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## CONTENTS



## The Planning of Research

ALTHOUGH the social reactions of science are now widely realised and the dynamic nature of science is also perceived, the idea that society itself is dynamic and not static has yet to be grasped. Once this fundamental conception has been realised by the general populace, effective attempts can be made to utilise the scientific method and outlook to release our social order from many of the disorders which it has incurred. The attention which is to be paid at the forthcoming British Association meeting in Aberdeen to the relations between the advance of science and the life of the community is definite evidence that the idea is gaining ground, and although speakers at that meeting may feel they are 'preaching to the converted', the consequent focusing of public opinion on the subject cannot be other than helpful.

Among other attempts in recent months to face these issues and to stimulate discussion may be mentioned the further statement on "Liberty and Democratic Leadership" issued early this year over a large number of representative signatures, which referred particularly to housing, the stimulation of consumption and the organisation of distribution, and the survey of scientific research in relation to social needs described by Prof. Julian Huxley in his recent book "Scientific Research and Social Needs". Apart altogether from his valuable account of research activities in progress, Prof. Huxley poses a number of fundamental questions which require attention before we can outline any adequate programme of research in relation to social problems. Something much more than scientific research in the narrow speculative sense is required : we need also the scientific spirit and method in the shape of careful planning.

The map of scientific research which Prof. Huxley attempts to draw is in itself an important preliminary to such planning. It reveals at once the lopsided development of the scientific structure of Great Britain and the lamentable neglect of the sciences dealing with man. The imperative necessity of organising research less from the production side and more from the consumption end towards the needs of the individual citizen also emerges, and these two factors alone throw a flood of light on the real causes of the displacement of labour or technological unemployment.

If science is to fulfil its function in the modern State, we must, in fact, regard it as a social activity

and not as something apart from the rest of human life and interest. Not only is sharp distinction between pure and applied science no longer possible, but also the scientific movement as a whole requires scientific study, and its activities must be planned as much as any other social or industrial activity, if the maximum results are to be obtained and its resources wisely exploited. This planning of science must precede the wider participation of the scientific worker in social activities. Through it must come the assembly and exploration of the scientifically ascertained facts in neglected fields, upon which alone wise action can be based.

It is probably at this point that such organisations as the Royal Society, the British Association, the British Science Guild, the Federation of British Industries, the Association of Scientific Workers might render valuable service. Through their efforts it should be possible to map out the scientific resources of the country, and make authoritative recommendations for the re-orientation of these resources and for the attack on neglected problems of outstanding importance. An important instrument in this respect would obviously be the newly reconstituted Parliamentary Science Committee.

Some of the more conspicuous gaps demanding such a re-distribution of scientific effort from the physical sciences into the biological and related sciences, as urged by Sir Josiah Stamp at the British Association meeting at Leicester last year, may be briefly indicated. In regard to agriculture, for example, even on the production side, many of the scientific results already available could be applied immediately to reduce costs for the farmers and enable more of them to make a reasonable and assured profit instead of living from hand to mouth with failure a persistent menace. On the other side, with very large sections of the population underfed and undernourished, the resources of science should be capable of ending the restriction of output and sabotage. The proper application of existing knowledge could at least double the production of food in Great Britain and raise world production to a level which would provide the population with a sufficiency of the right types of food to ensure full health and growth and energy for all.

Here, as in such questions as adequate housing, town and country planning, the utilisation of scientific results involves economics and politics. Without the large-scale planning of industry, science is liable to cause as many difficulties as it resolves. There is all the more reason therefore for applying scientific methods not only to technology and production but also to the organisation of particular industries and to the economic life of the nation as a whole. Any subject is capable of examination by the scientific method, and consumption is just as much a problem for scientific research as is production.

Even in regard to industry in the more limited sense, there are gaps in the existing structure of research which should be filled by such re-orientation of scientific resources. Taken as a whole, industry appears to be unwilling or unable to provide the broad scientific background of research out of which new applications grow, or to undertake long-range fundamental investigation on a large scale. The standardisation of materials and processes alone offers a field for much more extensive research, which would have important social as well as economic results, and frequently provide traditional methods and standards with a scientific foundation, thus making improvement possible. As craftsmanship thus becomes based on scientific data instead of half-conscious knowledge, technical obstacles to social progress in such fields as building, for example, are more readily removed.

The improvement of processes, the introduction of new processes and products, and the development of new uses for materials are all ways in which in many industries research needs organising and directing in a wider and more effective manner. This involves very often the acquisition of the scientific spirit by the management of industry, and the facing of the whole question of training for management. Next to nothing has yet been done in the scientific study of consumption and distribution. A really scientific investigation of how to stimulate consumption, or into retail distribution, is required to obtain the facts essential for scientific decision as to a policy for action.

The idea of regarding society itself as a proper object for scientific research is new to many, but is quite definitely forced on us by such surveys as that carried out by Prof. Huxley and the situation it reveals. Moreover, the scientific worker can scarcely be in any doubt that a scientific attitude to social questions is better than an unscientific one. There are many problems presented in education, the penal system, public health and industrial welfare, in which a proper supply of scientifically ascertained facts is an indispensable preliminary to wise action. Notably does the study

of population with the view of controlling it offer attractive possibilities.

The merest glimpse of the possibilities of improving the quality of human life in this way which emerges from such a survey should be sufficient incentive to the mobilisation of scientific forces to this end. To fill in the gaps which exist in research by national direction and planning of research is a first step, and may demand, as suggested by Prof. Huxley, the creation of a social advisory committee and research council corresponding to those responsible for planning and financing research in the economic field. Such a council would not only be able to plan out the lines of an adequate campaign of research, but also would assist in obtaining the necessary supply of research workers trained in the social sciences by modifying both the distribution of scholarships awarded in different branches of science and the science curricula in schools and universities.

Action along such lines is essential in the acquisition of scientific knowledge of the possibilities of changing society and solving our social problems if that knowledge is applied. To secure that application and exercise such control over society is another matter. Even in such matters as health there are all kinds of obstacles to be overcome. Poverty, religious prejudices, vested interests, public ignorance and apathy, and sectionalism are all barriers to action based on knowledge and to planning on a national scale. Moreover, the group mind itself is normally much more self-centred and backward than that of the average individual forming the group, and planning on a national scale has in itself at least the possibilities of further friction and obstacles to wider developments through the development of international friction. The exploitation of science for sectional ends, however large, may actually intensify present rivalries and create further chaos before men learn to subordinate their sectionalisms to the claims of the world unit and co-operation on an international scale.

The outstanding progress in every field of human activity and happiness, which is really within our grasp if science were applied in the international scale as thoroughly and efficiently as it is at present within the limits of a single business or a single industry, holds out every inducement to overcome the difficulties which private profit or national sovereignty present. After all, if the form and direction of science itself are largely determined by the social and economic needs of the place and period, even in the international sphere science is influencing the world structure. Here as elsewhere it is making for the breakdown of the system which gave it birth, and demanding the creation and development of a new order in which the needs of mankind can be more effectively served. The conception of science as a social function intimately linked up with human history and human destiny, moulding and being moulded by social forces, should summon forth from scientific workers something of the energy required to translate into policy and action the knowledge acquired by their work. Such energy will find its expression alike in the discharge of their own civic responsibilities and in sharing with their fellow citizens both this vision of the new and greater social possibilities if that knowledge is sincerely and courageously applied, and the faith that human reason by using wisely the scientific method can give us the control of our destiny.

