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State-Aided Research in Great Britain*

THE report of the Department of Scientific and Industrial Research for the period 1931–32 contains more encouraging reading than might at one time have been expected in view of the drive for national economy exemplified in the report of the May Committee and elsewhere. The absence of spectacular results in the year under review assists in the task of appraising the work of the Department in relation to national needs and more particularly in regard to new industrial development. There can be little room for doubt that the Department has discharged its difficult task with conspicuous success and that in applying available funds to work of the most immediate practical value to industry, there has been no sacrifice in the interests of supposed economy of the essential efficiency of industrial research organisations, built up over a long period of steady and patient endeavour with the assistance of public funds. True to its firm conviction that unless industry persistently applies scientific method and scientific knowledge to its problems it cannot escape from the difficulties with which it is surrounded, the Advisory Council has at least succeeded in preserving so far as possible the organisation for the pursuit of more fundamental inquiries upon which the future of all industrial research work must depend.

Leaving on one side for the moment this question of fundamental research, the Department's own report indicates how well deserved has been the praise which has recently been lavished upon it by spokesmen of finance as well as the authoritative tributes to its organisation paid last year by the Committee of New Industrial Development of the Economic Advisory Council and by Sir Harold Hartley in his address to the Institute of Transport. These tributes are, however, to be welcomed not merely as indication of appreciation of work already done, but more especially as betokening that spirit of general co-operation upon which the work of the Department is essentially founded.

Upon this question of co-operation the Report of the Advisory Council lays considerable stress. In relation to fuel research, for example, after explaining the importance of provision for an adequate programme of laboratory work and pointing out that extensive laboratory work is the best way of developing that real understanding

* Department of Scientific and Industrial Research. Report for the Year 1931–32. (Cmd. 4254.) Pp. iv+193. (London: H.M. Stationery Office, 1933.) 3*s*. net.

of root problems which may lead not merely to minor improvements in existing processes but also to suggestions for radical changes in production or in methods of utilising a raw material, the Report continues: "We were also impressed with the extent to which the research stations of the Department are bound to depend for their success upon the co-operation of industrial organisations. The most effective criterion of the value of industrial research is the extent to which its results are put into practice, but the application of the results is difficult to secure unless industry is prepared to take a real interest in the research work in progress."

No feature of the Report is more encouraging than the evidence that is afforded of such co-operation on the part of industry, of a growing realisation that the organisations of the Department are public concerns intended to promote the national welfare and the development of the industries with which they are associated. Certain of the research associations have, for example, succeeded in widening the basis of their membership by the inclusion of industrial groups which are interested either as manufacturers or users in materials discovered or improved by scientific research. Refractories research is an example in point of research which should not be left entirely to the makers of refractories to finance; and there are indeed already signs that the gas, electrical, iron and steel, coke-oven and pottery industries are more disposed to recognise such responsibility and co-operate in support of this work.

The British Non-Ferrous Metals Research Association has been conspicuously successful in this way, and the commercial possibilities of the new ternary lead alloys discovered by the Association have directly resulted in the enrolment of a large number of members from the lead manufacturing industry. Both the address of Sir Harold Hartley and the report of the Committee on New Industrial Development referred to above afford evidence of the approach of the railway companies towards research in these fields, while on the other hand the Cotton Research Association provides an example of conspicuous success attending an active liaison policy. Demonstration of the practical value of its results by sending members of its liaison staff out to mills and works in a series of more than two thousand visits in 1930–31 has given definite evidence of steadily increasing interest and appreciation of the value of scientific research through the industry as a whole.

This attempt to broaden the basis of a research association is, however, only a particular aspect of industrial research to which the Report directs special attention. While the need for research on the production of commodities is as strong as ever, even stronger is the need for research into their utilisation. In almost every industry to-day strenuous effort is directed to the application of old materials to new uses and to the discovery of uses for new materials, and such effort figures prominently in the programme of most of the research associations. Whether it is a case of finding new markets for existing products, of creating a wide demand for a commodity and thus reaping the advantages of modern methods of production, or of discovering the most suitable material for a particular purpose, it is equally important that the chemical and physical properties of the materials concerned should be fully understood.

The stress thus laid on the need of finding new uses and new markets for the products of industry not only encourages, as already indicated, the growth of a spirit of co-operation throughout industry, and particularly between user and consumer, making for better service as well as for more efficient production, but also contributes to that continued industrial development upon which the success of British industry depends. Without such continuous development under the guidance of applied science there can be little hope of survival, much less of recovery for our industrial enterprises in this era of international trade. Of the assistance given by the Department to such new industrial development the Report provides several instances, and it does not appear that the Department has failed, either in its functions of co-ordinating and acting as a clearing house of information from research associations and other organisations, or in the encouragement of the large-scale tests which form the final stage in development research.

Such limitations as have been imposed on the work of the Department in this respect are in the main financial. There has, for example, been a serious reduction in the income which the National Physical Laboratory derives from payments for tests and investigations and from contributions by industry to researches for its particular benefit. This is an unavoidable consequence of industrial depression.

These difficulties, however, are by no means the most disquieting feature of the report. In spite of signal services rendered to their respective industries, certain of the research associations have

found themselves in acute financial difficulties and the termination of the activities of the Cutlery Research Association has been followed by the suspension of the activities of the Research Association of the British Rubber Manufacturers. The Department's report comments on the lamentable lack of interest displayed by the cutlery industry in its Research Association as evidenced, for example, by a decline in membership from fifty to ten firms in a couple of years. Similarly, in spite of the highly important and industrially valuable results it has obtained, the British Cast Iron Research Association has had great difficulty in maintaining its industrial income, and in keeping its work going on an adequate scale; to make the Association self-supporting a substantial grant has been made by the Department for the period July 1, 1931–June, 1933.

The position of the Research Association of the British Rubber Manufacturers is related to another aspect of this question upon which the Report also touches. The Association ceased to operate on March 1 for lack of funds. A measure authorising a levy for its support and maintenance on firms in the rubber industry had been introduced into the House of Commons, but as a private member's bill, and it failed to come before the House in time. The Government has, however, now introduced a Rubber Industry Bill in the House of Lords (see NATURE, May 6, p. 650), so that we may hope shortly to see the Association at work again. There would be something farcical in a situation in which, after the State had contributed some £35,000 to the financing of research in an industry, an effort of the industry to place its research activities on an adequate self-supporting basis should have been limited to the introduction of a private member's Bill at the mercy of the slightest opposition from an active individualist minority.

When commenting, however, on the effect of recent political, financial and economic developments, the Advisory Council expresses the earnest hope that "the protection which has now been afforded to certain industries in the home market will be regarded as an opportunity for effecting the changes in organisation, the installation of modern plant, the development of research work and the employment of educated staffs which the experience of the last few years has shown to be necessary in some industries if they are to compete on level terms with industries in other parts of the world."

This is a point of view which might well have been much more forcibly expressed. A good deal of stress has been laid, in arguing the case for tariff protection of particular industries, on the opportunity which such protection affords for research and development and reorganisation on scientific lines. It has indeed been asserted that such temporary protection should be conditional on the industry undertaking to prosecute research and development on a scale adequate to accumulate a sufficient reserve of fundamental knowledge to assist both in tiding over bad times and in meeting independently competition from abroad. Unfortunately, already some industries show signs of a false sense of ease and security leading to relaxation of much needed effort of this kind, and the comment of the Advisory Council is welcome.

It should scarcely be necessary to add that, under tariff conditions more than ever, the technical efficiency of an industry ceases to be a purely domestic matter for the industry itself. When the community has voluntarily surrendered its right to purchase without interference, the protected industry must in return take a much less individualistic view of its obligations to the community. Under such conditions the community should not be expected to be satisfied with less than the highest possible standard of scientific and technical efficiency within the industry. The Government, once it adopted a tariff policy, should have allocated a portion of the revenue thus obtained for the more intensive and extensive prosecution of research in every branch of industry; its omission to do so is a sign that it does not realise the vital importance of industrial research as a factor in national recovery. Without detracting in the least from the ability with which the Department of Industrial and Scientific Research has carried out its varied tasks or the magnitude of the results already achieved, it is still possible to feel that its representations to the Government in certain fields have not been so effective as could have been desired. It is to be hoped that the success and expansion of the various stations now maintained directly under the control of the Department will not be allowed to weaken its interest and support of a scheme of research associations which, as the Committee on New Industrial Development has pointed out, has no counterpart in any other country and represents an attempt to build up an organisation of industrial research adapted to British needs and British psychology.

An Indian Sage

Life and Experiences of a Bengali Chemist. By Prafulla Chandra Rây. Pp. viii+557+6 plates. (Calcutta: Chuckervertty, Chatterjee and Co., Ltd.; London: Kegan Paul and Co., Ltd., 1932.) 7*s*. 6*d*.

A MORE remarkable career than that of P. C. Rây could not well be chronicled. The story told is not only fascinating: it has an altogether special value, as a presentation of a complex mentality, unique in character, range of ability and experience. The caption,

"nothing extenuate
Nor set down ought in malice,"
Othello.

set against the preface, is an indication of the spirit in which the book is written. In part, the study of a life overfull of action, of unusually varied occupations and interests; in no small degree, it is also a dispassionate statement and discussion of pressing, Indian, social problems; as a whole, therefore, it has exceptional value, scientific and social.

(Sir) Prafulla Chandra Rây was born on August 2, 1861. His father (born 1826), a landed proprietor, he tells us, began his career "like a country gentleman in the days of Fielding and had many traits in common with Squire Allworthy". That a Hindu should draw such comparison is remarkable, if only as proof of familiarity with a class of English literature not within even our ordinary range: the book teems with similar, often remote, literary references, showing how fully the author is possessed by the English spirit. This is accounted for by the fact that his father, who was a man of considerable culture, not only proficient in Persian —then the Court language in India—with a smattering of Arabic, also possessed a fair knowledge of classical English literature, acquired at Krishnagar College, under the principal, Capt. Richardson, a pioneer educationist in Bengal and author of "Lives of the British Poets"—a book Rây speaks of as "a priceless heirloom which he has read over and over again". A now surprising item of information he learnt from his father, when almost a child, he tells us, should be here mentioned, "that beef-eating was quite in vogue in ancient India and that the very word for 'guest' in Sanskrit is 'Goghna' (one in whose honour the fat cow is killed)".

Up to nine years of age, Rây was educated at his father's village school; in 1870, the family removed to Calcutta. We learn incidentally that, at that time, water-works had just been completed, so that the town enjoyed the blessing of a liberal supply of properly filtered, drinking water, which, however, the orthodox Hindu long refused to make use of "as being impure".

In 1874, Rây suddenly fell a victim to severe dysentery. Previously of robust constitution and healthy, the disease left him a permanent valetudinarian, a victim of sleeplessness and obliged always to subject himself to a strict dietary regimen and discipline. This makes the great activity he has displayed, throughout his life, all the more remarkable. During the two years he was away from school, he indulged in an orgy of reading. It is more than interesting to note how the Indian duck took to the water of an English classic literature. With such example before us—and India furnishes not a few—we might well try the experiment if it be possible to train English youth by close study of our English literature, leaving all classical study to a post-graduate period—*pace* the former headmaster of Westminster School: 'Oh, English—it's their own language!' Struck by the similarity between Sanskrit and Latin, he made a study of the latter, without the help of a teacher, gaining a passable knowledge of this language and of French. Sanskrit he learnt as a matter of course. Later, in carrying on his final studies in arts, he also attended lectures on chemistry and on physics at the Presidency College. He came under my student friend the late Sir Alexander Pedler and was greatly attracted by his manipulative skill: almost unconsciously he began to acquire a predilection for chemistry. Besides sitting for the B.A., he prepared privately for the Gilchrist scholarship examination and was ultimately one of the two Indian winners.

Rây left for England in August 1882 and entered the University of Edinburgh in the following October. His subjects of study were chemistry, physics, botany and zoology. In chemistry, he came under Crum Brown, of whom he speaks as "now growing indolent and fat" but he adds, "He revelled in speculation and every student of organic chemistry must be grateful to him for the graphic formulæ which he introduced, which considerably helped the progress of our science." However, he learnt to esteem him and the atmosphere was such that he became passionately fond of chemistry. He had Hugh Marshall, Alexander

Smith and James Walker as fellow students; J. Gibson and L. Dobbin were the assistants.

Rây's studies for the B.Sc. were interrupted, for a time, when an announcement was made that a prize would be given for the best essay on "India before and after the Mutiny". He read hard and very widely for this and discovered that he had the faculty of writing with some facility. Although not successful, his essay and another's were bracketted *Proxime accesserunt;* in it, 'he indulged in many bitter diatribes against British rule'—the child was already father to the man. The interruption was only temporary; the essay written, he gave himself up heart and soul to chemistry and gained his doctorate in the inorganic branch. As Hope prize fellow, he took part in the laboratory teaching and claims to have given Hugh Marshall a cobalt salt, which he had prepared, for analysis, which led Marshall to his well-known important discovery of persulphates. He tells of having asked the advice of Prof. Dittmar, a former assistant of Crum Brown, whether he should follow the example set by James Walker in taking up physical chemistry. The reply was—"Be a chemical chemist first!" Many more than know it have cause to rue the fact that such advice has not been theirs and followed. The argument applies equally to the more modern craze biochemistry.

Rây has much to say of the Scottish student's life. Living was cheap. A substantial penny breakfast was by no means uncommon: oatmeal porridge and milk. He recalls Carlyle's account, showing how boys in his day were sent to the University at fourteen and left to fend for themselves—living on the simplest fare from their farm homes and protected by poverty from vicious amusements. Some of us think that it may be well to restore such conditions—if education is to be of value as a preparation for life—if we are to recover our social balance.

At the end of six years, Rây returned to Calcutta, in the summer of 1888. After a year, he secured a professorial post at the Presidency College, Calcutta, becoming a junior colleague to Prof. Pedler, whom he ultimately succeeded. It is a noteworthy fact, showing the innate practical bent of his nature—on which he dilates—that, as soon as he had spare time, he began to work on butter and mustard oil, the two sources of fat in the dietary of the masses in Bengal; this occupied him during nearly three years.

He also engaged in social service. Troubled by the poverty of Bengali literature, on the scientific side, he wrote a primer on zoology, recognising that nature study offers more attractions to the juvenile mind than chemistry. His practical instincts then led him to add to his professorial activities that of a chemical manufacturer and ultimately to establish the Bengal Chemical and Pharmaceutical Works, Ltd. The firm at present employs 2,000 hands. It was a substantial organisation when I visited him in 1914.

A new laboratory for the Presidency College was begun in 1892 and first occupied in July 1894. In 1896, Rây became famous through his discovery of mercurous nitrite, a compound of unexpected stability. The study of the nitrites became his life work in the laboratory and was pursued by him so persistently that the myopic in our Chemical Society almost came to regard him as a public nuisance. He quotes, in this connexion, remarks I made when visiting the Presidency College in the autumn of 1914—"The way in which you have gradually made yourself 'master of nitrites' is very interesting and the fact that you have established, that, as a class, they are far from being the unstable bodies chemists had supposed, is an important addition to our knowledge." As an example of thoroughness his work on the subject stands apart.

He took care from the beginning, however, unlike most European workers, to divide his time equally between the study and the laboratory. After years of severe literary labour, he produced his well-known "History of Hindu Chemistry"—a work which has won universal praise, especially from Berthelot. As he rightly remarks: "English chemists as a class are rather indifferent to the history of chemistry and since the days of Thomson scarcely a single authoritative work on the subject has been written in English by any one of them. They have, in fact, contented themselves with simply translating Ladenburg's or Meyer's treatise dealing with the subject." The University of Durham stands out in having given Rây an honorary D.Sc., in 1912; in conferring the degree, the Vice-Chancellor spoke of his fame chiefly resting upon his monumental history of Hindu chemistry.

In 1916, he retired from the Presidency College to join the newly founded University College of Science. He had done a great work there.

From 1921 onwards, he has been much drawn into educational and political movements, in which he has been a leader. He has also played a leading part in organising relief works against

famine and floods. Half the book is devoted to discussion of these activities. The account is worthy of the closest study by those who are interested not only in the future of India but also in the larger problem of education, in general, in relation to the practical needs of the taught.

Our recognition of Rây's services, as chemist, as teacher, as historian and as founder of a great national school of scientific inquiry, is long overdue —it is nothing short of a reproach to our Royal Society that it should hitherto have been so narrow in its outlook as not to include his name in the roll of fellowship.

Often severely critical, Sir P. C. Rây is undoubtedly anti-English in his present sympathies —but he is mainly so on account of his greater sympathy with his fellow Indians—and his criticisms are constructive. He has much to say of faults in the drainage system and is a strong advocate, with Gandhi, of the return of the spinning wheel, in place of the textile factory, in order to provide work for idle hands to do during the long period of unemployment between crops—a problem which we should consider. He deprecates the insane craze for university education—a disease to which we also are subject—finding great fault with the system. His views are summarised in the statement—Western civilisation is our ruin ; we are on the way dimly to foresee that it may be ours. Nothing can compensate for lack of proper occupation and substitution of the machine for the man.

From beginning to end, the message of the book is one of the highest endeavour, pulsating with vitality and intellectual force. Few pages are without proof that the author is steeped in our best traditions, no mere nationalist. Full of hope for the future, he ends by saying :

"There is no reason why the Bengali, or for the matter of that, the Indian, should lag behind and not fulfil his destiny. I almost hear the echoes of the organ voice of the author of *Areopagitica*, '*Methinks I see in my mind a noble and puissant nation, rousing herself like a strong man after sleep and shaking her invincible locks.*' "

A man who begins with Othello and can thus end with Milton must be one with ourselves : ultimately, such a spirit cannot be at variance with ours and our joint task should be to strive to work together in fullest harmony of purpose—as complementary parts of one nation.

HENRY E. ARMSTRONG.

A Symposium on Science

Science in the Changing World. By Thomas Holland, H. Levy, Julian Huxley, John R. Baker, Bertrand Russell, Aldous Huxley, Hugh I'A. Fausset, Hilaire Belloc, J. B. S. Haldane, Oliver Lodge. Edited by Mary Adams. Pp. 286. (London : George Allen and Unwin, Ltd., 1933.) 6*s*. net.

IT cannot be said—if we listen-in to the programmes broadcast by the British Broadcasting Corporation—that the British public is ill-provided with views as to the leading questions which exercise the public mind. The volume referred to above, a collection of talks, is an admirable example of a great subject, fairly treated by competent speakers on all its main sides. They have all the character of clear and interesting exposition ; they are well arranged and answer one another so far as is possible in this form of discussion ; they are summed up and reconciled by the greatest master in this art, Sir Oliver Lodge. The gist of the volume is, of course, the enormous importance of science in the contemporary world and its possibilities for the future good of society, if we know how to make use of it rightly. Only two, what may be called negative, voices are admitted, Mr. Hugh Fausset's and Mr. Hilaire Belloc's. They say some wise words which are in substance complementary to the main theme, and are duly appreciated as such in Sir Oliver's concluding chapter.

Those who look for information and definite fresh views will find most of them in the two sections contributed by Prof. H. Levy and Dr. J. R. Baker. They were allowed the larger space and made excellent use of it. Prof. Levy, giving again the point of view developed in his "Universe of Science", with some lively detailed illustrations drawn from an aeronautics research laboratory, describes the general scope of science and the procedure of the scientific investigator. He has six chapters. Dr. Baker, in four, gives a masterly and delightful account of man's biological position, comparing him with the other primates, and summing up the main stages, which in the present century have re-created for us on an unassailable scientific basis the early human type which stood just above the apes. This particular section will probably be found the most useful in the book for those who desire a clear statement of a profoundly interesting advance in scientific thought, unencumbered by the multitude of facts, names

and classifications which generally accompany it.

There is one section of the book which is calculated to set people thinking on lines which reach rather further than the rest, indeed raise the deepest questions which may be suggested by the title. This is Prof. Julian Huxley's paper on "Man and Reality". He takes up the now well-known point connected with the name of Sir James Jeans—rather an *obiter dictum* when it was first uttered—that mathematical analysis seems to lead us to the idea of a mind of mathematical quality as the creating force in the universe. Prof. Julian Huxley, speaking as a biologist, replies that to him mind is an integral part of the universe, that something of the nature of mind must inhere in the essence of things. In this case the general conclusion would be that "the pressure of circumstances", what other thinkers have called the action of the "life-force", has driven mind to become more and more important and elaborate, until finally in man it has become self-conscious and the most important single characteristic of the most important embodiment of the life-force. This is Prof. Huxley's thesis, slightly paraphrased. We stress it here in contrast with the creative mathematical idea as the most profound and general topic which arises from the subjects treated in this symposium.

Those concerned with philosophical thought and teaching at the universities may well reflect on the need of coming more closely to grips with questions which go to the root of our view of the universe and man's position and prospect in it. The eager response which greets the occasional utterances of thinkers like Jeans and Eddington when they let themselves go, indicates clearly the public demand for guidance. It cannot be said that so far English philosophers as a whole have realised the need, or striven seriously to qualify themselves to meet it. F. S. MARVIN.

Reflexology

General Principles of Human Reflexology: an Introduction to the Objective Study of Personality. By Prof. Vladimir Michailovitch Bechterev. Translated by Emma and William Murphy from the Russian of the 4th (1928) edition. Pp. 467. (London: Jarrolds Publishers (London), Ltd., 1933.) 21*s.* net.

