of the stresses set up by a concealed intrusion which denudation has not yet exposed to the surface.

In addition to these, a number of other laccolithic intrusions appear to lie on a line which runs from Baroda *via* Bhavangar and Girnar to the Barda hills. An assumed northerly shift of this line makes it continuous along the intrusions of Cutch, Baluchistan, and Persia. It indicates a zone of weakness which keeps its parallellism to the coast and along which the basaltic magma was still able to intrude itself when the ascensive force was unable to bring it any longer to the surface. Slow crystallisation at some depth in the local magma reservoirs brought about differentiation and resulted in the production of acid types which took a plutonic, hypabyssal, or volcanic phase according to the mechanical strength of the intruded beds and the movement of the magma. The acid igneous rocks of the Deccan Trap, therefore, appear to represent the end product of differentiation in a basaltic magma.

This period of laccolithic and dyke intrusions was followed by the manifestation of local volcanic activity of the explosive type at various centres probably on the top of cooling reservoirs. Detailed investigations have been carried out by us on the Pawagadh hill, near Baroda, the rhyolites of which were first described, after a hurried visit to this locality, by Dr. L. L. Fermor, who had suspected an interbedding of rhyolite with basalt. The results of our examination of the hill show that Pawagadh became a centre of volcanic activity of an explosive type long after the cessation of the eruption of plateau basalt, during which interval valleys had been carved out in the existing lava flows. Doleritic olivine-basalt was extravasated in contrast to the olivine-free compact plateau basalt, followed by andesitic lavas and tuffs. Rhyolite flowed at the end from a central neck at the top of the hill (2811 feet) and from a few other subsidiary vents at a lower level. The Osham hill, where the rhyolite occurs again as the end product, appears to have had a similar history. A number of other volcanic vents are known on the line of laccoliths indicated above. This association confirms the explanation of volcanic activity of the explosive type put forward by Dr. A. L. Day and supported by Prof. A. Holmes (NATURE, vol. 117, p. 66).

The above outline serves to indicate the fact that in Gujrat, Kathiawar and Cutch we have an interesting record of events of an igneous cycle initiated by a fissure eruption. Field and laboratory work is in progress which will throw light on the detailed history of this period.

K. K. MATHUR.
V. S. DUBEY.

Department of Geology,
Hindu University, Benares,
September 23.

The State and Industrial Research Associations.

THE arguments adduced by Mr. J. W. Williamson in his paper on "The State and Industrial Research Associations," published in NATURE of Nov. 6, have made out several good reasons for the permanent subvention of such bodies by the State. No doubt his arguments might be met by the counter-argument that each industry should and could take out its own policy of insurance against ignorance.

Between these two alternatives there is a middle course which suggested itself to me in the course of past experience connected with the actual founding of one such association. This course would, I think, meet Mr. Williamson's views, and yet would still leave the responsibility for profitable development to be carried by the industry itself.

The suggestion I would make is cognate with my analysis of research into eight classes, defined by the restriction or freedom of their methods, aims, and subjects respectively (NATURE, Aug. 28, 1926). In the second of these classes the research is restricted to a subject which may be of industrial importance, such as cotton, but it is otherwise free; not bound to any particular technique or science, not constrained to any aim, but working simply to increase the total of scientific knowledge concerning its subject, whether such knowledge be 'useless' or otherwise. Such research is a fit and proper subject for State endowment to a limited extent; indeed, it could probably make out a more forcible claim on social grounds than could pure science, my unrestricted first class.

In the organisation of such a research association as already exists, the endowment would support a nucleus organisation within it, whereto some three members of the staff would be allocated in such a way that even if an industry decided to abandon its association, the nucleus thereof would still continue to exist and function, upon a laboratory footing. Laboratories are not costly if they have not to concern themselves with the application of results; the administrative charges of such a nucleus would be trivial; the staff would, by definition, be picked men who could co-operate as colleagues without other formal direction than that of the accidental senior amongst them. They could be housed in some existing institution until such time as their industry saw fit to re-crystallise its research around this nucleus, in order to make their results usable by further studies made under restrictions of aim or method.

A State endowment of less than 4000*l.* a year would ensure such a nucleus of permanent appointments—not permanent staff—for each industry, and this nucleus would cost the same amount for every industry, large or small. The staff of an existing association would then be assured that, even if their association dissolved, still the roots of their work would continue to grow forward. Issues too big to be profitable could be taken up by this nucleus staff; issues too profitable to be interesting would be willingly met by temporary expansion of the industry's direct contribution, and the subsequent contraction would not involve a risk of disintegrating the whole structure.

A certain insecurity which is inherent in any organisation built entirely on voluntary levies has an unfavourable influence on research, and while I do not quite agree with Mr. Williamson's cogent plea for a permanent State support of research associations as at present constructed, I believe that the insertion therein of such permanent nuclei would sufficiently ensure all the aims he has expressed, and more.

W. LAWRENCE BALLS.

Meldreth, Royston,
Herts., November 10.

Modern Photometry.

ALTHOUGH, as the reviewer of Mr. J. W. T. Walsh's "Photometry" in NATURE of October 23 says, "The reader must not object to change" and "This is not the place to discuss fully the vexed question of nomenclature," and that "of course" Mr. Walsh uses the terminology adopted by the International Commission, I join in regretting the exchange of 'candle-power' for the words 'luminous intensity.' The official language of the Commission is French. Of course, 'candle-power' cannot be literally translated into French. I pointed out, at the meeting of the Commission in 1921, that M. Blondel at the Geneva Congress in 1896 had used the expression '*puissance lumineuse*,' but it was objected that the word *puissance*

cannot now be employed in that sense. In English usage, 'candle-power' is strictly a form of power, and might, if we had the data, be defined in ergs per second. In French, an electric current cannot be strictly expressed in amperes, but the *intensité* of a current can be so stated. In English, the notion of *intensité* is here redundant, and, as the reviewer observes, "In scientific English the word 'intensity' always connotes something analogous to 'energy per unit area.'"

A good deal might be said about the proper use of the term 'flux,' when 'luminous flux' is to be substituted for 'light.' Flux is generally employed in English to connote a flow, not a rate. 'Luminous radiation' is all that is wanted, without introducing the conception of a rate. Need we stop to consider, or wait to know what light is before using the word in scientific English? Heat is not easy to define, temperature is less easy, but no new terms are wanted here.

A. P. TROTTER.

Teffont, Salisbury,
October 30.

I AM very glad to find Mr. Trotter in agreement with me regarding some points in photometric nomenclature, but in reply to his concluding remarks I have only to suggest that the scientific use of the term 'light' should be at least as exact and simple as its ordinary use in English. Terms like 'ultra-violet light' are simply ridiculous. That is why I suggested a greater care in the use of the word. Why manufacture new terms because a very small proportion of the population misuses the good old words?

L. C. M.

Broadcasting Birth-control.

SIR JAMES MARCHANT, in a letter published in the *Times* of November 17, refers to my "extreme and one-sided views" on the subject of birth-control. As there appears to be much misconception in regard to what I actually did say on this subject during the broadcast debate on "Is Science Bad for the World?" on November 16, I should like to have the opportunity of putting my words on record. They were as follows:

"Birth-control is capable of great harm, if it is not regulated; but its absence would lead to greater harm. It therefore must be regulated and supervised by the State" (or, I would now add, by the medical profession), "and the nation should allow no interference on the part of prudery or of religious intolerance. . . ." Here I was interrupted.

I claim that this statement was neither extreme nor one-sided. Whether subjects like 'birth-control' should ever be mentioned on the wireless is another issue altogether. To me personally, letters such as that of Sir James Marchant appear to add point to the fear which has been expressed that State control of broadcasting might well tend to dulness and sterility through a banning of all controversial matters. Had broadcasting been possible in 1859, doubtless no expression of opinion would have been allowed over the wireless on the shocking question of whether man had not been specially created, but had evolved from animals.

However, I am here only concerned to defend myself from the imputation of having abused my privileged position at the microphone. I should also add that a year ago I was invited to give a series of wireless talks on biology and human life, and that no objection was then raised by the B.B.C. to the brief references to birth-control which I there made. I therefore conclude (and earnestly hope that I am correct) that though the policy of the B.B.C. may be against the raising of the question in a controversial way in debate, this does not preclude the topic from ever being mentioned over the wireless.

JULIAN S. HUXLEY.

King's College,
Strand, London, W.C.2.

Spectrographic Junction between the X-ray Region and the Extreme Ultra-violet.

IN a letter published in NATURE of October 16, p. 551, Dr. A. Dauvillier has announced some preliminary results of attempts to get spectroscopic evidence of the unknown region between the X-rays and the extreme ultra-violet. He has followed the same general methods and technique as have been used by me in measuring the *K*- and *L*-series of the formerly unknown domain of wave-lengths 12 Å.U.-25 Å.U. (*Phil. Mag.*, February 1926).

My experience from this work is that a thorough critical scrutiny of the obtained spectrograms is necessary to exclude erroneous interpretations. To show that the lines found were not ordinary short wave-lengths reflected in higher orders or in other atomic planes than those supposed, Dr. Dauvillier has used goldbeater's foil. Our experience is that such foils, even of the thinnest obtainable sort, absorb completely all wave-lengths greater than 13 Å.U.-15 Å.U., and therefore it is scarcely possible by this means to identify the longer wave-lengths.

It is also surprising that a foil of magnesium thick enough to prevent the photographic plate from fogging by the rather intense ordinary light would transmit this very soft radiation in any considerable amount, especially when the relatively small intensity of the *N*- and *O*-series, as also theoretically suggested by Kramers, is taken into account.

It will, however, be of great interest to get a detailed report of these experiments, which, if they prove to be correctly interpreted, are of high scientific value.

ROBERT THORÆUS.

Physical Laboratory of the University,
Upsala, Sweden, October 29.

Quantum Theory and Intensity Distribution in Continuous Spectra.

THE undulatory mechanics makes it possible to give a quantum theory of aperiodic phenomena, and, in particular, to compute the intensity distribution for continuous spectra. The theory has recently been applied to the hyperbolic orbits of the hydrogen atom (*Proc. Camb. Phil. Soc.*, Oct. 1926). The results are too complicated to be given here in detail; but they yield an estimate of the intensity distribution in the continuous X-ray absorption spectra. This is, I believe, the first experimental verification of this part of the theory.

According to the theory, absorption sets in discontinuously at the series limit with a finite value, which, for a given n_k electron, is proportional to the wave-length of the limit. For very short waves the absorption coefficient is of the form $f(n,k)Z^{2k+2}\lambda^{2+k}$, where Z is the effective nuclear charge and λ the wave-length of the radiation, and where $k = \frac{1}{2}, \frac{3}{2} \ldots$. The values of $f(n, k)$ give atomic absorption coefficients $Z^{\alpha}\lambda^{\beta}$, where α ranges from 3 to 4·5, and where β, for the shortest waves, is 2·5, and for the customary range varies between 2·5 and 3. This is in agreement with the empirical formulæ.

J. R. OPPENHEIMER.

Institut für Theoretische Physik,
Göttingen, October 30.

University Laboratories and Research.[1]

By Sir J. J. THOMSON, O.M., F.R.S.

PHYSICAL laboratories at the present day are very different from those existing when I began to study physics now, alas, more than fifty years ago. In those days they could be counted on the fingers of one hand. They were not palatial buildings, but for the most part consisted of a few odd rooms, wrung from a reluctant governing body by the importunity of the professor. The physical laboratory of Owens College, now the University of Manchester, where I began my study of physics, was a few rooms which nobody else wanted in Cobden's house in Quay Street, and I believe that one of the rooms in Lord Kelvin's laboratory at Glasgow was an old coal-cellar. The whole equipment of apparatus could in many cases not have cost more than a few hundred pounds. Now almost every university and technical school has a separate building equipped with expensive apparatus.

The provision of these laboratories, and the funds required for their maintenance, has become a very serious question for those responsible for the finances of our universities. I am afraid that physical laboratories are especially expensive. I am afraid, too, that the sums required for their equipment and maintenance are much more likely to increase than to diminish. They have indeed increased very rapidly of late years. Let me give an example of my own experience. At the beginning of this century there were about thirty persons doing original work at the Cavendish Laboratory. Their researches cost the laboratory between 300*l.* and 400*l.* a year. The cost now would be at least six times that amount. As science progresses the instruments required become more and more elaborate and expensive. The old endowments of the universities and the fees from students are quite inadequate to meet the expenses on the new scale. New studies require new endowments; there is still need, nay, there is increasing need, for the 'pious founder.'

It would be ungrateful, however, not to acknowledge the liberal help which is now given to physical science by the Government of the country, partly by grants to the universities, partly by grants for research administered by the Royal Society, and partly by the formation of the Advisory Council for Scientific and Industrial Research, which, among other things, finances the National Physical Laboratory. The Government, indeed, is now giving to physical science far more than any Government gave before. To the liberality of some of the city companies we owe some fine laboratories, and there are many private benefactors to whom our gratitude is due, but there is still room, nay, need, for many more.

It is not necessary for me to dwell on the educational value of the study of science in our universities and schools. Indeed, there are those who maintain that it is the literary studies that are in danger of neglect. I believe, however, that the vast majority of scientific men recognise the great, nay, the vital importance of literary subjects in education, and would view with horror a system from which they were absent. Both are necessary, but in my opinion science without literature would be worse than the old system of literature without science.

The educational value of the training in science depends to a great extent upon work in the laboratory. What are the educational values of science? Are they not that science arouses and does something to satisfy the wonder and curiosity we feel about the marvellous processes going on in the world around us; that it cultivates and develops the powers of observation; that, and this is a most important point, it teaches us to reason about facts that come under our own notice? It gives the student confidence in the powers of reason. I think every teacher of science knows that when a student calculates from the principles he has been taught what will happen, say, when light passes through a system of lenses, and on proceeding to try the experiment finds that the result agrees with his predictions, it comes to him as a great surprise. It comes almost as a shock that human reason can lead to accurate results. Nothing helps a student to use his reason more than the belief that it can be trusted. But to get these educational values from science the laboratory is essential; it is there that the facts on which he has to exert his reason are to be found, where the contact between the facts and the intellectual effort takes place. Again, by his experiments the properties of light, electricity, and so on are impressed upon his mind with a vividness possible in no other way. It is in the laboratory that we realise that close touch with Nature which is essential to the progress of science.

It is the duty of the universities to enlarge the bounds of knowledge, as well as to instruct the community in the knowledge already won. Such research is of great value to the community. The discoveries made in the universities by people working simply to increase human knowledge, without any idea whatever of any industrial application, are the very discoveries which create new industries and revolutionise the old. Take the case of the electrical industry. How did that come into existence? It was not because somebody set to work to develop a method for the transmission of power. It arose because Faraday wanted to try, in the laboratory at the Royal Institution in London, what would happen if he moved a magnet about near a coil of wire. That industry would never have been created if he had simply worked with the idea of discovering something to transmit power. I want to emphasise this point because there are many who say that the only legitimate object of research to which public funds should be applied is research with definite industrial intention. I am the last to decry *ad hoc* research, but it is not enough.

When bows and arrows were the most formidable weapons, it would have been a very good thing to establish a Bow-and-Arrow Research Association to make sure that one had got the best bow and arrow possible. But some man, working to get knowledge for its own sake, discovered gunpowder, and made the best bow and arrow obsolete. The truth is that Nature is so full of wonderful things that there is probably a much better solution of any problem than any we possess. We shall not find it by working directly on the problem, but if we work away, faithfully recording

[1] From an address delivered at the opening of the new science laboratories at the University College of North Wales, Bangor, on November 2.

what we see in our experiments, we shall probably get a hint and arrive at results which may be of importance. It is difficult to say that any discovery which is made is devoid of commercial value. Our experience in the War showed us that the most recondite phenomena, known only to a few, could be applied for the service of the country.

I have heard the fear expressed that the multiplication of laboratories may lead to something like over-production—that there may not be enough discoveries to go round. Such a fear seems ludicrous to a physicist who knows that a discovery is not a terminus but an avenue opening up new and wider fields for work. We are surrounded on all sides by physical and chemical phenomena of which our knowledge is not even in its infancy, scarcely in embryo. Consider for example the chemical and physical properties of living matter. A tiny seed is put into the ground and becomes with nothing but the soil, water, air, and light a workshop weaving for leaf, flower, and fruit fabrics of exquisite texture, moulding these with unerring accuracy into shapes of the greatest variety and complexity, dyeing them all the colours of rainbow, often spreading the colours in patterns full of minute and elaborate detail, laying up stores of substances, most of which are beyond the power of the chemist to produce, and finally producing other seeds able to produce the same effects. Compared with results like this our workshops, our looms, our dye-works seem clumsy and inefficient. What is the mechanism by which these wonderful results are produced? We have no idea.