## Electroacoustical Reproducers

*Loud Speakers: Theory, Performance, Testing and Design.* By Dr. N. W. McLachlan. (Oxford Engineering Science Series.) Pp. xii+399. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 40*s*. net.

A PERUSAL of recently published textbooks on acoustical matters reveals that the major problems associated with the design and operation of reproducing equipment are dismissed with provoking brevity, or politely ignored. It is a source of some wonder that until now this subject of such vital concern to all designers of wireless receivers should have the singular distinction of being overlooked by the vigorous band of technical authors. Yet such is the case with but trivial exceptions. However, in this third and massive volume of the Oxford Engineering Science Series, Dr. McLachlan has dealt with the broad subject of loud speakers in a fresh and thoroughgoing manner. The treatment of the multifarious topics has been as mathematical as the themes allow, and on the theoretical side is strikingly complete. The author has been such a prolific contributor to the knowledge of the subject himself that we have good grounds for expecting the information to be up to date and authoritative.

The widely scattered and recent literature on loud speakers has been drawn together in an excellent way, and the bibliography is particularly well set out, while the reliability of the statements

made is of a high order. But the book is much more than a full account of Dr. McLachlan's own work plus excerpts from British, German and American technical literature. It contains many paragraphs of original and hitherto unpublished work which is the hall-mark of a good textbook. These have been inserted at the time of writing to complete the various discussions, and they are found especially in the more theoretical portions of the book. Incidentally the author has also found time and energy to write a separate book dealing with the special Bessel functions involved, and this should provide an easy approach to the more difficult portions of the present text.

The volume under review has been written from a scientific rather than from a manufacturer's point of view, and those associated with the development of reproducing equipment will find certain topics of paramount importance only briefly referred to. Mention may be made of the step-down transformer, a standard fitting on practically all modern moving-coil loud speakers, the discussion of which is limited to a few lines. No reference is made to the usual method of introducing a small fixed air-gap into the iron circuit to prevent serious anode current polarisation of the transformer core. In fact, the word 'transformer' is not even in the index. Centring devices for voice coils are likewise dismissed in less than a page, while concerning the all-important matter of the choice of cone angle, we are merely told "that for general reproduction an angle midway between a disk and cylinder gives the best results". In actual moving-coil loud speaker practice, apical angles ranging between 90° and 140°, in steps of 5°, are to be found among the vast range of modern commercial instruments. However, these are defects which to some extent are due to the paucity of published data and must not be taken as truly representative of a textbook which was not written primarily to solve the troubles of the harassed designer. Nevertheless, he cannot fail to find some of his difficulties discussed within its covers, and the solutions given.

Turning our attention to a more detailed consideration, we find that after a complete list of symbols and a chapter on definitions the formal theory of propagation of sound is developed with loud speaker problems clearly in view. For example, the vibration in different modes of the ideal sphere is considered in detail, and the results are applied to explain the action of baffles on diaphragms, and practical conclusions are drawn.

Following a formal consideration of the accession to inertia of disk and spherical vibrators, is an interesting chapter on vibration modes curiously sandwiched between two other formal and excellent chapters on the calculation of the spatial distribution of sound from vibrating diaphragms of various shapes and on the theoretical acoustical power radiated. A commendable feature of these early chapters is the inclusion of clear tables summarising the solutions for special boundary conditions.

The theory of the moving-coil principle and the calculation of the coil-driven rigid disk occupy the next two chapters, and after this there are chapters devoted to electrostatic speakers, the theory of horns, sound waves of finite amplitude, and transients. This concludes the analytical portion of the book.

Under the heading of driving mechanisms, are briefly described the principal types of loud speaker motor, and all the well-known principles are mentioned. Magnets are adequately discussed from the aspects of measurement and design and a full treatment is given of the influence of non-uniform gap flux distribution. Further sections deal with questions of acoustical efficiency, its definition and measurement, electrical impedance determinations and the quantities deducible therefrom. The bridge shown in Fig. 107 is preferably described as the 'Heaviside-Campbell', especially in the form given. A wealth of information is given in these experimental chapters and much timely warning of likely pitfalls.

Response curves and their measurement are next considered, and a good selection of results is given. In subsequent editions an expansion of the section giving details of suitable testing apparatus would be advantageous to those readers about to undertake response measurements for the first time. A comprehensive discussion of the vibrational frequencies of conical shells concludes the experimental portion of the book, and this is a subject that Dr. McLachlan has made peculiarly his own. A valuable elucidation of a difficult set of phenomena is given in this chapter and the research worker in this field will find many of the explanations put forward eminently helpful.

In the concluding section embracing two chapters, design calculations on hornless and horn type moving-coil loud speakers are given and many useful formulæ developed. Several interesting topics are also included in an appendix. It was good to see the recent equal loudness contours of Fletcher and Munson in Fig. 150, but the term

"isobel" is to be decried since loudness is not "measured in decibels", as the description of the ordinates in that figure would suggest. The word "level" inserted after "loudness" would improve matters considerably and makes an all-important distinction. In fact, "loudness" and "decibels" seem to have been inextricably mixed up in definition 46. The decibel should be defined without any reference to the fallacious Weber-Fechner law or to subjective aural impressions, but just simply in suitable terms as the logarithm of a power ratio. These points can be corrected in future editions, as this excellent volume has undoubtedly come to stay as a standard work.

The Clarendon Press is to be congratulated on the clarity of the production, the formulæ and illustrations being set out particularly well. Misprints, too, are few in number and are not of a serious nature. Finally, the book is warmly commended to research workers, teachers and advanced students of acoustical engineering.

D. A. OLIVER.

## Pioneering in Chinese Palæontology and Archæology

*Children of the Yellow Earth: Studies in Prehistoric China.* By J. Gunnar Andersson. Translated from the Swedish by Dr. E. Classen. Pp. xxi+345+32 plates. (London: Kegan Paul and Co., Ltd., 1934.) 25*s*. net.

READERS of NATURE are aware of the important work accomplished by Dr. J. Gunnar Andersson in opening up the field of palæontology in China, and preparing the setting for the epoch-making work of the late Prof. Davidson Black, to whom he dedicates his book in these words: "This volume is dedicated to the memory of my charming friend Davidson Black (†March 15, 1934), Professor at the Peking Union Medical College, who with such penetrating genius identified and described *Sinanthropus pekinensis*."

Not only did Dr. Andersson discover the site of the earliest phase of human history, but he also recovered the earliest known cultural remains in China, which provided evidence to confirm the reality of the intimate connexion between the first civilisation of China and that of Western Asia, and convincing evidence of the derivation of Chinese culture indirectly from Mesopotamia, as suggested long ago, but without the conclusive evidence, by Prof. Terrien de la Couperie. The book he has written is not only a fascinating introduction to the early geological and cultural history of China, but also is deeply interesting as giving the great pioneer's account of the circumstances of his discoveries, written in a vivid and entertaining style which throws valuable light upon the personal factors of the international co-operation which led to such momentous results.