BRITISH and American workers in psychology owe a debt of gratitude to the translators and publishers of this book for making accessible to them the life-work of the late Prof. Bechterev. Although somewhat overshadowed by the greater international reputation of Prof. Pavlov, Bechterev is an important and influential figure. He taught the essentials of behaviourist doctrine before the American school of behaviourists was born, and yet avoided some of the more indefensible exaggerations of J. B. Watson and his followers.

The essence of Bechterev's method is the abandonment of all reference to conscious processes, and the investigation only of reflexes and behaviour. Such non-subjective study has, in fact, added much to our knowledge of human psychology, not only as used by Bechterev and the behaviourists but also in the hands of other psychologists, since none but eccentrics resemble the 'subjectivist' of Bechterev's criticism in interesting themselves only in states of consciousness.

Every method of attack is justifiable in psychology if it leads to fruitful results in increased knowledge of human behaviour and thought. Every method becomes dangerous when its advocates begin to claim that it is the sole scientific method in psychology. Bechterev was convinced not merely that he was founding a new science but also that this was the only science of human personality and behaviour. The value and interest of many of the experiments of Bechterev and his followers must not blind us to the extravagance of this claim. Bechterev's work is indeed not free from the defects of prescientific psychology —such as anecdotalism and speculation. The fourth chapter, on energy, is a bad example of unscientific vagueness. He is content to define energy as "movement", he says that the "thing-in-itself" is merely "potential energy", and speaks of the energy of a nervous current as being "transformed into the molecular energy of the muscles".

The making scientific of our knowledge of human behaviour and thought is not to be accomplished by narrowing the field of study to reflexes and other externally observable data, and leaving the field of conscious data to uncontrolled speculation, but by the application to the widest possible range of psychological data of the proved methods of science—exact observation and experiment, measurement wherever this is possible and the sceptical testing of numerical results by statistical methods. To this desirable end, Bechterev's reflexology seems to have made a lesser contribution than might have been hoped.

R. H. T.

Short Reviews

Annual Reports on the Progress of Chemistry for 1932. Vol. 29. Pp. 344. (London: Chemical Society, 1933.) 10*s.* 6*d.* net.

The appearance at the end of each February of the "Annual Reports on the Progress of Chemistry", issued by the Chemical Society, is naturally an event of some importance in the chemical world. The value of this publication is not, however, restricted to chemists, but is apparent to those who are interested in almost any of the natural sciences. This year the report on general and physical chemistry is the joint work of Mr. E. J. Bowen, Mr. C. N. Hinshelwood, Dr. N. V. Sidgwick, Dr. H. W. Thompson, and Mr. J. H. Wolfenden, each of whom has written one or more of the nine sections: general; the 'true' degree of dissociation of strong electrolytes; the thermochemistry of electrolytes; quantum mechanics and electrochemistry; chemical kinetics; photochemistry; flames and the mechanism of chemical change; the structure of simple molecules from spectroscopic, X-ray, and electron diffraction data; and general stereochemistry. Prof. H. Bassett again reports on inorganic chemistry, Dr. J. J. Fox and Mr. B. A. Ellis on analytical chemistry, Mr. A. G. Pollard and Mr. J. Pryde on biochemistry. The reports on organic chemistry are on this occasion contributed by Dr. E. H. Farmer (aliphatic), Dr. G. A. R. Kon (homocyclic) and Dr. H. King (heterocyclic). The report on geochemistry by Mr. A. F. Hallimond covers 1931 and 1932, whilst that on radioactivity and sub-atomic phenomena, by Dr. A. S. Russell, is also a two-year report.

So much of fundamental importance and of general scientific interest is discussed that a short review can give but little idea of the subjects examined. As he turns over the pages and sees references to the hydrogen isotope of mass 2, to an announcement that krypton combines with chlorine and bromine, to the reaction $Li^7 + H^1 = 2He^4$, to the discovery of the neutron, to evidence for the existence of elements 85 and 87, and to equally solid, although less spectacular, advances in organic and biological chemistry, it becomes evident to the 'ordinary man of science' who desires to keep abreast of progress in the chemical branch that this is just such a series of appreciations as he needs. A. A. E.

Physikalisch-chemisches Taschenbuch. Herausgegeben von C. Drucker und E. Proskauer. Band 1. Pp. viii+546. 29 gold marks. Band 2. Pp. viii+481. 17 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932–1933.)

The two volumes of the "Physico-Chemical Pocket-Book" are actually small enough to be carried (one at a time) in the pocket; but they include more than 1,000 pages of well-illustrated text and will cost the English buyer more than £3. The text is divided into nine sections as follows: structure of matter, optics, electricity, magnetism, micromechanics (molecular physics), macromechanics, chemical statics and dynamics, heat, systematics of inorganic and organic chemistry. The various sections have been divided amongst a team of some forty-eight writers, several of whom are well-known authorities on the subjects which they handle.

It is difficult to assess the value of such a publication, apart from experience of using it over a considerable period of time. In particular, it does not contain the tables of data that one expects to find in a chemists' pocket-book (for example, no values of Sugden's atomic and molecular parachors are included in the text); it consists rather of a series of brief reviews of our present knowledge of various branches of physical chemistry, and of the methods of measurement which are now in use, with the relevant equations for applying them. A teacher who knows the book well might therefore find it useful to refer his students to particular sections; and a student who has not time to master one of the longer treatises on physical chemistry might find it useful to survey the field with the help of this 'small-scale map'; but in general the book may very well be added to one's collection, in order to compete with neighbouring volumes of abstracts, annual reports, monographs, textbooks and treatises as a means of information and as a pointer to the original sources.

The Proper Study of Mankind. By B. A. Howard. Pp. 254. (London: Ginn and Co., Ltd., 1933.) 3*s.* 6*d.* net.

The headmaster of the Addey and Stanhope School has written an excellent short book on a fascinating topic. Perhaps too it is the most important which faces those who have to train young people for their work in life. How are we to accommodate our teaching of history, morals and religion to the new views of man's early history and evolution?

One must believe that the change will be in the long run strengthening and stimulating, as Mr. Howard makes sufficiently clear in his book; but the transition, the way of pouring in the new wine, calls for very careful thought, and it has not yet come into the range of current and popular discussion. Hence the very interesting, open-minded and high-thinking treatment of the subject in Mr. Howard's volume is specially welcome. Darwinism is assumed as the starting point and its implications fully explored. The stress is rightly laid on the necessity of treating the life-process as one continuous thing of which man is the highest known manifestation, and the fact that man's mind is the supreme factor in the

analysis of the evolution occupies the largest part of the author's small space. How our thinking may be made more effective and reliable is the subject of the concluding sections, and a syllabus, sketching the whole and suggesting points for discussion with a class, is appended.

It is an extremely careful and useful piece of work. If one general critical impression may be added, it is that the tone leans rather more than is necessary towards a gloomy view of the present world-situation and its dangers. F. S. M.

The Flint Miners of Blackpatch. By J. H. Pull. Pp. 152 + 8 plates. (London: Williams and Norgate, Ltd., 1932.) 10*s.* 6*d.* net.

BLACKPATCH, a prehistoric mining site on the Sussex Downs, was discovered by Mr. Pull ten years ago, and since then, with the assistance of Mr. C. E. Sainsbury, he has devoted himself to its excavation. It lies in the middle of a stretch of downland, extending from the Adur to the Arun, which teems with evidence of prehistoric man, including Cissbury and Chanctonbury Rings. Seven mine shafts, twelve burial mounds, four chipping-floors and several pit-dwellings have been excavated; but much more remains to be done before the history of the site can be completely elucidated. It is evident that the site was mined under the influence of the round barrow people, though it is a matter of doubt whether some of the shafts may not have been mined in pre-round barrow times. The exact date of the mines has not yet been determined, though it is probable that they were being worked as late as the end of the round barrow period. The skeletal remains of two individuals, one male, one female, were discovered. These have been examined by Sir Arthur Keith and exhibit evidence of a first cross between round and long barrow peoples.

Mr. Pull's excavations have evidently been conducted with great skill and his results are described with full and constant reference to their bearing on broader issues. He has made a valuable contribution to the history of the flint-mining industry in Britain.

Middlesex in British, Roman and Saxon Times. By Sir Montagu Sharpe. Second edition, revised. Pp. xix + 240 + 5 plates. (London: Methuen and Co., Ltd., 1932.) 15*s.* net.

SIR MONTAGU SHARPE has made considerable additions to this new edition of his account of the archæology of Middlesex in the period extending from just before the Roman conquest down to Domesday, which was first published in 1919. It will be scarcely necessary to recall his vivid reconstruction of Middlesex life in the British period, the detailed treatment of matters affecting the land and settlement, or the intimate knowledge of county topography which was displayed in the discussion of communications, of the exact point at which Cæsar crossed the Thames, or of the scene of Boadicea's last battle.

The attention which was directed in the earlier edition to the Roman land survey and its relation to the ancient ways, has borne fruit and much fresh information is now incorporated. A much enlarged and revised chapter argues that the Roman land system with the decuria survived in Saxon times in the common field and the tything and is to be discerned in detail in the particulars of Domesday. Other additions or revisions are a new table giving with dates the earliest known form of the names of many places in the county, a diagram explaining the Roman method of distributing plots for cultivation in the common fields, and a map of the common fields in a Middlesex parish so late as 1813.

Modern Handbooks on Religion. By the Rev. A. C. Bouquet. (1) *A Study of the Ordinary Arguments for the Existence and Nature of God.* Pp. iii+63. 2*s.* 6*d.* net. (2) *Religious Experience: its Nature, Types and Validity.* Pp. v+133. 3*s.* net. (3) *Phases of the Christian Church: a Short View of its History.* Pp. v+150. 4*s.* net. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1932.)

TOO many vital problems are raised in these small handbooks on religion to dispose of them with a few casual remarks. The general aim of the author, however, deserves a strong support. He wishes to restate in the light of modern knowledge, the ordinary arguments for the existence and nature of God, the nature and types of religious experience and the interpretation of the development of Christianism. To Anglicans and non-Conformists in general, these books should be welcome, in so far as the rational and technical study of these questions has been allowed in recent years to fall into the background, partly on account of the emphasis which has come to be laid upon intuition and direct experience, partly because philosophical criticism has apparently weakened its validity and value. To Catholics, however, though some pronouncements and interpretations of the author will appear highly controversial, these studies will provide an alternative ground of reflection, the more so as they are put forward by a sincere Christian and a genuine scholar. T. G.

Drehung der Polarisationsebene des Lichtes. Von W. Kuhn und K. Freudenberg. (Hand- und Jahrbuch der chemischen Physik, herausgegeben von A. Eucken und K. L. Wolf, Band 8, Abschnitt 3.) Pp. ii+142. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932.) 12.80 gold marks.

THIS monograph is in four sections dealing with the asymmetric molecule, optical rotation and circular dichroism, physical explanations of optical rotatory power and optical rotation in relation to chemical constitution. It contains an excellent account of the work done by the authors in Heidelberg and Karlsruhe, and will be welcomed by those who wish to read it in a less costly medium than Freudenberg's "Stereochemie".

The Royal Entomological Society of London

ON May 3, 1833, a few enthusiastic entomologists met in the rooms at the British Museum then occupied by Mr. J. G. Children, at that time an official of the Natural History Department, and resolved to establish a society for the promotion of the science of entomology in its various branches. This was the inauguration of the body which, under the designation of the Entomological Society of London, has just completed a hundred years of useful and increasingly beneficial activity.

Previous attempts had been made to form an association with the same or similar objects, the first of which attempts can be traced to a date at least so early as 1745, when an association, under the name of the Aurelian Society, is recorded to have held meetings at the Swan Tavern, Change Alley. This, however, and several other societies afterwards established with the like aims, had only an ephemeral existence ; and it was reserved for the small company which met as stated on May 3, 1833, to found an organisation which, after passing through many vicissitudes and suffering many perils that seemed to threaten its very existence, has to-day reached a position of permanent security.

To this result many distinguished votaries of the science have, in their several ways, contributed. Among the original members of the Society was J. O. Westwood, to whom more than to any other person is due, as the present honorary secretary, Dr. S. A. Neave, says in the "History of the Entomological Society" which he has compiled with the assistance of the registrar, Mr. F. J. Griffin, and just published*, the successful growth of the enterprise during this early period. Westwood was unremitting in his efforts for its welfare ; the influence which he exercised in various official positions, including three periods as president, was most valuable ; and in the jubilee year, 1883, his services met with due recognition by his unanimous election as honorary life president.

Those who knew Westwood recall with affectionate appreciation his genial and kindly nature, tempered with a touch of oddity, and his old-fashioned outlook on many scientific questions, not entirely unprejudiced, but never bitter. His association with Hope, one of the original officers, led to his appointment as keeper of the collection and library presented by Hope to the University of Oxford, and ultimately to his occupancy of the Hope professorship of zoology founded in 1861.

The financial difficulties encountered by the Society in a critical period of its career might well have been fatal to its continued existence but for the generosity of J. W. Dunning, a fellow of Trinity College, Cambridge, whose gifts, many of them anonymous at the time but now known to be his, included the whole expense incurred in connexion with the grant of the Royal Charter in 1885 and cannot have fallen far short of £1,000.

In the list of those who have occupied the presidential chair are found the names of Sir John Lubbock, afterwards Lord Avebury, Lord Walsingham, F. Du C. Godman, R. Meldola, R. Trimen, N. C. Rothschild and Lord Rothschild. H. W. Bates was president in 1868–69, and was followed in 1870 by Alfred Russel Wallace, his associate in their famous journey to the Amazon. Bates again became president in 1878. Darwin was an original member, and was vice-president in 1838, but never filled the presidential chair.

Besides Westwood, the only other recipient of the honour of the life presidentship until the present occasion was the Rev. W. Kirby, joint author with W. Spence of the well-known "Introduction to Entomology". At the recent centenary celebration, Prof. E. B. Poulton, who succeeded Westwood as Hope professor at Oxford, was accorded the highest honour in the power of the Society to bestow, and became the third holder of the distinguished office of honorary life president. Prof. Poulton, who had held the presidentship on three separate occasions, was acknowledged by all to have advanced the cause of entomology in general and of the Society in particular more efficiently than any other living person. The introduction which he has furnished to the admirable "History" of the Society is a most interesting record of his memories of the Society over a period of fifty years, and includes some notable words both of warning and encouragement, the fruit of wide experience and ripe consideration. It was universally felt that he was, without any doubt, the right person to preside over the Society in this hundredth year of its existence, and his holding of the office is happily signalised by the Royal Command in accordance with which the Society has now the distinction of adding the word 'Royal' to its name.

It is interesting to note the various places in which, from time to time, the Society has found a home. The first general meeting after the founding of the Society in J. G. Children's quarters at the British Museum took place at the Thatched House Tavern, St. James's Street ; but before the end of the year a fresh domicile was acquired at 17 Old Bond Street. Here the Society remained until 1852, when it removed to 12 Bedford Row. Some years after this, an arrangement was made by which the library was left at Bedford Row, but the meetings were held by the hospitality of the Linnean Society in the latter's rooms at Burlington House. In 1874 a proposal was set on foot for an amalgamation of the two Societies ; but difficulties arose about the accommodation of the library, and the scheme fell through. In 1875 a home was found

* The History of the Entomological Society of London, 1833–1933. By Dr. S. A. Neave, assisted by F. J. Griffin. With an Introduction by Dr. E. B. Poulton, and a Financial Chapter by A. F. Hemming. Pp. xlvi+224+8 plates. (London : Entomological Society of London, 1933.) 10*s.* 6*d.*

for the entomologists at 11 Chandos Street, quarters which they occupied as tenants of the Medical Society of London, until in 1920 the present house, 41 Queen's Gate, was bought and in the course of the next few years was gradually adapted for all the purposes of the Society.

That this solution of the housing difficulty became possible was due to the exertions and generosity of many of the Society's members, and especially to the untiring activity and skilful management of W. G. Sheldon as honorary treasurer. The house in its present condition must strike every visitor as being excellently fitted for its purpose. The library, which occupies the whole of the first floor, contains the extremely valuable collection of books belonging to the Society, well arranged in substantially constructed bookcases and adequately catalogued. There are a council room and commodious offices on the ground floor, but the chief glory of the house is the new lecture room, which has been built on the basement level at the back of the property. This is a remarkably handsome structure, well-proportioned and suitably furnished; but what gives it its main distinction is the oak-panelled interior and finely moulded ceiling, the latter a reproduction of the work in the Bromley Room at the Victoria and Albert Museum. These features, together with the presidential chair and desk, structures worthy of their surroundings, were provided by Mr. R. W. Lloyd, a fellow of the Society, entirely at his own expense.

On the walls of the rooms and staircase at Queen's Gate hangs an interesting collection of portraits of prominent fellows of the Society; and in one of the ground-floor rooms is a large painting by J. Cooke, "The Aurelians", depicting Dr. G. B. Longstaff, a keen and travelled entomologist and generous benefactor to the fund for the purchase of the Queen's Gate House; and his friend Selwyn Image, also an enthusiastic entomologist and sometime Slade professor of fine art in the University of Oxford.

The celebrations of the Society's centenary lately held were attended by a large number of delegates from the British Empire and from foreign countries. The proceedings included a general meeting on May 3, when speeches were made and addresses presented, a scientific conversazione at Queen's Gate, a reception by the trustees of the British Museum, a supper at the Gardens of the Zoological Society of London, excursions to Tring and to Whipsnade, and a reception by His Majesty's Government at Lancaster House. F. A. D.

'Red Coal'

MAN is unceasing in his quest for power—social, political and mechanical. In his search for sources of mechanical power, which, with a charming allegiance to the past, is still associated with the horse when it is measured, man has dug deep mines to bring 'black coal' to the surface and learned how to convert energy into steam and electricity. He has harnessed the waterfall—'white coal'—to the same end, making it swiftly turn a wheel, a turbine, and put areas containing only rivers on an equality with those perched on top of the coalfields. In one favoured district he has dared those forces of the inner earth which manifest themselves as volcanoes, or in their milder form as fumaroles, and tamed their steam to pass through turbines and generate electricity, which may be regarded as produced from 'red coal'.

The story of this achievement, largely that of Prince Ginori Conti and his devoted band of helpers, is a thrilling one: it has in part been told in these columns by him (NATURE, 121, 59, Jan. 14, 1928), and it has been brought up to date in a lecture delivered by him before the Royal Society of Arts on May 3.

Originally the enterprise was a chemical one to exploit the boric acid contained in the *lagoni* discovered by Höfer in 1777, and begun by Larderel in 1818; for fully fifty years, Tuscan boric acid was practically without a competitor in the world's markets. To-day the use of the steam to produce electricity is the important activity, and to-morrow it may well be that the amount of cheap power produced in this way will have a deciding effect on the progress of Italian industry.

Three factors have contributed to the advance: the gradual development under Prince Ginori Conti's leadership of a technique for steam drilling; the fact that the wells maintain a steady head of steam and are not intermittent like the geysers in Yellowstone National Park; and the development of turbines of the free exhaust type.

The rotary or percussion systems of drilling, or both alternatively, are used; for the *soffioni* steam is often found at a depth of 100 ft. and, as the jet increases in volume, drilling becomes more difficult. There comes a moment when the steam gains the upper hand and an explosion takes place with the expulsion of stones and mud and a deafening noise which goes on for weeks and can be heard for several miles. The biggest well, completed in 1931, has an output of 440,800 lb. of steam per hour at a pressure of 3·5 atmospheres with a temperature of 205° C. A second large well completed a year after has an hourly output of 396,000 lb. of steam.

The total output of steam from all the wells of the district is now estimated at more than two million lb. per hour. Only a portion is utilised for feeding the power plants; these are yielding continuously 12,000 kw. for which there is a regular demand. Now that confidence in the trustworthiness of the supply has been obtained, the amount of power generated may be expected to increase rapidly.

The volcanic region around Larderello has been but scantily explored so far; it is believed, however, that all the Tuscan *soffioni* have one common origin.

The choice of condenser or free exhaust turbines is an economic question involving careful study. The latter have advantages from the point of view of economy in installation, upkeep and running costs, but they also have a higher steam consumption.

There is little that is new in the production of boric acid at Larderello, which is putting on the market a crude acid of 95 per cent purity; this industry is to-day a highly competitive one consequent on the discovery of vast quantities of boric acid at Searles Lake, California, and elsewhere.

The steam contains about 6 per cent by weight of gas, of which about 92 per cent is carbon dioxide. A large plant has been erected for its separation and compression, both to liquid and solid carbon dioxide, both products which have increasing importance for refrigeration and other purposes.

Work is in hand also to separate the sulphur dioxide for the production of hyposulphites and sulphites, and further, the methane which, if obtained sufficiently cheaply, can be made the source from which to obtain numerous synthetic carbon derivatives. It is projected even to obtain the rare gases, including helium, which, it is believed, is present in sufficient proportions to justify its separation.

To those with vision, the whole achievement is a very remarkable one. The *soffioni* steam is being exploited in the most complete manner, both on account of its thermal and of its chemical value: to draw from the earth a source of power and at the same time obtain from it an antiseptic, a fertiliser, a refrigerant, a photographic chemical, an illuminating gas as well as the rare gases, makes the inferno a source of wealth far richer than Aladdin's Cave. The exploitation of such riches is a task which is taxing to the full the ingenuity and ability of Italian engineers and chemists, who are proving well fitted for their honourable task. There can be no more convincing example of a saying of Sir Oliver Lodge's which Prince Conti quoted: "There is lavishness in Nature but no waste."