To find out the mechanism of this tiny seed we shall have to develop methods of investigating the changes that go on, almost molecule by molecule. Of late years methods have been devised which are continually diminishing the distance between us and the solution of these problems, and in the not too indefinite future we may hope to get to know something of the way in which those marvels are accomplished. This requires the co-operation of many sciences, and it seems to me that the new buildings at Bangor are admirably fitted to take part in this great work.

Richard of Wallingford and his Rectangulus.

By Dr. R. T. GUNTHER.

THE celebration of the sixth centenary of the elevation of Richard of Wallingford to the Abbacy of St. Albans in 1326 is an occasion of far more than local interest, for it is also the celebration of the sixth centenary of the beginning of trigonometry in England.

Richard's father was a blacksmith in the village of Wallingford, who died when the son was only ten years of age, but Richard was fortunate enough to be adopted by the Prior of Wallingford, who sent him to Oxford at the age of seventeen. Six years later he was admitted to the monastery of St. Albans, perhaps, as Sir Edgar Wigram has suggested, because he instinctively recognised that in those days a monastery was the only refuge where a man of science could find license and leisure to prosecute his studies undisturbed. But after three years training, Abbot Hugh sent him back to Oxford as one of the students whom every Benedictine house was bound by statute to maintain at the University, in order to ensure that its learning should be kept up to standard. Apparently to the deep concern of the chronicler, Richard then proceeded to spend valuable time on mathematics and astronomy, which he was expected to devote to theology. But in 1326 he had his reward by being elected Abbot of St. Albans, and, as after events proved, turned his scientific training to good purpose by reducing the debt and by rebuilding the Cloister of his Abbey.

We have two miniature portraits of Richard of Wallingford in the illuminated chronicle of Matthew Paris. In the first he is engaged at his bench making or measuring a circular instrument with a pair of compasses. His simple tools are lying by his side and his Abbot's mitre is on the floor. In the second portrait he is pointing to the famous clock which he made for the Abbey. A point of singular interest is the fact that in both portraits he is represented with a spotty face, indicating the ravages of the incurable disease of leprosy which he had contracted at Avignon. Indeed, of this we have confirmatory evidence in a prayer composed by him in later life after his promotion as Abbot. The words are worth quoting, if only as an example of the devotions of an English man of science of the fourteenth century.

> Though I be a man of lowly state, and smitten by Thy providence with an evil plague, so that I am not worthy to walk among men, but should by law be cast without the camp; yet Thou, O Lord my God, by what secret judgement I know not, dost yet hold me in honour, such honour as I have known none of my parents or kindred to attain to, in all health of body; and as I oft-times remember with wonder at Thy great bounty, dost so incline the hearts of the great towards me, that ever when present, they d not abhor my speech and the deformity of my face and hands, but rejoice to converse with me. . . .

We may, therefore, claim that the miniatures are truthful representations of "The Father of Trigonometry" in England.

Wallingford's trigonometrical methods are indicated in two works, *De sinubus demonstratis* and *De sinubus et arcubus in circulo inveniendis*, and their practical application is further described in his treatise on the Art of working with a Rectangulus.

Two scientific treatises on the 'Albion' and the Rectangulus are dated about the time of his election as Abbot. Fortunately, illustrated copies of the manuscript are still extant and they include many working drawings which reveal the construction of the instruments so clearly that a reconstruction is possible.

The 'Albion' has often been stated to have been the Abbey clock for which he is famous; but the evidence of the original manuscript points to its having been an elaborate Aequatorium or Volvelle composed of a number of circular dials for showing the position of the planets: the name 'Albion,' or all-by-one, having reference to the various operations which could be performed by the one instrument. There is no mention of cogwheels, pulleys, and weights, or of any driving

or regulating apparatus in connexion with the Albion. Doubtless it was intended to be used with his other invention, the Rectangulus, with which the relative positions of stars could be measured.

In the prefatory sentences to his treatise on this instrument, Richard tells us that he invented the Rectangulus in order to obviate the laborious and difficult use of the Armillary Sphere in determining the course and place of fixed stars and planets, and for other problems which were usually solved by the astrolabe and the torquetum. The fundamental principle of the instrument is based on the theorem of Euclid on the equality of the angles and lengths of equidistant lines between parallels.

The instrument consists of three superposed limbs or rules connected by hinges in such a manner that each limb may not only be opened out at varying angles like the blade of a pocket knife, but may also be rotated round a peg-pivot below its hinge. Above all is an alidade, or rule with perforated sight-vanes, which is so hinged to the third limb that it can be either elevated above it or be moved parallel with it. The hinges may all be clamped more or less tightly by wedges driven through slots in the pegs, like those used in astrolabes.

To complete the instrument six scales of bronze were prepared and graduated. Three of these are fixed to the sides of the three limbs; the other three are movable, being pivoted on the pegs under the limbs. The lowest scale was divided along the edges into 60 equal divisions called degrees or parts of chords, *gradus seu partes cordarum*, each of which might, in the case of a large instrument, be further subdivided into 60 parts, while the middle or intervening band was divided by a table of right and versed chords, *corde recte et verse*. This middle divided band is omitted in the five other scales. The division of the upper scale of chords, which are called right chords, are numbered from the peg to the end of the scale; the lower scale, called versed chord, is numbered from the end of the rule to the peg. The ends of the alidade and upper limbs are provided with plumb-lines.

In his second treatise on the use of the Rectangulus, Wallingford explains in ten chapters how various observations and calculations are to be made. In the first place the whole instrument must be adjusted for level by a plumb-line fixed near the surface of the base pillar. The instrument is then ready for the first exercise, "To find the right and versed chord of a given arc less than a quarter of a circle and to find any arc from a given chord." The method in his own words, as translated by Sir John Findlay, is to

> let the perpendicular of the second limb hang over the first limb at the given arc, the length between the peg and the string reckoned from the peg to the end of the limb is the right chord of the arc. The distance beyond the string, reckoning from the point of the limb, gives the versed chord of the same arc. The reverse process enables an arc to be found from its chord. Note that the plumb-line hangs at right angles when it falls on equal divisions of the scales on both sides of the limb, and this is chiefly why the scales of chords are double on all the scales. The right and versed sine of an arc greater than a quarter of a circle may be easily found from what has been said, for the right sine of an arc less than a quarter of a circle is the right sine of the arc of the rest of the circle. Further, the versed sine of an arc greater than the quarter of a circle but less than a semicircle is greater than the semidiameter by the amount of the right chord of the angle by which the given arc is greater than a quarter of a circle, as is shown elsewhere.

Then follow chapters upon how "To find the meridian," "To find the altitude of a star above the horizon and its azimuth," "To find the latitude of a place by a star which does not set," "To find the latitude and longitude of a star from the equinoctial circle," "The declination of a star and its latitude in the ecliptic," "To find the true place of the sun from its aspect," "To find the true place of the moon in longitude and latitude," "The true place of fixed stars in latitude and longitude."

The treatise concludes with the sentence, "The Rectangulus was invented for the purposes which have been explained, and therefore, because what has been explained is sufficient for an apt pupil, the way is clear to everything that can be done by other instruments. Here I finish."

Wallingford died in 1335 at the age of forty-three. It is reported that the Abbot's house where he was sleeping was struck by lightning, and, weakened as he was by his disease, he did not survive the shock. His tomb is in the Abbey Sanctuary just east of the altar rails.

A Remarkable Suborder of Fishes.

DURING the Danish *Dana* Expeditions of 1920–1922 in the North Atlantic and the Gulf of Panama, under the leadership of Prof. Johs. Schmidt, a magnificent collection of ceratioid fishes was made, which forms the subject of a monograph by Mr. C. Tate Regan,[1] Keeper of Zoology in the British Museum (Natural History), from which the accompanying illustrations have been reproduced. Prior to the *Dana* Expeditions, and excluding the *Michael Sars* collection, as yet undescribed, only about sixty examples of this amazing suborder of fishes were known, so that the *Dana* addition of 220 specimens representing 39 species, many of which were new to science, was of great biological value.

The Ceratioidea form part of the order Pediculata, that group of highly specialised fishes in which the first ray (illicium) of the spinous dorsal fin is placed on the head and modified into a 'line and bait.' Their characteristic features are evidently related to their conditions of life. They are inhabitants of the deeper parts of the ocean, the majority living in mid-water, probably from 500 to 1500 metres below the surface, where there is little or no light. Related to the absence of light is the structure of the 'bait,' or terminal expansion of the illicium, which is a luminous bulb; the outer skin of the bulb is generally transparent, and within is a glandular sac that opens to the exterior by a pore and has a luminous secretion; the lower, or

[1] "The Pediculate Fishes of the Suborder Ceratioidea." By C. Tate Regan. The Danish *Dana* Expeditions 1920–1922 in the North Atlantic and the Gulf of Panama. Oceanographical Reports edited by the *Dana* Committee, No. 2. (Copenhagen; Gyldendalske Boghandel. London: Wheldon and Wesley, Ltd., 1926.) 15s.

sometimes the posterior part of the sac is pigmented, and this pigmented area, according to Brauer, is covered inside by a layer of cells which acts as a reflector. Externally the bulb may be furnished with papillæ, flaps or tentacle-like filaments. There are great differences in the length of the 'line' or first dorsal ray; from fishes in which the luminous bulb is sessile on the head, to those in which it is borne on a line several times as long as the fish itself. The line is articulated to the anterior end of a movable basal bone which as a rule lies in a trough on the upper side of the head. Those more highly specialised forms, in which the basal bone is slender and flexible and completely exserted, may be considered true anglers, for they have both rod and line, and Lasiognathus (Fig. 1), which is in addition provided with hooks, may well be termed a complete angler.

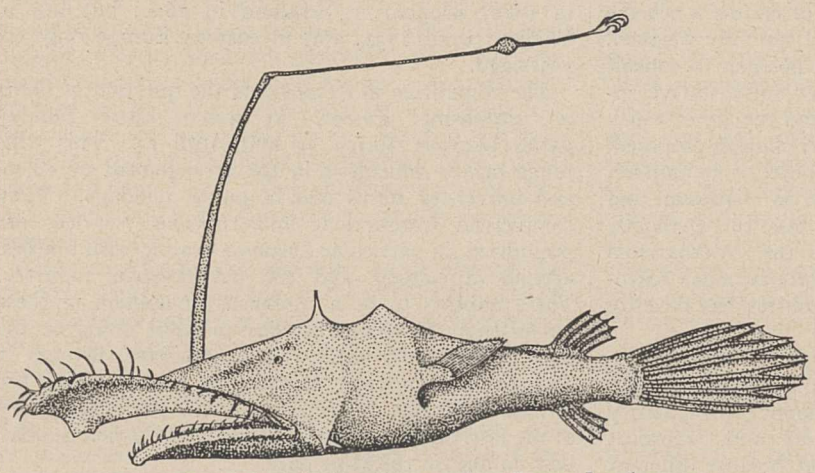

FIG. 1.—Lateral view of *Lasiognathus saccostoma*, Regan. Length 75 mm.

The majority of the ceratioids appear to be piscivorous, and have a large mouth and jaws furnished with slender acute teeth which are generally arranged in about three series. The teeth are depressible inwards, an arrangement which would make it very difficult for a ceratioid to release a fish it had seized, even if it wanted to. Neoceratias (Fig. 2), with teeth on top of the head that recall the spines of an echinoid, is perhaps the strangest of all. In some genera the stomach is extraordinarily distensible; thus a Melanocetus has been known to swallow a Lampanyctus three times its own length and many times its weight. Equally remarkable are the pincer-like jaws of Rhynchoceratias, and the forwardly directed telescopic eyes of Aceratias, indicating that the fishes of this genus have binocular vision.

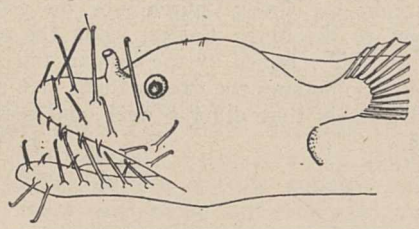

FIG. 2.—Head of *Neoceratias spinifer*, Pappenheim. Length to base of caudal fin, 25 mm. After Pappenheim, 1914.

Probably the chief interest in the ceratioids lies in the fact that they are unique among vertebrates in having the males dwarfed and parasitic on the females. The species in which males are known are *Photocorynus spiniceps* (male 10 mm. long attached to a female of 62 mm.), *Edriolychnus schmidti* (male 14 mm. long attached to a female of 62 mm.), and *Ceratias holboelli* (males of 80 and 85 mm. on a female of 1030 mm., and a male of 105 mm. on a female of 1000 mm.) (Fig. 3). The males resemble the females in general form, but differ from them in the development of structures for attachment, in the absence of the illicium, the reduction or absence of spines on the head, the absence of teeth, and the vestigial condition of the gut; the only organ of importance in the abdominal cavity is the large testis. The method of attachment to the female is of especial interest. In Photocorynus and Ceratias, upper and lower outgrowths of the anterior end of the head of the male unite in front of the mouth and fuse with a papilla-like projection from the skin of the female.

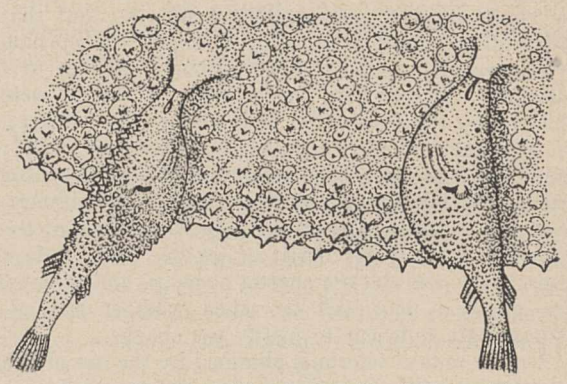

FIG. 3.—Two males of *Ceratias holboelli*. Half natural size. After Sæmundsson.

From his microscopic examination of sections of a strip of the tissue connecting the male and female Ceratias, Mr. Tate Regan is of the opinion that the male and female are completely blended, the highly vascular fibrous tissue of the outgrowths of the male being continuous with that of the papilla of the female, and he regards it as almost certain that the blood-systems of the two fishes are continuous. He does not favour the view that the attachment may be of the nature of a placenta, which implies that the two animals separate later on, but suggests that the males, soon after they are hatched, attach themselves to the females, if they are fortunate enough to meet them, and remain attached throughout life. In all probability the males are incapable of free development, and it is likely that the majority fail to find a female and perish, although another possibility has been suggested, namely, that the post-larval fishes that find and become attached to females develop into males, and those that do not, into females.

The Reform of the Calendar.

SINCE the War a number of ingenious schemes have been put forward for the reform of the calendar. Such an important step should not be taken unadvisedly, lightly, or wantonly, but the advantages claimed should be considered, the extent of the demand for it assessed, and the possibility of finding a scheme which would meet general approval carefully weighed. The League of Nations, being in a position to consult the various bodies which could give authoritative expression to opinion on the subject and the aid of which would be required in carrying out any changes proposed, undertook a full inquiry. It appointed a committee, with Prof. van Eysinga of Leyden as chairman, and with representatives of the Holy See, the Orthodox Church, the Church of England, the International Chamber of Commerce, and the International Astronomical Union upon it. This committee has recently issued a short and valuable report.[1]

The principal defect in the Gregorian Calendar arises from the unequal lengths of months, quarters, and half-years, which introduce a certain amount of irregularity in statistics, accounts, commercial and transport figures. This is increased somewhat because different days of the week are of unequal value as regards volume of trade, and thus one year or one quarter is not strictly comparable with another.

Minor defects are that special tables are required by banks in their calculations of interest, and that dates of periodical events, for example, the opening of Parliament, cannot be fixed without reference to a calendar. As many as 185 schemes of reform were received by the committee, including 33 from France, 27 from the United States, 24 from Germany, and 5 from Great Britain. The minimum change proposed was to take a day from August and give it to February. A second suggestion made the months of three of the quarters of the year consist of 30, 30, and 31 days respectively, and the last quarter of 30, 31, and 31 days. The question may well be asked whether the advantages are sufficient to justify the change.