The simple and direct narrative is illuminated by reference to many personal incidents. A quotation will illustrate the method and qualities of the bright narrative of the book. The inauguration of the work is described in these terms:

"It was a little piece of stone which from the very beginning gave a definite direction to my work in China and from this beginning my fate unfolded throughout a decade of varied and shifting change in which the milestones bear the inscriptions: mining expert—fossil collector—archæologist."

Dr. Andersson gives a full account of the labours of the Swedish geologists that led to the discovery of *Sinanthropus*, and sheds illuminating glimpses of light on the personalities of the participants, European and Chinese, in this great achievement. The story of Dr. Andersson's location of the important site at Chou Kou Tien has often been told and is given again in this book with the personal authority of the finder:

"I could never forget the thought of the hominid remains in this cave and thus it happened that Zdansky, at my request, returned to Chou Kou Tien for further excavations in the summer of 1923. He found a molar and a premolar of a creature resembling a human being, which he designated merely *Homo sp.? So the hominid expected by me was found.*"

The cautious French palæontologist, P. Teilhard de Chardin, impressed upon Dr. Andersson the risk of identifying human remains from a mere tooth and suggested, no doubt remembering the incidents of the so-called Nebraska man, the desirability of making sure the tooth was not a carnivore's. Dr. Andersson replied that he placed complete reliance upon Zdansky's palæontological experience, more especially as he had made extensive investigations in the fossil carnivores of China and thus should be proof against the danger suggested by Teilhard. While this discussion was fresh in men's minds, there was a public dinner in Peking for the secretary of the French Academy of Sciences, at which everyone of importance in science in Peking and Tientsin was present to do honour to the distinguished visitor. Spirits ran

high towards the end of the dinner and pointed remarks flew like arrows across the table.

"Then," writes Dr. Andersson, "I was struck by a full bull's eye. 'Well, Dr. Andersson,' the inexhaustible and delightful Grabau exclaimed to me, 'how are things just now with the Peking man? Is it a man or a carnivore?' 'My dear Dr. Grabau, the latest news from Chou Kou Tien is that our old friend is neither a man nor a carnivore. It is rather something half-way between the two. It is a *lady*!' "

For some months after this bantering, the name of the discovery changed to the "*Peking Lady*".

Then Dr. Andersson provides a lucid summary of the reasons given by Dr. Davidson Black (in his serious scientific argument) for the creation of a new genus of the human family. It is in this entertaining way that Dr. Andersson blends gay and grave in giving a lucid and vivid account of the great research, and a vast amount of information concerning the geology, the fossil animals and plants of China. Then he explains how, as the range of the search for fossils extended, he was led into important discoveries of archæological material and how in studying painted pottery he was impressed by the close resemblance to the material found by Prof. Pumpelly at Anau in Russian Turkestan.

This charming book is an entertaining first-hand report of two discoveries of outstanding importance in human history; and it will be welcomed for the intrinsic interest of the story no less than the information it affords in such delightful fashion.

G. ELLIOT SMITH.

## Fibres under the Microscope

(1) *Modern Textile Microscopy*. By J. M. Preston. Pp. xi+315. (London and Manchester: Emmott and Co., Ltd., 1933.) 15*s*. net.

(2) *Textiles and the Microscope*. By Prof. Edward Robinson Schwarz. Pp. xi+329. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 24*s*. net.

(1) FIBRES, like most things, need both to be looked at and looked into, if the best is to be made of them. For thousands of years we were satisfied with the unaided human eye and 'visible' light—such natural equipment still suffices, or is made to suffice, for general industrial purposes—but lately we have begun to make use, not only of the microscope, but also of the 'light' of the X-rays. The immediate result has been, of course, to show how little we understand well about fibres, those elongated structures that are so common a feature of the architecture of living things; but we are making good progress, and the times are full ready to receive an authoritative statement on the present position of textile microscopy.

This makes it rather a pity that the author of "Modern Textile Microscopy" has perhaps not made the most of the opportunity: the subject, especially at this juncture, was worth something more than he has put into it, a more systematic arrangement of the sections, for example, more explanation of the difficult parts and less of the easy parts, more thorough and convincing discussion of the fundamental structural aspects, and lastly, more careful scrutiny of the proofs to eliminate misprints and grammatical faults. "Modern Textile Microscopy" is a valuable book for all that, if only for the range of problems dealt with or touched upon and the comprehensive bibliography of 351 references, for much of the literature on textiles is depressingly confined to immediate practical affairs, with never a thought for the fundamentals and the great possibilities that surely still remain.

The treatment proceeds from the microscope and the preparation of sections and other experimental material, through photomicrography, photometry, staining, swelling, ultra-microscopy, the appearance of surface structures, and fluorescence microscopy, to a final chapter on the methods of polarised light. This last chapter might have been the best, the most suggestive for the problems that await solution and for the linking-up of optical with still deeper molecular studies—but somehow it is not: the confused definition of birefringence (p. 270) and the tangle in which Wiener's provocative formula has been left (p. 267) are alone sufficiently disappointing, even were the argument less superficial than it is. The correct interpretation of birefringence measurements on fibres under various conditions and after various chemical and physical adventures is difficult, very difficult; but that makes it all the more imperative to set out clearly what we know and what we do not know. There was a golden opportunity here!

Much the larger part of Mr. Preston's book is devoted to cellulose fibres: the protein fibres, wool and silk, have not yet come into their own, optically at least, though undoubtedly they will

have far more to teach in the end. But cellulose, thanks to the recent happy combination of chemical and X-ray results, is in a very promising state. The reader should beware, however, especially if he is minded to apply a little physics to biology, of taking seriously what is said on p. 193 about the extinction directions in the cellulose wall of *Valonia ventricosa*. The original paper says something quite different.

(2) "Textiles and the Microscope", as the respective titles somehow suggest, has not quite such high aims, whether or not they have been realised, as "Modern Textile Microscopy". Prof. Schwarz frankly eschews the deeper aspects of fibre structure—wisely, we think, for such excursions as he makes into the unknown are not particularly well supported by the most up-to-date results—but for the purposes for which his book was written, and embodying as it does the author's experience accumulated over ten years or so, it is a sound contribution to textile literature, well written and beautifully produced.

The development follows the usual lines, starting with the microscope and its accessories, passing through the preparation, examination, photography, etc., of the specimens, and culminating with chapters on fabric-, yarn-, and fibre-analysis. There are copious illustrations. Prof. Schwarz and other enthusiasts appear to have devised a 'gadget' for every conceivable operation in textile microscopic research, however elementary, and photographed it too. Most of the illustrations, however, are from the publications of instrument makers, which makes the book at first sight look like a glorified catalogue, which it is not, by any means. In fact, it is a book eminently suited to certain needs of textile research associations, for it is neither too highbrow nor too sordidly industrial, but preserves a nice balance between the two, just as a research association should.