The organisation under the leadership of Prince Conti has been built up as the result of full recognition of the vital importance of what pure or fundamental research can contribute towards the better utilisation of natural resources: it was also emphasised how completely it has enjoyed the support of the Italian National Government. Great have been the ravages wrought in Italy by volcanic disturbances; perhaps they may be to some extent equated in the future by the benefit arising out of the harnessing of their forces in the manner described. E. F. A.

Leicester Meeting of the British Association

FROM the point of view of the British Association, Leicester is a changed city since the meeting in 1907. When the Association meets there on September 6–13, a whole range of fine buildings will be found to have become available since 1907 for its use. The Wyggeston Girls' School, where the reception room, offices, and one of the sections will be established, must be one of the most notable buildings of its kind in the country. The University College, though it occupies an old building, was not established at the time of the last meeting: it now offers accommodation for sections and the inspiration which, for such an occasion as an Association meeting, is afforded by the mere existence of such an institution. The Wyggeston Boys' School adjoins it. The De Montfort Hall is admirably suited for the inaugural meeting. These and other available buildings have the advantage of being situated conveniently to the centre of the city but outside it, a consideration making for the comfort of audiences as external noise is avoided, and access is easy.

Among the many points of interest for scientific visitors in the area for which Leicester is the centre —and they are far more numerous than is realised, probably, by most people—Loughborough College must be specially mentioned. This institution, the outcome of engineering and kindred activities during the War, is of peculiar interest in itself. But not only this: it also offers, what Leicester itself does not, save for the purposes of the secretariat and a few other members, a remarkably fine series of hostels. Living accommodation in hostels during Association meetings is found always to be popular among visiting members, and those who like it need not be discouraged by the distance of thirteen miles from Leicester, for rail and road communications are easy and quick.

The preliminary programme just issued and obtainable from the Association offices at Burlington House, Piccadilly, London, W.1, gives details of the foregoing arrangements and much else besides. The city itself is seen to be well provided with hotels and private hotels convenient to the meeting-rooms. The list of possible excursions and visits indicates the wide scientific interests of the locality. Charnwood Forest, Derbyshire, the Fen Country, the Warwickshire area, are all within reach. Many industrial, agricultural, and educational establishments are to be seen, the last including University College, Nottingham.

The president, Sir Frederick Gowland Hopkins, combining for the year the onerous duties of the chairs of the Royal Society and of the Association, will deal in his inaugural address with the chemical aspects of life. As for the programme of scientific transactions at large, the Association cannot be

accused of neglecting current affairs of public interest. The policy of tackling such topics as the gold standard and increasing the supply of gold, a national educational system, the evolution of terrestrial life, industrial physics, and others which find place in the present programme, has its rewards, and occasionally something more. The introduction of some pregnant subject of public concern has sometimes led people to ask why the Association does not do more than merely talk about them : a few were disappointed last year when one noteworthy pronouncement was not followed by immediate action ; and quite lately a newspaper correspondent demanded that the Association should not merely formulate a remedy for unemployment, but also apply it. Such action may be scarcely within the Association's powers.

On the other hand, the effort indicated in the programme and by documents issued along with it, to bring the publications of the Association more widely into notice, is an effort, deserving of all support, toward the removal of a weakness. The Association, though supplying to the ephemeral press and to specialist publications a vast range of scientific material, has never yet itself become as effective a recording instrument as stronger public support might make of it.

The Association, from the point of view of those who must raise local funds for its reception, is a less exacting guest than it used to be, and it is right and indeed necessary that this should be so. The programme gives amply sufficient evidence of the hospitality which Leicester intends to offer, including as it does a reception to be given by the Lord Mayor (Councillor Arthur Hawkes), another by the Leicester Literary and Philosophical Society, and a garden party by the University College. Nor, as already suggested, will Leicester fail in the heavy task of finding meeting-rooms—for in that matter the Association does not moderate its demands. Yet, when sections ask to form departments and run two or three meetings at once, or propose to arrange cinematograph or other demonstrations, it would be ungenerous to deny opportunities to the devoted bands of workers who arrange the sectional programmes for the honour of science and the Association, and maintain, as in the present programme they certainly do maintain, the high standard of interest which they and their predecessors have set up. Participation in the Leicester meeting may be confidently recommended, for the sake not only of the Association, but also of Leicester.

Obituary

PROF. W. C. UNWIN, F.R.S.

TO understand the great debt which engineering science owes to the late Prof. William Cawthorne Unwin, it must be remembered that it was in 1856 that he started on his engineering career and that it is sixty-five years since he first began to teach engineering. Born at Coggeshall in Essex, on December 12, 1838, Unwin had all the advantages of being brought up in academic surroundings, for his father, Dr. William J. Unwin, was principal of Homerton College.

On leaving school in 1856, Unwin was fortunate in being apprenticed to Sir William Fairbairn, an engineer and a most distinguished research worker in engineering science. As might be expected in those early days of experimental engineering, the work was of a most varied nature and this had an important bearing on Unwin's later work. Elaborate researches were carried out on the specific volume of saturated steam, and on the effects of repeated loading of plate girders, the most arduous part of the experimental work devolving on the young and enthusiastic Unwin. But, though interesting and instructive, engineering research was not very remunerative and, no doubt, Unwin was recalling his own experiences when in one of his latest addresses, he deplored the fact that the importance of engineering research was not even then recognised by those who had charge of great engineering undertakings. Working at engineering research all day Unwin found time at night to continue his studies, and in 1860 took the degree of B.Sc. at the University of London, where he played so important a part many years later when the course for a degree in engineering was being arranged.

In 1862, theoretical and practical training completed, Unwin became manager at the works of Messrs. Williams at Kendal where the manufacture of Thomson's new vortex turbine had been begun. Then, in 1867, he was appointed manager of the engine department of the Fairbairn Engineering Company. He remained, however, only a short time with this firm, as in 1868 he was made instructor in marine engineering in the Royal School of Naval Architecture, and in 1872 he was appointed professor of hydraulics and mechanical engineering at the Royal Indian Engineering College, Coopers Hill, which position he held until 1884. In 1877 was published his textbook on the "Elements of Machine Design", probably the most widely known of all his books and deservedly so. He wrote as a teacher who gave his readers the necessary information acquired either by his own research or by that of others. Clear and concise explanation was his strong point, and so no textbooks are required to explain Unwin.

Unwin's great success as the teacher of young engineers became possible when in 1884 he was appointed professor of civil and mechanical engineering in the newly established City and Guilds Central Technical College. London was at last to have a college in which engineering science could be taught systematically, in suitable laboratories, equipped with all the necessary plant and

apparatus. Four departments were established—chemistry, engineering, mathematics and physics—presided over by Armstrong, Unwin, Henrici and Ayrton respectively, all experts in their subjects and all experienced and enthusiastic teachers. From its very initiation the College was a success, and as a school of engineering an unparalleled success. Unwin's engineering students, trained in specially arranged courses in mathematics, chemistry, and physics, were able generally to profit fully from the instruction given by their exceptional teacher and though, at first, employers did not realise the importance of having trained engineering assistants, still in time Unwin had the gratification of seeing his former students holding the highest positions in the engineering profession and in industry.

Unwin knew that to teach engineering one must practise it, and owing to his international reputation, he had no lack of consultation work. In 1890 an American company appointed an international commission of five eminent experts under the presidency of Lord Kelvin (then Sir William Thomson) to determine the best way of developing the power at Niagara and distributing it. The headquarters of the Commission were at the 'Central' and Unwin was the secretary. In his report he discussed fourteen different proposals which were presented and none of which was considered suitable. He continued to serve on the Commission, making several trips to Niagara to study the conditions of the problem on the ground and advising in connexion with the actual project. He also carried out a long research on the flow of tidal waters in the Thames with reference specially to the pollution of the upper waters by the sewage from the London main outfalls. He was consulted with regard to the Coolgardie Hydraulic Scheme and prepared a report on the loss of head in the mains of the proposed South Staffordshire power gas scheme.

Recognised now as the leading expert in engineering education, Unwin was practically the author of the course in engineering for the London degree and so naturally the course laid down was the same as that followed at the 'Central'. When later the 'Central' became the engineering section of the Imperial College of Science and Technology, Unwin often stated that one of the chief advantages to the University would be the possibility of having many alternative subjects for the degree—a possibility of which advantage has been taken in later years, certain courses given at different schools of the University being recognised as equivalents, allowing in this way a much wider choice to the student.

In 1904 Unwin resigned his professorship, being appointed professor emeritus, but he by no means gave up his engineering practice. His close touch with the profession was maintained. On the council of the Institution of Civil Engineers he had a large part in framing the new proposals relating to the preliminary training of the civil engineer, and when in 1911 he was elected president of the Institution, his presidential address discussed specially the training of the young engineer. In 1915 he was elected president of the Institution of Mechanical Engineers, and again in 1916.

It is usual in this generation to speak of a man's War service, and certainly mention of Unwin's must not be omitted. At the age of seventy-seven he devoted his technical knowledge and business ability to his country and served on the Management Board of the Metropolitan Munitions Committee from 1915 until 1918.

Unwin was a great teacher. While not a brilliant lecturer he was always sound and was valued by those looking for reliable up-to-date information expressed in the clearest language. That his lectures outside the class-room were highly appreciated may be judged by the number of special lectures he was asked to give: the Cantor lectures, the Howard lectures, the James Forrest and James Watt lectures. In the class-room his lectures were definitely serious. In an engineering college in which there is only a qualifying entrance examination there must be many students who are not likely to go very far in the profession, but all those who attended Unwin's lectures remember him with affection. He was not one to suffer fools gladly, but he was very willing to help the real student. He did not wander in the least from the subject in hand, and he had his own methods for gauging his students' capacity. In later years they were often surprised to know how much the professor knew of the personality of each of his students. He had a keen sense of humour, but he probably appreciated his own jokes more than those of other people.

Unwin's long life, though filled with interest, was uneventful. He did not marry. While a most genial companion, he would not talk of himself, and his correspondence was only professional. His published papers, reports and textbooks range into all fields of engineering so that his working hours were fully occupied. But he did take vacations, though his recreations were tranquil and scientific. He was an enthusiastic fisherman and devoted many hours to photography, having begun as an amateur in the early days of the wet plate, and on all his travels a camera went with him. Though he had travelled considerably he was no wanderer, and it is typical of him that he lived the last fifty years of his life in the same house where, since his retirement from the 'Central', his niece, Miss Dorothy Unwin, was his devoted companion. He died on March 17. Few men who have lived to so great an age have left so many who are glad to have known them.

Naturally many distinctions were conferred on him. He was awarded the Kelvin medal, was a fellow of the Royal Society, LL.D. of Edinburgh, honorary member of both the American Societies of Civil Engineers and Mechanical Engineers and an honorary associate of the Royal Institute of British Architects. S. M. D.

News and Views

Sir John Marshall, C.I.E.

SIR JOHN H. MARSHALL, it is reported by the Bombay correspondent of the *Times*, has been awarded the triennial gold medal for historical research by the Royal Asiatic Society of Bombay. Sir John Marshall, who was director-general of the Archæological Survey of India from 1902 until 1931, was formerly a scholar of King's College, Cambridge, and was a student of the British School of Archæology at Athens in 1898–99. He was Prendergast student in 1900–1 and Craven student in 1901–2, while in 1927 his old college made him an honorary fellow. Under his directorship, the work of the Archæological Survey of India has been much stimulated, especially in the direction of excavation of prehistoric and early historic sites. It was due to him that the work was undertaken which led to the epoch-making discovery of the prehistoric sites in the Indus Valley at Harappa and Mohenjo-daro, and on his initiative that the co-operation of investigators from outside the service, experienced in the exploration of the sites of Mesopotamia and with knowledge of the cultures of that area, was invited.

Prof. Paul A. Murphy

THE Royal Dublin Society's Boyle medal, awarded to Prof. Paul A. Murphy in recognition of the value of his work in phytopathology, was presented to him at a special scientific meeting of the Society on May 5. The medal, which was instituted in commemoration of Robert Boyle, the illustrious Irish chemist, is awarded to Irish workers in all branches of science, pure and applied, whose work is adjudged to be of outstanding merit and importance. It was first awarded in 1899 to Prof. G. Johnstone Stoney for his work, which included what was probably the first approximate estimate of the electronic charge. Prof. Murphy's name is the eleventh on the list of holders. In presenting the report of the Committee of Science recommending the award of the medal, Prof. H. H. Dixon gave a brief summary of Prof. Murphy's work, which may be said to have commenced with his investigations in conjunction with Dr. G. H. Pethybridge into the life-history and biology of *Phytophthora infestans*, the fungus responsible for potato blight. Prof. Murphy then attacked the problem of the virus diseases and showed that the progressive deterioration which generally occurs in every variety of the potato is attributable to the accumulation of virus in successive crops. His work has also thrown much light on the complex nature of many virus diseases. He has contributed largely to our knowledge of various diseases of other plants, amongst which onion mildew and dry rot in turnips may be especially mentioned. Sir Frederick Moore, in supporting the award, referred especially to the great value of the work on potato blight, and of the important bearing of the investigations into the virus diseases on the seed potato industry. In making the presentation to Prof. Murphy, the Right Hon. Viscount Powerscourt, president of the Society, pointed out how particularly appropriate it was for the presentation to be made at a meeting held during the Society's Agricultural Show, since Prof. Murphy's work, in addition to being of great importance to pure science, is also a very valuable contribution to the advancement of agriculture, thus linking the two great branches of the Society's activities.

International Colonial Conference, 1935

A BRIEF announcement in the latter part of last month that Lord Lugard had been elected president of the Institut Colonial International at the biennial conference held at Lisbon on April 18–20 seems to have attracted very little attention. In an article by Prof. Basil Williams which appears in the *Times* of May 4, it is pointed out that Great Britain, the power most extensively interested in questions relating to colonial administration, has taken a relatively unimportant part in the conferences held by the Institut. These have been supported more especially by France, Holland, Belgium and Portugal. Great Britain, the United States and Italy, however, as well as these powers, are represented in the secretariat of the Institut. As the next conference will be held in London in 1935, under the presidency of Lord Lugard, and among the subjects already marked for special consideration is the question of the detribalisation of natives, it may be hoped that an active part will be taken in the work of the conference by officials and others who are concerned, whether in practice or as a matter of scientific study, with the administration of native affairs. A conference in London should afford an especially favourable opportunity, such as will not recur for some time to come, of pooling the views and experience of an exceptionally large and well-informed membership on the causes and effects of detribalisation, and, should opinion incline to the view that it is inevitable in the long run, of the best means of controlling and guiding it in the interests of the native. It is, perhaps, too much to hope for any approach towards a native policy common to all the powers and based on a thorough scientific study of the native, which would have any prospect of adoption by the countries represented at the conference.

Indian Rhinoceros at the London Zoo

FELLOWS of the Zoological Society, and the public at large, are greatly indebted to the King, who is the patron of the Society, for the young rhinoceros from Nepal which he has just given for permanent exhibition. It was presented to His Majesty by Maharajah Sir Judha Shumshere Jung, Prime Minister and Commander-in-chief of Nepal. Though the Society has two African rhinoceroses, it has only one Indian, which was presented by the Maharajah of Nepal nearly ten years ago; and since this animal is now found only in Nepal, where it is in sore need of protection if it is to escape speedy extermination, the recent gift is a valuable one. It will be interesting to compare the new arrival, which is 1½–2 years old,

not only with the fully adult animal, but also with the African species, because of the striking and singular differences displayed by the two species in the matter of what one might almost call the 'armour-plating' formed by the hide. No one has yet been able to find any explanation for the fact that in the Indian species this forms what looks like a series of separate shields, or 'bucklers', studded with relatively small round bosses, while in the African species the hide forms a continuous covering. Again, we seek in vain for any intelligible explanation of the fact that while the African species has two nasal horns, in the Indian and other Asiatic rhinoceroses there is but one horn. There are, of course, other structural differences between these two types, which, some day, may be compared with all the known fossil remains. When this has been done, we may well find clues such as will help us to gain an insight as to the factors and mode of evolution of these singularly interesting ungulates.

The Old Ashmolean, Oxford

THE two hundred and fiftieth anniversary of the opening of the Old Ashmolean, Oxford, falls on May 21, a date duly recorded by Elias Ashmole, donor of its original possessions. In recognition of this occasion, Dr. R. T. Gunther, curator of the Lewis Evans Collection of Scientific Instruments, housed in the Old Ashmolean, has been able to conclude a series of arrangements to mark the event. Here it may be mentioned that the Old Ashmolean building itself was erected between 1679 and 1683, and is attributed, on fairly good grounds, to Christopher Wren. The appropriateness of this historic establishment for the housing of the Lewis Evans collection of ancient scientific instruments was demonstrated in 1925, when this notable gift to Oxford was dedicated by the Earl of Crawford and Balcarres at a special meeting held in the Old Ashmolean, and the collection was declared open. The principal celebration arrangements referred to above comprise a reception by the curator of the Lewis Evans Collection, on Sunday, May 21, whilst on May 22, at 2.30 p.m., in the University Museum, Sir Arthur Smith Woodward will deliver a lecture on "Plot and Lhwyd and the Dawn of Geology". These naturalists were the first keepers of the Old Ashmolean. During the week, exhibitions of Ashmolean interest will be open to the public, including portraits and relics, books, manuscripts, and engravings.

Centenary of the University of Zurich

THE centenary celebrations of the University of Zurich, which extended from April 28 until May 1, attracted a large number of delegates from the universities and learned societies of the world. At the chief ceremony, held in the noble 'Lichthof' of the University on April 29, the addresses of the Rector (Prof. F. Fleiner) and the director of education of Canton Zurich (Dr. O. Wettstein) were followed by congratulatory speeches by selected representatives of the various nations. The delegates from the British Isles were Prof. A. E. Zimmern (Oxford), Prof. G. H. F. Nuttall (Cambridge), Dr. T. Loveday (Bristol), Sir Henry Miers (Royal Society), Prof. J. Read (St. Andrews), Prof. E. Dieth (Aberdeen), Prof. J. H. S. Burleigh (Edinburgh), and Prof. F. E. Hackett (Dublin). At its foundation, the teaching staff of the University comprised twenty-three professors, thirty-three lecturers, and 161 students; at the present day, it has about a hundred professors, ninety lecturers, and some 2,000 matriculated students. In 1908, the University took a great step forward as a result of a referendum in which the people of Canton Zurich voted in favour of the provision of extensive new accommodation: "durch den Willen des Volkes", runs the inscription carved in stone over the western entrance to the magnificent central building which was erected at that time. The city of Zurich was *en fête* during the celebrations, and the popular interest and pride in the cantonal university were pleasingly evident on every hand. "Akademische Lehr- und Lernfreiheit ist an ihr geltend", is a significant sentence occurring in the original statutes of the University, and the adherence of the University, the canton, and the Swiss nation to the cherished ideals of freedom and toleration formed the keynote of most of the speeches at the celebrations.

Huxley and Scientific Education

HUXLEY memorial lectures have been delivered at the Imperial College of Science and Technology, London, annually since 1925 to commemorate the life and work of Thomas Henry Huxley, who was born on May 4, 1825, was professor of biology from 1854, and dean of the Royal College (then Normal School) of Science and Royal School of Mines from 1881 until his death in 1895. The lecture this year was delivered by Prof. H. E. Armstrong, who, as a pupil of Huxley's, and as professor of chemistry at the Central Technical College, and equally concerned with the outlook and methods of education, was able to garnish his tribute with personal reminiscence and with forceful criticism of the scientific world as it appears to him to-day. Huxley's reputation as a master of education rests, he said, mainly upon his writings and public addresses, not upon his work as a teacher. "He was a marvellous exponent—therefore, a bad teacher, as are all who are eloquent"; "a master of fine logic, but encased in hard bones". Prof. Armstrong attended some of Huxley's lectures, but they failed to hold the interest of one who hoped to learn how things had been found out; nevertheless, he ever regretted that he did not attend the Working Men's Lectures, in which Huxley told a consecutive story.

PROF. ARMSTRONG said he knew no book from which more general inspiration is to be derived than from the third volume of Huxley's essays, "Science and Education", though it was published in 1895 and goes back to 1854; yet there is little in the essays bearing on actual teaching. Huxley was insistent on the need for organisation. "In the sense in which he meant it, we remain unorganised to-day, whilst the need is much greater. Many may think that his

'Essays' are now out of date, that we have introduced Science into the schools and got what he asked for. It is not so. In fact, we have only the shadow—not the substance. The teaching, for the most part, is of the kind he abhorred and knew to be useless." "Huxley was undoubtedly a man of very great innate ability, a man who had gained full grasp of the world; he saw very clearly what the needs were, but was no master of method. Cannot men be found to study his great example but go further, especially in developing methods?" Prof. Armstrong said that it is in connexion with medical education that Huxley's instructions have been least regarded. Huxley complained specifically of the unsatisfactory character of the teaching in physiology and asked for a proper scientific foundation at school, followed by a minimum burden during the period of professional training.