A more radical reform is obtained by the use of one day without name in ordinary years and two such days in leap-years. The remaining days of the year may then be divided into 52 weeks, which may be arranged as four quarters of thirteen weeks, the months consisting of 30, 30, and 31 days, or as 13 months of 4 weeks each. The advantages and disadvantages of these two schemes are compared, and preference on the whole given to the former. The committee is satisfied, and most people will agree with it, that there is no general demand for these changes, which would be strongly opposed by many religious bodies. Without general assent, confusion would result, and it may be remembered that the Gregorian Calendar was introduced in 1582, adopted in Scotland in 1600, but not in England until 1751, and in eastern Europe only six years ago.

The committee next considers the question of fixing or 'stabilising' Easter. At present Easter Sunday varies between March 22 and April 25. This wide range makes difficulties in the arrangement of school and university terms and of public holidays. Many commercial transactions and transport services are prejudiced, in particular, business dealing with textiles, articles of fashion, and the hotel-keeping industry. There appears to be a consensus of opinion in these circles that the second Sunday in April would be the most convenient date. The committee favours a slightly different date, namely, the day following the second Saturday, in order to avoid the contingency of the festival of the Annunciation and Passion Sunday both falling on the same date.

The committee has made general inquiries of the attitude of the heads of different Christian Churches on the stabilisation of Easter. It is agreed that there is no dogmatic reason against a fixed date. It appears that the Church of England and the Greek Church are ready to accept the change if the Church of Rome also accepts it. The Holy See does not consider that there is sufficient reason for changing a date handed down by immemorial tradition and sanctioned by councils from early times, and would not be prepared to consider the question except on the advice of an Œcumenical Council. The Protestant Churches of Europe and America and the Jewish Community raise no objections to the proposal.

The report of the committee of the League of Nations shows that there is a general belief, certainly in England, that the stabilisation of Easter would bring substantial advantages and a wish to see the change made. As there are no difficulties of dogma involved, it may be hoped that ecclesiastical concurrence is not impossible. Incidentally, uniformity in keeping Easter will be secured between the different Churches. At the present time the Greek Church uses the position of the moon to determine Easter, while the tables of Clavius are still retained by the Roman and Anglican Churches. Sometimes the two methods give the same date; frequently they differ a week, and occasionally a month.

F. W. D.

[1] Publication of the League of Nations, viii. Transit, 1926, viii. 6. (London: Constable and Co.) 3s. 6d.

Obituary.

Prof. J. D. F. Gilchrist.

PROF. J. D. F. GILCHRIST, who died recently in Capetown at the age of sixty years, had been in South Africa for thirty-one years. Gilchrist's early university days were spent at St. Andrews and Edinburgh. At one time he had thought of entering the Presbyterian ministry, but after coming under the influence of inspiring leaders in natural science at St. Andrews and Edinburgh, he definitely resolved to pursue a biological career. After a period at Münich and Zürich, and at biological stations, more especially that of St. Andrews, he was appointed, on the recommendation of the late Sir John Murray, of the *Challenger*, and of Prof. M'Intosh, St. Andrews, to the position of Government Marine Biologist at the Cape of Good Hope.

Gilchrist was probably the first to hold the title of Government Biologist in any country, and in his later days he was wont to tell his friends about the weary,

uphill task he had during his first year, in a government office in Parliament Street, Cape Town, without either laboratory or practical equipment of any kind. He was, however, able to persuade the Ministry of Agriculture that a vessel for dredging and trawling, a museum for storing the specimens, and a marine laboratory and aquarium were necessary.

Gilchrist was particularly fortunate in securing as the first captain of the government trawler, Alexander Turbyne, a keen fisherman naturalist, who had been trained under the late Sir John Murray. An important practical result of the preliminary surveys of the S.S. *Pieter Faure* was the discovery in 1898 of a rich fish-ground on the Agulhas Bank, within easy reach of the markets of Cape Town. This discovery appealed alike to the public and to the Government, and led to greater financial support.

While recognising the necessity of developing the economic aspect of marine biology, Gilchrist always kept the more purely scientific point of view in his mind. The Cape waters had only been explored in a cursory manner by such expeditions as the *Challenger* and the *Gazelle*, and thus there was open ground for more thorough investigations. The dredging and trawling expeditions of the *Pieter Faure* resulted in the capture of more than twenty thousand specimens, the majority of which, with the exception of the fishes, were despatched home to be studied by specialists. From the papers published by these workers, and from his own contributions, Gilchrist edited the volumes "Marine Investigations in South Africa" (1902–1907). In 1907, however, during a period of severe financial depression in the colony, the office of Government Biologist was abolished, but the publications were revived in 1913, under a new board, as "Marine Biological Reports of the Cape Province."

From 1905 to 1917, Gilchrist was professor of zoology in the South African College, and when, in 1918, the latter developed into the University of Cape Town, he held the chair of zoology until in 1925 ill-health compelled his retirement. After his resignation he still carried on some work at his favourite haunt, the St. James Marine Station, on the shores of Kalk Bay.

Gilchrist was the author of numerous papers, dealing more especially with the description of new or rare species of fish, and of their larval development; but he also contributed publications of more general interest, such as those on the early stages of *Cephalodiscus gilchristi*, on the enteropneust, *Xenopleura vivipara*, on the remarkable crawling medusa (*Cnidonema capensis*, g. et sp. n.), and on the temperature and currents of South African seas.

Sometimes Gilchrist may have conveyed the impression of a man who lived in a little world of his own, wrapped up in thoughts of his fishes and other denizens of the sea, but that he could free himself from these deliberations is proved by his work for science in the colony, as president of the Philosophical and later of the Royal Society of South Africa, and as one of the main organisers of the South African Association for the Advancement of Science.

Gilchrist married Elfreda Ruth, daughter of S. H. Raubenheimer, of George, C.C., and is survived by his widow, a son, and a daughter.

News and Views.

ONE of the problems to which the Imperial Conference has been devoting attention is the present position of forestry within the British Empire. A sub-committee was set up, which dealt with this matter on broad lines. It is a hopeful augury for the future that the question of a forest policy common to the Empire as a whole, with especial reference to the world's timber supplies, should have been examined in some detail. It is an accepted fact that the available virgin supplies of the soft woods (pines and firs) are giving out, Canada and north Russia and Siberia containing the chief remaining stocks. About eighty per cent. of the wood used for industrial purposes consists of the soft woods. As regards the hard woods, the available supplies of these from temperate climates are not regarded as satisfactory, and their replacement by tropical hard woods offers difficulties which are very far from solution. Apart from the question of the availability of the existing supplies to meet demands, there exist social and economic problems which make it necessary that each country, and perhaps more especially the British Empire, should formulate a policy which shall maintain a sufficient forest area under a conservative forest management. At the present day a large proportion of the Empire forests have little that can be termed a scientific conservative management in being; the Imperial Conference will have made a long step forward if, as a result of the deliberations and recommendations of the sub-committee, a consistent forest policy is formulated and adhered to. Other matters given consideration were Empire settlement and its connexion with forestry, the meeting of the Empire Forestry Conference in Australia and New Zealand in 1928, forest products research work, and the proposed inauguration of an Imperial Forestry Bureau.

THE silver medal of the Zoological Society of London has been awarded to Capt. H. C. Brocklehurst, the Game Warden of the Sudan, in recognition of his services to the Society, and for the active part which he has taken in the preservation of the wild fauna of that part of Africa. The medal, which was designed by Landseer, has been awarded on forty-eight previous occasions, the first recipient being Sir Roderick Murchison, in 1847, "for assisting in the introduction of the Aurochs." Capt. Brocklehurst has been instrumental in obtaining several valuable collections of animals for the London Zoo. The last of these included two giraffes, two Sudanese oryx, and three shoebills, or whaleheaded storks, now one of the rarest birds in the world. The white rhinoceros, which a little time ago was threatened with extinction, comes directly under Capt. Brocklehurst's care, and it is reassuring to hear from him that, owing to the proper administration of suitable game laws, this wonderful

animal, which sometimes exceeds 6 ft. at the shoulder, not only is out of danger of becoming extinct, but is even increasing so rapidly that a certain number are now allowed to be shot each year, and he has every hope of obtaining a young one for the Society's collection. From other parts of Africa the reports on game preservation are equally reassuring, especially from the Transvaal, where, after twenty-six years of political struggle, the Great Sabi Game Reserve has been established on a permanent basis, and has been given the name of the Kruger National Park. In relation to this it is highly satisfactory to note that Col. J. Stevenson Hamilton, who was chiefly responsible for getting this measure approved by the Union Government, has accepted the post of secretary to the Society for the Preservation of the Fauna of the Empire.

THE Nobel prize for medicine has been awarded to Dr. Johannes Fibiger, professor of pathological anatomy in the University of Copenhagen, who has spent many years in the study of cancer and is best known for his work on the nematode *Gongylonema neoplasticum*. This worm lives in cochroaches, and, when these are eaten by rats, passes into their stomachs, where by the irritation it produces it initiates the growth of malignant tumours. Prof. Fibiger has worked out the whole process in great detail, and thus made notable additions to our knowledge of the relationship of irritation to cancer. Other examples where the irritant is a worm are the cancers of the bladder in man in Egypt caused by Schistosomum and the sarcoma of the liver in rats often associated with the hydatid phase of *Taenia crassicollis*.

CANON J. M. WILSON, who at Rugby and Clifton did much to introduce practical science teaching into schools, and is now in his ninety-first year, must be known to a wide public as having been a consistent champion of evolutionary ideas in religion long before such ideas had become at all popular in theological circles. The earnestness, moderation, and candour of his writings commended evolution to many minds which otherwise would have continued to regard it with dislike and misgiving. A recent pamphlet by Canon Wilson, "Christianity in the Light of the Idea of Evolution" (London: *Guardian* Office), shows that the powers of this veteran apologist have not declined. Indeed, with remarkable acumen, he lays his finger on what certainly are the critical points to-day. The principle of evolution has now been extended beyond the biological sphere to anthropology and psychology, and it is these applications which are causing trouble to many thoughtful people. Religious beliefs are no longer refuted, but explained, as one writer has put it. Yet, as Canon Wilson sees it, the idea of a gradual evolution of belief is a very valuable one, even from the specifically religious point of view. "The evolution of theology," he writes, "may be welcomed; or it may be ignored and hushed up; or it may be disliked and denounced. But it cannot be denied. It is a fact, and a fact of the greatest significance." This evolution of ideas may be regarded as "progressive discovery," which from another point of view can still be called revelation. This conception is especially fruitful in the study of the Old Testament, which is "the story of man's progressive discovery in theology."

IN England this would nowadays be accepted by even conservative scholars; but it is not always realised, as it is by Canon Wilson, that the same principle applies to the New Testament and to the development of the Creeds. In the New Testament there are several quite distinct strata of theological development, and the need for 'restatement' was felt so early as the first century. It is only by disregarding history that the idea of a fixed and final theology becomes possible. The problem now is, as Canon Wilson points out, "to enshrine in a transformed and more elastic framework the old and deep religious experiences expressed in the Bible and the Creeds and other formularies." This is scarcely the place to expand these ideas, but it is gratifying and encouraging for students of science when they see an eminent theologian taking up an attitude of this kind; for even men of science have their religious instincts, which they would be better able to satisfy if the spirit animating Canon Wilson were more widespread. His position is that "religious faith is henceforth to be based on experience and observation; it has become scientific." From this point of view theology must always be secondary, being the interpretation of an experience. In science there are no such things as final interpretations or unchangeable hypotheses; and if the same principle were recognised in religion, religion would share some of the vitality of natural science, and be a great deal more useful to humanity.

WE have received the abstract of a lecture entitled "Life and Mind" which was delivered by Dr. Bernard Hollander before the Ethological Society on October 25. Dr. Hollander is to be congratulated on his courage, for life and mind may be said to be the two ultimate problems of the universe, since only through the senses and minds of living beings do we know anything at all about the universe. He asserts that life and mind are 'forms' of energy—a statement which we think erroneous. Dr. Hollander, indeed, is not comfortable about it himself, for he goes on to say: "If the brain were purely a mechanical apparatus producing mind, we could not be at the same time spectators. Those who think so always look at others. No one considers his own self a piece of mechanism, a part of the universal clockwork." We think that the confusion arises from overlooking the fact that life and mind are presuppositions of all knowledge. What we call 'mind' is a name for our own personality and its activities through which we learn about everything else, energy included. All else is a series of presentations to our mind, presentations which are coloured by its activities. We can no more get outside ourselves and view ourselves from outside than we could lift ourselves out of a marsh by our own waistbands. The first and soundest conclusion which we come to about phenomena, a conclusion arrived at before we reach the mature age of one year, is that many of these

phenomena are the result of the activities of personalities like our own. Other phenomena we gradually perceive are the expression of simpler activities, and our conceptions of matter and energy are all in the last resort pale abstractions from our primary conception of 'selves.' For the sake of convenience in classifying phenomena, we neglect this consideration, and affect to regard animals and plants as mere collections of matter and their activities as 'a kind of energy.' Life, as Tyndall pointed out long ago, is not energy at all but the control of energy, the constant composition and moulding of energy. If in attempting to solve an algebraic problem we should designedly leave out one factor in order to arrive at a simpler solution, we should fully realise that this solution could only be partially true. When mechanistic biologists ignore the subjective element in knowledge, their solutions must necessarily be profoundly untrue.

IN a lecture to the Royal Geographical Society on November 15, Mr. J. A. Steers discussed some of the changes that are taking place in the coastline between Hunstanton and the Orwell-Stour estuary. This is a submerged low coast modified by marine erosion and the action of longshore currents which have dammed several of the streams and elsewhere have led to the growth of spits. Mr Steers mentioned an effect of tides which is sometimes overlooked. The direction of tidal drift is known to change with ebb and flow, but owing to the difference in level of the water the material worked on at high water is distinct from that worked on at low water, so that there often are two opposed movements of beach material on the same foreshore. This is noticeable at Blakeney, where the shingle has pushed westward, and the sand, at a lower level, eastward. Among other interesting points raised in the lecture was the origin of the shingle on the north coast of Norfolk. Analysis shows 99 per cent. of it to be flint, and the remainder to be igneous rock of Scottish and, to a less extent, Scandinavian origin, with a few fragments of sedimentary rock. The prevalence of flint points to an origin not far distant, but the exact source is not yet known. Mr. Steers discussed at some length the origin of Blakeney Point, Lowestoft Ness, Orford Ness, and other recent growths of the coast.

To hold an exhibition of coal products during the present stressful period in the coal industry might be considered somewhat hazardous, for exhibitions involve considerable expenditure on the part of exhibitors, but publicity, and especially co-operative publicity, has been found to pay, and nothing seems to daunt the spirits of our industrial firms in good times or in bad. The National Coal Products, Chemical, and Engineering Exhibition, which is being held on November 16–27 in Manchester, is a co-operative venture sponsored by the Manchester Section of the Society of Chemical Industry, and organised by Provincial Exhibitions, Ltd. When planned last May, it was hoped that the coal strike would be ended long before November, but as events proved contrary, the original scheme of confining the exhibition to tar and tar-products was abandoned, and the subject of methods of utilising coal was substituted. As the strike still continued, it was decided also to display many exhibits relating to the value of research upon coal and its products. The list of exhibitors in the City Hall contains the names of the principal organisations that are investigating coal, those of a few chemical firms and a large number of plant manufacturers. Everything possible has been done to attract and instruct the public, and if we are not sure that (as the official catalogue states) all the visitors will feel that in Manchester they are in the actual workshop of the country, and not merely looking into the Empire's shop-window as in London, we are certain that the promoters of the exhibition deserve the thanks of the scientific community for their initiative and enterprise. In connexion with the exhibition, a conferenee on tar is being held on November 26, at which important papers are being read by members of the Society of Chemical Industry, the Institution of Gas Engineers, and the Coke Oven Managers' Association.