## Short Reviews

(1) *Toads and Toad Life.* By Jean Rostand. Translated from the French by Joan Fletcher. Pp. xii+192+8 plates. (London: Methuen and Co., Ltd., 1934.) 7*s.* 6*d.* net.

(2) *Handbook of Frogs and Toads: the Frogs and Toads of the United States and Canada.* By Anna Allen Wright and Prof. A. H. Wright. (Handbooks of American Natural History, Vol. 1.) Pp. xi+231. (Ithaca, N.Y.: The Comstock Publishing Co., Ltd., 1933.) 2.50 dollars.

Two books so diverse in purpose, style and treatment it is difficult to imagine. Both are about amphibians, but whereas M. Rostand's book deals essentially with only a single animal, the common European toad, Prof. and Mrs. Wright are concerned with no fewer than 86 different species; the former is best read in slippered ease, but the other is designed essentially for the field naturalist who needs to identify the creatures he is observing. "Toads and Toad Life" gives a full account of the animal in relation to its environment; every phase of its normal life cycle is considered and its reactions are analysed and compared with those of other amphibians. But although there is much of scientific interest in the book, the manner of its presentation is unusual. It combines an astonishing *naïveté* with more than a touch of pedantry; at one moment the author is telling us that (p. 29) "The Toad is a good jumper, particularly when young. It can easily jump 6 inches (15 centimetres). It can walk quickly. Often it stops itself suddenly by using its back legs as a brake"; and at another (p. 38) "Bufotalin is a cardiac poison, very similar in its effects to digitalis. It stops the heart during systole and affects the nerves, causing paralysis". The authorities for many of the statements made in the text are mentioned by name, but no references are given; and the bibliography at the end of the book appears to have been compiled solely for the benefit of French readers.

The first of the "Handbooks of American Natural History" is vastly different; it is a simple, straightforward guide to the Anura of North America, intended for the student. It contains a brief, concise, general account of the group, a series of 'keys' for the identification of living specimens, one or more excellent photographs of nearly every species considered, together with distributional, morphological and ecological notes, and an extensive bibliography.

*Einführung in die Physik der Gasentladungen.* Von Prof. Dr. Rudolf Seeliger. Zweite umgearbeitete und erweiterte Auflage. Pp. xii+563+8 plates. (Leipzig: Johann Ambrosius Barth, 1934.) 46 gold marks.

THE second edition of Seeliger's introduction to the physics of electrical discharges in gases, of which the first edition appeared in 1927, is bound to be of interest to all concerned with the work in this branch of science. Prof. Seeliger avoids unnecessary mathematical discussions, and, at the same time, gives the reader the feeling that he has before him adequate theoretical preparation for the proper understanding of the experiments and phenomena described.

The book is intended as an introduction to the fundamentals of discharge phenomena and does

not pretend to deal with technical applications, and the author succeeds in giving an interesting and critical survey of the subject. The survey is indeed sufficiently critical to bring considerable relief to those who have tried to follow the somewhat contradictory accounts which are to be found in different sources of information. In this connexion, footnotes are avoided, and the author condenses his special notes and criticisms into a valuable appendix, which also contains the necessary original references. Of particular excellence is the chapter on the Townsend discharge with its treatment of corona investigations, and the account of modern methods of active probe measurements in discharge tubes. The whole treatment is thoroughly up to date and can be heartily recommended.

*Huxley.* By E. W. MacBride. (Great Lives, No. 34.) Pp. 143. (London : Gerald Duckworth and Co., Ltd., 1934.) 2*s.* net.

THIS is not a very appreciative 'life' of Huxley. Prof. MacBride tells us that although Huxley invented the term 'biology', he was not a biologist but a necrologist "dealing with dried bones, fossils and the materials of dissection". He considers that his scientific fame must undergo some diminution, if evolution by natural selection is a bubble, based on a truism, and the bubble has burst, because he "accepted it wholeheartedly". He agrees that Huxley's definition of the agnostic position "conferred the greatest possible service to modern thought" but, on the other hand, his theory of the relation of mind to matter "if seriously taken and acted on, would destroy the whole basis of morality".

With all these criticisms of Huxley's opinions, of his methods and indeed in some respects of his superficiality (p. 92) the real greatness of the man is almost lost. Credit is indeed given him for his immense influence in spreading the light of the doctrine of evolution ; but few people who knew Huxley personally will feel that in this 'life' full justice has been done to his great power as a teacher, as a reformer of old and obsolete methods and as a desperate fighter for truth against error and superstition. But for all that, as Prof. MacBride always writes clearly and forcibly on all contentious matters, this little book will prove to be of value as it includes what is perhaps the best short statement we have read of the Lamarckian position at the present day, and also a very able counterblast to Huxley's materialism.

*Darwin.* By R. W. G. Hingston. (Great Lives, No. 27.) Pp. 144. (London : Gerald Duckworth and Co., Ltd., 1934.) 2*s.* net.

THERE has been so much criticism in recent years of what may be called nineteenth-century Darwinism that we are perhaps losing sight of the great revolution of thought in all branches of learning that was brought about by the "Origin of Species" and the other works of the great English naturalist. In Major Hingston's account of his life we find a full appreciation of the value of his researches and a welcome reminder of the immense value of his philosophy in the promotion of science.

Major Hingston summarises an interesting chapter on the great controversy about the doctrine of evolution in these words : "What the nineteenth century struggled hard to destroy the twentieth universally and quietly accepts, indeed, perhaps accepts too blindly. Darwinism is no longer the brand of Atheism, and Geology lives in peace with Genesis." He distinguishes Darwin the evolutionist from Darwin the natural selectionist and points out, quite justly, that there are but few naturalists now who would regard natural selection to be the whole cause of evolution ; "Yet the whole world," he adds, "has not been able to find a better explanation."

This is an excellent little book, well worth reading and indeed valuable for reference as a brief summary and chronology of the Darwin's life and work.

*Wild Flowers in Literature.* By Vernon Rendall. Pp. 372. (London : The Scholartis Press, 1934.) 12*s.* 6*d.* net.

ALL can share the heritage of delight which is to be obtained from wild flowers and literature, so that there will be few who will not rejoice to have an anthology which combines them both in association, especially when it comes from the pen of Mr. Vernon Rendall, who tells us that his reading to prepare it has ranged over half a century of his life.

The flowers are arranged in the anthology according to the natural orders, and the quotations come more or less in order of date interspersed with a running comment which is in itself a delight. Where all is delectable each can pick for himself, and although the pedantic may miss his favourite quotation, to have included all would have meant a perfection which in itself would be disappointing. In Nature, there is always the hope for something still more beautiful round the corner, and though we may return home today satisfied that there can be nothing more beautiful and that the quotation perfectly expresses what we have seen, it is comforting also to have the feeling that next week we may experience yet such another moment. To Nature lovers these thrills make up the real joys in life—to relive them at home with the aid of this companionable book is an added blessing for which we are grateful.