HUXLEY'S efforts to secure public recognition of the value of scientific education, said Prof. Armstrong, led to the establishment of the City and Guilds of London Institute for the Advancement of Technical Education and of its two colleges, the Finsbury Technical College (1879) and the Central Technical College (1884). The latter is now known as the City and Guilds (Engineering) College, and forms part of the Imperial College of Science and Technology. In an address on "Science and Culture", Huxley defended the thesis that for the purpose of attaining real culture an exclusively scientific education is at least as effectual as an exclusively literary education—to which Prof. Armstrong replies that he does not believe that either in itself can give us culture or is, in fact, possible exclusively. "The world insists on teaching a good deal, however much the schools may fail to teach." But Huxley made an important recommendation: that provision should be made for teaching sociology. Already in 1887 he foresaw the coming gravity of our industrial position, and wrote a remarkable letter to the *Times*. He called upon the nation to 'organise victory', and Prof. Armstrong echoed his words. A nation of shopkeepers, we have, he says, worshipped technical education; unfortunately, it has not taught us to keep shop: only to make things to be sold but not how to sell them, to the general good, when made. The problem of food looms in full face of a present need; that our food supply must be our first care is as yet realised by few. We can no longer allow uncontrolled use of the soil. We must learn how to use our knowledge. Scientific workers must bestir themselves to educate the public, even as Prof. Armstrong educates while he castigates.

New Medals of the Royal Aeronautical Society

Two new medals have been founded by the Royal Aeronautical Society, to be known as the British Gold Medal for Aeronautics and the British Silver Medal for Aeronautics. These medals have been founded following a request from Lord Amulree, when Secretary of State for Air, that the Royal Aeronautical Society should give some award for outstanding feats in aviation. A permanent Committee has been appointed to consider the awards of the medals, consisting of six members of the Royal Aeronautical Society, and the chairmen of the Royal Aero Club and the Air League of the British Empire. The design of the Gold Medal incorporates a portrait of Sir George Cayley and his first model aeroplane of 1804, and the design of the Silver Medal incorporates the Henson and Stringfellow machines. The medals will be awarded for an achievement leading to advancement in aeronautical science and will be confined, so far as possible, to subjects of the British Empire, but other nationals will not be excluded. The expenses of founding these two medals have been defrayed by the president, Mr. C. R. Fairey. The first awards of the British Silver Medal for Aeronautics have been made for the following achievements which have led to advances in aeronautical science: Capt. C. F. Uwins, for reaching a world record height in a heavier-than-air craft of 43,976 ft. on September 16, 1932; Squadron Leader O. R. Gayford, and Flight-Lieut. G. E. Nicholetts, who flew from Cranwell, England, to Walvis Bay, South Africa, non-stop on February 6–8, 1933, a distance of 5,340 miles.

Excavations in Northern Mesopotamia

EXPECTATION of the importance of the results likely to be obtained by the joint expedition of the British Museum and the British School of Archæology in Iraq to Tell Arpachiyah in northern Mesopotamia under Mr. M. E. L. Mallowan is fully confirmed by the report of the first half season's work which appears in the *Times* of May 5. The expedition left London in January. It will be remembered that this site was selected for excavation as the result of a preliminary reconnaissance from Nineveh in the previous year. Surface finds of painted potsherds then suggested that this site would probably prove of great importance to the little-known earlier prehistory of northern Mesopotamia. The discovery of pottery of the Ur and Tell el-Ubaid type in mud-brick dwellings of a humble character on the top of the mound carries the first settlement well back into the fifth millennium B.C., and proves the site to be among the oldest yet discovered in Mesopotamia. As excavation proceeds, Arpachiyah is shown to be the centre of convergence for peoples transitional between neolithic and chalcolithic times; while connexions are being traced with Anatolia, Syria, southern Mesopotamia and, through Persia, with Baluchistan. It may be noted, in passing, that Arpachiyah supports and extends the evidence obtained by the American School of Oriental Research at Tepe Gawra and Tell Billa that northern Mesopotamia was a place of settlement for peoples from the north and north-east, who were there subjected to strong cultural influences from the south. Among the more noteworthy discoveries now reported at Arpachiyah are a method of fractional burial which is compared with the practice on the prehistoric site of Nál in Baluchistan, the use of a bucranium or ox's head as a motif to an extent which suggests a special cult,

female figurines pointing to affinities with the Anatolian mother-goddess, a variety of beads and amulets, and a store of wheat, the earliest probably in Mesopotamia. Excavations are being carried through the lower levels in the hope of reaching virgin soil.

Road Research Station, Harmondsworth

IN accordance with a recommendation of the Select Committee on Estimates of the House of Commons in its Second Report for 1932, arrangements have been made for the Road Research Station at Harmondsworth to be transferred from the Ministry of Transport to the Department of Scientific and Industrial Research as from April 1 last. The Committee of the Privy Council for Scientific and Industrial Research has decided to appoint a Road Research Board to advise generally on the conduct of road research undertaken by the Department, and with the concurrence of the Ministry of Transport, has appointed Major F. C. Cook, deputy chief engineer, Roads Department, Ministry of Transport, to be the first chairman of the Board. The following gentlemen have accepted invitations to serve on the Board :—Prof. R. G. H. Clements, Mr. T. Pierson Frank, Mr. W. J. Hadfield, Mr. W. P. Robinson, Prof. C. G. Cullis, Mr. E. V. Evans, Prof. E. H. Lamb, Prof. C. H. Lees, Lieut.-Col. Mervyn O'Gorman, and Dr. T. Franklin Sibly. The immediate direction and control of road research undertaken by the Department of Scientific and Industrial Research will be in the hands of Dr. R. E. Stradling, director of building research under the Department. Road tests throughout Great Britain under normal traffic conditions will continue, as heretofore, to be carried out by the Ministry of Transport in conjunction with the responsible highway authorities. In connexion with these tests, as well as the research work at the laboratory, and the issue of reports thereon, arrangements have been made for the closest collaboration between the Ministry of Transport and the Department of Scientific and Industrial Research.

Science Teaching

IN connexion with the notice of Badcock and Holmyard's "Electricity and Magnetism for Beginners" in NATURE of March 11, Dr. Dorothy Turner protests against the suggestion that a good qualitative treatment may involve the danger of dulling the pupils' subsequent interest in the subject when the time comes for more complete quantitative treatment, on the ground that for ninety-five per cent of those attending State-aided secondary schools such a time never comes. We referred Dr. Turner's letter to the reviewer who, however, still maintains that the essential danger to which teachers of science will have to give serious consideration is that, in the otherwise laudable desire to extend the ground covered, anything worthy to be called a training in science may be superseded by just talking about science, with the consequence that the subject may become little more than a branch of English, providing good topics for general knowledge essays.

Rockefeller Gift to the Royal Institution

IT was announced by the Managers of the Royal Institution at the general monthly meeting of the members, held on May 8, that the capital payment of £20,000 promised by the Rockefeller Foundation nearly three years ago, on condition of obtaining £50,000 from other sources, had now been received. The gift was promised for the endowment of research in the Davy Faraday Research Laboratory of the Royal Institution, and the fulfilment of the Rockefeller promise implies that in the past three years the Managers have been successful in securing research endowment for the Laboratory to a total capital value of upwards of £70,000.

Spurious University Degrees

A BILL to prohibit the unauthorised use and issue of university degrees, a subject which has been taken up by the Association of Scientific Workers, was introduced into the House of Lords by Lord Jessel on May 3 and read a first time. The main part of the Bill, which, if passed, will be known as the University Spurious Degrees (Prohibition of Use and Issue) Act, proposes to make it a penal offence for any person to use letters after his name denoting a university degree unless he actually holds such a degree ; and also it prohibits the conferment of degrees by any person or organisation other than a recognised university. The term "recognised university" is defined at length ; briefly, it may be described as a university or similar institution granting academic degrees as a result of a prescribed course of at least three years' training or definitely recognised as a university by the government of the country where it is situated. The "Lambeth degrees" conferred by the Archbishop of Canterbury are definitely exempted from the provisions of the Act.

Californian Earthquake of March 10

THIS earthquake has been studied by Messrs. H. O. Wood and C. F. Richter, seismologists of the Pasadena Seismological Laboratory, and a summary of their results appears in the Mail Report of Science Service, Washington, D.C. for April 19. The intensity of the shock was far less than that of the Nevada earthquake of November 20–21, and may have been less than that of the Santa Barbara earthquake of June 29, 1925. The greater loss of life (about 120 persons) and property caused by the recent shock is attributed to the strongly shaken area being more thickly settled. In some places, considerable destruction occurred and this was probably due to the water-soaked alluvial nature of the ground ; but, in all, serious damage was confined to bad or improperly designed construction. The study of the records of seven seismographs in California under the charge of the Pasadena Laboratory shows that the origin of the earthquake was probably in one of a system of faults that runs parallel to the coast in the district between Huntington Beach and Newport Beach. The depth of the focus seems to have been less than usual and was probably about six miles. Nearly continuous

movements were recorded for many hours afterwards, but none of the after-shocks was comparable with the main earthquake.

Announcements

THE first conversazione this year of the Royal Society will be held in the rooms of the Society at Burlington House, London, W.1, on May 17, at 8.30 p.m.

PROF. HENRY E. ARMSTRONG will deliver the sixth Hugo Müller lecture before the Chemical Society, in the meeting hall of the Institution of Mechanical Engineers, on May 25, at 5.30. The title of the lecture will be "Chemistry at the Cross Roads".

MR. H. BRADLEY will deliver the nineteenth "Physics in Industry" lecture before the Institute of Physics at the Royal Institution, 21 Albemarle Street, W.1, on May 23 at 5.15 p.m. The title of the lecture will be "Physics in the Boot and Shoe Industry".

THE Halley lecture for 1933 of the University of Oxford will be delivered in the lecture theatre at the University Museum on June 1, at 5 p.m., by Prof. Henry Norris Russell, professor of astronomy and director of the Observatory, Princeton University. The subject will be "The Composition of the Stars".

AT the ordinary meeting of the Royal Society of Edinburgh, held on May 1, the James Scott Prize for 1933 for an essay or lecture on the fundamental concepts of natural philosophy, was presented to Prof. Arnold Sommerfeld, professor of natural philosophy in the University of Munich. Prof. Sommerfeld, whose lecture was entitled "Ways to the Knowledge of Nature", dealt with a recent book of similar title by Prof. Max Planck, and gave his own views on such questions as the mathematical character of the laws of Nature, causality, duality in physics and in human life.

AT the anniversary meeting of the Royal Society of South Africa, held on March 15, the following officers for the year 1933 were elected :—*President :* Dr. A. W. Rogers ; *Hon. Treasurer :* Prof. L. Crawford ; *Hon. General Secretary :* Dr. B. F. J. Schonland.

MR. H. T. PAGDEN, assistant entomologist in the Agricultural Department, Straits Settlements, has been appointed by the Secretary of State for the Colonies to be entomologist in the British Solomon Islands Protectorate.

IN our issue of April 29, p. 612, reference was made to resignations of Jewish professors from university chairs in Germany. During the past few days, the following three distinguished chemists have resigned their posts : Prof. F. Haber, director of the Kaiser Wilhelm Institut für physikalische Chemie und Elektrochemie, Berlin-Dahlem, who was awarded the Rumford medal for 1932 of the Royal Society for his work on physical chemistry, notably in the application of thermodynamics to chemical reactions ; Prof. H. Freundlich, author of works on colloid chemistry, and Prof. M. Polanyi, distinguished for his work on physical chemistry, both of whom were also at the Kaiser Wilhelm Institut.

THE Society for Cultural Relations between the Peoples of the British Commonwealth and the U.S.S.R. is organising tours of medical men and scientific workers to the U.S.S.R., and the first party will leave London for Leningrad on July 1. The return journey will cost £22–£36 inclusive, according to the type of accommodation selected. The party will spend a total of sixteen days in Russia ; three days in Leningrad, five days in Moscow, then either (*a*) Gorky, down the Volga to Stalingrad—Leningrad ; (*b*) Rostov/Don, Kharkov—Leningrad ; or (*c*) Kharkov, Kiev—Leningrad. The latest date for receiving applications for the first party leaving London is June 15. Inquiries should be addressed to the Secretary of the S.C.R., 1 Montague Street, London, W.C.1.

ON May 23, the second part of a two volume work entitled "An Introduction to the Sociology of Islam", by Mr. Rueben Levy, lecturer in Persian at the University of Cambridge, will be published by Messrs. Williams and Norgate, Ltd., for the trustees of Herbert Spencer, in continuance of his "Descriptive Sociology".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A technical assistant to the Adviser in Agricultural Economics at Armstrong College, Newcastle-upon-Tyne—The Registrar (May 16). A full-time lecturer in chemistry at the Wigan and District Mining and Technical College—The Principal (May 19). A junior assistant bacteriologist and demonstrator at the University of Sheffield—The Registrar (May 20). A Sharpey physiological scholar at University College, London—The Secretary (May 27). A principal at St. Katherine's Training College for Women Teachers, Tottenham—The Rev. Canon G. L. Gosling, S.P.C.K. House, Northumberland Avenue, W.C.2 (May 31). A lecturer in mathematics at East London College, Mile End Road, E.1—The Registrar (May 31). A head of the Department of Electrical Engineering and a lecturer in the Department of Mechanical Engineering of the Central Technical College, Birmingham—The Principal (June 3). A lecturer in organic chemistry at the Manchester Municipal College of Technology—The Principal (June 14). A University lecturer and a University demonstrator in physics—The Secretary, Appointments Committee of the Faculty of Physics and Chemistry, Clare College, Cambridge. A mechanical engineer in the Egyptian Irrigation Service in the Sudan—Chief Inspecting Engineer, Egyptian Government, 41, Tothill Street, S.W.1. A full-time assistant in the Engineering Department of the Technical College, West Hartlepool—The Secretary, Education Offices, Park Road, West Hartlepool. A plant engineer for the locomotive, carriage and waggon shops of the South Indian Railway Co.—Messrs. Robert White and Partners, 3, Victoria Street, London, S.W.1.

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.*]

Boric Acid in Sea Water and its Effect on the Carbon Dioxide Equilibrium

ACCORDING to recent investigations on the boron content of sea water, amongst others, spectrographic analyses by V. M. Goldschmidt and Cl. Peters[1], the boron content is considerably higher than hitherto assumed. In consequence, quantitative analyses for this substance have been undertaken in several laboratories. The following table shows the results of a series of titration analyses of five different water samples of varying salinity, giving the origin of the sample, the boric acid content in milli-equivalents per litre and in grams B_2O_3 per cub. m., as well as the chlorinities in per mille and the ratio boron to chlorine.

Origin	Latitude	Longitude	Cl‰	Boron content		Ratio B‰/Cl‰
				m. equ./l.	B_2O_3 gm/m.³	
English Channel, Plymouth	—	—	19·33	0·456	15·9	0·000248
North Sea	55°39′ N	4°50′ E	19·20	0·433	15·1	0·000237
Cattegat	57°35′	11°08′	13·32	0·292	10·8	0·000233
Cattegat	56°16′	12°25′	6·89	0·157	5·8	0·000242
North Baltic	59°30′	22°35′	3·41	0·078	2·7	0·000245

Oceanic water thus contains 15 gm. B_2O_3 per cubic metre as against 0·7 as given in oceanographical text-books. The values for the ratio boron to chlorine agree well with the results (received by private communication) by H. W. Wattenberg, Institut für Meereskunde, Berlin, who found the value $0{\cdot}250 \times 10^{-3}$, and by E. G. Moberg and D. M. Greenberg, Scripps Institution, La Jolla, California, whose values vary between $0{\cdot}235 \times 10^{-3}$ and $0{\cdot}242 \times 10^{-3}$.

As the presence of boric acid may affect the carbon dioxide equilibrium of sea water, recently investigated by a committee of the International Council[2], it was desirable to repeat the determinations of the second dissociation constant of carbonic acid in *boron-free artificial* sea water. The constant determined by the Committee is a working constant, valid in a certain *p*H range. The new determinations of K_2' were carried out at 20°, with artificial sea water of varying salinity. The result may be summarised in the following equation relating the negative logarithm of the constant, pK_2', to the chlorinity of the water:

$$pK_2' = 10{\cdot}45 - 0{\cdot}682\sqrt[3]{\text{Cl}‰} + 0{\cdot}020\text{Cl}‰.$$

For 35 per mille sea water, the value of pK_2' is 9·00. By means of this constant and determinations of boric acid and total carbon dioxide, it is possible to calculate also the apparent dissociation constant of boric acid in sea water at different salinities. The following relation was found between the negative logarithm of the constant pK_B' and the chlorinity:

$$pK'_B = 9{\cdot}22 - 0{\cdot}123\sqrt[3]{\text{Cl}‰} - 0{\cdot}0086\text{Cl}‰.$$

For water of 35 per mille the value of pK_B' is 8·72. Calculation of the different carbonic acid constituents of sea water is possible when chlorinity, *p*H and alkali reserve are known. The values of total carbon dioxide as given in the tables worked out by the Committee of the International Council are at the most 2·5 per cent lower than those obtained when both pK' and the corrected pK_2'-value enter into the calculations. The tension of carbon dioxide is not appreciably affected by the boric acid.

KURT BUCH.

Thalassological Institute,
Helsingfors, Finland.
March 20.

[1] Goldschmidt, V. M., und Peters, Cl., "Zur Geochemie des Bors II". *Nach. Gesell. Wiss. Göttingen*, Math.-Phys. Klasse, 1932. III. Chemie, etc. 28. IV. Geologie, etc. 31. S. 536.
[2] Buch, K., Harvey, H. W., Wattenberg, H., und Gripenberg, S.: "Über das Kohlensäuresystem im Meerwasser". Conseil Perm. Inter. pour l'Explor. Mer. Rapports et Procès-Verbaux. Vol. 79, 1932.

Calcium Isotope with Mass 41 and the Radioactive Half-Period of Potassium

CAREFUL determinations have been made of the atomic weight of calcium extracted from two very old potassium-rich deposits—one a felspar from Rhiconich, Sutherlandshire, estimated at 1,000 million years old, the other a pegmatite from Portsoy, Banffshire, probably about 600 million years old. Each mineral contained approximately 9 per cent K_2O and less than 0·3 per cent CaO, so that there seemed reasonable grounds for hope that the accumulation of the calcium isotope with mass 41, through the slow radio-active disintegration of the potassium in the deposit, might be sufficient to induce a detect-able change in the atomic weight from the normal value.

Extraction with hydrochloric acid removed about one-third of its calcium content from the finely pulverised rock very rapidly. The residue proved much more resistant and, in view of the probability that 'abnormal' calcium atoms, occupying the position of their parent potassium in the crystal lattice, were being preferentially extracted, no attempt was made to carry the process to com-pletion.

180 gm. of crude calcium oxalate was thus obtained from about two hundredweights of each mineral. This oxalate was rigorously purified in accordance with the procedure of Hönigschmid and Kempter[1], to ensure the removal of all traces of barium and strontium, then converted to the nitrate and repeatedly recrystallised. Finally, the ratio $CaCl_2$: 2Ag was determined, using all the standard refine-ments of technique.

Six determinations with Rhiconich calcium gave an atomic weight of 40·092, with a probable error of 0·0006. Six determinations with Portsoy calcium gave an atomic weight of 40·089, with a probable error of 0·0004. Parallel experiments with calcium derived from recent marine sources—sea-shells and Bermuda limestone—gave values of 40·076 and 40·077 respectively.

From the above results, the radioactive half-period of the potassium isotope with mass 41 may be calculated on two limiting assumptions: (*a*) that all the calcium with mass 41 existent in the rock was extracted therefrom, and (*b*) that only one-third of this calcium was extracted. The resultant times are, on the former assumption, 2×10^{12} years (Rhiconich) and $1{\cdot}3 \times 10^{12}$ years (Portsoy); on the latter assumption, 7×10^{11} years (Rhiconich) and

$4 \cdot 3 \times 10^{11}$ years (Portsoy). The value indicated is thus of the order 1×10^{12} years, in definite agreement with the recent work of Mühlhoff[2].

JAMES KENDALL.
WILLIAM W. SMITH.
THOMAS TAIT.

Chemistry Department,
University, Edinburgh.
May 2.

[1] *Z. anorgan. Chem.*, **195**, 1; 1931.
[2] *Ann. Rep. Chem. Soc.*, **27**, 310; 1930.

Surface Tension of Colloidal Solutions, and the Action of Light on Soap Solutions

SOME time ago[1] a discussion arose between Prof. Mahajan and myself about the interpretation of a phenomenon which I described for the first time in 1922, namely, the slow decrease in the surface tension of colloid solutions in general, as a consequence of the adsorption in the surface layer. I showed that this decrease could be followed step by step by means of a proper instrument.

Prof. Mahajan questioned my interpretation of the mechanism of this phenomenon especially in the case of Boys's soap solutions, and suggested that it was due to the action of light, as he had noticed a difference whether the solutions were kept in the dark or not. I replied and, I believe, I succeeded in convincing him that the phenomenon in question was indeed due to adsorption in the surface layer, and of a much greater amplitude than that which might be attributed to the action of light alone.

Since then, I have had an opportunity of checking at the same time my statements and Prof. Mahajan's, and I found that, as I had suggested, the effect of light—which is real—was small in comparison with the main phenomenon, namely adsorption as a function of time. This being settled, credit must be given to Prof. Mahajan for his discovery of this effect. The figures given below will indicate the relative importance of the two factors.

Decrease of Surface Tension of Sodium Oleate solutions as a Function of Time
(Exp. Sept. 30, 1931)

	Solution kept in the dark and measurements made in the dark.	Solution exposed to daylight for 3 hours.
Decrease at concentration of 10^{-4}	3·3 dynes	6·2 dynes
Decrease at concentration of 10^{-5}	18·3 „	23·6 „

Here we observe a difference of 2·9 dynes and 5·3 dynes at two different concentrations, in favour of the solution exposed to light. The difference is not always so important: another experiment, at a concentration of 10^{-4}, gives a difference of 2·2, another one (Oct. 5, 1931) shows no difference at all (1·6 in both cases), and another still, shows a greater drop for the wrong solution. However, in general, there is a difference, and the difference increases when the dilution increases. At a concentration of 10^{-2} the difference may be of the order of 0·1 to 0·5 dyne, while it reached as much as 6·4 dynes, in one experiment, at 10^{-5}.