THE Lloyd Roberts Memorial Lecture was delivered at the Manchester Royal Infirmary on November 9 by Dr. W. E. Gye, who chose as his subject "The Cancer Problem." He reviewed his former work and described further experiments, all of which tend to confirm the conclusions he then reached. His work has been largely prosecuted with the Rous chicken sarcoma, which, unlike most malignant tumours, possesses a 'filterable' virus. If a Rous tumour be triturated and filtered through a porcelain filter, the filtrate injected into a fowl induces tumour-formation; the causative agent is therefore a filterable or ultramicroscopic one. If the filtrate be heated to 55° C. for 15 minutes, or treated with an antiseptic such as acriflavine before injection, it loses its potency, the causative agent becoming inactivated. But if a portion of heated filtrate be mixed with a portion of filtrate treated with acriflavine and the mixture injected into a fowl, tumour formation results. Dr. Gye concludes, therefore, that the causative agent of the Rous tumour consists of two parts, one of which may be destroyed by heat, the other by an antiseptic such as acriflavine, and that both are necessary for tumour formation. To the former heat-labile substance the name of 'specific factor' is given; the other factor is regarded as being a living virus or micro-organism. A tumour of one species of animal cannot be transplanted into another, but a mixture of inactive Rous tumour extract (inactivated by acriflavine) with extract of human cancer produces in the fowl a tumour microscopically like the Rous tumour. Many substitution experiments of this kind have been performed with similar results, with one or two curious and inexplicable exceptions only. Dr. Gye believes that the specificity or essential characters of a malignant tumour are carried by the heat-labile agent called the 'specific factor,' and that the other factor is a living virus (or viruses) which becomes operative only when the specific factor is present as well. The fact that cultures in serum broth of

tumours (up to the seventh remove) may be substituted for direct extracts in these experiments supports this view. At the same time, other possible, though unlikely, hypothesis are being explored.

THE Factories and Workshops Report for 1925, which was recently issued by H.M. Stationery Office, is instructive and interesting. The work done by the inspectors is very thorough, and the recommendations they have made in previous years have been of great value to the many industries concerned. It seems fairly certain that explosions in works employing benzene and other inflammable products are sometimes caused by electrostatic sparks. This can be prevented in some cases by the use of suitable brush collectors to discharge the electricity on driving-belts. The total number of accidents directly attributable to electricity is 414, and includes 24 fatal cases. This is less than last year; and considering the great increase in the work done in the electrical industry last year it is satisfactory. Twelve of the fatal cases were due to shocks from pressures not exceeding 250 volts. In all these cases alternating current was employed. In one case when a man was inspecting the machinery of a motor car, using a lamp connected with the supply, the lamp broke and the metal car, being insulated from earth by the tyres, became 'alive,' owing to touching a terminal. Although the man was able to call out for the switch to be turned off he was unable to let go and was killed. Another fatal accident was due to a practical joke, the bell handle being connected with one of the supply mains. The worst accidents are caused by a hand to foot shock; the hand, for example, touching the cover of a defective switch, the cover of which has become alive, and the foot making a good contact with the earth through a damp boot. If a person is well insulated from earth he only gets a trifling shock when a spark takes place between him and a high-tension terminal. The present regulations seem quite satisfactory, but they need to be enforced. The senior electric inspector, Mr. G. S. Ram, urges that contractors and others should take special precautions when installing an alternating current supply.

THE increasing facilities rendered available in recent years for the publication of geophysical papers have amply justified themselves, and appear to have greatly stimulated interest and investigation in the subject. In Great Britain the only distinctively geophysical periodical is the *Geophysical Supplement to the Monthly Notices of the Royal Astronomical Society*, and the Society has rendered great service by giving the subject of geophysics this valuable support. The supplement is paged separately from the *Monthly Notices* proper, and forms a distinct journal; it is now nearing the end of its first volume, and No. 7, recently issued, deals in its eight papers with an interesting variety of subjects: seismic waves, the elastic yielding of the earth, the rigidity of its central core, magnetic storms, tidal motion, and the relation between barometric pressure and gas pressure in mines. All these papers have been presented to the Society in the early part of this year. Another thriving journal, also published mainly in English, which deals largely but not entirely with geophysics, is the *Japanese Journal of Astronomy and Geophysics*, published by the National Research Council for Japan; beside published papers in full, it gives short abstracts of other cognate papers published in Japan. The recently issued part, vol. 3, No. 3, contains an article on the possibility of gravitational waves in soil, together with no less than 86 abstracts (occupying 33 pages of small print) of other astronomical and geophysical papers.

AN Egyptian wing has been added to the Museum of the University of Pennsylvania, Philadelphia, in memory of the late Mr. Eckley Brinton Coxe, junior. Mr. Coxe was president of the Museum from 1910 until 1916, and was not only a generous benefactor during his lifetime, but also left a sum of half a million dollars at his death for the promotion of Egyptian studies. It will be remembered that extensive investigations at Memphis, including the excavation of the Palace of Merenptah, were carried out by the Eckley B. Coxe Expedition, and many of the objects now installed in the wing and shown for the first time were obtained by this expedition or others on this foundation. A description of the new wing, which was opened in May last, and of some of the principal exhibits, appears in the *Museum Journal* (Philadelphia) for June. It contains twelve rooms appropriate in design and harmonising in colour and proportion with the exhibits. Eight rooms are devoted to Egypt, while Ur, Beisan, Persian art, and Arabic art each have a room, those of Ur and Beisan being used for exhibition of the objects obtained by the expeditions of the Museum now in progress.

THE Sterling fellowships were established by a gift of one million dollars from the trustees of the estate of the late John W. Sterling to stimulate scholarship and advanced research in all fields of knowledge. They are open to graduates who desire to carry on studies under the direction of the Graduate Faculty of Yale University. The fellowships are divided into two general classes: Research or Senior Fellowships for candidates of the standing of the Ph.D. degree, of the annual value of 200*l.*-500*l.*; and Junior Fellowships for candidates who are well advanced in their work towards the Ph.D. degree, of the annual value of 200*l.*-300*l.* All fellows are appointed for a single year in the first instance and are required to submit reports on their work, either at stated intervals or at the expiration of their fellowships. Application forms, to be returned by March 1, can be obtained from the Dean of the Graduate School of Yale University, New Haven, Connecticut.

THE British Museum (Natural History) has issued four additional natural history booklets in the attractive series commenced last year. The new subjects include the pine marten, the harvest mouse, the fallow deer and the barn owl (Price 6*d.* each). As before, each booklet contains a short account of the history and habits of the animal, and is accompanied by a charming coloured illustration. Among

the latest sets of postcards to be published by the Museum is the second series of portraits of famous naturalists (Price 1s.). This set includes Sloane, Banks, Leeuwenhoek, Mendel, Seba and Shaw, among others, and a pamphlet enclosed with the set gives concise details of their lives, with special reference to their contributions to natural history. The series of British Museum postcards now covers a wide range of subject and interest, and there can be little doubt that their publication has contributed considerably to the popularity of the institution and to public interest in its collections.

MR. F. G. LLOYD, 1 Sinclair Road, Kensington, W. 14, writes to ask if it is very uncommon now to find the Camberwell Beauty butterfly near London, as a patient had given him a perfect specimen caught near Honor Oak Park Station in the summer of 1911 or 1912. Dr. James Waterston, of the Natural History Museum, South Kensington, has been good enough to send us the following answer to this inquiry: "The Camberwell Beauty is, in Great Britain, a somewhat rare visitor, occurring not in the late spring or early summer (as is commonly the case with other immigrants), but more frequently in August or later. While the species has been proved to hibernate occasionally in Britain, no authentic occurrence of the larva or pupa is on record. 1911 appears to have been a Camberwell Beauty year, and, according to information supplied by my friend Capt. N. D. Riley, the species was then recorded (August) from, amongst other places, Berkhampstead; Bradwell-on-Sea, Essex; Brading, Isle of Wight; Chelsfield, Kent. With all this, the occurrence of the Honor Oak Park Station specimen falls into line. The interest of Mr. Lloyd's record is rather a sentimental one, the species on this occasion having been taken, after a long interval, in the locality from which it received its popular name."

THE *Scientific American* for October contains a very discursive but interesting article on "Hunting Fossil Insects," written in the well-known free-lance style of that entomological genius Prof. T. D. A. Cockerell. The insects dealt with are two collections of Tertiary fossils, one from some new beds on the banks of the Kudia river in the Amagu region of Siberia, opposite the southern shores of Sachalin, the other from the Santa Barbara district, Province of Jujuy, Northern Argentina. In each case, Prof. and Mrs. Cockerell underwent an adventurous journey to obtain the specimens, and the chief interest of the article lies perhaps in the illuminating remarks about the conditions of the countries through which they passed. Prof. Cockerell has, we believe, dealt with both collections scientifically elsewhere. We think it important to point out that he is in error in assuming that his Argentine Tertiary insects were the first fossil insects to be discovered in the whole of South America. Prof. Wieland, of Yale University, discovered two very fine Rhaetic specimens near Mendoza a good many years ago; one of these was a Homopteron and the other a caddis-fly. It was a pity that Prof. Cockerell did not know of this bed, as he might have found further specimens. From the article before us we learn some interesting points about the sect of the "Old Believers," whom, it appears, the Bolsheviks have left somewhat severely alone, so that they still keep their old religion and customs. "Our guide explained that even the Old Believers had had their revolution"; but apparently it was a mild one, as they are still allowed to drink whisky, though tea and coffee are taboo!

SIR ARTHUR KEITH and Mr. C. R. Peers have been elected honorary members of the Yorkshire Philosophical Society.

REPLYING to a question in the House of Commons on November 21, Mr. Amery, Secretary of State for the Colonies, said that the appointment of director of the Amani Institute has been accepted by Mr. W. Nowell, Director of Science and Agriculture, British Guiana. On his arrival in England from British Guiana the new director will be invited to submit recommendations as to the staffing of the Institute.

A PORTRAIT of Michael Faraday, and a reproduction of the portrait of Lord Kelvin painted by Herkomer for the Institution of Civil Engineers, both by Mr. George Harcourt, R.A., will be shown in the lecture theatre of the Institution of Electrical Engineers in the positions allotted to them at the ordinary meeting on December 2. After introductory remarks by the president, Mr. Harcourt's portrait of Faraday will be presented to the Institution by Mr. Sydney Evershed.

AT the annual general meeting of the London Mathematical Society, held on November 11, the following officers were elected: *President*, Prof. G. H. Hardy; *Vice-Presidents*, Prof. S. Chapman, Prof. A. L. Dixon, Mr. J. E. Littlewood; *Treasurer*, Dr. A. E. Western; *Librarian*, Prof. H. Hilton; *Secretaries*, Prof. G. N. Watson, Mr. F. P. White; *New Members of Council*, Prof. H. F. Baker, Prof. A. S. Eddington, Prof. E. H. Neville.

IT is announced in *Science* that the Perkin medal for 1927 has been awarded to Dr. John Teeple, treasurer of the American Chemical Society, for "significant scientific, technical, and administrative achievements, particularly the economic development of an American potassium industry at Searles Lake, Calif." The committee of award consists of representatives of the American Section of the Society of Chemical Industry, the American Chemical Society, the American Electrochemical Society, the American Institute of Chemical Engineers, and the American Section of the Société de Chimie Industrielle.

AT the annual general meeting of the Philosophical Society of the University of Durham, the following officers were elected: *President*, The Earl of Durham (Chancellor of the University of Durham); *Secretary*, Dr. Grace Leitch; *Treasurer*, Mr. J. W. Bullerwell; *Editor*, Dr. Todd; *Librarian*, Dr. Bradshaw; *Assistant Librarian*, Mr. E. Patterson; Sectional Officers, the chairman and secretary of each section being given in brackets: Chemical and Physical (Dr. P. L. Robinson and Mr. O. Darbyshire), Geo-

logical and Biological (Dr. Kathleen Blackburn and Dr. Allan), Mathematical (Mr. Colborne and Mr. Miles), Applied Science (Dr. Morrow and Dr. Baker), Philosophy (Dr. A. Robinson and Mrs. Alderson), Archæological and Historical (Dr. J. Wight Duff).

WE are informed by Messrs. Ernest Benn, Ltd., that Lady Bell is editing the letters of Gertrude Bell, which will be published, probably in two volumes, during the course of 1927.

THE latest catalogue (No. 146) of Messrs. Dulau and Co., Ltd., 34 Margaret Street, W.1, gives particulars of nearly 1300 volumes on zoology, botany and gardening, agriculture, geology, palæontology and mineralogy. Copies can be had free from the publishers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant in the Engineering School, Trinity College, Dublin—The Registrar (November 29). An assistant master, with qualifications in mathematics, at the Government High School, Nassau, Bahamas—C.A. (T.), Board of Education, Whitehall, S.W.1. For Scottish candidates (T.), Scottish Education Department, Whitehall, S.W.1 (December 6). An officer for research work and a professor of pathology at the Punjab Veterinary College, Lahore—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (December 10). Chief designer, designer, chief testing engineer, and first assistant testing engineer at Admiralty Engineering Laboratory, West Drayton—Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (December 13). An instructress in fruit and vegetable preservation, and housemistress of one of the hostels of the Swanley Horticultural College for Women—The Principal of the College, Swanley, Kent (December 15). A bacteriologist in the Department of Agriculture of the Irish Free State—The Secretary, Civil Service Commission, 33 St. Stephen's Green, Dublin (December 16). A principal of the University College of Wales, Aberystwyth, in succession to the late Principal J. H. Davies—The President of the College (D. Davies, Esq., M.P.), Plas Dinam, Llandinam, or The General Secretary, University College, Aberystwyth (January 31). A pathologist at the Cancer Hospital to conduct investigations in the effects of radiation on malignant and normal tissues and body fluids—The Secretary, Cancer Hospital, Fulham Road, S.W.3. A government analyst for the Public Health Department, Southern Rhodesia—The Secretary, High Commissioner for Southern Rhodesia, Crown House, Aldwych, W.C.2. A keeper of the laboratories of the Royal Horticultural Society at Wisley—The Secretary, Royal Horticultural Society, Vincent Square, S.W.1. A temporary assistant in the Research Department, Woolwich, under the Directorate of Explosives Research—The Chief Superintendent, Research Department, Woolwich, S.E.18. An agricultural chemist at the Kirton Agricultural Institute—The Principal, Kirton Agricultural Institute, near Boston, Lincs.

Our Astronomical Column.

COMET COMAS SOLA.—It appears fairly certain from the first ten days' observations of this comet that it is a periodic one, of Jupiter's family. The following orbits are by Mr. G. Merton and Dr. A. C. D. Crommelin respectively:

T = 1927, March 2·316 U.T.	1927, March 24·940 U.T.
ω = 24° 58′ 20″	37° 0′ 18″
Ω = 68 8 14	65 24 50
i = 11 50 54	14 0 4
e = 0·41065	0·53380
log q = 0·26526	0·26290
Period = 5y·525	7y·789
Equinox = 1926·0	1926·0

The elements bear some resemblance to those of Spitaler's Comet, 1890, VII.: ω for that comet was 13° 20′; Ω 45° 6′; i 12° 51′; log q 0·2596; period 6·4 years. It has not been seen since that apparition. Observations of the present comet are expected to continue for several months, which should decide the question of identity.

BRITISH TELESCOPES.—We have pleasure in directing attention to a recent publication entitled "Astronomical and Optical Instruments" which has been issued by Sir Howard Grubb, Parsons and Company, largely for the purpose of describing and illustrating the resources and equipment of the Company's new optical works at Newcastle-on-Tyne. The contents of the publication consist of a series of four short articles on (1) the development of optical instruments for astronomy and astrophysics; (2) the British optical industry; (3) the history of Sir Howard Grubb, Parsons and Company; (4) the new optical works of the Company at Walker Gate, Newcastle-on-Tyne. The articles are very attractively written, and are well illustrated with a number of clear reproductions. Of special interest are the plans of sectional elevation of the 45-ft. dome and the 41-inch refractor, and two photographs showing the framework of the dome and its rising floor now under construction at the works. Reference to this large telescope and to the optical works in general was made in NATURE of September 4, p. 340. The list on pages 44-45 of some of the principal large astronomical instruments made by the firm since it was founded by Thomas Grubb is eloquent testimony to the debt which astronomy, in particular, owes to these noted makers of telescope objectives and instruments.

EARLY ARABIAN ASTROPHYSICS.—More than 90 pages of volume 56/57 of the *Sitzungsberichte der Phys.-Med. Soz. Erlangen* are devoted to a presentation of the contents of an early Arabic treatise on the Light of the Moon by Al Hazen, with comments by the translator, Dr. Karl Kohl, of the University of Erlangen. Al Hazen, or al Hasen Ibn al Haitham, was born at Basra but spent most of his life in Egypt. He incurred the displeasure of the Calif al Hakim by the failure of his scheme for preventing the flooding of the Nile and had to conceal himself until the death of the Calif in 1020. He then returned to Cairo, where he died in 1038. His book begins with a short account of contemporaneous knowledge as to the light of the moon; he then shows that phases and eclipses necessitate a spherical moon, goes on to describe his own apparatus and observations, shows that neither transmission nor reflection (according to the laws of ordinary reflection) can explain the light, and concludes, therefore, that the moon is self-luminous, the sun imparting by means of its rays the power of self-luminosity. The original treatise appears to be in the India Office, but we have been unable to find any statement as to how it became available for translation.