*The Construction of Man's Family Tree.* By Sir Arthur Keith. (The Forum Series, No. 18.) Pp. vi+54. (London : Watts and Co., 1934.) Cloth, 1*s.* net ; paper, 7*d.* net.

IN this little book, Sir Arthur Keith reviews and summarises the attempts which have been made to construct a family tree for man. He begins with Hæckel, and after restating his own position, discusses recent controversy on the position of the anthropoids.

*The World in Modern Science: Matter and Quanta.* By Leopold Infeld. Translated by Louis Infeld. Pp. 287. (London: Victor Gollancz, Ltd., 1934.) 5*s*. net.

"IF we ignore the mathematics of physics, is there anything that remains?" So asks Prof. Einstein in his introduction to this brilliant little work, which supplies a convincing answer to the question. The introduction states that the book is neither a treatise nor a textbook, and gives no mathematical formulæ or experimental details, but treats methodically and philosophically a restricted range of facts to enable the reader to appreciate and understand the limitless perspective and beauty of modern science. Actually the fundamental principles of physics are expounded in the simplest possible language with a wealth of apposite analogies and illustrations, so that the reader feels as if engaged in an absorbing novel. Under the chapter headings of methods of thought in physics—radiation, matter, the nuclei of atoms, matter and radiation, and modern quantum mechanics—all the main features of the picture of modern physics are presented in a co-ordinated and most up-to-date manner. The neutron and positron are treated as integral features in the exposition, and not as matter "received too late for classification". One is, as it were, taken behind the scenes, and shown with the liberal help of genealogical type diagrams how theories have arisen, the contributions which they made, and how and why their limitations have caused them to be superseded by newer ideas. The more advanced reader will appreciate especially the final chapter in which separate but co-ordinated accounts of the lines of reasoning of de Broglie, Schrödinger, Heisenberg and Dirac are described with a simplicity of style which, under the restriction of excluding mathematics, could scarcely be excelled.

Though it would perhaps be unduly optimistic to endorse the statement that no prior knowledge is demanded, Prof. Infeld's admirable survey can be recommended unreservedly to everyone interested in, engaged in, or instructing on modern theoretical physics. An unusual feature of a book of this type is the really good index. N. M. B.

*Late Tudor and Early Stuart Geography, 1583–1650: a Sequel to Tudor Geography, 1485–1583.* By Prof. E. G. R. Taylor. Pp. xi+322+8 plates. (London: Methuen and Co., Ltd., 1934.) 15*s*. net.

IN her previous volume, Dr. Taylor set out the background of geographical thought and nautical theory between 1485 and 1583. The present volume deals with a period in which the chief note is transition. The Hakluyts, more farseeing than most men of their age, thought of the new lands across the seas, not as sources of immediate wealth for spoliation, but as possible colonies which by the slower process of plantation and settlement might become more truly valuable. Ideas of control and planning appear in studies of economic geography, and gratitude is due to the author for the insertion of Plate VII, which shows contemporary cartoons dealing with those still vital questions, the beginning of capitalism and the traffic problem.

The latter half of the book consists of a very full bibliography, arranged under year of publication. This method illustrates the change in type from astronomical works and pilgrim literature to the increasing output of works on colonial geography and trade and agricultural improvements which characterise the end of the period. The first fifteen pages are addenda to the bibliography given in "Tudor Geography".

Students of historical geography will welcome this serious and fully documented account of a period when for the first time a large body of specifically English geographical literature made its appearance. But the book should appeal to a wider public; for Dr. Taylor's clear style, and her wide background of sources, combined with a flair for seizing on relevant and interesting detail, make the book well worth reading.

*Die kosmologischen Probleme der Physik.* Von Prof. Dr. Arthur Haas. Pp. vii+124. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.) 3.80 gold marks.

AT a time when the struggle between rival theories of the phenomenon of the recession of the nebulæ is still in progress, Prof. Haas's excellent summary of the whole position will be welcome to both experts and non-experts. Prof. Haas has divided his book into two parts. In the more popular first portion, he deals with the observational material regarding the recession phenomenon and describes the methods of determining the distances, distribution in space, and red-shifts of the spectral lines of the nebulæ. He shows how puzzling is the short time-scale permitted by the rapid rate of expansion and refers to the problem of the cosmic rays. Prof. Haas has succeeded in presenting the results of the observations objectively whilst evidently favouring the relativistic theory for accounting for them.

The second half of the book contains a short account of the work of Einstein, de Sitter, Lemaître and Eddington on the theory of expanding curved space, which will be found a useful introduction to more exhaustive expositions. A critic would find only two small points to object to, first, the statement that the de Sitter universe gives only a quadratic, and not a linear, law for the recession of distant objects, and, secondly, the fact that Milne's "kinematical" theory is presented rather as being what its author hoped at first to make it than what it has since turned out to be. A concluding chapter is devoted to Eddington's and Prof. Haas's own speculations on the connexion between the cosmical constant and the constants of atomic physics.

# The Engineer and Modern Civilisation*

By SIR FRANK SMITH, K.C.B., SEC.R.S.

## THE PRIME MOVER

IN examining the picture of the prime mover I shall look at it through the spectacles of the scientist, and endeavour to find out why the industrial revolution came when it did and not thousands of years before, and why Hero's steam engine of two thousand years ago was never more than a toy. The reason was not that the brains of Hero were not as good as those of James Watt or Trevithick, for whatever the claims may be of the engineer, he does not claim to have markedly improved the thinking power of the human race.

For thousands of years the engineer's prime mover consisted of nothing more than the water-wheel and the windmill. How came it that the steam engine was ever invented ?

Hero's steam engine was the forerunner of Barker's water mill, and some might even say of the steam turbine. Why did Hero's engine remain undeveloped ? The reason is, I think, that knowledge of the physics of gases and liquids and of pressure was almost non-existent in those days, and without such knowledge progress was impossible. For 2,000 years philosophers spoke of the horror that Nature had for empty space. Nature, they said, abhors a vacuum. Even Galileo, when told that a suction pump would not raise water higher than about 33 ft., appeared to think that it was due to Nature's resistance to a vacuum being limited.

It was Pascal, the mathematical physicist, who showed that a pressure exerted upon a fluid is transmitted in all directions, and it was Torricelli who discovered that the atmosphere exerted a pressure. It was almost inconceivable at the time that the air in which people moved and which appeared to impede their progress so little exerted a force the aggregate pressure of which on the human body was of the order of 15 tons. It was one of the great discoveries of the seventeenth century. To-day this discovery of Torricelli's may appear to be of slight importance, but one of the first committees which the Royal Society appointed for a scientific purpose considered Torricelli's results. Christopher Wren was a member of the committee ; Boyle was another. Boyle made a distinct contribution to the knowledge required for steam engine practice, for he proved the relationship between the pressure and volume of a constant mass of gas, in fact, he demonstrated the elastic properties of air.