We must not forget, however, that when dealing with a soap solution at a concentration of 10^{-4}, the *measurable* dynamic surface tension of which is about 43 dynes, we are forced to neglect the first, and almost instantaneous drop from 73·7 dynes (pure water) to 43. When we deal with more dilute solutions (10^{-5}) the dynamic surface tension rises to 73 dynes—very close to that of pure water—and the observed drop amounts to as much as 26 dynes (in the dark).

To summarise, we can say that the drop in the surface tension of colloidal solutions in general, and in particular of soaps, is due as I have contended since 1922, to adsorption as a function of time, as predicted by elementary thermodynamic considerations, and as expressed by the Gibbs-Thomson equation.

To this general statement we can now add that Prof. Mahajan has shown that, in the case of soap solutions, light has an effect, and increases the amplitude of the decrease. The increase may reach the order of magnitude of 20–25 per cent of the total drop, when the solutions are highly diluted (10^{-5}). When the solutions are more concentrated, the phenomenon is less clear and sometimes even absent, and the percentage cannot well be expressed, as the measurement of the real dynamic surface tension is impossible.

P. LECOMTE DU NOÜY.
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[1] NATURE, **128**, 674, Oct. 17, 1931, and **129**, 278, Feb. 20, 1932.

Methionine in Wool

THE method of estimating methyl thiol groups devised by Kirpal and Buhn[1], and Pollak and Spitzer[2] (analogous to the Zeisel process for the estimation of methoxy groups) has recently been used by Baernstein[3] for methionine estimations in a study of the sulphur distribution in a number of proteins. In a subsequent paper, Baernstein[4] refers to the work of Rimington[5] and the writer on the cystine content of keratins, in which it was shown that these substances contain enough cystine to account for nearly all this sulphur, and presumably as a consequence, he did not carry out any determinations of methionine on keratin.

King[6], in discussing the sulphur economy of animal fibre production, has pointed out the possible significance of methionine as a thiol body concerned in the auto-oxidation of glutathione, and thus from these two points of view more definite information as to the amount of this acid in wool becomes of some interest.

Some determinations on wool have been carried out by the author as described by Baernstein, with minor modifications, and with the few wools so far examined, the methionine content is of the order of 0·5 per cent on the dry weight on the keratin. Mueller[7] has actually isolated methionine from wool to the extent of about 0·2 per cent.

In considering the effect on the relationship between total sulphur and cystine sulphur in keratin of this quantity (0·5 per cent) of methionine, which corresponds to approximately 3 per cent of the total sulphur[8], it may be regarded as doubtful if such a discrepancy would be revealed by the Folin-Marenzi technique for cystine determination.

Moreover, recent work of Butz and du Vigneaud[9] shows that methionine, though not reactive to the Folin-Marenzi reagent itself, gives on hydrolysis with acids (particularly with sulphuric and to a lesser degree with hydriodic) 'homo-cystine', the next higher homologue of cystine, which is reactive to the Folin-Marenzi reagent.

Thus although it appears that methionine may be present in wool keratin to the extent of 0·5 per cent (and the possibility of other sulphur acids occurring in small amount must not be overlooked) it does not influence unduly the previous conclusion of Rimington[4] and the writer, that substantially the whole of the sulphur in keratin may be accounted for as cystine, even though some methionine, because of its hydrolysis to 'homo-cystine', may have been previously recorded as cystine when using the Folin-Marenzi technique.

The complete distribution of sulphur in keratins will be more readily realised when more precise methods are available for the determination and isolation of cystine.

JOHN BARRITT.

Wool Industries Research Association,
Headingley, Leeds, 6.
April 6.

[1] Kirpal and Buhn, *Monats. Chem.*, **36**, 853; 1915.
[2] Pollak and Spitzer, *ibid.*, **43**, 113; 1922.
[3] Baernstein, *J. Biol. Chem.*, **97**, 663; 1932.
[4] *ibid.*, **97**, 669; 1932.
[5] Barritt and Rimington, *Biochem. J.*, **25**, 1072; 1931.
[6] King, *Trans. Far. Soc.*, **29**, 258; 1933.
[7] Mueller, *J. Biol. Chem.*, **56**, 157: 1923.
[8] Barritt and King, *J. Text. Inst.*, **17**, 394T; 1926.
[9] Butz and du Vigneaud, *J. Biol. Chem.*, **99**, 135; 1932.

Priestley as a Practical Chemist

WITHOUT wishing to be captious, may I say that the statement by Prof. Meldrum at the Chemical Society on April 6 (NATURE, April 15, page 555) that Priestley had confessed himself "not a practical chemist", seems to me to convey rather a wrong impression, because I fancy that by the term *practical chemist*, Priestley meant something a little different from what we nowadays would mean by the expression.

In the passage in which the phrase occurs ("Experiments on Air", 2nd edition. 1776. Vol. II, page 1) Priestley says he "had no access to any person of that *profession*" and on page 51 speaks of having got Dr. Higgins to make him a quantity of red lead. From these, and other passages, I fancy he meant by the term *practical chemist*, a person who made his living by the preparation and selling of chemical compounds—a professional chemist.

Priestley was an amateur, and might very well have claimed to be—though I do not know if he did so—an *experimental chemist*, which is much the meaning of *practical chemist* at the present day, and, in this sense of the term, Priestley was perhaps the most practical chemist that ever lived.

T. S. PATTERSON.

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April 14.

Upper Limit in Explosive Chain Reactions

THE existence of an upper limiting pressure for explosion in thermal chain reactions has been explained in two ways. (1) The rate of branching of the chains, at the limit, is just sufficient to balance the rate of gas phase deactivation of the carriers; (2) a sudden change in the nature of the absorbed layer of gas on the walls of the reaction tube leads to the ejection of atoms or molecules into the gas capable of starting the chain. In two recent letters[1] to NATURE, the gas phase deactivation theory has been further extended to explain the occurrence of the upper limit. It may be of interest, therefore, to describe an experiment with phosphine-oxygen mixtures in which it can be shown that in the region above the upper limit there is a gradual decrease in the length of the reaction chains as the pressure is increased.

In order to initiate the chain, dissociation of the phosphine molecule was effected by collision with an optically excited ($2\,^3P_1$) mercury atom[2]. The pressure of the phosphine was maintained at a constant value (0·130 mm. mercury) and a series of experiments was made at different oxygen pressures with the mercury lamp burning at a constant intensity. As can be observed from Fig. 1, the rate of reaction increases at first, reaches a maximum and then decreases; and the pressure of oxygen at the maximum is of the same order as that where the curves representing the upper and the lower limit coincide[3]. The chain length consequently increases in the region below the lower limit, but above the upper limit it apparently decreases as the pressure of gas rises.

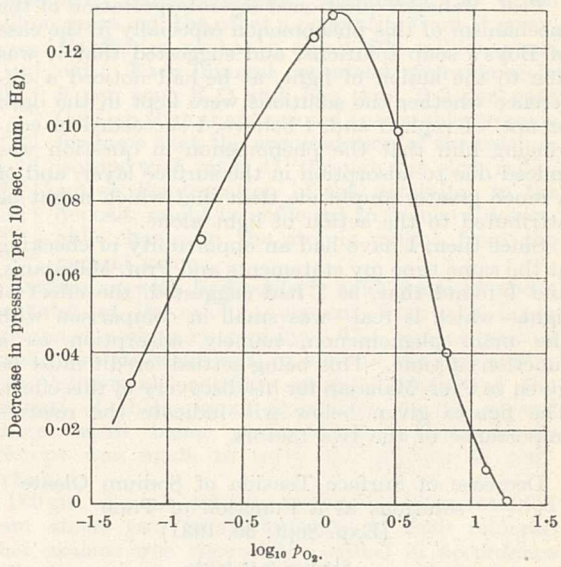

FIG. 1.

It might be argued that this decrease in chain length is due to deactivation of the mercury atoms by oxygen as the oxygen pressure is increased. Taking this factor into account, the rate of oxidation of phosphine is then given by

$$R = -\frac{d[PH_3]}{dt} = \frac{K_1 k_1 [PH_3]}{k_1[PH_3] + k_2[O_2] + 1/\tau} \cdot K_2[PH_3] f([O_2]),$$

the first term representing the rate of starting and the second the chain length; k_1 and k_2 are velocity coefficients and τ the mean life of the excited mercury atom. If $f([O_2]) = [O_2]$, as is probably the case below the lower limit, R would increase with $[O_2]$ and tend to a maximum steady value when $[O_2] >> [PH_3]$. The fact that R decreases shows that $f([O_2])$ is of the form $1/[O_2]^n$ and hence the chain length must decrease as $[O_2]$ increases. From the results, it may be readily shown by plotting $1/R$ against $[O_2]^2$ that n approaches unity. The oxygen molecule is thus an inhibitor for the reaction in this

region by virtue of its deactivating influence on the chain carriers in the gas phase. As the upper limit is approached, such deactivation diminishes until the rate of branching effects a balance between the two, and explosion occurs.

H. W. MELVILLE.
H. L. ROXBURGH.

Chemistry Department,
University of Edinburgh.
March 24.

[1] Ubbelohde, March 4, p. 328; Hinshelwood and Grant, March 11, p. 361.
[2] Melville, *Proc. Roy. Soc.*, A, **138**, 374; 1932.
[3] Dalton, *ibid.*, A, **128**, 263; 1930.

Interaction Between Soot Films and Oil

IF a piece of glass, say a 3 in. × 1 in. microscope slip, is thinly smoked in a luminous flame, allowed to cool and a drop of oil allowed to fall from a height of a few centimetres on to the film, a circular pattern is formed immediately, radiating from the centre of the drop. This figure usually has a central part of concentric striæ of soot, surrounded by a circle of clear dots formed by the withdrawal of soot and its concentration at their peripheries. These dots are surrounded by a further region of rather larger dots with an outer annulus of smaller ones, all formed by the concentration of soot into the surrounding areas. Breaks in the outlines in places show that the figure is strained. Outside the figure, annular regions of attenuation and concentration may be observed. The figure is usually about 0·5 cm. in diameter but varies with the size of the drop. The structure is strong enough for the oil to be washed off the glass with an appropriate solvent, when it may be preserved by mounting *in situ* with Canada balsam-xylene. It may also be formed by letting balsam, instead of oil, fall on the smoked slide.

The following liquids have been found to yield patterns: medicinal paraffin, which is very viscous, castor oil, cotton-seed oil, olive oil, and ordinary paraffin. Peripheral disruption was shown by bromoform, pentachloroethane, chloroform and nitrobenzene. Aniline yielded a pattern with central disruption and radiating effects. Cyclohexanol and cyclohexanone yielded patterns. With glycerol and with sulphuric acid, disruption of the film occurred.

Observation of the film as the drop falls shows that an evolution of gas occurs, the gas bubbles being responsible for surface stresses which drag the film away from the glass under them. Both new films and films formed overnight yield patterns. As oil which has been recently boiled forms patterns, it would appear that the gas is adsorbed by the soot as the film is formed and is not that dissolved in the oil.

I have not seen this effect described; if it had been, it would surely have been well known to microscopists, as the patterns form very beautiful objects under a magnification of from 20 to 50 diameters. They are easily visible to the naked eye and most of the structure can be seen under a hand lens. The general appearance is like a plant section or a coarse circular diatom.

J. H. COSTE.

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April 8.

Production of Electronic Oscillations with a Two-Electrode Valve

IN 1920, Barkhausen and Kurz discovered that an ordinary three-electrode valve could be made to give rise to oscillations of very high frequency (greater than 3×10^8 cycles per second) if the grid was maintained at a relatively high positive potential while the anode was made slightly negative with respect to the filament. The explanation for the occurrence of such oscillations appears to be that a condition of negative resistance is possible when the electrons are given a to and fro motion within the valve. It occurred to me some time ago that such a vibratory motion of electrons should be obtainable from a two-electrode valve of special design but circumstances prevented the construction of the valve until recently.

The valve, constructed by H.M. Signal School, Portsmouth, consists of a central metal rod anode of 1 mm. diameter around which are arranged four filaments in parallel spaced equally on a ring 12·5 mm. diameter. When the filaments are heated and the anode is maintained at a high positive potential, the electrons are attracted from the external cathode towards the anode. A certain number of electrons, however, escape capture by the anode and travel towards the filament diametrically opposite to that from which they were emitted. In this way the necessary to and fro motion of the electrons may be obtained in a diode without any external field being necessary as in the case of the magnetron. Preliminary experiments have shown that the valve behaves in exactly the way predicted and strong oscillations have been obtained. Another important feature is that by means of a tuned external circuit the frequency of the oscillations appears to be adjustable within fairly wide limits while all other operating conditions are kept constant.

A two-electrode valve of somewhat similar design has recently been described by J. Sahánek[1], but he gives a different explanation for the occurrence of oscillations.

J. S. MCPETRIE.

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April 4.

[1] J. Sahánek, *Phys. Z.*, **33**, 693; 1932.

Structure of the Lines of the Arc Spectrum of Silver

THE fine structure of the more important lines of the arc spectrum of silver was examined by means of a reflecting echelon grating of high resolving power. This instrument and its mounting have been previously described[1]. The light source was a tube of fused silica fitted with external electrodes similar to those used by me in the investigation of the structures of the arc lines of indium[1], thallium[2], and gallium[3], excited by means of a high frequency oscillator. The discharge tube was filled with neon at a pressure of about 0·5 mm. of mercury, and the capillary portion of the tube contained a small quantity of silver chloride. The capillary was heated to a temperature of about 600° C. All the lines examined were found to be simple. The half-value width of the lines was determined by obtaining two images of the line under investigation on the same plate, making two exposures at different pressures of the air surrounding the echelon grating; the separation of the

images at the smallest pressure difference at which the two images could still be resolved was measured and taken to be the half-value width of the line.

Now the half-value width of a line with no fine structure (a simple line) due to the Doppler effect arising from the movement of the atoms is equal to $\nu \times \sqrt{\theta/M}/1{\cdot}2 \times 10^6$, where ν is the frequency of the line, M is the atomic weight and θ the absolute temperature of the radiating atoms. In the following table the observed half-value width of the lines examined is compared with the calculated width for a simple line.

Line	3280 $1S_{1/2}$-$2^2P_{3/2}$	3380 $1S_{1/2}$-$2^2P_{1/2}$	5209 $2^2P_{1/2}$-$3^2D_{3/2}$	5465 $2^2P_{3/2}$-$3^2D_{5/2}$	5471 $2^2P_{3/2}$-$3^2D_{3/2}$	4055 $2^2P_{1/2}$-$4^2D_{3/2}$	421 $2^2P_{3/2}$-$4^2D_{5/2}$
Observed half-value width of line	0·07 cm.$^{-1}$	0·07 cm.$^{-1}$	0·04 cm.$^{-1}$	0·04 cm.$^{-1}$	0·04 cm.$^{-1}$	0·05 cm.$^{-1}$	0·05 cm.$^{-1}$
Calculated width of simple line	0·07 cm.$^{-1}$	0·07 cm.$^{-1}$	0·04 cm.$^{-1}$	0·04 cm.$^{-1}$	0·04 cm.$^{-1}$	0·05 cm.$^{-1}$	0·05 cm.$^{-1}$

None of the observed lines has a greater width than that calculated for a simple line. It can therefore be concluded from the observed width of the lines of the diffuse series that any structure in the terms $2^2P_{1/2}$, $2^2P_{3/2}$, $3^2D_{3/2}$ and $3^2D_{5/2}$ must be less than 0·04 cm.$^{-1}$; and from the width of the resonance lines, any structure in the $1S_{1/2}$ term must be less than 0·07 cm.$^{-1}$ (The triplet structure observed by Mohammad and Sharma[4] in the resonance lines is due to self-reversal of the lines given by the vacuum arc lamp they used and also a ghost in the Lummer plate fringes in the ultra-violet.) This simplicity of the $1S_{1/2}$ term is of the greatest interest for it signifies that any doubling of this level arising from magnetic moments of the nuclei of the silver isotopes must be smaller than 0·07 cm.$^{-1}$ This seems to indicate an abnormally low magnetic moment of the silver nuclei; for the $1S_{1/2}$ term of copper has a doublet structure with a separation of about 0·3 cm.$^{-1}$, and since the $1S_{1/2}$ term of silver corresponds to a more penetrating orbit, it would be expected that, if the silver nuclei possessed magnetic moments comparable with those of the copper nuclei, the $1S_{1/2}$ term of silver would possess a doublet separation of the order of 0·5 cm.$^{-1}$

It has been suggested to me by Dr. S. Tolansky that the absence of structure in the deeply penetrating $1S_{1/2}$ level does not prove that the magnetic moments of the silver nuclei are abnormally small. In the spectrum of thallium, the $2S_{1/2}$ and $2^2P_{1/2}$ terms possess large hyperfine structures, while the $2^2P_{3/2}$ term, which corresponds to an almost equally deeply penetrating orbit, possesses no observable structure. No explanation of this anomaly has been found, and it must therefore be considered possible that, owing to a similar cause, a normal magnetic moment of the nuclei gives rise to no observable structure in the $1S_{1/2}$ term of silver. The absence of fine structure could also be explained by ascribing a mechanical moment of 0 to the nuclei of silver; but this seems to be improbable as silver possesses two isotopes of odd atomic weight (107 and 109) and all atoms of odd atomic weight hitherto investigated have been found to possess mechanical moments.

Clarendon Laboratory, Oxford.
April 4.
D. A. JACKSON.

[1] D. A. Jackson, *Proc. Roy. Soc.*, A, **123**, 508; 1930.
[2] D. A. Jackson, *Z. Phys.*, **75**, 229; 1932.
[3] D. A. Jackson, *Z. Phys.*, **74**, 291; 1932.
[4] W. Mohammad and P. N. Sharma, *Indian J. Phys.*, **6**, 75; 1931.

Fine Structure of the Resonance Ag I Lines

THE structure of the silver lines 3280 A. and 3383 A. have been examined with Lummer plates by W. Mohammad and P. N. Sharma[1] using a specially constructed vacuum arc. They report identical triplet structures of intensity ratio 5 : 5 : 1 and separations of 0·218 and 0·116 cm.$^{-1}$ respectively, the weaker component being on the violet side. They therefore attribute this structure to the common $5s^2S_{\frac{1}{2}}$ term, which, with a J value of $\frac{1}{2}$ should only give a fine structure multiplicity $2J + 1$ when $J \ll I$. A triplet could only arise if there were an isotopic displacement effect and provided the g (I) factors of the nucleii differed so that two of the four components superposed. In this somewhat unlikely event the intensity ratios should be very different from the values quoted above since the abundance ratio is unity. This, however, would not be a serious contradiction since it is well known that intensity measurements with resonance lines are necessarily unreliable owing to self-absorption.

We have examined these lines with 25 and 35 plate reflection echelons, employing water and liquid air cooled hollow cathode discharges. Two hollow cathodes of 8 mm. internal diameter and 15 cm. length were used, the one consisting of 5 per cent silver and 95 per cent cadmium, the other with the proportions reversed.

With both cathodes, the two lines appeared single, of a total width not exceeding 0·050 cm.$^{-1}$, when the discharge current was low (0·1 amp.). As the current was increased these particular lines broadened while the other lines remained equally sharp. With the silver cathode a sharp reversal occurs at about 0·2 amp., the width of the clear centre band steadily increasing with heavier currents until, with a current of 0·8 amp., the separation between the wings of the reversed line amounts to 0·13 cm.$^{-1}$. With the cadmium cathode the current could be increased to 0·4 amp. without reversal.

It may be concluded, therefore, that the structure observed by Mohammad and Sharma is a case of self-reversal due to the unsuitability of the vacuum arc source. The total structure width of the lines must be appreciably less than 0·050 cm.$^{-1}$

The peculiar absence of structure in these and other Ag I lines is explained in a forthcoming paper (*Proc. Phys. Soc.*) by Dr. Tolansky, who infers that it is due to anomalous external electron coupling, and not necessarily to zero spin or small magnetic moment.

Wheatstone Laboratory, King's College, Strand, W.C.2.
March 30.
W. E. WILLIAMS.
A. MIDDLETON.

[1] *Indian J. Phys.*, **6**, 75; 1931.

The 'Tail' of the Male American Toad, *Ascaphus*

Ascaphus (North America) and *Liopelma* (New Zealand) constitute, according to Dr. G. K. Noble, the Liopelmidæ, the most primitive anuran family in existence. Apart from the importance of *Ascaphus* from the general phylogenetic aspect, it has often been credited with possessing a tail. Noble has

described a pair of tail-wagging muscles for the genus. Moreover, *Ascaphus* possesses a prepelvic skeletal structure of the nature of a prepubis (or epipubis) and is further notorious in possessing post-pelvic 'Nobelian cartilages' (Mehelij). Presumably the epipubis and the Nobelian cartilages represent chondrifications of the pre- and post-pelvic portions of the linea alba respectively. The latter are known in *Ascaphus* only.