Research Items.

PROMISCUITY AND PRIMITIVE MARRIAGE.—A discussion on promiscuity and group marriage by Lieut.-Col. E. F. Gordon Tucker and Mr. Leslie H. Gilbert appears in the *Sociological Review*, vol. 18, No. 4. Col. Tucker holds that the investigation of marriage must start with the physiological facts of the intensity of the sexual inclination. He argues that while no very helpful lesson can be derived from the varied conduct of the Quadrumana as to the sexual relations of human precursors among savage men, we get on one hand a widespread 'incest horror,' and, on the other, compulsory marriage among close relatives, but not the closest. Yet among Polynesians brother and sister marriage is a source of honour. Postulating a primitive group, the extent of continuity in gregariousness would be dependent on food supply. If the group were constant and sedentary, promiscuity would arise owing to the strength of the sex instinct and the hypothetical absence of the restraining forces of education, law, and religion. It is a question whether sexual jealousy would be strong enough to overcome these forces. Where the group was not constant owing to scarcity of food supply, either permanent or seasonal, individual men going off to find food would each take a woman to perform woman's work—root and beetle grubbing—and this custom would tend to give rise to individual marriage. In these conditions it is unnecessary to postulate promiscuity as a precedent condition of the classificatory system of relationships as Morgan did. The position of the mother's brother follows as a natural result. In his reply Mr. Gilbert argues from the universality of the individual marriage, while the terms of the classificatory system might be deduced from the Levirate and Sororate, which functions actively to-day, and further, that in the marriage groups, eligibility for marriage does not necessarily connote actual sexual relation. The so-called vestigial customs are magico-religious, though no one explanation can account for the diverse sexual orgies. The promiscuity theory demands the abrogation of the parental instinct, both of woman and man, which are essential to the survival of society in view of the conditions of human birth and infancy.

PHYSICAL ANTHROPOLOGY OF THE PAMIRS AND AMU-DARIA BASIN.—Physical measurements collected by Sir M. Aurel Stein on his third archæological expedition to Central Asia in 1915, are analysed by Mr. T. A. Joyce in the *Journal of the Royal Anthropological Institute*, Vol. 56, Pt. 1. The measurements are of fourteen different groups covering Mongolo-Turki, Tajik, and Iranian and Persian stock, for the most part nomad pastorals, but including primitive hunters and fishers from the Helmand River and military levies from Baluchistan. The examination of these measurements points to a double grouping into (1) those of the north and north-west—the Yazghulami, Vanji, Darwazi, and Karateghin, relatively dolichocephalic, narrow-nosed, euryprosopic and short-statured; and (2) those of the south and south-east—the Shignani, Ishkashmi, and Wakhi, relatively brachycephalic, long-nosed, leptoprosopic, and tall-statured. Intermediate to these groups are the Roshani, dwellers in a secluded valley, who may be taken as the main element of the bulk of these peoples in its purest form, the pure *Homo Alpinus* type. North and east this type has been modified in various degrees by contact with a broad-nosed Mongolo-Turki type. A Karateghin-Vanji group has been modified by contact with a narrow-nosed branch of Mongoloid peoples, while a Seistani-Sayad group are basically Indo-Persian or Indo-Afghan, but contain a leaven of the old Pamir strain.

INHERITANCE OF FLEECE CHARACTERS.—Fraser Roberts (*Jour. of Genetics*, 17 1, 1926) has an interesting paper dealing with the genetics of the piebald sheep, described variously as Spanish, or Barbary, or Jacob's sheep. He is of opinion that the characterisation of these sheep in Great Britain has not altered since 1760, and in his experience they invariably breed true, whole black or self-white lambs never appearing. In crosses with English breeds, the F_1 offspring were uniformly self-blacks, and it is concluded from further experimentation that the piebald sheep possesses a dominant black factor and also a recessive factor which restricts the black to certain areas.

HADDOCK BIOLOGY.—Mr. Harold Thompson has recently published the third of an important series of studies on haddock biology (*Fisheries, Scotland, Sci. Invest.* 1926, No. 2. Edinburgh and London: H.M.S.O. 2*s*. 6*d*. net.) In preceding papers it was shown that the acceptance of the "scale theory" for haddock is substantially vindicated by the test of experience, and that few, if any, unsurmountable difficulties occur in its general application to the study of the stock in the sea from year to year. The present paper deals with the growth of sea-born baby haddock reared under artificial conditions in aquaria. Two or three weeks were necessary before the fish accommodated themselves to the new conditions, and this check in growth was marked by an apparent ('false') winter mark on the scale in all cases in which transference of the fish from the sea was carried out during the season of greatest growth, namely, from May to October. Abundant proof was obtained of the unfailing formation of normal winter markings on each occasion that a fish passed through one or two winters in captivity. The experiments also demonstrated the important fact that, for the first three years at least, the size of the haddock scale increases on the average in proportion to that of the fish. The growth under artificial conditions was surprising, for all the captive fish showed an increase of nearly 100 per cent in their growth-rate as compared with controls at sea—a result probably due in large measure to the fact that the food-supply was continuous and plentiful.

SEX DIFFERENTIATION IN BONELLIA.—Prof. R. Goldschmidt (*Biol. Zentralbl.*, Bd. 46, Heft 8, 1926) holds that the male Bonellia cannot be regarded simply as a case of neoteny and of suppressed development. Regarded from the point of view of the morphogenesis of the female, the male is by comparison suppressed in development, but from the point of view of sex differentiation the male is an early ripening larva; it is not neotenic like axolotl, but precocious like the larva of Miastor. Prof. Goldschmidt regards the quickening of the sexual differentiation of the male as evidence of the activating function of the secretion on the proboscis of the female, while Baltzer, who places the retardation of metamorphosis in the foreground, takes the opposite view of the action of the proboscis secretion. Prof. Goldschmidt, reviewing Baltzer's results, concludes that in Bonellia sex is genetic; those larvæ with the female determinant develop always into females; those with the male determinant which develop as parasites become as a rule males, but after only short parasitism become intersexes; and those developing without parasitism pass through transitory intersexuality into females.

He also examines Baltzer's work from the point of view of developmental physiology and concludes that, before this and the genetical side of the problem can be elucidated, more observations are required.

HOST-PARASITE SPECIFICITY.—Prof. R. W. Hegner (*Science Progress*, Oct. 1926) discusses host-parasite specificity—the association of a particular species of host with a particular species of parasite—with special reference to human protozoa. In many cases a parasitic species appears to be rigidly adjusted to one species of host and unable to live in any other species, *e.g.* the organism of human malaria must often be transferred to horses, cattle, and pigs, but infections do not result. The habits of the host often determine the transmission of human protozoa, *e.g.* insanitary conditions determine largely the spread of intestinal protozoa. The factors within a host which enable natural parasites to bring about an infection but prevent 'foreign' parasites from doing so are briefly considered. Prof. Hegner points out that the conditions within the bodies of anopheline and culicine mosquitoes, and especially of closely allied anophelines, must be very similar, and that therefore the adjustments of the malarial parasites to their insect hosts must be very delicate. The actual factors responsible for the minute differences are unknown but are open to experimental study. In discussing the conditions responsible for differences in susceptibility between young and old, he suggests that some type of resistance develops with age, but the mechanism of this resistance is not known. The termination of an infection with protozoa also probably depends largely on the building up of resistance by the host; failure of the food supply appears to play a minor part. A more extensive account of the biology of host-parasite relationships, with special reference to the protozoa living in man, is given by Prof. Hegner in *Quart. Review of Biol.*, 1, 3, 1926.

PROBLEMS OF VEGETATIVE PROPAGATION.—Dr. R. C. Knight makes an interesting contribution to our knowledge of conditions under which hard-wood cuttings can be successfully propagated as a result of his experiments, mainly with plum stocks, reported in the *Journal of Pomology*, vol. 5, pp. 248-266, October 1926. He concludes that the amount of callus formation is not necessarily indicative of the amount of root production, these two processes bearing no consequential relation to one another. They are not similarly affected by external conditions: thus callus formation is favoured by a high water content in the soil, while root production, on the other hand, may be better with a lower water content, because the lower water content permits more efficient aeration. Treatment of the tissue of the cuttings with various reagents was attempted, but on the whole the results of such treatments were irregular and never so favourable as to give a hint of a method of practical importance.

THE FALL OF FLORAL ORGANS.—Isawo Namikawa has investigated fully the details of the abscission or exfoliation of floral organs, and publishes many details of interest in the *Journal of the College of Agriculture*, Hokkaido Imperial University, 27, pp. 63-131, July 1926. Catkins particularly have formed the subject of study, and in every case a more or less differentiated separation zone is present. Except in the fertilised female cone of Alnus, abscission takes place in all catkins examined. By abscission is understood a separation brought about by living tissue; exfoliation is the term given to the falling of floral organs as the result of drying and death, with separation following mechanical rupture. In Narcissus, Lycoris, Menyanthes, and Ribes, the floral organs are thus exfoliated as the result of ligno-suberisation of a more or less differentiated cell-layer at the base of the floral organ. The female cone of Alnus falls with a part of the vegetative shoot when this is cut off by abscission.

EARTHQUAKES IN FRANCE.—The earthquakes of France, studied in past times by Perrey (1872) and Montessus de Ballore (1892), have lately attracted closer attention. For a valuable summary of recent investigations we are indebted to M. Edmond Rothé, director of the French Seismological Bureau (*Matériaux pour l'étude des calamités*, No. 9, 1926, pp. 3-47). During the seven years 1919–25, the number of earthquakes felt in the whole of France was 79, the yearly average being thus about the same as in Great Britain. Of the six seismic regions which M. Rothé defines, the more prominent are those of the Alpes Maritimes and the valley of the Rhône, and of the Pyrenees, in the former of which were felt the Riviera earthquake of 1887 (of Italian origin) and the Provence earthquake of 1909, an earthquake of special interest, as the ground in the central region seems to have been elevated by about 1½ inches.

OIL AND COAL RESOURCES OF THE OREGON BASIN, WYOMING.—The area covered by this geological survey (the work of D. F. Hewett, *U.S. Geol. Sur. Prof. Paper* 145) lies along the west side of the well-known Big Horn Basin in north-western Wyoming. Stratigraphically, the Carboniferous, Jurassic, Cretaceous, and Tertiary systems are represented; coal deposits, mainly of a lenticular character, occur in the Montana members of the Upper Cretaceous, also in the Fort Union formation of middle Tertiary age; petroleum is mainly derived from the Frontier member of the Upper Cretaceous, and is exploited particularly at the Grass Creek field. Apart from detailed studies of these natural resources, this monograph is of interest for the attention which is given therein to the analysis of the sediments involved. In particular 'bentonite,' a peculiar clay with some unusual properties and of widespread occurrence in the Rocky Mountain region, receives discussion; from mineralogical and mechanical analyses the author concludes that this substance is the alteration product of a volcanic glass, or at least partially derived from some mineral which was crystallised in the glass. It would seem that the alteration ensued soon after explosive phases of vulcanicity had taken place, vapours being condensed and gathering particles into drops, thus producing mud-showers, ultimately forming the clay; the volcanoes responsible for the mother-substance of bentonite were probably situated in the region west of Wyoming, possibly in central Idaho. The mineralogical analyses of other sediments are clearly not exhaustive, most of the 'heavy' mineral constituents being disregarded, except biotite, apatite, and zircon, where these species occur; it is quite certain that further investigation of such accessories would have served the author's purpose still better, "in the hope that . . . additional light on the character, source, and manner of deposition of the sediments" would be forthcoming. This monograph is rich in diagrams, photographs, and maps, but the mass of detail, the absence of any introductory abstract of essential geology and economics, and the omission of any summary make it difficult reading.

SPECTRA OF HEAVY METALS.—Vol. 2, No. 6, of the *Proceedings of the Imperial Academy of Japan* contains preliminary notes of some spectroscopic investigations. The fine structure of several bismuth lines has been examined by Nagaoka and Mishima by means of crossed Lummer-Gehrcke plates, and tables

of wave-length intervals are given. By exciting the spectra of thallium and gold by means of high tension and heavy current (20 kv. and 1 ka.) Nagaoka and Futagami find that new lines are produced in almost coincident positions for the two metals. They give also a considerable list of almost coincident lines for these substances taken from existing measures, and point out that gold and thallium respectively could be produced from mercury if a proton could be expelled from or introduced into the mercury nucleus. The same experimenters record also the spectra of mercury produced by two different types of explosion.

IMPROVED SPECTROGRAPHS AND SPECTROMETERS.—Messrs. Hilger's supplementary catalogue describes a considerable number of improvements to existing forms of instrument and includes also particulars of apparatus of new type. Among the latter is a new range of spectrograph with interchangeable optical systems containing plane or concave grating, or prism (glass or quartz). Each model is made in three sizes, for focal lengths of 100, 150, and 300 cm. respectively. A large aperture glass spectrograph, giving small dispersion, for use with faint sources, should commend itself to many investigators. A special spectroscope is made also for the rapid detection of foreign metals in steel, and is in use in important steel works in Great Britain and America. Visual observation of ultra-violet radiation can be made by an instrument similar in form to the well-known Hilger small quartz spectrograph, but provided with a fluorescent screen above which is fixed a wave-length scale. The instrument is in constant adjustment. Numerous improvements in the constant deviation wave-length spectrometer have been embodied in the "1926 Model." The older form of the instrument ("Standard Model") is, however, still available at a slightly lower price.

ELECTRONIC STRUCTURE OF THE ATOM.—The lecture recently delivered by Prof. A. Sommerfeld at Manchester has been reprinted, under the title of "Electronic Structure of the Atom and the Quantum Theory," from vol. 70 of the *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*. After outlining the main features of the present view of electronic orbits in the atom, Prof. Sommerfeld goes on to consider the relation of atomic structure, as revealed by spectroscopy, to chemistry. He attaches great importance to the work of Main Smith and Stoner in dividing the energy levels characterised by given principal and azimuthal quantum numbers (n_k) into sub-groups distinguished by the value of the inner quantum number, j. Chemical combination is considered to be determined by the tendency of an atom to complete its outermost shell of electrons, and there is considerable evidence that the tendency to complete a sub-group, n_{kj}, is effective in this respect, as well as the tendency to complete a group, n_k. From such considerations, many of the observed chemical combinations which otherwise appear to be inexplicable receive a natural interpretation (see also NATURE, June 5, p. 793).

THE INERTIA OF THE ELECTRIC CARRIER IN COPPER.—In the October number of the *Physical Review*, R. C. Tolman and M. Mott-Smith describe a comprehensive series of experiments designed to study the inertia of the electric carrier in copper. They used an apparatus similar to that used in the experiments of Tolman, Karrer, and Guernsey, in which a copper cylinder was oscillated about its axis, and the current due to the lag of the electrons in the cylinder was detected by means of a coil of many turns of fine wire connected through an amplifier to a tuned vibration galvanometer. In order to determine the phase of the effect, the alternating electromotive force in the coil was balanced against an alternating electromotive force produced in an earth inductor which rotated in synchronism with the oscillation of the cylinder, so that adjustments of the amplitude and phase of the balancing electromotive force were possible. An exhaustive investigation of the effect of the earth's field on the magnitude and phase of the effect was also made. It was found that the actual magnitude of the electromotive force observed was 19 per cent. less than that expected on the simple theory in which the effective mass of the carrier was assumed to be that of an electron in free space. The average phase of the observed electromotive force lagged 10° behind the acceleration, whereas on the simple theory it should be in unison.

OPTICAL PROPERTIES OF SUGARS.—The *Journal of the Washington Academy of Sciences* for October 4 contains a short paper on the optical properties of *l*-arabinose, fructose, *d*-glucose hydrate, α-lactose hydrate, lyxose, *d*-mannose, *d*-melibiose, raffinose, rhamnose monohydrate, *d*-ribose, sucrose, trehalose and *d*-xylose, giving the refractive indices determined by the immersion method in mixtures of mineral oil and monochloronaphthalene, in yellow light. The behaviour in polarised light between crossed nicols is also listed, as well as the appearance of the crystals. The work is due to G. T. Keenan, of the Bureau of Chemistry.