In the days of Boyle the coal industry was in a bad way, as it is to-day, but the cause was different. The mines were becoming flooded with water, and man and horse-power were insufficient to cope with the trouble. The knowledge obtained by Torricelli and Boyle was used by Papin (1690) who observed that a small quantity of water made a large volume of steam, and this steam appeared to have all the elastic properties of air. I can but surmise that Papin concluded that if he condensed the steam a vacuum would be produced, and that water might thus be caused to rise to a higher level by the pressure of the air. In such a way atmospheric engines arose. Worcester's, Savery's and Newcomen's engines were all atmospheric engines. If the air had not exerted a pressure on the earth's surface, these early steam engines would not have worked. Watt's first engine was an atmospheric engine. It was only when steam was used at high pressure and allowed to do work by virtue of its elastic properties, that is by expansion, that there was departure from a simple atmospheric engine. Trevithick's engine was a high-pressure engine, and it was Trevithick, you will remember, who applied it to propel carriages on roads. To Trevithick also belongs the honour of being the first to use a steam carriage on a rail.

With such scant knowledge of the internal mechanism of gases the nineteenth century began. The scientist looking at the picture of that period sees more than 10,000 steam engines in use in England developing in all about 200,000 horse-power and many of these were used to prevent coal mines being flooded. All these steam engines, from a scientific point of view, were based on a knowledge of atmospheric pressure and the elasticity of gases. True, Carnot had already written his wonderful paper on the motive power of heat, but it received little attention.

There was practically no knowledge of the nature of heat. Indeed, until the latter part of the eighteenth century, heat was regarded as a material substance to which the name 'caloric' was given. After all, the idea was by no means absurd. The heat was supposed to fall from a high temperature to a lower one, like water falls from a high level to a lower one, and in the fall in temperature it was thought work was done. The heat was supposed never to disappear ; it was believed to be indestructible. To-day we believe that work is done electrically in a similar fashion ; the electricity falls from a high pressure to a lower pressure and in doing so work is done but the electricity is not destroyed. It is not therefore so very strange that the view that heat was a material substance should have been accepted in the early part of the nineteenth century. So far back as 1756 Dr. Black discovered latent heat. He had pondered over the slowness with which ice melts and water disappears in boiling and concluded, since the caloric put into the boiling water did not raise its temperature, that the heat was latent. James Watt, who was in close contact with Dr. Black, measured the change of volume

* From the Gustave Canet Lecture delivered before the Junior Institution of Engineers on June 28.

when water vaporised. He no doubt saw that the atmospheric engine worked best when the cylinder was hot and the condenser as cold as possible, and hence concluded that the best efficiency was obtained when the heat was introduced at a high level and rejected at the lowest possible level.

Nearly fifty years after Black's discovery of latent heat, Rumford made a great discovery. Without being able to see the minute particles of matter he concluded that they were in vibration and that this vibratory motion was heat. Heat was not a material substance; it was a mode of motion. For the first time in history, the mechanism of heat was revealed. Rumford's conclusion was vigorously attacked by the calorists, and although Davy confirmed his conclusions by experiments it was not until 1812 that he felt sure in asserting that "the immediate cause of the phenomenon of heat is motion and the laws of its communication are precisely the same as the laws of the communication of motion". There was thus an explanation of why water under reduced pressure lost heat, and therefore fell in temperature as more and more vapour was formed and removed. On evaporation, a particle of the vapour possessed more energy due to its motion than a particle of the liquid at the same temperature and of the same mass. Hence the water cooled. It was known even before the nature of heat was understood that ultimately the water in such circumstances would freeze. To-day, many of our large refrigerating machines operate on this simple principle.

The greatest engineering discovery of the nineteenth century was made, however, by Joule and others. The discovery was that heat and work are mutually convertible at a fixed rate of exchange; the law which is known to engineers as the first law of thermodynamics. The new idea was that the vibratory motion of the minute particles of matter which we call heat were integrated through an appropriate medium into a larger single motion, say, that of a fly-wheel, and thus a means of doing work was provided. The old idea that heat was indestructible was completely overthrown. Steam engines were then in existence, and it was realised that when work was done by a steam engine heat passed out of existence. If, on the other hand, work was done to produce heat a definite quantity of heat came into existence for each unit of work expended. It is difficult to realise that this principle of conversion of heat into work was unrecognised in the early days of Lord Kelvin, whom many here, including myself, knew quite well. The discovery was not only of the greatest importance to engineers; it was, I believe, the greatest generalisation in physics of the nineteenth century. Engineering could not have developed in the way it has had this fact never been discovered. Moreover, work was to be interpreted in the broadest sense whether done mechanically, electrically or by chemical combination. The engineer could at last visualise what happened to steam when its temperature was raised and its volume was kept constant. Increase of temperature meant increased vibratory motion of the particles which bombarded the walls of the enclosing chamber in a way that Pascal could not have dreamt of. Thus the pressure of the steam was increased. If the steam were allowed to expand, the energy of motion and the pressure fell. Work had been done and some heat had disappeared.

The new doctrine met with a good deal of opposition. A doubting scientist remarked to Mayer that if the theory were correct water would be warmed by shaking. Several weeks later Mayer proved that it was. A somewhat similar story is told by Lord Kelvin who met Joule carrying a thermometer near Chamonix. Joule told him that he wished to demonstrate that at a waterfall there was a rise in temperature due to the work done on the water itself.

It is in this way that the scientist sees the birth of the prime mover. To-day the knowledge of the internal mechanism of gases is fairly complete, the nature of heat is known and Carnot's cycle of operations is fully appreciated. All that is necessary to convert heat into work or work into heat is a suitable medium. Steam was the first medium chosen, flame or the heated products of combustion has also been chosen, mercury has been experimented with, and ammonia and sulphur dioxide are used for special purposes. In all cases the medium is in motion and it is the total heat, or total internal energy of the medium which changes during the working cycle.

In the same way as the first steam engine was an atmospheric one, that is, it worked by virtue of atmospheric pressure, so the first 'gas' engines were atmospheric. The Rev. W. Cecil produced the first in 1820; it was "an engine which is moved by the pressure of the atmosphere upon a vacuum caused by explosions". Later, Samuel Brown made engines for commercial purposes in which there was produced a partial vacuum by flame with subsequent extinction of the flame by a jet of water. It is of interest to note that Brown applied his engine to pump water, to propel a carriage and to propel a small paddle boat. There was, however, no internal combustion engine in the modern sense until some years after Joule (1843) had made his famous experiments. It was then apparent that the energy of chemical decomposition and combustion which takes place on an explosion could be converted into work, and that a definite relationship existed between the chemical energy and the work it was possible to produce.

The story I have told will, I know, appear far too simple to many to explain why the industrial revolution started when it did, and not a thousand years before. It may be that the engineer with that wonderful intuition of which we are all aware would have developed the steam engine without any knowledge of the properties of gases and with no knowledge of what heat is and what happens when chemical combination takes place. But the progress would have been very slow and,

I fear, the efficiency of the engines would have been low. There is little doubt that the early engineers sought scientific knowledge on gases and utilised it in their designs, and there is even less doubt that in modern designs the thermodynamical expert and the designer are either the one and same person or are in intimate contact. In that great engineer, Sir Charles Parsons, we had the combination of the two. The defects of the steam reciprocating engine were clear to him, and he applied all his inventive genius to bring his turbine nearer and nearer to one working in Carnot's cycle than which none can be more efficient. Parsons triumphed because he was not only a great engineer but also a great physicist. He knew thermodynamics better than most physicists of his generation, and the result of beautiful design in closest accord with thermodynamical principles can be seen in the great steam turbines in our electrical generating stations.