The microtomised pelvic region of *Ascaphus* reveals the following features: (1) the frog has the epipubis in the form of an inverted Y, the arms of which are synchrondrotically fused with the pelvic girdle, whereas in *Xenopus* the epipubis is merely articulated with the girdle. Presumably the structure is a derivative of the linea alba as in *Xenopus*, whereas some Urodeles have a prepelvic element developing as a zonal derivative, and therefore not homologous with an epipubis. The Nobelian 'cartilages' *prove to be true bones* with enormous marrow cavities. Their ontogeny is unknown, but they look suspiciously like sesamoid bones (tendon bones). The cloaca is continued into the tail, at the end of which it has a groove-like opening. The cloacal opening has large dermal proctodeal glands. The 'tail' is a mass of spongiose fibres, the interstices of the network filled with blood. This erectile tissue is distributed into a pair of strands ventral to the cloaca and lateral to the Nobelian *bones*, and a strand is pierced by the cloaca. The skin is separated from the erectile tissue by large subdermal lymph spaces, but is adherent ventrally and mid-dorsally.

There is no doubt that the 'tail' of the male *Ascaphus* is an intromittent organ with highly developed erectile tissue comparable with that of the penis. If the genus is really very primitive, the cloacal region in the male may be of very great importance for the evolution of the omniote reproductive system.

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The Neuro-Muscular Junction and Curare

WHEN, some years ago, I suggested [1] that the phenomena associated with the action of drugs on muscle might more appropriately be explained by reference to the actual facts of minute anatomy than to a hypothetical 'neuro-muscular junction', what I had in mind was the histological conditions present at the eminences of Doyère and not the "part of the nerve which is exposed to the action of the drug, namely, its ending where the medullary sheath is absent". The situation, to which Prof. A. V. Hill refers in his article on "The Physical Nature of the Nerve Impulse",[2] is not materially different from any other node of Ranvier (it is only a node of Ranvier), and the axis core is here consolidated and compact. At the eminences of Doyère it is, on the contrary, considerably subdivided beneath the expansive surface of the sarcolemma, and is accessible to the action of drugs.

The result of Fromherz's experiment is consistent with this view, but scarcely with the view that curare acts on the part of the nerve mentioned by Prof. Hill, since numbers of precisely similar parts are contained within the length of nerve subjected to experiment after removal.

I make this comment on a detail of Prof. Hill's interesting paper because the point is capable of further development. The transformation of the nervous material from a dense to an attenuated state is carried a stage further within the muscle fibre proper, a fact which should receive more attention than has yet been accorded to it if the physical nature of the muscular contraction is to be understood in correlation with the actual mechanisms which subserve it and not merely in correlation with associated phenomena.

While it is desirable that the histological accounts of muscle and nerve should be pruned of their many inaccuracies and irrelevancies, may I suggest to Prof. Hill that the existence of what are called 'end-plates' is not dubitable by those familiar with muscle histology?

TUDOR JONES.

University of Liverpool.
April 8.

[1] "Proceedings of the Anatomical Society." *J. Anat.*, **63**, 168, October, 1928.
[2] NATURE, **131**, 501, April 8, 1933.

Some Limiting Factors in the Environment of the Common Limpet, *P. vulgata*

THE relation of the organism to the environment, especially to limiting factors in the environment, is a subject of much importance to the student of bionomics, hence the following observations made in 1932 are considered worthy of record.

On the morning of August 28, 1932, at about the end of the period of hot dry sunny weather, dead, dying and weak limpets, *Patella vulgata*, were found at about high-water neap-tide level on a platform of cliff at Stepper Point, near Padstow. The dead and dying limpets (about 3 cm. long) were found both in and at the edge of healthy-looking pools which were lined by a pink encrusting calcareous alga (*Lithothamnion* or an ally). Around these pools and exposed to the air was a rim of white dead alga on which were numerous dead *Patella*, some having *dried-up* bodies. Suspicion that the pools may have been polluted—although pollution alone would scarcely suffice to explain the dead limpets on the rims—led to an examination of limpets at higher levels. It was then found that much larger limpets whose 'homes' were out of water were so weak that one could easily lift them off the rock slowly with a silver fruit-knife, whereas ordinarily a stout potato knife is barely strong enough to remove them even when plunged suddenly under the edge of the shell. The occurrence of these weak limpets enhanced the probability that the reduction in the level of the pools was natural, and led to the examination of more alga-encrusted pools in the locality, where more dead limpets were found, especially in the dried-up rims. There seems little doubt therefore that evaporation had exposed the rims of pools and the pool-limpets to the air. A few days later limpets in this locality—after immersion in sea-water during the increasing tides—were firmly seated on the rock.

The pools were situated at about the level of high-water neaps where usually the splash of the waves would renew the water even at neap tides, but on August 28 it is clear that the pools had remained stranded from some unusual cause, since many of the limpets had dried-up bodies. An explanation is

suggested by an examination of the Admiralty Tide Tables and a consideration of local conditions.

The sea had maintained in the locality a continuous and arrestingly noticeable flat calm for some days previously; such light winds as occurred being off-shore. It also happened that the period coincided (*a*) with low (summer) H.W. neap tides, August 25–28[1], and (*b*) with rather warm weather[2]. Thus the absence of renewal of the water extended over an unusually long and warm period and caused the limpets to be exposed to hot weather conditions at midday. It is known that limpets may not be wetted during a few successive neap tides in calm weather[3], but the exposure during a set of neap tides following the normal midday exposure at low water of spring tides would impose a severe strain upon the animals.

The death of the limpets on the rim of the pools therefore followed an unusual exposure to sun and air, while those succumbing in the pools had doubtless been subject to large and complicated variations in the little-known co-existing physical and chemical conditions[4]. At the same time limpets accustomed to exposure higher in the foreshore survived, though in a weak condition. These facts confirm the critical nature of the environment round about the level of H.W. neaps[5]. Limiting natural environmental conditions—unfortunately not closely definable—in temperature, humidity, certain chemical and other physical factors were therefore either approached or surpassed in this locality for *P. vulgata* in August 1932.

J. H. ORTON.

Department of Zoology,
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April 6.

[1] Admiralty Tide Tables 1932.
[2] Daily Weather Report, British Section, Meteorological Office, London.
[3] J. H. Orton, *J. of Mar. Biol. Assoc.*, **16**, 279; 1929.
[4] J. R. Bruce, *Proc. and Trans. Liv. Biol. Soc.*, p. 19; 1931.
[5] J. Colman, *J. Mar. Biol. Assoc.*, **18**, 467; 1933.

Measurement of Light for Biological Purposes

THE measurement of light intensity has always presented certain difficulties to biologists, especially when it was necessary for the measurements to be made under field conditions. The available methods were either slow, or measured only limited spectral ranges, or else involved the use of cumbrous apparatus of limited portability. We have lately used, however, a form of apparatus which seems to be free from these disadvantages. We are so impressed with the usefulness and simplicity of this apparatus that we wish to bring it to the notice of readers of NATURE and particularly to that of biologists.

The essential part of the apparatus is a Bernheim photo-voltaic cell. The current produced by exposing this cell to light is measured by the deflection of a Unipivot galvanometer, which is sufficiently robust to be read easily in a small boat and has already travelled many hundreds of miles in a motor-car over bad roads. A manganin resistance of 1,000 ohms is put into the circuit for readings in full daylight. There is no lag in the readings and there is no dark current. Moreover, there is no reversal of the current at certain spectral ranges, as may be the case in some rectifier photo-cells.

Using this cell enclosed in a watertight container we obtained the following measurements of light penetration in Windermere. For comparison with the figures so obtained are given those measured with a recent form of potassium-on-copper vacuum cell. In using the latter, it is necessary to amplify the primary photoelectric current about two hundred times in order to obtain readings comparable with those of the Bernheim cell. The thermionic potentiometer devised to accomplish the amplification and measurement is naturally somewhat bulky and less readily portable.

Light intensity at different depths in Windermere.
February 8, 1933.

Depth in m.	1	2	3	5	7	9	11	13
Bernheim cell	38·0	19·9	11·1	3·84	1·33	0·45	0·15	0·052
Vacuum cell amplified	36·3	15·9	7·41	1·82	0·43	0·11		

Values as percentages of full daylight.

The greater utility of the Bernheim cell for this type of work is due not only to its greater sensitivity but also to the fact that it is sensitive over the whole range of the visible spectrum. The cell we have employed for outdoor work has the following spectral sensitivity, given as galvanometer deflection per 1,000 ergs per cm.^{2} per sec. (for the facilities necessary to make these determinations we are indebted to Prof. R. Whiddington):

Wave-length in A.	3500	4200	5000	5700	6200	7000
Sensitivity	1·4	3·0	5·6	6·7	4·8	1·1

The vacuum cell used in the above mentioned measurements has a maximum sensitivity in the region 4000–4900 A. and only slight sensitivity in the red.

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Preservation of Fossil Bones

UNDER the above heading in NATURE of March 11, p. 366, Mr. Ludovic McL. Mann states that the mammalian bones in the Kelvingrove Museum, Glasgow, "were all found . . . in the laminated gravels of the old raised terrace of the Kelvin river, some eight miles east of Glasgow, at about 170 ft. O.D."

Readers will probably interpret "raised terrace" as they are accustomed to interpret raised beach, that is, as a terrace originally formed at a lower level and owing its present position to relative elevation of the land. Certainly they will think that the gravel deposit in which the bones were found is a *higher* terrace of the River Kelvin, in the same way as the implementiferous terraces of southern England are higher terraces of the rivers occupying the valleys.

Recently, I have been studying the Kelvin valley terraces in an attempt to understand the glacial history of the Glasgow district. I think, with other geologists, that there is no connexion between the 170-ft. terrace of current-bedded sands and gravels and the present River Kelvin, other than that they occur in the same valley, referred to above as the Kelvin valley.

The late Prof. Gregory[1], on more than one occasion, gave a Mousterian age to the gravels of these terraces, but it is now clear that they must be very much more recent than the Early Magdalenian.

W. J. MCCALLIEN.

University of Glasgow.
April 1.

[1] cf. Gregory, J. W., and Currie, E. D., "The Vertebrate Fossils from the Glacial and Post-Glacial Beds of Scotland in the Hunterian Museum, University of Glasgow, and their Evidence on the Classification of the Scottish Glacial Deposits", *Monographs of the Geological Department of the Hunterian Museum, Glasgow University*, 1928, p. 20.

Research Items

Woolly Hair in a Nordic Pedigree. An interesting case of an apparent mutation in hair character inherited as a simple Mendelian dominant through five generations in a Norwegian family has been described by Dr. O. L. Mohr (*J. Hered.*, vol. 23, No. 9). The hair is woolly or ulotrichous and short, closely resembling that of a negro but densely set. The individuals are otherwise of Nordic type and colouring, and all the circumstances render any crossing in the ancestry highly improbable. The descent is from a woman who married twice and left woolly-haired individuals in both lines of descent, the sibships numbering 38 woolly, 42 non-woolly and 3 unknown. The parents and grandparents of this woman are known, but not their hair characters. The woolly hair is flattened or kidney-shaped in cross-section and shows only traces of a medulla. It only reaches the length of negroid hair but is light in colour. This appears illuminating in regard to the origin of the ulotrichous races of mankind, as such hair is also dominant in racial crosses. The similarity cannot, however, be pressed too far, since in negro crosses the later generations show various degrees of the woolly condition. Nevertheless it helps to indicate how the ulotrichous character may have arisen, possibly independently, in Negro and Melanesian.

Destruction of Predatory Animals in Alaska. The past five years have shown in Alaska an increased destruction of predatory animals owing to the assistance and advice given to trappers by the local control leader of the Bureau of Biological Survey (Report for year ended June 30, 1932). In the year before control work was undertaken, 1925–26, 1,111 wolves and coyotes were presented for the 15 dollar bounty, and in 1927–28 the number was 2,161. In 1929–30, notwithstanding that the legislature reduced the bounty to 7.50 dollars on wolf and 5 dollars on coyote, there were 2,304 individuals presented. In 1931, with the bounty re-established at 15 dollars, though fewer private trappers worked in the Territory, reports to the Bureau show an increase in the catch over the preceding year of nearly 70 per cent.

Penguin Embryos. C. W. Parsons has described the series of penguin embryos, 64 of the gentoo and 14 of the ring penguin, collected by the "Discovery" Expedition (Reports, vol. 6, 139–164; 1932). The earliest embryo corresponds with an embryo of the fowl of 24 hours incubation; the latest is a ring penguin about six inches long, fledged in the coat of silky down with which it hatches. The intervening embryos are arranged in six stages. A description of the more outstanding features of each of the eight stages is given and is followed by comparative studies on the brain, feathers, and cartilaginous skeleton. In the brain, one of the notable features is the precocious development of the pineal body and for a time its disproportionate size. The last feather rudiments to appear are those on the wings. The author comments on the controversy as to whether feathers can be derived, like scales, from conical skin papillæ and refers to the granular type of skin reproduced in the earliest feather papillæ "as being a likely characteristic both of the ancestors of birds and of the scaly reptiles". In the skeleton the cartilages of the fore-limb grow at a prodigious pace. The author remarks that the body of the penguin, with its back arched and its limbs hanging vertically, is extraordinarily reminiscent of the aquatic reptiles of Mesozoic age. Small transitory papillæ which appear on the dorsal side of the lung are interpreted as incipient air-sacs which do not proceed with their development; air-sacs in that position would be hemmed in between the distended lung and the unyielding dorsal wall of the cœlomic cavity and in time would be eliminated. The development of the heart is traced in some detail. The paper is illustrated by text figures and by six admirable plates.

Tintinnids of Mutsu Bay. Much of the fauna and flora of Mutsu Bay has been described already systematically in the Science Reports of the Tôhoku Imperial University (Reports of the Biological Survey of Mutsu Bay). Vol. 8, No. 4, November 1932, contains the Stomatopoda, Cirripedia and the pelagic Ciliata, suborder Tintinnoinea. The last, by Yoshine Hada, includes a large number of species obtained by the author himself in surface collections and vertical hauls at numerous stations, August 1929–September 1930, and plankton collected with a surface tow-net twice a month in 1927–31 and preserved in the Asamushi Marine Biological Station of the Tôhoku Imperial University. Tintinnids form a very important part of the unicellular plankton and their importance is being recognised more and more, for they are the food of innumerable small marine animals swimming in the surface layers, from Protozoa to young fishes. From this region, thirty-four species belonging to twelve genera and eight families are recorded, seven species being new to science. The most predominant genus is *Tintinnopsis*. Some of the genera *Tintinnopsis* have a wide distribution and such a well-known species as *Tintinnopsis beroidea*, common in British waters, abounds in Japanese seas in February-April and September. The family Tintinnidæ, the members of which assume comparatively large dimensions in warm waters, is represented by only four species, but three of those recorded are common, including a new *Tintinnus* closely related to *Tintinnus tenuis* Kofoid and Campbell, and both of these occur abundantly. The paper is illustrated by clearly drawn text figures of the lorica of most of the forms.

Root Systems of Fruit Trees. The results of modern research are revealing many striking facts about the extent of the root systems of various plants. Older ideas about shallow-rooted and deep-rooted plants do not seem to hold. A recent paper by Mr. W. S. Rogers ("Root Studies III", *J. Pomol. and Hort. Sci.*, 11, No. 1, 1–18, March, 1933) shows not only that the roots of gooseberries penetrate the soil to a depth of 8 ft. but also correlates root development with manurial treatment. Pears and black currants were also studied. Roots of the former reach a depth of 11 ft. and of the latter 7 ft. Pears grafted on seedlings were compared with those grafted on Angers quince. The seedling roots consisted of a large number of main roots going almost vertically downwards, whilst quince roots form a horizontal 'scaffolding' from which fine roots descend. Heavy manuring with farmyard manure increased the total amount of root produced, but tended to make the system more compact.

Plant Geography of Ulijanowsk. This part of Russia in Europe lies south of the middle reaches of the Volga. The variation in natural conditions within this area causes great diversity in the vegetative covering. Most of the forests are pine, or subsidiaries resulting from felling, and are classified into the *Pinetum querceto-tiliosum* type growing on the higher and wetter places, and the *Pinetum querceto-substepposum siccum* type. The composition of these forests and the undergrowth, including the grassy soil covering, has been examined by H. Grosset (*Bull. Soc. Nat. Moscou*, 41, Nos. 1–2). The study terminates with a short discussion on the steppe vegetation. The author emphasises the value of a consideration of the vegetation of areas in schemes of agricultural development. Water is the limiting factor in crop production, and, as the same amount of rainfall may give different effects according to the nature of the soil, the vegetation is suggested as a means of detecting biologically equivalent areas.

Land Bridges of Gondwanaland. In the *Bulletin of the Geological Society of America*, 1932, Prof. C. Schuchert deals with Gondwana land bridges (pp. 875–915), and his discussion is followed by a paper on isthmian links by Prof. Bailey Willis (pp. 917–952). Both papers are admirably illustrated by coloured maps. As the result of some thirty years' study of the palæontological evidence, Schuchert concludes that (*a*) the marine life of southern North America and southern Europe, and of South America and Africa, from the Silurian to the end of the Miocene; (*b*) the distribution of the land plants and animals from the Permian to the Cretaceous; and (*c*) the discontinuous localisation of recent life in Africa and South America, are overwhelmingly in favour of the existence of the Gondwana land bridge up to the end of Cretaceous time. The submergence of the bridge is thought to have taken place from the Eocene to the close of the Miocene, and it is considered likely that during this time there may have been a South Atlantic archipelago. Willis discusses the orogenic processes that may have been responsible for the formation of bridges such as the Isthmus of Panama, arguing from this particular case that marginal upthrusting has been due to expansive forces originating in adjoining basins and deeps. Similar "isthmian links" of the past are traced between Africa and India; Asia and Australia; and Africa and Brazil, along the lines of present-day submerged ridges and island chains. Assuming some general cause of moderate refrigeration, an attempt is made to show that the diversity of Permian climates in the northern and southern hemispheres is not inconsistent with the atmospheric and oceanic circulations controlled by the postulated "isthmian links" of that period.

Katabatic Winds. In spite of all that has appeared during the past few years dealing with katabatic winds, there is evidently still a large field of research into these and other winds that arise during the night when cooling of the lower layers of the atmosphere tends to isolate them from the upper 'free' atmosphere. S. Atmanathan (India: Meteorological Department. *Scientific Notes*, vol. 5, No. 46: Calcutta: Government of India Central Publication Branch, 1932; 10 annas; 1*s*.) describes the occurrence at Poona of a curious type of squall which he calls a solitary gust. These are sudden onsets of wind from the direction of the gradient wind that interrupt intervals of calm separating periods during which katabatic winds are blowing, and last from three to fifteen minutes. In most cases the squall is accompanied by a slight rise of pressure, and no subsequent fall; temperature generally falls temporarily during the squall, sometimes by so much as 4° F. This is a very unusual accompaniment of a sudden increase of wind on a clear night, and seems to rule out the possibility that the effect may be due to the gradient wind suddenly undercutting the cold surface layers. The author makes a tentative attempt to explain matters with the aid of mathematical dynamics, following Margules, but it is doubtful whether the observational material is complete enough for this, to mention only one obstacle to such an undertaking. Another difficulty of explanation arises from the fact that the usual direction of the gradient wind agrees roughly with the trend of the valley. He seems justified, however, in concluding that the phenomenon is in some respects analogous to a tidal bore—a surge of colder air of slightly higher pressure up the valley from the regions fed by the normal katabatic wind.

Anomalous Absorption of γ-Rays. B. Arakatsu has made (*Mem. Sci., Taihoku Imperial University*, Dec. 1932) an interesting suggestion to account for the anomalous absorption of γ-rays, observed by Tarrant, Chao, and others as an excess absorption for the heavier elements over that predicted by the Klein-Nishina formula for electronic absorption. This excess has usually been regarded as nuclear in origin. Arakatsu ascribes the effect to the extranuclear electrons, and he suggests that the rest-energy of these electrons may be capable of quantum jumps. He regards the electrons as wave-mechanical systems the energies of which may be calculated like those of a two-dimensional oscillator. The electrons taking part in the process are supposed to be those lying within a radial distance of the nucleus which is less than a half wave-length of the quantum radiation from a 'jumping electron'. The density of these electrons is obtained by the method of Thomas and Fermi, and the additional absorption is found to vary with the atomic number in fair accord with experiment.

Effects of the Addition of Tellurium to Lead. A paper read by Messrs. W. Singleton and Brindley Jones before the Institute of Metals on March 8 dealt with the chemical and mechanical effects of the addition of tellurium to lead to the extent of say 0·07–0·10 per cent. It is shown that such alloyed lead has a greatly increased resistance to attack by sulphuric acid, actual plant tests indicating that the loss of weight is only one-seventh of that of the most resistant chemical lead hitherto produced. Chemical lead is known to recrystallise spontaneously after strain at room temperature, and cannot, therefore, be hardened in that manner. With more than about 0·1 per cent. of tellurium, the product shows no softening through cold rolling after 140 days, with the result that tensile strengths up to about 4,000 lb. per sq. in. can be obtained in cold-rolled sheets. The degree of ductility associated with this tensile strength is good. On annealing after cold work the alloyed lead shows a relatively very fine crystal size as compared with that for the lead itself. The alloy can be extruded normally when both the strength and elongation are distinctly greater than those of the pure metal, and with slow rates of straining the elongation may approximate to 100 per cent. The

fatigue limit of the tellurium-lead is of the order of ± 0·5 tons per sq. in., nearly three times that of ordinary lead. Tests made on the resistance of pipes to bursting by frost, showed that the addition of tellurium greatly improves the material. It is stated, though no actual results are given, that the addition of tellurium to lead alloys exerts similarly beneficial effects.