TECHNIQUE IN ENZYME INVESTIGATION.—In *Die Naturwissenschaften* for October 15, appears an interesting résumé by R. Willstätter of the methods and results of the work upon enzymes proceeding under his direction at Munich. Willstätter emphasises the point that though the enzyme system is colloidal it is also a complex organic substance the chemical composition of which is of first importance in understanding its behaviour. Thus, as a catalyst, an enzyme is frequently very specific in its action, and undoubtedly chemical structure must be accountable for such specific action on saccharose as R. Kuhn is reported to have found. Unpublished experiments suggest that there are glucosaccharases and fructosaccharases that can be isolated from fungi which, as their name suggests, attack the biose by linkage on to different constituent hexose molecules. Willstätter discusses the problem of isolation of enzymes and describes methods by which, within one day, invertase preparations can be obtained 300–500 times purer than previously. The invertase content in yeast can be increased 15–20 times by allowing it to ferment at the lowest possible sugar concentration for a day. This result raises a doubt whether conclusions can be drawn from the natural presence of an enzyme as to its significance to the organism. An account is also given of the method of purification by adsorption and regeneration of the enzyme from the adsorbent which has been developed with so much success at Munich. In this connexion, Willstätter points out that the suspended hydrates of alumina are by no means simple inorganic complexes; a whole series of compounds is possible, different in their amount of chemically combined water and in their general properties, including their behaviour as adsorbents. Thus "alumina γ" adsorbs lipase, leaving trypsin and anylase in solution; "β alumina," on the other hand, also adsorbs the trypsin. Many other interesting examples are given and the difficulties are discussed that lie in the way of attempts to estimate enzyme quantities in view of the many factors modifying the kinetics of an enzyme catalysed reaction.

Recent Industrial Research in Cotton.[1]

THE British Cotton Industry Research Association, the non-confidential work of which is published yearly in this form, is pursuing a very steady policy. Nearly all of the fifteen researches described in the volume under notice are extensions of previous work, and nearly all aim at establishing on a scientific basis the many phenomena observed by the practical textile technologist in his daily work, which he has learned to use in controlling the quality of his productions. If their immediate value to the industry is not apparent, they are invaluable as records and as information available to all who follow their profession earnestly. Much of the instinctive genius which has guided the textile technologist in the past comes only of long and patient practice. Many of these technologists are men whose senses are highly developed in limited directions, with the result that they are capable of controlling complex processes in a strongly subjective way. They cannot pass on their acquired skill to their colleagues, for they never measure in units. Their skill dies with them, and educationally their activities are wasted. The reviewer looks to these published researches as a means of overcoming this difficulty and thus providing for a greater body of men whose interest in textile technology is more than a means of earning their daily bread. Unfortunately, technical scientific literature is hard reading to those in the textile industry who would profit by a more thorough understanding of its phraseology; and it is only through the efforts of textile colleges and schools that its value can be appreciated. The language barrier between the scientific textile technologist and the practical textile technologist has yet to be broken down, and one feels that these Memoirs will be better appreciated in years to come than they will be now.

The work on mildew in cotton goods has been carried to a very definite stage. With a given mould fungus, the rate at which growth proceeds is shown to be a function of the starch used in sizing and finishing; while under the same conditions of steeping, if wheat flour is used, the rate is found to vary with the type of fungus. It appears to be impossible to make generalisations, and a grouping system has been adopted.

The hygroscopic properties of scoured cotton and mercerised cotton have been compared; and, using this comparison, a method of measuring the degree of mercerisation has been established, though the reviewer is doubtful as to the possibility of its extended application. The mercerisation process continues to absorb the interest of textile scientific men, and a discussion on the rôle of the cuticle during the swelling of the cotton hair, illustrated by some excellent photomicrographs, has indicated that a final solution of the problem can only be reached by a detailed study of the micro-structure of the hair. Most workers have felt the need of more information about the cuticular structure, and some have even doubted the existence of a cuticle at all, but those who have been guided by faith and analogy with other plant structures will find this paper very interesting reading.

The problem of the swelling of cotton hairs has been attacked from a different direction. The dimensional changes have been measured after immersion of the hairs in sodium, potassium, lithium, rubidium and cæsium hydroxides of varying concentration. Unfortunately the relation between the maximum swelling and maximum electrical conductivity has not been established with all these metallic hydroxides, though earlier work had indicated a correlation. The textile industry has always employed sodium hydroxide in the mercerising process; and it is interesting to find that once more commercial practice is right, for with this hydroxide the change in diameter of the hair is found to be about twice that with any of the others, thus suggesting its specific action on cellulose.

Earlier work on moisture absorption by cotton has been responsible for a widespread impression that Indian, American and Egyptian cottons differ in their moisture-absorbing capacity; but a careful study has failed to confirm these earlier results. A suggestive comment on the acquired skill of practical textile technologists is found in the researches on the lustre of yarns and fabrics, in which it has been considered necessary to employ the Lummer Brodhun photometer, the most accurate instrument available, in order to compete with the acute observation of those employed in the finishing trade.

The mixing of different varieties of cotton is shown to cause variation in shade during dyeing, and a purely geometrical reason is given for this inter-varietal variation.

A study of the surface tension of various starch pastes used in sizing yarns has revealed an interesting analogy with viscosity determinations. The rate at which size permeates cotton is found to increase much more rapidly with increasing temperature than the lowering of the surface tension would indicate. The temperature should be carefully controlled during the sizing process if a level result is to be obtained, a conclusion which commercial practice has been slow to appreciate in England, though the advantages of thermostatic control have long been known in the United States.

Contributions to our knowledge of the chemical constituents of cotton are made in papers on the waxes of cottons of different origin and their characteristics, on the identification of fatty ingredients in sized goods, and on the ash content and ash alkalinity of typical cottons.

The photographic reproductions, graphs, tables and general lay-out of this volume are excellent. The inclusion of a short summary under the title of each paper in the table of contents is a welcome innovation.

F. P. SLATER.

[1] Shirley Institute Memoirs, vol. 4, 1925. Pp. vii+182+iv. Didsbury, Manchester: Shirley Institute, 1926.

The Function of Chlorophyll.

SINCE the chemistry of chlorophyll was elucidated by the researches of Willstätter, very little progress has been made in the interpretation of its function. Recently Noack has attempted an experimental attack upon the problem along a new line, and a general account of his experiments which appeared in *Die Naturwissenschaften* for April 30, 1926, provides a convenient opportunity to review his results.

Stern has provided experimental grounds for the conclusion that chlorophyll, as present in the living plant, is fluorescent. Noack's investigations concern themselves directly with the photo-oxidative effects produced by fluorescent pigments. A saturated aqueous solution of benzidin undergoes oxidation in light, in the presence of eosin 1 in 30,000. In the absence of eosin, or in the dark, it is quite unaffected, but the light change is materially accelerated if salts of iron, manganese, or copper are present in addition to the eosin. In alcoholic solution, benzidin similarly undergoes photo-oxidation in the presence of eosin,

the process being again accelerated by the presence of manganese or iron. In alcoholic solution it is possible to replace eosin by chlorophyll or by the methyl and ethyl chlorophyllides. Photo-oxidation again occurs, but is not produced if the non-fluorescent copper compound is used instead of the magnesium-containing chlorophyll compounds, which are fluorescent in alcoholic solution.

Water plants, living or dead, immersed in aqueous solutions of benzidin produce brown oxidation products of benzidin in the neighbourhood of the chloroplasts when exposed to the light. There is no such reaction in the dark, or in dead plant tissue which has been boiled in copper sulphate, so that the fluorescent pigment is replaced by the presumably non-fluorescent copper derivative. Dead green cells, which bleached in a few minutes in a strong light, could be kept green by the addition of neutral sodium sulphite. Noack considers that this is evidence that under certain conditions the photo-oxidative change results in the destruction of the pigment. Dead green tissues in the dark showed no absorption of oxygen in twelve hours, but in a strong light at 10° strong oxygen absorption took place, proportional to the oxygen pressure.

There is an obvious difficulty in associating these photo-oxidative changes with the photo-synthetic reduction of carbonic acid. Noack and Metzner have shown their close connexion with the so-called photo-dynamic action by which species of Paramœcia, normally insensitive to light, in the presence of very dilute solutions of fluorescent pigment and oxygen, become photo-tactic in the light, showing positive or negative movements according to the strength of the light or variation in oxygen pressure or pigment concentration whilst under stronger photo-dynamic action, they are killed. Metzner (*Ber. der Deutsch. Bot. Ges.* 41, pp. 268-274, 1923) has even extended this work to root systems growing in dilute solution of fluorescent pigments, which have thus been rendered photo-tropically sensitive, a phenomenon which he describes as induced photo-tropism.

From this point of view, Noack argues that in normal photo-synthesis the photo-oxidative change must hand energy on to carbonic acid, and he points out the interesting bearing in this connexion of the toxic action of sunlight on leaves, in the absence of carbon dioxide. This phenomenon was reported long ago by Jost. Noack now explains it as a photo-dynamic effect of the fluorescent pigment upon the surrounding protoplasm, produced in the absence of carbon dioxide. He also thus explains the death and bleaching of Fontinalis when exposed to sunlight in the presence of phenyl urethane, a substance which, as Warburg has shown, hinders photo-synthesis. Noack also offers a similar explanation of the toxic action of sulphur dioxide upon green tissues; the sulphite hinders photosynthesis and under these conditions photo-dynamic destruction of the protoplasm occurs in the light. This interpretation does not seem quite in harmony with the demonstration of the effect of sulphites in hindering photo-oxidation.

Noack adds some further experiments as to the rôle of the yellow pigments in the leaf plastids. In experiments *in vitro*, these carotinoids were bleached by photo-oxidation in sunlight in less than an hour in the presence of chlorophyll (1 in 100,000); without this trace of chlorophyll they remained unaltered after six hours' exposure.

Stern explains chlorophyll fluorescence as due to its solution in lipoids, but Noack finds that dry leaf tissue from which lipoids and carotinoids have been removed by 24 hours' extraction with petrol ether, still retain their chlorophyll and still show the photo-oxidation of benzidin and bleach as the result of photo-oxidation. These experiments seem in closer agreement with Willstälter's view that chlorophyll is adsorbed on some substance of high molecular weight, although in agreement with Stern's view that the pigment itself is in the fluorescent condition.

It must be admitted that the theoretical interpretation of these experiments of Noack is still far from clear, but they seem well worth consideration as suggesting yet another line of experimental approach to a very fundamental problem, the function of chlorophyll.

Tide-predicting Machines.

THE simplicity of the harmonic methods of analysis and prediction of tides is very fascinating, and the invention of the tide-predicting machine by Lord Kelvin almost ensured the success of the methods. A predicting machine sums a number of harmonic variations, transmitted vertically to pulleys, round which passes a wire or chain which is fixed at one end and carries a recording pen at the free end. For the majority of ports the harmonic method of analysis is unrivalled in accuracy and cheapness; consequently we find machines in active use in the following countries: Great Britain (one at Broadstairs and one at Bidston Observatory), France, Germany, Portugal, United States, Argentina, Brazil, India, and Japan (2). In addition to these, three machines are no longer used: one was destroyed at Tokyo, and the Brazilian machine is being replaced by a model under construction at the present time. It is noteworthy that since the War five machines have been built at Glasgow by Messrs. Kelvin, Bottomley, and Baird.

The number of harmonic variations utilised by the machines varies from ten to thirty-seven, and much ingenuity has been practised, especially in connexion with devices to reduce the cost of predictions. Considering that a port cannot do business without tide predictions, it is remarkable that 10*l*.-20*l*. should be considered excessive cost, and that too often accuracy is subordinated to price. For the more important ports, however, accuracy is increasingly demanded. Considering only prediction, accuracy depends upon the number of constituents incorporated in the machine, and also upon the performance of the machine. For some ports, especially those situated in estuaries, a machine with, say, eighty constituents would be required; the initial cost would be very great and the difficulties of operation enormously increased.

The present writer has had actual experience with five of the latest machines; he has carried out tests on two others, and has witnessed the performance of another one. There is no possible doubt but that the principal source of error in performance is that of friction. A change in tension of 1 per cent. at each pulley means a considerable average change over of tension throughout the wire under certain conditions. This leads either to stretching with a soft wire or to 'bowing' from the vertical with a resilient wire, and it seems impossible to find a wire of circular cross-section that will satisfy all conditions. A chain is used on two machines (United States and Germany), and a flexible tape of relatively large cross-section is used on the Liverpool Tidal Institute machine at Bidston. The machine now under construction for Brazil is being fitted with ball-bearings for each pulley.

Even if a perfect machine, with a large number of

constituents, could be built, it is still doubtful whether the harmonic method can be adequately used for the direct prediction of tides for estuary ports; part of the difficulty has to do with the validity of the resolution into harmonic constituents at such places. It is possible, however, to apply adequate corrections to the machine predictions, and such corrections may be 'non-harmonic' (functions of the range of tide) or 'harmonic'; in the latter case the machine may be used with a special time-scale to run off a separate curve for the corrections. Even this method is not without its difficulties. The harmonic method has thus had to confront many serious hindrances to universal adoption, especially in the case of the most important ports where its defects are most apparent; there is no doubt, however, that the harmonic method of prediction and the use of predicting machines will increase, but perhaps with some loss of apparent simplicity of operation.

Various details of the machines hitherto constructed are brought together in Special Publication, No. 13, issued by the International Hydrographic Bureau of Monaco, entitled "Tide Predicting Machines." Most of the remarks appear to have been culled from official accounts of the machines. The whole volume would have been more useful if it had been subjected to more helpful criticism. Appendix II. and the tables of astronomical arguments for ten constituents are of no value to any one likely to be using a machine and are out of place in the volume. Certain formulæ on p. 81 are inconsistent, and the table on p. 83 cannot be understood unless certain symbols, x and y, are explained.

A. T. DOODSON.

University and Educational Intelligence.

CAMBRIDGE.—An offer has been made of 25,000*l.* by the Empire Marketing Board, through the Committee of the Privy Council for Scientific and Industrial Research, for the building and equipping of an extension of the Low Temperature Research Station.

Sir Josiah Stamp has been appointed Rede lecturer, Dr. C. Hose has been elected to an honorary fellowship at Jesus College, and C. Rimington, Emmanuel College, has been elected Benn W. Levy student in bio-chemistry. The Raymond Horton-Smith Prize has been awarded to Dr. A. J. Copeland, Pembroke College, for his thesis on "The Cocaine Substitutes, with Special Reference to Borocaines"; *proxime accessit*, Dr. T. A. Butcher, Queen's College, for a thesis on "The Normal Gastric Secretion as Determined by the Fractional Test Meal."

EDINBURGH.—At the meeting of the University Court on November 15, Prof. Baldwin Brown was appointed Munro lecturer for the current academical year. He will deliver a course of ten lectures in the summer term on "Activities of Prehistoric Man in their Relation to the Origin of the Arts."

Mr. J. A. V. Butler was appointed a lecturer in the Department of Chemistry.

LEEDS.—The following appointments have been made in the Cancer Research laboratories: Mr. J. S. Young to be lecturer in experimental pathology and assistant director of cancer research; Mr. Young has held appointments as resident assistant physician at the Western Infirmary, Glasgow, as University assistant to Prof. Muir, and, for the past two years, as assistant pathologist at the Western Infirmary; Mr. H. J. Channon to be bio-chemist in the Department of Experimental Pathology; Mr. Channon held a Beit Memorial Fellowship for Medical Research under Prof. J. C. Drummond, University College, London; Cancer Research fellowships to Dr. Georgiana M. Duthie, who has been a demonstrator in the Pathology Department of the University since January 1925; and to Mr. G. A. Collinson, who during the same period has acted as research assistant to Sir Berkeley Moynihan.

LONDON.—The following free public lectures are announced:—"The Present Position of the Logic of Induction," Dr. C. D. Broad, at King's College, at 5.30, on December 1; "Colour Vision," Prof. H. E. Roaf, at University College, at 5, on December 1 and 8; "Nervous Affections of the Œsophagus" (The Semon Lecture), Dr. A. Brown Kelly, at the Royal Society of Medicine, at 5, on December 2; and "Influence of Environment on Bacteria," Mr F. W. Twort, at the Royal College of Surgeons of England, at 4, on December 6, 7, 9, 13, and 14.