Let us consider the effect of the discovery of the prime mover. In the early part of the nineteenth-century Stuart, in his "Anecdotes of the Steam Engine", opened his introduction with the following lines :

"Some years ago the ten thousand steam engines which then were reckoned to be in Great Britain were estimated to perform daily the labour of more than two hundred thousand horses, equal to the power of twelve hundred thousand men expending their energy to the greatest mechanical advantage. But as machines require neither rest nor relaxation and can operate without impairing their power during those portions of time usually assigned for a cessation of animal labour, these ten thousand engines could develop from sunrise to sunrise a power superior to that of four and a half millions of labourers ; an effect greater than the entire manual labour of England."

To-day in factories, industrial undertakings and electricity supply undertakings in Great Britain, steam reciprocating engines and steam turbines develop more than 20 million horse-power, equivalent to 450 millions of Stuart's labouring men. On such a basis every man, woman and child in this country has on an average ten slaves working for him in the factory and supply stations in the form of steam power. This power turns the machines in our factories for producing manufactured goods, operates generators for the supply of electric light, heat and power, sweeps many of our floors, carries us up in lifts, causes great pumps to force water to our cities, and operates numerous other mechanisms, including those for which the steam engine was first invented, namely, pumps for freeing the mines of water. In addition to these 20 millions of steam horse-power, probably another 20 millions are produced on the railways for the transportation of people and goods and we must add to this total the power of internal combustion engines, of which there were none in Stuart's time. To-day the rated horse-power of private motor-cars is above 15 millions, and that for motor lorries is above 12 millions. For motor vehicles alone there is therefore a total of 27 millions rated horse-power.

How many mechanical slaves in all the people of Great Britain have at their command it is very difficult to say. In the United States an estimate has been made that every individual there has an average of 900 of such slaves, and this is on a much more moderate basis than that of Stuart's, the new basis being that 1 horse-power is equivalent to the power of 10 men. In Great Britain we are no doubt more modest in our demands, but it is, I think, obvious to all that the harnessing of coal and oil in the service of man is easily the greatest contribution of the engineer or anyone else to our materialistic progress.

This story of the prime mover is, of course, a totally inadequate account. Many of the men I have talked about are not even classified as engineers, while some of the really great engineers like Boulton, Stephenson, Otto and Daimler have not even been mentioned. I must express my apologies. In excuse, I can but say that the work of these great men is very well known, and that I could not adequately deal with the work of one of them in the course of a single address. I hasten to say that my admiration of the inventive genius of these and others is unbounded and though to-day the solutions of the troubles they overcame may appear to be small, it is as Milton said :

"Th' invention all admired and each how he
To be th' inventor missed ; so easily it seemed
Once found which yet unfound most would have
thought impossible."

As some form of compensation I propose to sound a note of praise about the latest large power station which the engineer has erected. I refer to the Battersea Power Station, which is one of the bright spots in our industrial England, inasmuch as coal is burned and power produced practically without smoke.

In the olden days the engineer burnt his fuel to raise steam, and by pouring out huge volumes of smoke and otherwise polluting the atmosphere, he showed little regard for the feeling of his neighbours. There are many such to-day, indeed far too many ; but the more modern engineer is aware of the harmful effects of atmospheric pollution and is trying to abolish them. Experiments show that this veil of pollution in our atmosphere curtails the ultra-violet light from the sun by as much as 50–75 per cent, and this deprives our bodies of their proper share of sunlight. This air sewage, as it has been aptly called, damages vegetation and destroys our buildings, and it is believed that there is correlation between the sulphur compounds in it and the health of the people.

So if I were now asked where the application of science to engineering has reached its highest stage of development, I should instance the Battersea Power Station. Perhaps I am prejudiced.

I have this evening in a humble way been endeavouring to pay tribute to Rumford and Joule and other great scientists. The Battersea Power Station pays tribute to Faraday in a manner which justifies me in regarding the modern engineer as one who fully appreciates the work of his brother engineer who concerns himself with the minute electrical machines of Nature which the eye cannot even see.

This is a copy of the inscription on the Foundation Stone of the Station :

THE LONDON POWER COMPANY, LIMITED
ON ST. GEORGE'S DAY
IN THE YEAR OF THE CENTENARY OF MICHAEL FARADAY'S
GREAT DISCOVERY
THIS STONE OF COMMEMORATION
UNVEILED AT A MOMENT ABOUT NOON AND BY A
WIRELESS MESSAGE FROM OTTAWA BY
HIS EXCELLENCY THE GOVERNOR-GENERAL OF CANADA
THE RIGHT HONOURABLE THE EARL OF BESSBOROUGH,
G.C.M.G.
A FORMER DIRECTOR OF THE COMPANY
WAS PLACED AS A LANDMARK IN THE DEVELOPMENT OF
LARGER LONDON'S LIGHT AND POWER
AND TO SERVE AS ANOTHER MEMORIAL
OF THE SCIENTIFIC HERITAGE DERIVED
FROM FAMOUS ENGLISHMEN
BATTERSEA POWER STATION 23RD APRIL 1931.

In the engine room, which looks like the nave of a modern cathedral, there are at present two steam turbines with an output of 120,000 kilowatts and soon there will be a third, making a total output of 220,000 kilowatts or nearly 300,000 horse power. When I visited the Station I saw very few engineers and technicians. There was only one in the main engine-room, and he wore a spotless white coat. The 100 tons of coal which the furnaces consume every hour had never once been man-handled from the moment the mechanical grabs lifted 5 tons of it at a time from the ships alongside the wharves, until the time at which the remnants were finally removed as ash. The stoker aisle, as long as an average street, was absolutely deserted. The toiling, half-naked stoker, shovelling coal into white-hot furnaces, has no place at Battersea. Instead I saw one man controlling the six furnaces in action from a desk panel in accordance with instructions from the combustion engineers' office high up in the building. In that office the pressure, temperature and everything it is necessary to know about the steam-generating plant can be obtained from distant recording instruments and recorders by the twist of a knob. In this way, two or three men control the firing and generation of steam raising equipment, each of the six units of which generates a quarter of a million pounds of steam an hour at a pressure of 650 lbs. per square inch. What goes out of the chimneys is steam and not smoke ; it is the steam of the water used in cleaning the smoke in the flues. The gases from the furnaces are driven by fans into washers in which they are sprayed with water so that 20 per cent of the sulphur is removed. They then pass into the scrubbers proper which are arranged in the main flue between the two chimneys where, by the action of moist iron filings, a further 70–75 per cent of the sulphur is removed. Further on, the gases are treated with an alkaline solution and finally passed through moisture eliminators. The wash water used to purify the gases passes away through aerating tanks and filter beds outside the Station for purification before return to the river. With its three great steam turbines the horse power available will be greater than that of the 10,000 steam engines which were reckoned to be in Great Britain at the beginning of last century, a power superior according to Stuart to that of four and a half millions of labourers.