Sewage Purification by a New Process. The problems of sludge disposal and effluent purification are still troubling inland municipalities in most civilised countries, and though this century has seen many improvements in detail, the broad problems remain unsolved. A novel process has recently been developed in New York, which originated in the desire of Messrs. Guggenheim Brothers to find a new outlet for sodium nitrate. The desire has not been fulfilled, but G. H. Gleason and A. C. Loonam, on behalf of the firm, have succeeded in devising a system of purification and disposal that demands the attention of all concerned. The principles of their system consist in clarifying the sewage by precipitation with ferric sulphate and lime, filtering and burning the sludge, recovering the ferric sulphate by treating the ash with sulphuric acid, and purifying the effluent by means of the base-exchange material, zeolite. During the precipitation process, air is passed continually through the liquid to keep the iron in the ferric state, and careful control of the hydrogen ion concentration, at *p*H 6–8, is essential for success. Ferric iron, followed by lime, was found to be the best precipitant. In the base-exchange process, the basic nitrogen in the organic compounds present in the effluent is exchanged for the sodium in the zeolite, and when the latter is spent, it is regenerated by washing with a 20 per cent solution of sodium chloride. The nitrogen compounds in the brine are decomposed by distillation with lime and the ammonia is recovered, whilst the purified brine becomes available for further use. Tests on a plant treating 2,500 gall. of crude sewage a day have given excellent results, and a plant of ten times this capacity is now being installed at Chicago. The proprietors of the process are sanguine that capital and operating costs will compare very favourably with those of existing processes.

Astronomical Topics

Periodic Comet Pons-Winnecke. This comet attracted much attention in 1921 and 1927 from its near approaches to the earth, the least distances being 12 and 3½ million miles. Since 1927, it has made a close approach to Jupiter, which has increased the perihelion distance by six million miles, so that there will be no more approaches to the earth so close as that of 1927, which was the second closest approach on record; the closest was Lexell's comet in 1770, the distance being 1½ million miles; but this proximity was not known until later.

The first to observe comet Pons-Winnecke at this return was Dr. A. Wachmann at Bergedorf; the following two positions were obtained there from photographs taken with the Lippert astrograph (*Beob. Zirk.* No. 12):

U.T.	R.A. (1933.0)	N. Decl.	Mag.
March 24d 2h 55·0m	17h 44·0m	9°27′	14
25 2 2·6	17 47·3	9 22	14½

The indicated date of perihelion passage is about May 18·7; the comet will be nearest to the earth about the same time, its least distance being about fifty million miles; it should be within reach of moderate instruments this month. As the period is now 6 yr. 1 mon., there is likely to be a closer approach in 1939 than this year.

Photographing the Moon's Shadow on the Earth during the Eclipse of August 31, 1932. *Popular Astronomy* for April contains an article by W. M. Browne, of the U.S. Naval Observatory, Washington, in which he describes a successful attempt to photograph this shadow from an aeroplane, which was just outside the southern limit of totality. A cinematograph was used; at the beginning and end of the exposure, the camera was directed to a chronometer, so that the accurate time can be deduced for each part of the picture; the focus was altered before directing it to the ground. It was noted that one of Baily's Beads remained visible throughout, showing that the aeroplane was almost on the limit, but just outside it. To the eye, no definite edge of the shadow could be seen on the ground, but on developing the film it was found that some details on the landscape could be seen before and after totality, becoming invisible during totality, which lasted 9·4 sec. at the region photographed. As the predicted time was 14 sec., it is concluded that the predicted southern limit was 0·4 mile too far south; also mid-totality was later than the predicted time by 3·8 sec. The region was the town of Suncook, New Hampshire, six miles south-east of Concord.

Motion of the Spiral Nebulæ. The presidential address to the Royal Astronomical Society on this subject by Dr. Knox Shaw has now been published (*Mon. Not. Roy. Ast. Soc.*, Feb. 1933). When the first determinations of radial velocity were made, the high speed of the sun due to galactic rotation was not applied; this accounts for most of the approaching velocity found in the case of the Andromeda nebula. Early discussions seemed to indicate that the galactic system had a velocity relatively to the mean of the spirals of some 200 km./sec. towards the direction of Capricornus, as seen from the sun. However, when the correction for galactic rotation is applied, our own galaxy seems to have a small velocity referred to the mean of the others. This is not unexpected, since our galaxy seems to be unusually large and massive. The value actually adopted for the solar motion (due to de Sitter) was 286 km./sec. towards R.A. 314°, N. Decl. 66°. One rather surprising point is that the red spectral shift has an appreciable effect on the photographic magnitudes of the nebulæ, amounting to a quarter of a magnitude for the distant ones. It might have been expected that the shift would bring some ultra-violet spectrum into the visible region; but these nebulæ do not appear to have an ultra-violet spectrum strong enough to register on the plates.

Dr. Knox Shaw estimated the average peculiar motion of the nebulæ as about 140 km./sec. He also suggested that the individual members of the clusters of spirals are considerably fainter (some 0·9 magnitude) than isolated spirals. But more evidence is needed before this can be received with confidence.

Copepods of Woods Hole*

DR. CHARLES BRANCH WILSON has recently published a beautiful and important monograph which he dedicates to the late Richard Rathbun, assistant secretary of the Smithsonian Institution from 1897 until 1918*. This is a study of marine, brackish-water and fresh-water species of copepods, including those that are free-swimming, commensal, semi-parasitic and parasitic. The area studied is large, including the whole of Cape Cod, Mass., and all the islands south of it and those portions of the surrounding ocean between latitude 40° and 42° N. and between longitude 69° and 72° W. It lies at the latitude where the northern and southern faunas meet and overlap, and therefore contains representatives of three distinct plankton faunas, those of the area itself, especially of the ponds and beach sands which make up the bulk of the species, the northern species brought by currents from the Bay of Fundy, the Gulf of the St. Lawrence or even farther north, and the southern species brought from the tropical Atlantic and the Gulf Stream.

The number of species previously reported from the area is 148. The present work increases this to 373 including 178 genera, several of which are new, and there are many new species. It is based mainly on a collection made in this area by the late Dr. Rathbun during the summers and early autumns of the years 1881–85 inclusive. Some of the specimens were obtained by surface towing and the rest were taken during the trawling and dredging operations carried on by the steamers of the Bureau of Fisheries, the *Fish Hawk* and *Albatross*. In addition there is the entire collection of local copepods made by the Bureau of Fisheries, collections from fresh-water, brackish-water and salt-water ponds made by Dr. Rathbun and continued by Dr. Wilson and many specimens from the beach sands. The whole forms a unique collection which is specially valuable on account of the notes, particularly colour notes, made by Dr. Rathbun when the animals were still alive, many of the copepods having only been described previously from preserved specimens.

There are new records of numerous species which are only taken very early in the morning or late at night and an important addition to the 'gear' was a device known as the 'trawl wings' attached to the bean trawl which captures the small free-swimming animals often living in extreme abundance just above the bottom. Dr. Rathbun's dissections, microscopic preparations and drawings were also of much use, but this monograph could not have been written unless the author himself were an expert on the subject. Dr. Wilson is well known as such an expert and there is a large amount of his own work here and much that is original. A clear account is given of so many groups illustrated with neat text figures and plates that the volume may well serve as a text-book to workers in all lands, including as it does representatives from almost every copepod family with a large number of species figured and described and useful keys to the sub-orders, genera and species.

* Charles Branch Wilson. "The Copepods of the Woods Hole Region, Massachusetts." *Bull.* 158, *U.S. Nat. Mus.*, Smithsonian Institution, Washington, D.C., 1932.

Amino-Acids, Proteins and Proteolytic Enzymes

By PROF. MAX BERGMANN, University of Dresden

II

THIS is perhaps a suitable moment at which to assess our knowledge of the proteolytic enzymes. It remains a fact that dipeptidase, aminopolypeptidase and carboxypolypeptidase are three distinct enzymes ; for the present, we may retain these names, but only so long as we bear in mind that they do not truly express the characteristic properties of the enzymes. We have seen that there is a dipeptide of naturally occurring amino-acids (asparagyltyrosine) which is not attacked by any intestinal proteolytic enzyme ; there is a dipeptide (tyrosyltyrosine) which is hydrolysed not only by dipeptidase but also by carboxypolypeptidase ; finally there are dipeptides (glycyl- and alanyl-proline) which are resistant to dipeptidases but are attacked by polypeptidase. It is therefore clearly not the number of amino-acids in the molecule of a peptide which determines its susceptibility to a particular peptidase. The presence of free amino and carboxyl groups adjacent to the peptide linkage does not necessarily render the compound open to attack by dipeptidase, nor will aminopolypeptidase hydrolyse all peptides in which the peptide linkage adjoins a free amino but no free carboxyl group. On the other hand, the action of the latter enzyme is not always inhibited by the proximity of a free carboxyl group to the peptide linkage.

It is evident that we must take further circumstances into consideration before we can hope to define rigidly the conditions of action of the various peptidases ; in particular, careful attention must be given to electro-chemical effects and to such structural features as the secondary or tertiary nature of the nitrogen participating in the peptide bond. The accumulation of facts bearing on this question will be a major object of future work ; this work can be undertaken hopefully now that the benzylcarbonato method affords a means of obtaining almost any peptide which may be desired.

From still another point of view, it has been possible to gain an insight into the structural and electro-chemical conditions which regulate the enzymic hydrolysis of peptides, namely, by experiments concerning the transformation of proteins into non-nitrogenous compounds. Hitherto, it has been thought that this transformation could only take place by way of the individual amino-acids themselves, which were supposed to undergo dehydrogenation and subsequent hydrolytic loss of nitrogen with formation of a ketonic acid.

At the time when we began experiments bearing on this point, no enzyme had been discovered which was capable of dehydrogenating amino-acids. For reasons which need not be discussed here, the idea occurred to us that such a dehydrogenation might be accomplished at the peptide stage. In order to

test this hypothesis, a number of unsaturated di- and tri-peptides were synthesised and a search was made for an enzyme which might be capable of hydrolysing these compounds. An enzyme was in fact obtained from kidney[9] which attacked glycyldehydrophenylalanine with the production of glycine, phenylpyruvic acid and ammonia; the same enzyme also attacked glycyldehydroalanine with analogous results:

$$C_6H_5.CH{:}C(NH.CO.CH_2.NH_2).COOH \longrightarrow$$

$$CH_2.NH_2.COOH + C_6H_5.CH_2.CO.COOH + NH_3$$

Glycyldehydrophenylalanine is completely resistant towards dipeptidases of plant and animal origin, amino- and carboxy-polypeptidase, trypsin and pepsin. On the other hand, the kidney enzyme is quite unable to attack glycylphenylalanine. It is clear therefore that the kidney enzyme is no ordinary dipeptidase but is indeed specifically adapted to the hydrolysis of unsaturated peptides.

The fact that glycylphenylalanine and glycyldehydrophenylalanine, two peptides which differ only by two hydrogen atoms, should require distinct enzymes for their hydrolysis, is of great importance in relation to the conditions of action of the various peptidases; it indicates that a compound may possess all the characteristics (a normal peptide linkage adjacent to free amino and carboxyl groups) hitherto regarded as essential to a substrate for dipeptidase and may still fail to be hydrolysed by this enzyme.

The existence and properties of the kidney dehydrodipeptidase have also important physiological implications, since they demonstrate a possible mechanism of deamination of protein degradation products in the body; moreover, the process involves the simultaneous formation in the kidney of keto-acids and ammonia, which are well known to occur in the urine in considerable quantities under certain conditions. It appears that the kidney, through its possession of this enzyme, may play a definite part in protein metabolism, particularly if we may assume that unsaturated peptides or related compounds of unsaturated amino-acids are produced in the course of renal metabolism. The likelihood of the latter assumption is indicated by the work of Krebs[10] who has shown that the kidney is capable of dehydrogenating amino-acids and peptides; in these experiments, however, the action of the kidney was not confined to the naturally occurring amino-acids but extended to their optical enantiomorphs, and it is therefore too early to say whether the results are of true biological significance.

Up to the present point, we have been dealing with the synthesis of new peptides and their behaviour towards enzymes. We must now pass on to consider the various conclusions, which experiments of this type enable us to draw, concerning the structure of the natural proteins themselves. This matter can best be exemplified by a consideration of the position occupied by proline in the natural proteins in the light of the behaviour of synthetic proline peptides of known structure[11].

The process of enzymic hydrolysis of a protein must be pictured as the successive scission of peptide linkages; this being so, it is natural to assume that every such scission will involve the liberation of an amino and a carboxyl group. The carboxyl groups liberated during digestion can be readily determined by titration in alcoholic solution by the method of Willstätter and Waldschmidt-Leitz, and the amino groups by the method of van Slyke. The course of enzymic digestion of many proteins has been followed with the aid of these methods and it has invariably been found that amino and carboxyl groups are liberated in equivalent amounts; in spite of the fact therefore that various authors, for example, Emil Fischer himself, have discussed at different times the possible occurrence of other than normal peptide linkages in proteins, no analytical evidence of the existence of such other linkages has been obtained, and the liberation of amino and carboxyl groups in equivalent amounts has indeed been taken as a criterion of true proteolysis.

Now we have already discussed two synthetic proline peptides, glycyl- and alanyl-proline, which are peculiar in that they are hydrolysed by amino-polypeptidase but not by dipeptidase; moreover, the hydrolysis of such a peptide, when it does occur, will give rise to liberation of a free carboxyl group but not of an amino group; in this case, therefore, the accepted rule of equivalent liberation of amino and carboxyl groups evidently does not apply. This fact can be utilised to throw light upon the mode of combination of proline and hydroxyproline in gelatin.

Proline can clearly occupy three distinct positions in the peptide chain of gelatin: (1) it may be attached through its carboxyl group to the amino end of the chain; (2) it may be attached through its imino group to the carboxyl end; (3) it may lie inside the chain and be linked through its carboxyl and imino groups. The second and third of these possibilities involve the existence of linkages similar to that of glycylproline, and it is therefore possible, by comparing the action of proteolytic enzymes on gelatin and glycylproline, to decide whether this type of linkage is indeed present in gelatin or whether the proline is combined in the protein molecule entirely through its carboxyl group.

In order to test this question, gelatin has been submitted to digestion with trypsin followed by intestinal peptidase. Tryptic digestion causes rapid and equivalent increases in free amino and carboxyl groups whilst the peptidases cause a predominant increase in free carboxyl. Reference to the results obtained in the enzymic hydrolysis of the proline peptides will make it clear, therefore, that a large part at any rate of the proline (and perhaps also of the hydroxyproline) of gelatin must be combined through its imino group.

These experiments provide an example of a protein digestion in which free amino and carboxyl groups are not liberated in equivalent amounts; such equivalence can therefore no longer be regarded as an essential characteristic of proteolysis. Furthermore, they show in a convincing manner the importance of the individual constituent amino-acids in determining the behaviour of a protein towards enzymes; owing to the structure of proline the peptide chain is heterogeneous at those positions where proline is linked through its imino group, and this heterogeneity forces the process of enzymic degradation of the protein to follow a certain course.

We may now pass from the amino-acids, peptides and peptidases to a brief consideration of the enzymic degradation of complete proteins. Very little is known of the enzymes (proteinases) which are able to attack proteins of high molecular weight, but the action of these enzymes is of great importance; not only are

they responsible for the first stages of the digestion of all protein taken in the food, but also there are industrial processes of the first importance which depend on the enzymic digestion of proteins.

A serious difficulty in the investigation of proteinase action is that these enzymes often have to work in heterogeneous systems, since the substrate may be largely undissolved, and hence the simple rules of mass action cannot be applied; the variable magnitude of the surface of the protein exposed to enzymic attack complicates the situation so that the curves representing the course of action of proteinases on undissolved proteins are not susceptible of simple interpretation.

In the case of gelatin the problem can be simplified to some extent by using the protein in the form of films of uniform size and thickness, so that the surface of protein remains practically constant during digestion; moreover, the course of the digestion can be conveniently followed optically if a black insoluble substance be previously distributed evenly through the gelatin, so that it gradually passes into the aqueous phase as digestion proceeds. With the aid of this method it has been found that the course of digestion of gelatin is represented by the simple formula: $x = kt\sqrt{E}$, where x = digestion (per cent); k = constant, t = time, E = enzyme concentration (per cent).

This formula is valid during the whole of the process of digestion, and for concentrations of enzyme varying from 0·0001 to 0·1 per cent and more. Thus apart from variations in the surface exposed, it may be stated that the rate of digestion of a protein is proportional to the time and to the square root of the enzyme concentration, but is not affected by the total amount of enzyme or of protein[12].

The same rule applies to the digestion of fibrous collagen, at least during the first third of the digestion period, provided that precautions are taken to prevent the inactivation of the enzyme. The validity of the formula in the case of collagen is at first sight surprising, since it might be expected that the fibres would become thinner during the digestion and that the surface would then be altered. The only explanation of the constancy of the rate of digestion actually observed seems to be that digestion of the collagen fibres proceeds only from their ends. That this is indeed the case is shown by the fact that the rate of digestion of true skin is proportional to the area of the external surface in which the ends of the collagen fibres lie.

The key to present-day and future protein chemistry lies in the development of new synthetic methods, and this is the justification for the expenditure of so much time and labour on the improvement of such methods. In these lectures I have described technical advances made during the last few years in my laboratory, which have thrown some new light on the specificity of the proteolytic enzymes, at the same time extending our knowledge of normal and pathological protein metabolism. With the aid of the combined efforts of enzyme chemistry and organic synthesis, we may reasonably hope that these advances will be continued.

[9] Bergmann and Schleich, *Z. physiol. Chem.*, **205**, 65; 1932: **207**, 235; 1932: Bergmann and Grafe, *Z. physiol. Chem.*, **187**, 187; 1930: Bergmann, Schmitt and Miekeley, *Z. physiol. Chem.*, **187**, 264; 1930.
[10] Krebs, *Klin. Woch.*, **11**, 1744; 1932.
[11] Bergmann, Zervas and Schleich, *Ber. deutsch. chem. Ges.*, **65**, 1747; 1932.
[12] Bergmann and Föhr, *Biochem. Z.*, **250**, 568; 1932.

University and Educational Intelligence

CAMBRIDGE.—In his will, Mr. F. E. Elmore, who died last year, bequeathed the income of a trust fund for the provision of scholarships for medical research to male post-graduates of British or Colonial birth at the University of Cambridge.

Prof. A. C. Seward has announced the gift of 6,000 sheets of mounted and named British plants to the University Herbarium by Mr. J. E. Little, of Hitchin.

A University lecturer and a University demonstrator in physics will be appointed shortly. Further information can be obtained from Mr. H. Thirkill, Clare College.

The Buildings Syndicate recommends that the plans prepared by Mr. Lodge for an extension to the Botany School be approved and that the tender of £13,652 from J. Parnell and Sons for the work be accepted.

C. F. A. Pantin, of Trinity College, has been approved for the degree of Sc.D.

EDINBURGH.—Prof. Ivan de Burgh Daly, professor of physiology in the University of Birmingham, has been appointed professor of physiology in succession to Sir Edward Sharpey Schafer, who will retire on September 30.

LONDON.—The following grants have been made to the University, payment being spread over a period of years: Haberdashers' Company, £500; Saddlers' Company, 500 guineas; and Apothecaries' Society, £500. A small donation has also been made by the Glass-sellers' Company, which expressed its desire to be associated with the Bloomsbury scheme. These benefactions will be applied towards meeting the cost of the new Ceremonial Hall to be erected on the University's site in Bloomsbury.

IT is announced by the New York correspondent of the *Times* that Dr. James B. Conant, Sheldon Emery professor of organic chemistry at Harvard University, has been made president of the University in succession to Dr. A. Lawrence Lowell, who has resigned.

THE report of the University of Leeds on the session 1931–32 shows that the number of students as a whole and in the various faculties was well maintained despite its having been a time of severe retrenchments of expenditure. Of the 1,520 full-time students (including 367 women) 1,197 were from Yorkshire homes, 24 from other English counties, 54 from India, 12 from Wales, 12 from Egypt and 34 from other countries. Their distribution by faculties was: arts 45 per cent, medicine 24, pure science 14, technology (engineering, mining, coal, textiles, dyeing and leather industries) 14, agriculture 3. Of the students who graduated in 1931, not more than eight per cent were known to be unemployed by December of that year but "there are signs during the current year that greater difficulties than formerly may be experienced in placing our graduates". In a separate pamphlet is given a list of 215 publications (chiefly in science and technology) by members of the University, and abstracts of theses (also chiefly in science and technology) accepted for higher degrees. In the course of the year, the Clothworkers'

Company renewed its grant of £3,000 a year for research in textiles, in addition to the £3,000 for the Textile Industries and Colour Chemistry Departments. Quite recently the University authorities have announced that a discovery made in the Textiles Department by a Swedish investigator, Mr. Hellberg, of a new type of wool pack, is likely to obviate losses of many thousands of pounds suffered annually through contamination of wool packed for shipment. An outstanding event of the year was the institution of a new chair, of the philosophy and history of religion, for which an endowment of £20,000 was provided under the will of Mrs. Emily Fawcett.