The following doctorates have been conferred: *D.Sc. in Physiology* on Prof. D. T. Harris (University College) for a thesis entitled "Biological Action of Light"; *D.Sc. (Engineering)* on Mr. H. E. Merritt (West Ham Municipal College) for a thesis entitled "Generated Gear Teeth."; *D.Sc. in Physics* on Mr. C. E. P. Brooks, for a thesis entitled "The Variations of Pressure from Month to Month in the Region of the British Isles," and on Mr. Wilfred Jevons for a thesis entitled "(1) A Band Spectrum of Tin Monochloride exhibiting Isotope Effects; (2) The More Refrangible Band System of Cyanogen as developed in Active Nitrogen."

MANCHESTER.—The honorary degree of D.Sc. has been conferred upon Mr. S. L. Pierce, formerly manager of the Manchester Corporation electricity undertaking and an Electricity Commissioner; Prof. A. C. Seward, professor of botany in the University of Cambridge; Dr. A. E. H. Tutton, formerly H.M. Inspector of Schools (Technological Branch).

THE date of the second biennial conference of the World Federation of Education Associations, to be held at Toronto, Canada, in 1927, is to be August 7–12 instead of some days earlier. The secretary of the Federation is Charles H. Williams, 101 Jesse Hall, Columbia, Missouri, U.S.A.

ACCORDING to a note in the October issue of the *Scientific American*, Princeton University is appealing to the public of the United States for an endowment of two million dollars in order to strengthen and enlarge its research work in the fundamental sciences. A further one million dollars will be granted by the General Education Board if the public subscribes the two million. The note directs attention to the large amount of research in science which has been carried out at Princeton during the past twenty-five years without an adequate endowment, and repeats Secretary Hoover's warning that the United States is falling behind in research in pure science. Several other universities of the United States are making similar appeals for endowment.

MR. W. R. BOWER, Head of the Department of Physics and Electrical Engineering at the Huddersfield Technical College and a past president of the Association of Teachers in Technical Institutions, is retiring at the end of the current term after holding his present post for thirty years. The College authorities are now creating separate departments of physics and electrical engineering. The new head of the Physics Department will be Mr. H. Lowery, lecturer in physics at the Bradford Technical College and formerly assistant lecturer in physics in the

University of Manchester, who has published several papers on spectroscopic and other subjects. Mr. W. M. Wilcox, now lecturer in electrical engineering in the College, will become head of the new Electrical Engineering Department.

THE League of Nations International Committee on Intellectual Co-operation held at Geneva on July 26-29 its eighth plenary session, a report of which has recently been issued. A large number of resolutions proposed by sub-committees were approved, including the following, proposed by the sub-committee on university relations: National universities' associations and similar organisations should be asked for their views and observations on a scheme for the institution of an international universities' association, to be prepared for by an inter-university conference. A summary should be published of the subjects dealt with in the various universities' courses devoted to contemporary history, foreign literature, and international law. A special committee should investigate ways and means and with the least possible delay present a detailed plan for the publication of year-books and catalogues of interest to the university and scientific world. Special agreements, on a basis of reciprocity between States, should provide for reductions in transport rates for students, and the International Institute should consider, in agreement with the Transit Section of the League of Nations, the best means of achieving this result. Among resolutions prepared by other sub-committees and approved by the plenary committee was one for establishing an international office of museums, one for constituting an autonomous international society or academy of translators, and one for convening expert committees early in 1927 for the co-ordination of bibliography in (*a*) economic sciences, (*b*) Greco-Roman antiquity, and (*c*) biological sciences.

THE University of London Bill passed its second reading in the House of Commons on November 19 without a division. Lord Eustace Percy, president of the Board of Education, in explaining the provisions of the bill, emphasised the importance of the creation of a council to deal with all questions of finance, and the need to secure the direct representation of the colleges on the Senate. He disclaimed any desire on the part of the Board of Education to control the University, the chief object of the representation of the Crown and the London County Council on the Council of the University being to introduce elements outside the University "competent in matters of business administration and finance." On this point he gave the most emphatic assurance. He promised to move an amendment in Committee to meet the special position of the theological colleges which did not receive public grants. Replying to the criticism that the bill might affect adversely the interests of the external student, he said that the Government "desired to preserve the external side in the full enjoyment of its privileges." Mr. Trevelyan, on behalf of the Labour Party, supported the second reading and hoped the bill would become law this year. Dr. Graham Little, member for the University, moved the rejection of the bill. He laid stress on the present financial independence of the colleges which was threatened by the bill, because public grants to the colleges would in future be paid through the University. Those who belonged to the external side felt that the menace to their special interests would be serious. Sir A. Hopkinson, supporting the bill, said that the University of London needed the business element, though he is not sure that Crown nomination is the best method of introducing this element into the government of the University.

Contemporary Birthdays.

November 27, 1849. Prof. Horace Lamb, F.R.S.
November 28, 1840. Sir James Crichton Browne, F.R.S.
November 29, 1866. Prof. Ernest W. Brown, F.R.S.
November 29, 1859. Sir Robert A. Hadfield, Bart., F.R.S.
November 29, 1847. Sir George Greenhill, F.R.S.
November 29, 1859. Prof. John Ambrose Fleming, F.R.S.
November 30, 1858. Sir Jagadis Chunder Bose, C.S.I., C.I.E., F.R.S.
December 2, 1860. Right Hon. Lord Southborough, G.C.B., G.C.V.O.

Prof. LAMB, born at Stockport, was educated at the Grammar School there, at Owens College and at Trinity College, Cambridge, graduating second wrangler. Leaving tutorial work at Cambridge he became professor of mathematics in the University of Adelaide, returning to Manchester in 1885 on acceptance of the chair of mathematics in the University, a post he held until 1920. Prof. Lamb has received from the Royal Society the Copley medal and a Royal medal. In 1925 he was president of the British Association.

Sir J. CRICHTON BROWNE was educated at Dumfries Academy and the University of Edinburgh. An authority on mental and nervous diseases, he was from 1875 until 1922 Lord Chancellor's Visitor in Lunacy. As treasurer of the Royal Institution Sir James rendered devoted service for many years.

Prof. E. W. BROWN is a graduate of Christ's College, Cambridge. From 1891 until 1907 he was professor of mathematics in Haverford College, Pennsylvania, accepting afterwards a similar chair at Yale University. He is a corresponding member of the Academy of Sciences, Paris. In 1907 Prof. Brown received the Royal Astronomical Society's medal for his researches on lunar motion, followed in 1914 by the Royal Society's award of a Royal medal for similar studies.

Sir ROBERT HADFIELD, the well-known metallurgist, is chairman and managing director of Messrs. Hadfield's, Ltd., Sheffield. He is a corresponding member of the Academy of Sciences, Paris. In 1904 he received the Bessemer gold medal of the Iron and Steel Institute, at the hands of Mr. Andrew Carnegie, for the advancement of the metallurgy of iron and steel, in particular the discovery of manganese steel. Specimens of the first manganese-iron alloy, made in 1882, were shown on that occasion. Sir Robert is a past president of the Iron and Steel Institute and of the Faraday Society.

Sir GEORGE GREENHILL graduated at the University of Cambridge. He was formerly professor of mathematics in the Artillery College, Woolwich; he received a Royal medal from the Royal Society in 1906.

Sir JAGADIS BOSE, emeritus professor of the Presidency College, Calcutta, and founder and director of the Bose Research Institute, Calcutta, was educated in India and at Christ's College, Cambridge. He has conducted prolonged researches and written several works on life movements in plants. His latest treatise, published this year, was entitled "The Nervous Mechanism of Plants."

LORD SOUTHBOROUGH has been permanent secretary of the Board of Trade and of the Colonial Office. In 1910 he was vice-chairman of the Development Commission; in 1918–19, president of the Commission to India on reform. The National Physical Laboratory owes much to him for advice and assistance in the past.

Societies and Academies.

LONDON.

Royal Society, November 18.—W. S. **Patton** and E. **Hindle**: Reports from the Royal Society's Kala Azar Commission in China.—R. **Hill**: The chemical nature of hæmochromogen and its carbon monoxide compound. The hæmochromogen type of spectrum shown by compounds of hæmatoporphyrin with metals other than iron is not due to the presence of nitrogen compounds. It is suggested that the property of forming hæmochromogens is limited to the iron-porphyrin compounds. Two molecules of pyridin are necessary to convert reduced hæmatin into the corresponding hæmochromogen. Carbon monoxide hæmochromogen has one molecule of pyridin in combination when produced in the presence of the latter. The carbon monoxide compounds of reduced hæmatin and pyridin hæmochromogen both contain one molecule of carbon monoxide.—H. **Gremels** and R. **Bodo**: The excretion of uric acid by the kidney.—C. H. **Browning**, J. B. **Cohen**, S. **Ellingworth**, and R. **Gulbransen**: The antiseptic properties of the amino-derivatives of styryl and anil quinoline.—T. S. P. **Strangeways** and F. L. **Hopwood**: The effects of X-rays upon mitotic cell division in tissue cultures *in vitro*.—Sir Charles **Sherrington** and R. S. **Creed**: Observations on concurrent contraction of flexor muscles in the flexion reflex.—S. B. **Schryver** and H. W. **Buston**: The isolation of some hitherto undescribed products of hydrolysis of proteins (Part iii.).—J. A. **Crowther**: The action of X-rays on *Colpidium colpoda*.

Linnean Society, November 4.—G. **Tandy**: Abnormal fruiting branches of sweet chestnut (*Castanea vulgaris*), found by Mr. W. P. J. Le Brocq near Brecon. The catkins were wholly female, whereas usually only a few female flowers are found at the base of an androgynous catkin. Certain trees have been found consistently to produce such catkins.—T. A. **Sprague**: Visits to Wistman's Wood, Dartmoor, in May 1926.—C. M. **Yonge**: The ciliary-feeding mechanisms in the thecosomatous pteropods.

CAMBRIDGE.

Philosophical Society, October 25.—H. **Jeffreys**: On compressional waves in two superposed layers. The assumption that the compressional waves of earthquakes follow the ordinary laws of refraction, the energy within any pencil of rays remaining permanently within that pencil, leads to amplitudes too small for the indirect waves from near earthquakes. An analogous problem in the theory of sound is here considered. It is found that a large diffracted wave appears at the outer surface, having travelled with the velocity of sound in the lower medium; but it differs somewhat in character from the direct wave.—S. **Pollard**: (1) On the descriptive form of Taylor's theorem. The relation is obtained between the descriptive form of Taylor's theorem and the ordinary (Lagrange) form, and hence a precise statement of the descriptive form is found. This is employed to give a concise proof of the two-dimensional case of the descriptive form. (2) The summation of a Fourier integral of finite type. A Fourier integral is of finite type if the generative function vanishes outside a certain interval. The paper deals with the Cesaro summation of such integrals, it being assumed only that the generating function is integrable in Denjoy's sense. A necessary and sufficient condition is obtained for summability (C, k), where k is a positive integer, and this yields a special criterion which generalises the well-known criterion of Lebesque for summability $(C, 1)$.—G. C. **Steward**: Note on the Petzval optical condition. The 'Petzval' optical condition for flatness of field, produced by a symmetrical optical system, stands apart from the other aberration coefficients of the first order; it is independent of the positions of the conjugate planes considered and also of the pupil-planes of the system. An expression is obtained for the reduced focal eikonal for a single spherical surface.—E. A. **Milne**: Maxwell's law, and the absorption and emission of radiation.—T. L. **Wren**: The correspondence between lines in threefold space and points of a quadric fourfold in fivefold space, established by a geometrical construction.—F. J. W. **Roughton** and H. **Hartridge**: Improvements in the apparatus for measuring the velocity of very rapid chemical reactions (ii.). For very fast reactions an apparatus has been constructed which enables the first observation to be made on the reacting liquids in $\frac{1}{800}$th sec. from the commencement of mixing. The fastest chemical reaction that can be investigated is one half completed in $\frac{1}{2000}$th sec. It seems improbable that these times can be reduced appreciably without either making some radical change in design or using driving pressures higher than one atmosphere. Very slow reactions of from 2 minutes to 1 second have been investigated by simply increasing the length of the observation tube. Reactions in very dilute solution have been studied by examining spectroscopically a beam of light that has been passed through the observation tube parallel with its long axis. Observations on hæmoglobin solutions of concentration so low as $M/6 \times 10^6$ have been made possible. For work on small quantities of fluid a special spectro-camera has been devised.—F. H. **Constable**: On the stability of copper catalysts produced by thermal decomposition. The thermal decomposition of salts of copper leads to the production of active catalysts. The spacing of the copper atoms in the original compound is a secondary consideration, the real factor governing the nature of the final surface being the mixed crystallisation and freezing in the amorphous state of a mass of suddenly liberated copper atoms. The results agree with the hypothesis that the centres of activity of the surface are frozen groups of atoms with strong specific external fields. At moderate temperatures the stability of these preparations is very marked.—J. A. **Christiansen**: Note on the velocity of gas-reactions.—W. T. **Richards**: Note on the effect of α-particles on paraffin.—C. V. Hanumanta **Rao**: On the figure of Pappus' theorem.

PARIS.

Academy of Sciences, October 26.—Charles **Moureu**, Charles **Dufraisse** and Marius **Badoche**: Autoxidation and antioxygen action (xix.). The catalytic action of hydrocyanic acid and of various cyanogen compounds. Cyanogen compounds as a class are not exceptional in their behaviour when compared with other catalysts. The effects on the oxidation of acrolein and styrolene are shown graphically.—A. **Desgrez** and J. **Meunier**: The detection and determination of strontium in sea water. Common salt is separated from the calcium and strontium sulphates by 30 per cent. alcohol, and the insoluble portion submitted to quantitative spectrum analysis. The ratio found was strontium to calcium = 1/47.—S. **Winogradsky**: The decomposition of cellulose in the soil. A description of a micro-organism obtained from soil capable of rapidly breaking down cellulose, probably to an oxycellulose.—**Riquier**: The integration of the partial differential equation of the second

order with two independent variables.—Jacques **Chokhatte**: The asymptotic expressions of the Tchebycheff polynomials and of their derivatives.—**Véronnet**: Extension of Stokes's theorem. Each term of the development of the potential of a star on an external point is a constant independent of the internal constitution.—L. **d'Azambuja** and H. **Grenat**: The great activity of a group of sunspots followed by a magnetic storm and an aurora borealis. An exceptional eruption of hydrogen was observed in the Meudon spectro-heliograph on October 13 at $13^h\ 15^m$: magnetic disturbances set in 31 hours later and continued for 36 hours, and the aurora borealis was also observed. Similar correlation of solar activity and magnetic disturbances was proved by G. E. Hale and by T. Royds early in 1926.—René **Lutembacher** and Léon **Gaumont**: The application to teaching purposes of the optical recording of sound, combined with the kinematograph. An account of a method for studying the heart and the voice suitable for medical instruction.—A. **Paillot**: Rôle of the spore-bearing micro-organisms in silk-worm disease.—V. **Omeliansky**: The resistance of cultures of *azotobacter chroococcum* to desiccation.

WASHINGTON, D.C.

National Academy of Sciences (Proc., vol. 12, No. 10, October).—Fabio **Frassetto**: Relations between stature and chest-girth formula of normality and normal values. A linear relationship between height and weight has been demonstrated. Using measurements of more than a quarter of a million subjects, it is shown graphically and analytically that for Italians 20-21 years old, 154 cm. height, 84·6 cm. chest-girth, the chest-girth increases 0·24 cm. for every centimetre increase of stature.—Melville J. **Herskovits**: Social selection in a mixed population. From particulars obtained at Howard University, and some 400 families in the Harlem district of New York City, it appears that there is a marked tendency for negroes to marry negresses of lighter colour than themselves. Thus generally the daughters of the unions will be darker than their mothers and the American negro population will tend to approach negroid type more and more.—G. W. **Hammar**: (1) A preliminary report on the magnetic susceptibilities of some gases. (2) A possible explanation of the 'Glaser effect' (see NATURE, November 13, p. 712).—R. C. **Gibbs** and H. E. **White**: Stripped atoms of the first long period. The '*d*' electron seems to be the most tightly bound electron through this group of elements.—Enos E. **Witmer**: The rotational energy of the polyatomic molecule as an explicit function of the quantum numbers.—R. de L. **Kronig**: The dielectric constant of symmetrical polyatomic dipole-gases on the new quantum mechanics. As for diatomic molecules, the permanent electric moment and the part of the dielectric constant due to it are related by Debye's equation derived on the classical theory, if the temperature be sufficiently high.—W. J. **Crozier** and G. **Pincus**: Tropisms of mammals. Rats creeping in contact with the surface of a block follow the vertical surface on reaching a corner; if touching blocks on each side, they creep ahead on emerging from the zone of contacts, showing definite stereotropism. As regards phototropism, the path of a very young rat illuminated from two sources can be calculated from the intensities of the light sources. Creeping up a fine-meshed wire grid, orientation is upward, depending on the angle of inclination of the grid, and, between limits, is related directly to the inclination. Thus it is possible, as in many invertebrates, to obtain a quantitative analysis of behaviour.

Official Publications Received.

BRITISH AND COLONIAL.

Aeronautical Research Committee: Reports and Memoranda. No. 1017 (M. 37): Experiments relating to the Electrification of Balloon Fabrics. By Dr. Guy Barr. (B. 1. d. Fabrics-Airships, 58.—T. 2212.) Pp. 10. 9*d*. net. No. 1037 (M. 46): Mechanical Properties of Pure Magnesium and certain Magnesium Alloys in the Wrought Condition. By S. L. Archbutt and Dr. J. W. Jenkin. Work performed at the National Physical Laboratory for the Engineering Research Board of the Department of Scientific and Industrial Research. (B. 1. a. Materials, Strength and Properties, 52.—T. 2206.) Pp. 13+2 plates. 9*d*. net. (London: H.M. Stationery Office.)

Government of Madras: Law (Education) Department. Administration Report of the Madras Government Museum and Connemara Public Library for 1925–26. Pp. 8. (Madras: Government Press.)

Union of South Africa: Department of Agriculture. Bulletin No. 9: The Codling Moth; Measures necessary more effectively to Control the Pest. By Dr. F. W. Pettey. Pp. 15+7 plates. Division of Chemistry Series No. 63: Soil Formation and Classification. By Dr. B. de C. Marchand. Pp. 8. Division of Chemistry Series No. 64: On the Composition of the Fractions separated by Mechanical Analysis from some Transvaal Soils. By Dr. B. de C. Marchand and C. R. van der Merwe. Pp. 16. (Pretoria: Government Printing and Stationery Office.)

University of Cambridge: Solar Physics Observatory. Thirteenth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1925 April 1—1926 March 31. Pp. 8. (Cambridge.)

Proceedings of the Royal Irish Academy. Vol. 37, Section A, Nos. 4, 5: Two-Electron Orbits, by Dr. A. W. Conway and G. Keating; The Dynamics of the Spinning Electron, by Dr. A. W. Conway. Pp. 40-57. 1*s*. Vol. 37, Section A, No. 6: Atmospheric Dust and Condensation Nuclei. By R. K. Boylan. Pp. 58-70. 1*s*. Vol. 37, Section B, No. 14: The Influence of the Thyroid Gland on the Plumage of the Fowl. By Dr. F. W. Rogers Brambell. Pp. 117-124+1 plate. 1*s*. Vol 37, Section B, No. 15: A List of the Harvest Spiders of Ireland. By D. R. Pack-Beresford. Pp. 125-140. 1*s*. Vol. 37, Section B, Nos. 16, 17: Some Derivatives of γ-Piperonylidene-Methylethylketone, by Brendan O'Donoghue, Dr. Hugh Ryan and Dr. John Keane; Some Derivatives of α-Piperonylidene-Methylethylketone, by Brendan O'Donoghue, Dr. Hugh Ryan and Dr. John Keane. Pp. 141-153. 1*s*. Vol. 37, Section B, Nos. 18, 19: Notes on the Staminate Cone of *Larix leptolepis*, by Prof. Joseph Boyle; The Ovule of *Larix* and *Pseudotsuga*, by Prof. Joseph Boyle. Pp. 154-180+4 plates. 1*s*. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

FOREIGN.

The University of Chicago. Publications of the Yerkes Observatory, Vol. 4, Part 5: A Comparison of the Photometric Fields of the 6-inch Doublet, 24-inch Reflector, and 40-inch Refractor of the Yerkes Observatory, with some Investigation of the Astrometric Field of the Reflector. By Alice Hall Farnsworth. Pp. v+37. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press.)

Las estrellas variables cefeidas. Por Victoriano F. Ascarzo. (Publicado en el Anuario del Observatorio de Madrid para 1927.) Pp. 112. (Madrid.)

Arkiv för Matematik, Astronomi och Fysik utgivet av K. Svenska Vetenskapsakademien. Band 19A, No. 16, Meddelande från Lunds Astronomiska Observatorium, No. 109: On Star Streams. By C. V. L. Charlier. Pp. 23. Band 19A, No. 19, Meddelande från Lunds Observatorium Astronomiska, No. 110: The Relation between Absolute Magnitude and Proper Motion. By K. G. Malmquist. Pp. 32. Band 19B, No. 13, Meddelande från Lunds Astronomiska Observatorium, No. 111: Über die Entfernung des offenen Haufens NGC 752. Von K. G. Malmquist. Pp. 4. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.; London: Wheldon and Wesley, Ltd.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 535: A Fundamental Basis for Measurements of Length. By H. W. Bearce. Pp. 393-408. (Washington, D.C.: Government Printing Office.) 5 cents.

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 16, Part 2: Physico-Chemical Studies on the Specificity of Proteins of different Rice Varieties and Subvarieties, by Tetsutarō Tadokoro, Yukihiko Nakemura and Shukichi Watanabe; On the Differences between some Colloidal and Chemical Properties of Common and Glutinous Rice Starch, II, by Tetsutarō Tadokoro. Pp. 73-123. (Sapporo.)

Bulletin of the American Museum of Natural History. Vol. 55, 1926: The Distribution of Bird-Life in Ecuador; a Contribution to a Study of the Origin of Andean Bird-Life. By Frank M. Chapman. Pp. xiv+784+30 plates. (New York City.)

Annuaire de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique, 1926. 92e année. Pp. 214+6 planches. (Bruxelles: Maurice Lamertin.)

CATALOGUES.

Optical Glass. Pp. 10. (Little Chester, Derby: Parsons Optical Glass Co.)

Apparatus for Radiology: a Supplementary Abridged List. Pp. 14. (London: Newton and Wright, Ltd.)

The Cambridge Bulletin. No. 55, October. Pp. 32+8 plates. (Cambridge: At the University Press.)

A Catalogue of Books relating to the Sea; also Atlases, Log Books, and Books on the South Seas. No. 487. Pp. 66+6 plates. (London: Francis Edwards.)

Lager-Katalog Nr. 190: Allgemeine Geologie, Geophysik. Pp. ii+420. (Leipzig: Max Weg.)

Catalogue of Important Books and Papers on Zoology, Botany and Gardening, Agriculture, Geology, Palæontology, and Mineralogy. No. 146, November. Pp. 56. (London: Dulau and Co., Ltd.)

Diary of Societies.

SATURDAY, NOVEMBER 27.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. G. C. Simpson: Atmospheric Electricity (1).

MONDAY, NOVEMBER 29.

INSTITUTE OF ACTUARIES, at 5.—H. E. Raynes: The Mortality of Europeans in British West and British East Africa.

INSTITUTION OF AUTOMOBILE ENGINEERS (Loughborough Graduates' Meeting) (at Loughborough College), at 7.—S. Robertson: Crank Shafts.

INSTITUTION OF ENGINEERS-IN-CHARGE (at Gas Light and Coke Co., Church Street, Kensington), at 7.30.—J. Ennals: The Uses of Gas in Industry.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Dr. Dorothy Wrinch: Scientific Methodology and the Quantum Theory.

ROYAL SOCIETY OF ARTS, at 8.—Prof. H. L. Callendar: Recent Experiments on the Properties of Steam at High Pressure (Howard Lectures) (III.).

INSTITUTION OF WELDING ENGINEERS (at Caxton Hall, Westminster), at 8.—Dr. J. H. Paterson: Thermal Disturbance in Iron and Steel during Welding.

TUESDAY, NOVEMBER 30.

ROYAL SOCIETY, at 4.—Anniversary Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: The Imperfect Crystallisation of Common Things (2).

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. B. Cott: A Naturalist on the Amazon (Lecture).

CHEMICAL INDUSTRY CLUB, at 8.—Annual General Meeting.

WEDNESDAY, DECEMBER 1.

ELECTRICAL ASSOCIATION FOR WOMEN (at 49 Wellington Street, W.C.2), at 3.—Mrs. D. D. Cottington Taylor: Modern Housekeeping.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. P. C. Varrier-Jones: Settlements for Tuberculous Workers.

PHILOSOPHICAL SOCIETY OF ENGLAND (at 138 Piccadilly), at 4.30.—Mrs. Champion de Crespigny: The Evolution of the Inner Self.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—H. Williams: The Geology of the Snowdon Massif (North Wales).—Dr. A. Heard: On Old Red Sandstone Plants showing Structure from Brecon (South Wales).

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Dr. R. V. Hansford and H. Faulkner: Some Notes on the Design Details of a High-Power Radio Transmitter using Thermionic Valves.

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

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall), at 7.—H. C. B. Berkhout: The Use of Special Slide Rules in Computing Hot-Water Installations.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Newcastle-upon-Tyne), at 7.15.—G. J. Allan: Ice-breakers and their Services.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section, Middlesbrough Branch) (at Middlesbrough), at 7.30.—S. Stansfield: Behaviour of Metals under Special Conditions of Temperature and Stress.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—Dr. W. G. Savage: Recent Advances in the Bacteriological Methods of Examining Food and Water.—E. B. Hughes: The Detection of Furfural in Vinegar.—E. R. Dovey: The Rapid Determination of Opium in Stomach Contents.—C. H. Manley: A Rapid Method for the Sorting of Butters and Margarines.

ROYAL SOCIETY OF ARTS, at 8.—G. Constantinesco: The Torque Converter.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—Prof. G. E. Gask, S. Handley, and others: Discussion on The Treatment of Gangrene of the Extremities.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY DECEMBER 2.

ROYAL SOCIETY, at 4.30.—Prof. T. M. Lowry and W. R. C. Coode-Adams Optical Rotatory Dispersion. Part III. The Rotatory Dispersion of Quartz in the Infra-Red, Visible and Ultra-Violet Regions.—Prof. O. W Richardson: Structure in the Secondary Hydrogen Spectrum. V.—R. H. Fowler: General Forms of Statistical Mechanics, with special reference to the New Quantum Mechanics.—R. H. Fowler and Dr. E. K. Rideal: On the Rate of Maximum Activation by Collision for the Complex Molecules with Applications to Velocities of Gas Particles.—Prof. H. Dingle: The Spectrum of Fluorine (FI).—*To be read in title only*:—Prof. H. M. Macdonald: Integrals of the Equations of Electrodynamics, with an application to the Electric Constants of a Transparent Medium.—Prof. L. N. G. Filon: The Forces on a Cylinder in a Stream of Viscous Fluid.—R. C. Johnson: The Structure and Origin of the Swan Band Spectrum of Carbon.—Prof. W. A. Bone: Studies upon Catalytic Combustion, III.—A. Ross: Absorption Spectra of Pyrone Derivatives in the Near Infra Red.—Prof. S. R. Milner: An Analysis of the Electromagnetic Field into Moving Elements.—A. J. Bradley and J. Thewlis: The Structure of γ-Brass.—H. R. Robinson and A. M. Cassie: The Secondary and Tertiary Cathode Rays produced by External and Internal Absorption of Homogeneous X-rays.—W. Edmondson and A. Egerton: The Vapour Pressure and Melting Points of Sodium and Potassium.—W. Edmondson and A. Egerton: The Chemical and other Thermal Constants of Sodium and Potassium.—Dr. G. W. C. Kaye and W. F. Higgins: The Thermal Conductivity of Vitreous Silica, with a Note on Crystalline Quartz.—Prof. E. T. Whittaker: On Hilbert's World-Function.—Prof. E. V. Appleton and M. A. F. Barnett: On Wireless Interference Phenomena between Ground Waves and Waves deviated by the Upper Atmosphere.—W. H. George: An X-Ray Study of Isomorphism in Simple Organo-metallic Series. Part I. The Tetraphenyls.—J. Aberdeen and Prof. T. H. Laby: Conduction of Heat through Powders and its Dependence on the Pressure and Conductivity of the Gaseous Phase.—D. B. Deodhar: Supplementary Tables of Wave-lengths of New Lines in the Secondary Spectrum of Hydrogen.—J. A. V. Butler: The Equilibrium of Heterogeneous Systems including Electropytes. Part II. Equilibrium at Interfaces and the Theory of Electrocapillarity.—N. K. Adam: A Further Note upon 'Inter-traction.'—J. Topping and Prof. S. Chapman: On the Form and Energy of Crystalline Sodium Nitrate.

ROYAL SOCIETY OF MEDICINE, at 5.—Dr. B. Kelly: Nervous Affections of the Œsophagus (Semon Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. R. R. Marett: The Archæology of the Channel Islands (3): Neolithic and Bronze Ages.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. F. O'dell: An Outline of the Thinking Aspect of Automatic Telephones.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—P. B. Henshaw: Valve Steels for Aero Work.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7.30.—Dr. G. Martin: The Relative Efficiency of the Grinding Media employed in Ball and Tube Mill Grinding.

CHEMICAL SOCIETY, at 8.—F. Challenger and V. K. Wilson: Dicyanates and Dibenzoates of Triphenylbismuthine and Triphenylstibine.—F. Challenger, V. Subramaniam, and T. K. Walker: The Mechanism of Citric and Oxalic Acid Formation from Sugar by *Aspergillus niger*. Part I.

MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W.), at 8.30.—Prof. H. Littlejohn and Dr. D. Kerr: Monoxide Poisoning: Its Increasing Medico-Legal Importance.

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch) (at Glasgow).—E. T. Vincent: Combustion and Detonation in Heavy Oil Engines.

FRIDAY, DECEMBER 3.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—F. J. W. Whipple: On the Propagation of Sound to Great Distances. Chairman: Sir Gilbert Walker.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at 16 St. Mary's Parsonage, Manchester), at 7.—Prof. J. C. Drummond: Chemical Aspects of Organic Evolution.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—A. E. Harris: Industrial Ventilation.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—W. G. Hill: The Improvement of Bromide Prints: a New Method of Working-up (Lecture).

PHOTOMICROGRAPHIC SOCIETY (at 4 Fetter Lane), at 7.—F. Welch: The Photomicrography of Bacteria.

JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—Presentation of Medals and Awards, and Induction of Eng. Vice-Admiral Sir Robert B. Dixon as President, and Address on The Progress of Marine Engineering.

GEOLOGISTS' ASSOCIATION, at 7.30.—S. W. Wooldridge: The Early Pliocene Period in the London Basin.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. R. M. Dawkins: Medieval Cypriot.

ROYAL SOCIETY OF MEDICINE (Otology, Medicine, and Neurology Sections), at 8.15.—Sir William Milligan, Dr. W. J. Adie (for the Section of Neurology), G. J. Jenkins (for the Section of Otology): Discussion on The Relations of Abnormalities of the Blood-pressure to Diseases of the Ear.

SATURDAY, DECEMBER 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. G. C. Simpson: Atmospheric Electricity (2).

PUBLIC LECTURES.

SATURDAY, NOVEMBER 27.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Nature in Southern England.

SUNDAY, NOVEMBER 28.

GUILDHOUSE (Eccleston Square), at 3.30.—Viscount Haldane: The Wider Meaning of Relativity.

WEDNESDAY, DECEMBER 1.

UNIVERSITY COLLEGE, at 5.—Prof. H. E. Roaf: Colour Vision. (Succeeding Lecture on December 8.)—At 5.30.—Lt.-Col. J. M. Mitchell: The Public Library Service in America.

KING'S COLLEGE, at 5.30.—Dr. C. D. Broad: The Present Position of the Logic of Induction.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 6.—F. Hutchinson: Office Machinery in the United States (1).

THURSDAY, DECEMBER 2.

ROYAL SOCIETY OF MEDICINE, at 5.—Dr. A. Brown Kelly: Nervous Affections of the Œsophagus (Semon Lecture).

KING'S COLLEGE, at 5.30.—M. Beza: Roumanian Customs at Christmas and New Year.

COLLEGE OF NURSING (Henrietta Street, W.1), at 5.30.—Prof. Winifred Cullis: Adolescent and Social Hygiene from the Standpoint of the School.

ROYAL SOCIETY OF MEDICINE, at 8.—Sir Henry Gauvain: Sun, Sea, and Open Air in Relation to Health and the Prevention of Disease (Chadwick Lecture).

SATURDAY, DECEMBER 4.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Egyptian Hieroglyphs.

SUNDAY, DECEMBER 5.

GUILDHOUSE (Eccleston Square), at 3.30.—Sir George Newman: The Contribution of Medical Science to Human Life.