Calendar of Nature Topics

Indian Hot Weather

The year in India is divided into three seasons: the cold weather, the hot weather, and the monsoon. The cold is relative, for even in January the average temperature over the whole Indian land area is 67° F., but the hot weather, which begins in April and continues into June, is extreme. The climax comes in May, when the average of the twenty-four hours exceeds 90° F. over the greater part of the interior, and the day temperature regularly exceeds 100° F. over half the country. There is a considerable daily variation, but in many places the thermometer remains above 80° F. throughout the night. The air is dry and dusty, and the ground is baked hard. Early in June, before the monsoon breaks, the climate is even more oppressive, for the heat continues unabated while the air becomes moister and more sultry. The first steady rains bring an appreciable fall of temperature and are eagerly awaited.

An Experiment in Direction Finding

On May 15, 1900, there began one of the most instructive of experiments on the locality sense of birds. "Twelve noddies and twelve sooties [terns belonging to the species *Sterna stolida* and *S. fuliginosa*] were captured on Bird Key on May 15. The next day they were sent to Key West and, on May 17, put aboard a freight steamer for Galveston. The cages were hooded and, except at feeding time, the birds had no chance of seeing anything which would give them their bearings. On the night of May 20 two birds (both noddies) were released but neither returned to their nests.

"On May 21, at 8 a.m., four noddies and six sooties were released; at 7 p.m. two more noddies were set free under extremely difficult conditions, as a heavy rain began falling that night which continued without interruption all the next day. Of the twelve released five noddies and five sooties returned.

"During the morning of May 23 the remaining birds, four noddies and six sooties, were fed and freed in Galveston Harbor, 855 miles west of Bird Key. Of these ten, one noddy and two sooties reached their nests."

With reference to this last test, the experimenters, Drs. J. B. Watson and K. S. Lashley, pointed out that the failure of so many birds to return was not surprising in view of the numbers of hawks frequenting the Texas shore, and the tired condition of the terns after their eight days' confinement.

Conclusions regarding Homing Sense of Terns

The experiments, of which one has been described above, took place in the Gulf of Mexico, where regularly towards the end of April, a great colony of noddy and sooty terns arrives at Bird Key, one of the islands in the Tortugas group. The experimenters regarded the results of their many tests of the homing sense of the terns as showing that where care was taken to keep the captured birds in good condition before they were released, they could find their way back to the nesting colony over almost any distance up to a thousand miles, and this although the region of the return journey over the Gulf of Mexico presented no landmark to serve as a guide. It has been pointed out that the ability of these untrained birds to find their way home over a thousand miles through haze, storm and darkness, and over an unknown sea, is all the more remarkable when it is compared with the record long-distance flight of a homing pigeon, 1010 miles; for pigeons are selected and go through an intensive training to accustom them to the landmarks of the region they must traverse on their return journey.

Mayflies and Man

The disappearance of mayflies (*Ephemera* spp.) from many parts of England where formerly they appeared in vast numbers is well known. How far this is due, indirectly, to human agency is not yet clear, but it is likely that operations leading to rapid drainage of adjoining country with consequent flushing of watercourses are among the factors involved. A current too fast to allow of an adequate deposit of fine sand, 0·25 mm.–0·05 mm., markedly affects the normal development of eggs of *Ephemera danica* (Percival and Whitehead, 1926). Moreover, ephemerid nymphs in general need a substratum of a well-defined sort composed of particles 1 mm.–0·25 mm. in diameter in order to thrive. Such a bottom is easily disturbed by sudden rushes of flood water.

The influence of man both by land clearance and by the introduction of new species among the native fauna has been found to have very marked results on the New Zealand Ephemeroptera. Bush felling near watercourses has altered the conditions in streams so that in summer the beds dry up and nymphs and egg masses shrivel. The great increase in rapidity of the run-off from cleared land after freshets results in maimed insects pounded by current-borne stones and debris. Removal by felling of shelter for subimagines and imagines leaves them an easy prey to birds like the pied fantail, the ground lark and the introduced chaffinch. Of the food of the introduced trout, 9 per cent consists of various Ephemeroptera in the Wellington district. Between two and three hundred nymphs of *Coloburiscus humeralis* were found in the stomach of an Atlantic salmon—another introduced fish—from the Waiau River (Phillips, 1931).

A converse case has been noticed in the Yorkshire Nidd, a rapid stream where, owing to the impounding of water in reservoirs higher up the river, flooding has been very much reduced. In consequence, a certain amount of fine deposit occurs among the larger stones, affording shelter to many nymphs of *E. danica* (4 per 4 sq. dec.), a number sufficient to produce a considerable crop of adults annually (Percival and Whitehead).

Societies and Academies

LONDON

Physical Society, March 17. H. A. NANCARROW: A method for the determination of the thermal conductivities of rocks. The rock specimens are turned as circular cylinders of diameter 5 cm. and height 2 cm., and are bisected by a cut made perpendicular to the base along one diameter. The top of the cylinder is heated and the temperature-gradient in the specimen is measured by means of thermocouples held in a mica holder inserted in the cut. The temperature-distribution and heat flow in the specimen are each represented by a series containing Bessel and hyperbolic functions. Constants involved in the arguments of these functions are dependent upon the loss of heat from the hot surfaces exposed to the air in the apparatus. E. E. WRIGHT: A note on the Kerr cell. The distortion due to the curvature of the (light, voltage) characteristic of a Kerr cell is discussed, and an expression giving the amplitudes of the Fourier components of the light-variation due to a pure alternating potential applied to the cell is obtained. Sets of curves showing the variation of percentage of second and third harmonic with bias and with amplitude of the applied alternating potential are given. The working conditions for minimum distortion obtained from these curves agree with those used in practice. The late A. C. G. BEACH: An experiment bearing on Talbot's bands. The form of diffraction pattern observed in a spectroscope when a point of light is produced on the slit of the collimator, and an aperture in which the upper or lower half is covered with a retarding plate is between the collimator and telescope, is discussed and the bands so produced are used to explain Talbot's bands.

Society of Public Analysts, April 5. H. G. REES: Notes on the iron and copper in liver and liver extracts. The amounts of iron and copper previously recorded for the livers and liver extracts of various animals are too low; these metals are very incompletely extracted by water. In the author's experiments the proportion of iron was somewhat higher, whilst the copper was very much lower than the figures given by Meyer and Eggert. G. W. MONIER-WILLIAMS: Determination of the freezing-point of milk. The three main factors influencing the determination are: super-cooling; the water-value of the container, thermometer, bulb and stirrer; and the heat-exchange with the surrounding medium. With the new type of apparatus devised by the author, the supercooling correction can be determined with a fair degree of accuracy, the final temperature remains constant for several minutes, and excellent heat insulation is secured by the casing of compressed cork.

DUBLIN

Royal Irish Academy, Feb. 13. COMMON and CAIRNS: The colonisation of a disused millpond at Hillsborough, Co. Down. An account of observations made on the ecology of a disused millpond over a period of three years. The pond has become largely silted up during the past twenty years. The phases in the progressive colonisation of the pond are very clearly defined. The submerged phase, at first dominated by *Potamogeton*, is now dominated by *Chara*. The main emergent phase is an Equisetetum but this rôle is assumed at one place by *Caricetum* from which *Equisetetum* is absent. Invasion by *Carex* transforms the Equisetetum into sedge meadow: this is succeeded by *Salicetum*. The plant succession is regarded as a colonisation of a silt slope and not as a true hydrosere.

PARIS

Academy of Sciences, March 27 (*C.R.*, 196, 881–972). EMILE BOREL: An elementary problem of probabilities and the quasi periodicity of certain arithmetical phenomena. R. FOSSE, P. DE GRAEVE and P. E. THOMAS: The rôle of allantoic acid in the higher plants. Summary of the methods of identification and determination of allantoic acid in plants. Also a study of the changes in the proportions of this acid during germination. J. DELSARTE: On a ds^2 with non-static axial symmetry and some connected problems. GEORGES BOURION: A class of Taylor's series. JULIUS WOLFF: The extension of a theorem of Warschawski on conformal representation. MICHEL LUNTZ and PAUL SCHWARZ: A particular case of the movement set up in a viscous fluid by the rotation of a cylinder. FLORIN VASILESCO: Movement with a wake, in three dimensions, of a solid body in a fluid. R. D'ADHÉMAR: The equations of the gyroscopic movement of stable projectiles. JEAN MARIANI: Quantic mechanics and the theory of finite and continuous groups of Sophus Lie. G. LEMAÎTRE: Spherical condensations in an expanding universe. E. HOCHARD: Maintained oscillations. Some applications of a photoelectric cell for producing maintained electrical oscillations of determined period. E. GAMBETTA: The measurement of small luminous fluxes by means of the photoelectric cell. HENRI ABRAHAM: The definition of the magnetic field. A comparison of the modes of calculation of Maxwell and of J. J. Thomson: the latter is easier in its practical applications. P. LAINÉ: The magnetic properties of liquid ozone. Magnetic measurements on ozonised oxygen having given discordant results, experiments with liquid ozone are now described. From the results of these it is deduced that ozone is paramagnetic and has a susceptibility independent of the temperature. CH. BERTIN: The accuracy attainable in radiogoniometry and the use of the *droite-radio*. F. CROZE: The aberrations of coma of light pencils of large inclination. NY TSI-ZE and CHOONG SHIN-PIAW: The absorption of light by ozone between the wave-lengths 3050 A. and 2150 A. A table of coefficients of absorption for 194 wave-lengths. PARISELLE: A curious case of change of sign of the rotatory power and of mutarotation. A study of the properties of the complex compound obtained by dissolving aluminium hydroxide in tartaric acid. P. JACQUET: The adsorption of colloids by metallic surfaces and its influence on the adherence of electrolytic deposits. The colloids studied fall into two groups, those clearly affecting the adherence of the deposit, such as proteins and peptones, and those without action, such as gums and dextrin. MAURICE CURIE and S. TAKVORIAN: The radioactivity of a neodymium-samarium fractionation. The element 61. Starting with a mixture of 5 kilograms of neodymium and samarium (from Indian monazite) the authors find that neodymium and lanthanum show no radioactivity. Samarium emits a very absorbable radiation, apparently not due to element 61, but the intermediate fractions give a more penetrating radiation probably due to

element 61. A. GIRARD and G. CHAUDRON: Crystalline systems of microcrystallised ferric oxides. Results of X-ray analysis and thermomagnetic analysis of ferric oxide prepared by eight methods. P. MONTAGNE: The graphical resolution of problems of homogeneous chemical equilibrium between three constituents. G. CHAMPETIER: The action of solutions of orthophosphoric acid on ordinary cellulose. The existence of the addition compound $3C_6H_{10}O_5.H_3PO_4$ is proved by Schreinemakers' method: washing with water regenerates cellulose without mercerisation. E. CARRIÈRE and R. LIAUTÉ: The estimation of sulphurous acid and alkaline sulphites by potassium permanganate. A. SANFOURCHE: The relations between the properties and constitution of tricalcium phosphate. MME. G. ALLARD: The refractometric determination of organic acids. MLLES. H. VAN RISSEGHEM and B. GREDY and M. L. PIAUX: The ethylene linkage. Study of some linear or branched hexenes. Raman spectra of eight hexenes. V. KUNZL and J. KÖPPEL: A precision method for measuring the constants of crystalline networks. PAUL GAUBERT: The influence of foreign substances in the state of solid solution on the domain of stability of crystals. J. BARTHOUX: The Siwilak and the recent volcanic rocks in Afghanistan. ANDRÉ LENOBLE: The schisto-quartzo-limestone series in the centre of Madagascar. F. BLONDEL: The distribution of the richness of metalliferous deposits. L. TUWIM: First results obtained in a new cosmic ray observatory. J. CHAZE: The presence of anthocyanin pigments or oxyflavone compounds in the aleurone grains of certain Gramineæ. MARC SIMONET: The behaviour of the chromosomes in some complex hybrids of *Iris*. MLLE. PANCA EFTIMIU: The presence of a fungus in *Bucegia Romanica*. RAYMOND-HAMET: Digitalin compounds do not prevent cardiac syncope produced by adrenaline when it is made to act during the stimulation of the vagus. MME. HUFNAGEL and MARCEL JOLY: The different behaviour with regard to X-rays of the fly and butterfly in the course of their metamorphosis. FRED VLÈS, MLLES. ANNA GROSSMANN and MADELEINE GEX: The electromotive forces developed by man in contact with a metallic conductor. JEAN CAMINOPETROS and B. CONTOS: The intradermal reaction with pustular fever. CHARLES LAPP: The rotatory power of quinine salts in aqueous solution. If the *p*H is brought to about 5·5 with chlorophenol red as indicator, quinine can be determined optically whatever may be the acid with which it is combined.

MELBOURNE

Royal Society of Victoria, Dec. 8. R. T. PATTON: Ecological studies in Victoria. (1) The Cheltenham flora. The association is closely allied to the heaths of the northern hemisphere, both ecologically and taxonomically, a constituent family being Epacridaceæ. The composition of the association is very rich, consisting of members of many diverse families. All, however, possess an ericoid type of leaf. The physiognomy is related to both the climatic and the soil conditions. The soil is very sandy and belongs to the podsol type but it exists under climatic conditions widely different from those of the podsol areas of Europe. The association is typically xerophytic but the morphology of the ericoid leaves does not show any consistent adaptation to the dry period of the year. E. BROADHURST and J. D. CAMPBELL: The geology and petrology of the Mount Leinster district, north-east Victoria. The oldest rocks are Upper Ordovician sediments which have been converted to schists and quartzites by an intrusion of granodiorite, which itself becomes gneissic at its border. A granite porphyry is intruded into the granodiorite. A younger series of alkaline rocks consist of trachytes and trachyte tuffs, into which a soda syenite has been intruded. At the contact with the syenite, the biotite in granodiorite has inverted to hornblende and finally to augite, and quartz has been dissolved and orthoclase has been deposited in its place. A fault on Mount Leinster has brought the granodiorite and trachyte into contact, and a series of specimens across the shear zone, showing granulation, is described. The felspars in the syenite, particularly in some of the dykes, have a peculiar interpenetrating structure. FREDERICK CHAPMAN: Some Palæozoic fossils from Victoria. The following are described and figured: A species of Silurian seaweed, *Bythotrephis divaricata*, first described from the Wenlock of England, and occurring near Walhalla and at Studley Park; two new species of foraminifera from the Silurian of Lilydale and Mitcham, *Hemigordius lilydalensis* and *Trochammina bursaria*, both of which genera have hitherto been unknown from rocks older than the Carboniferous; and a new species of brachiopod, *Orbiculoidea antipodum* from the Lower Ordovician of Lancefield (Darriwilian Series), related to *O. perrugata* from the Caradoc beds of Ireland, described by McCoy in 1846.

VIENNA

Academy of Sciences, Jan. 12. JOSEF SCHAFFER: Differences in the tissue structure of homologous organs (prepuce glands) in mice and rats. In arrangement and external form these glands, although of different size, are very similar in the two animals. As regards fine structure and type of secretion, however, such marked differences appear that the glands must be regarded as of quite different types. In the rat, the secretion is mainly albuminous, and in the mouse purely fatty in character. KARL MAYR: Definite integrals with Bessel's functions. The investigations begun in the author's "Bestimmte Integrale und hypergeometrische Functionen" are continued and applied to the generalisation of an integral examined by Struve and Rayleigh. KARL KLEMENZ: Investigations on Archimedean bodies in spaces of several dimensions. It was found earlier that, in space of four dimensions, only two of these bodies are possible, when congruence of the angles and equality of the edges are required. Extension of the investigations to spaces of more than four dimensions shows that, in such spaces, polytopes with congruent angles and equal edges no longer exist. FRIEDA KANN: Influence of temperature on the stages of growth of *Dixippus* (*Carausius*) *morosus* Br. et Redt. ROMAN J. WOJTUSIAK: Antagonistic action of ultra-violet rays on the phototaxy of *Daphnia magna* Straus. Like blue and violet light, light rich in ultra-violet rays repels daphnids; like darkness, light poor in ultra-violet rays exerts no action, and like red and yellow light, white light free from ultra-violet components has an attracting effect. TOSHIHIKO YAMANÔUTI: Growth measurements on *Sphodromantis bioculata* Burm. (5) Determination of the absolute increases in the size and number of the facets. HANS HORNICH. (1) Construction of integrals of the first genus on special transcendent Riemann surfaces.

Jan. 19. MARTIN KOFLER: Distribution of precipitations according to their diurnal periods. FRIEDRICH HERNEGGER: Sensitive methods for the detection of uranium in spring waters and deposits. For determining the traces of uranium present in radium-containing springs, the chemical method with potassium ferrocyanide and methods based on fluorescence have been investigated. JOSEF HOFFMANN: Alkali- and barium-silver chlorides. Huantajayite and similar sodium-silver chlorides artificially prepared remain unchanged in sunlight, but if the content of silver chloride is increased, the compounds become sensitive to light. The coloration of huantajayite under radium irradiation is similar to that of natural rock-salt, but the irradiated pressed mineral exhibits no colour changes. The colours of potassium-, barium-, and cæsium-silver chlorides are considered. RUDOLF TOTH: Geology of the "Schneeberg" region. VIKTOR PIETSCHMANN: Three new fish species (Cyprinides) from Asia Minor. These species are: *Acanthorutilus handlirschi* nov. spec., *Varicorhinus pestai* nov. spec., and *Schizothorax prophylax* nov. spec.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 15

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Prof. Giotto Dainelli (and others): "The Geographical Work of H.R.H. the Late Duke of the Abruzzi".

Tuesday, May 16

BRITISH SCIENCE GUILD, at 4.30—(Research and Development Lecture in the Carpenters' Hall, Throgmorton Avenue, E.C.2.)—Sir Harold Carpenter: "Metals in the Service of Human Life and Industry".

ROYAL PHOTOGRAPHIC SOCIETY.—Dr. G. M. B. Dobson: "The Significance of Ozone in the Atmosphere and its Measurement by Photographic and Photoelectric Methods".

Wednesday, May 17

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 3.15.—Dr. R. H. Crowley: "Child Guidance".*

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. Maiuri (director of excavations at Pompeii and Herculaneum): "The Recent Excavations of Herculaneum and Pompeii".

FOLK-LORE SOCIETY, at 8—(at University College, Gower Street, W.C.1.)—Sir Reginald F. Johnston: "Tree Worship and Holy Wells in China".

Friday, May 19

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Arnold T. Wilson: "The Suez and the Panama Canals—a Comparison".

BEDSON CLUB, at 6.30—(in the Chemistry Theatre, Armstrong College, Newcastle-upon-Tyne).—Prof. A. Harden: "The Chemistry of Fermentation".

ROYAL INSTITUTION, at 9.—Dr. V. M. Slipher: "Planet Studies at the Lowell Observatory".

THIRD GLASS CONVENTION, May 18–20. To be held at Buxton.

Official Publications Received

GREAT BRITAIN AND IRELAND

Ancient Monuments of Great Britain. List of Monuments prepared by the Commissioners of Works (to December 31, 1932). Pp. 72. (London: H.M. Stationery Office.) 1*s.* 3*d.* net.

The Journal of the Royal Agricultural Society of England. Vol. 93. Pp. 7+388+clxx+xii+12. (London: John Murray.) 15*s.*

Science and the Community. By Dr. Alexander Findlay. Pp. 18. (London: Institute of Chemistry.)

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1932 presented to the Annual Meeting, February 13. 1933. Pp. 44+31. (York.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 72, No. 436, April. Pp. 269–364+xvi. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

The Board of Greenkeeping Research. Report for 1932. Pp. 32. The Journal of the Board of Greenkeeping Research. Vol. 3, No. 8. Pp. viii+56+xxxv+8 plates. 2*s.* 6*d.* (Bingley: St. Ives Research Station.)

Modern Technology: a Select List of Recent Books available at the Coventry Public Libraries. Pp. 16. (Coventry.)

Department of Health for Scotland. Third Report of the Scottish Advisory Committee on Rivers Pollution Prevention. Rivers Leven and Ore (Fife). Pp. 46. (Edinburgh and London: H.M. Stationery Office.) 9*d.* net.

Reports of the Council and Auditors of the Zoological Society of London for the Year 1932, prepared for the Annual General Meeting to be held on Friday, April 28, 1933. Pp. 99. (London.)

The Buckland Foundation (1926). The Buckland Lectures, First Series for 1929. i. Frank Buckland's Life and Work; ii. Fish Farming—Old and New; iii. The Balance of Life in the Sea. By Prof. W. Garstang. Pp. 46. (Aberdeen: The *Fishing News*.) 6*d.*

Economic Advisory Council: Committee on Locust Control. The Locust Outbreak in Africa and Western Asia, 1925–31. Survey prepared by B. P. Uvarov. Pp. 87+13 maps. (London: H.M. Stationery Office.) 5*s.* net.

Fumifugium: or the Inconvenience of the Aer and Smoake of London Dissipated. By John Evelyn. First published in 1661 and reprinted with an Introduction by Rose Macaulay. Pp. 42. (Manchester: National Smoke Abatement Society.) 6*d.* net.

Science Library. Bibliographical Series, No. 82: Plastics. Pp. 104. (London: Science Museum.) 5*s.*

OTHER COUNTRIES

Reale Accademia d'Italia. Fondazione Alessandro Volta. Viaggi di Studio et Esplorazioni, 1: Viaggi di Studio ed Explorazioni. Pp. 78. (Roma: Reale Accademia d'Italia.) 8 lire.

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 16: October, November, December, 1932. By Ernest A. Hodgson. Pp. 265–286. (Ottawa: F. A. Acland.) 25 cents.

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