Here, indeed, is a fine example of the engineer's service to man.

*(To be continued.)*

## The Museum of Practical Geology

IN his report for the year 1933*, the Director of the Geological Survey and Museum of Practical Geology has included a short history of the Museum from its inception to the present day. The occasion was appropriate, for at the end of that year the Museum finally closed its door to the public, thereby placing one more milestone on the road of development of a characteristically British institution.

The prime cause of the Museum's foundation was the private geological mapping undertaken by De la Beche in Cornwall and Devon by arrangement with the Board of Ordnance. Four sheets of the Devon 1-in. map, geologically coloured, were published in 1834. In 1835 the Board of Ordnance decided to establish a department to deal with the geological colouring of its maps. It was known as the Ordnance Geological Survey, De la Beche was put in charge, and the Treasury allotted £300 a year for its upkeep. By this time, however, so much material had been collected by De la Beche that he was compelled to ask for suitable housing for it, and in 1837, Woods and Forests provided accommodation in a house in Craig's Court, Charing Cross ; by 1839 the collections were in a fair state of order. In the same year a small laboratory was installed for the analysis of rocks, minerals and soils, with R. Phillips, the curator, as chemist. In 1838, T. Sopwith, with the support of De la Beche, had read a paper before the Newcastle meeting of the British Association, on the need for the conservation of mining records ; this, the Association backed by a resolution which

* Report of the Geological Survey of Great Britain and the Museum of Practical Geology (Summary of Progress) for the Year 1933, Part 1. H.M. Stationery Office. Price 1*s.* 6*d.* net.

resulted in the establishment of the Mining Record Office at Craig's Court.

De la Beche's great conception of an organisation uniting with the Geological Survey, the Museum of Economic Geology (as it was then called), and the Mining Record Office, a School of Mines having teaching equipment to cover, besides mining and metallurgy, all the related sciences required for a knowledge of mineral products and their uses, was impossible of realisation at Craig's Court. Consequently, he agitated for more suitable accommodation and, the time being ripe, he met with rapid success; the new Museum in Jermyn Street was commenced in 1848 and opened by the Prince Consort on May 12, 1851, as the "Museum of Practical Geology, Government School of Mines and Science applied to the Arts".

Within the limitations set by the confined space and the complex functions of the new building, Pennethorne's design must be regarded as successful. Yet from the beginning, its scale was too small for its duties; room had to be found in a small house on the west side of the new building for the Geological Survey staff and Mining Record Office; while on the east side, another house was occupied in part by the metallurgical laboratory.

It was here that De la Beche, 'President' of the new school, with the small but brilliant staff he had assembled, laid the foundations of what are to-day the Imperial College of Science and Technology and the Royal School of Mines at South Kensington. The first professors were, Lyon Playfair (chemistry); Edward Forbes (natural history applied to geology and the arts); T. Hunt (mechanical science, including some physics); J. Percy (metallurgy); Andrew C. Ramsay (geology); Warrington W. Smyth (mining and mineralogy). Hunt was also keeper of mining records, and Trenham Reeks was registrar of the School and curator of the Museum.

In 1853 there was some expansion of the scope of the School and its title became the "Metropolitan School of Science applied to Mining and the Arts"; then in 1859 the courses for the associateship were restricted to mining and metallurgy, with geology, and the title of the School reverted to the original one. In 1863 the School became the Royal School of Mines.

From the commencement, instruction had been given mainly by lectures, though practical work was done in metallurgy, chemistry and geology under restricted conditions. The demand for more laboratory teaching grew, with the result that the Departments of Chemistry, Physics and Biology were transferred to South Kensington, in what is now the Huxley Building; Geology, Metallurgy, Mining and Applied Mechanics followed later, but Percy clung to his old laboratory until 1880.

Besides being used for most of the School lectures, the theatre, capable of seating about six hundred, was employed for a series of evening "Lectures to Working Men". These were delivered mostly by professors of the School, but included also some of the foremost scientific workers of the day. Every effort was made to limit admission to *bona fide* working men, but the lectures became so popular that there was keen competition for tickets from persons of all classes. After the transfer of some of the departments, the public lectures ceased to be given at Jermyn Street, but until the close of the last century, the theatre was in demand for the meetings of scientific societies; its demolition then permitted a much needed expansion for the exhibition and storage of specimens and models.

The duty of the Museum was, in the first place, to be the depository for material collected by the Geological Survey and for its display, along with the geological maps and models; but in order to function as a museum of practical geology, its field had to embrace all useful mineral substances. The exhibits of rocks and fossils were limited to those of the United Kingdom and were arranged in stratigraphical order; the minerals included specimens from all parts of the world and these were arranged in groups according to their bases and topographically, by far the most convenient system for public use. Along with the ores of metals were exhibits illustrating the mode of extraction and metallurgy, with examples of manufactured products.

The rapid growth of industrial application of the sciences soon made it impossible to keep pace with progress in the arts. The metallurgical exhibits ceased to be developed for lack of room, though the fine collection of porcelain and pottery had been allowed to expand to dimensions quite out of proportion to the rest of the scheme. Eventually these technological exhibits were dispersed to other museums, and the Jermyn Street display during the past thirty years has been confined to the practical aspects of geology and mineralogy.

From time to time various proposals had been made for the reorganisation of the Survey and Museum, but no decision was taken until the Museums Commission met in 1927; acting upon the Commission's recommendation, the Government agreed to the transfer to the site in Exhibition Road, proposed by the Bell Committee's Report of 1912, and the new building for the Museum of Practical Geology and offices of the Geological Survey was put in hand and completed by H.M. Office of Works in 1933. This spacious building will afford the long-desired opportunity to arrange an exhibition on modern and more popular lines and with greater facilities for use as an educational instrument. Here De la Beche's ideal will attain its consummation, to the mutual advantage of all the related institutions at South Kensington.

The arduous work of removal and re-arrangement of the collections is in progress, and it is intended to synchronise the centenary celebration of the birth of the Geological Survey with the opening of the new museum in 1935.

## Obituary

### DR. N. L. BRITTON

THE death on June 19 of Dr. Nathaniel Lord Britton, for many years director-in-chief of the New York Botanical Garden, removes one of the most prominent figures in North American botany. Born on January 15, 1859, Britton took the degree of E.M. at Columbia University in 1879, proceeding to Ph.D. in 1881. It will come as a surprise to many who knew his work that the first nine years of his professional career (1879–87) were spent as assistant in geology at Columbia University, and that fourteen of his early papers published during the period 1882–89 dealt with geological subjects. His heart even then, however, was in botany, as is shown by the list of twenty-nine botanical papers covering the period 1878–87. From 1880 until 1890, Britton was botanist and assistant geologist to the New Jersey Geological Survey. His appointment as instructor in botany at Columbia University in 1887, followed by promotion to adjunct professor in 1890 and professor (1891–96), coincided with a great increase in his botanical output.

Among Britton's more important publications during the period 1888–96 was a series of papers on "New or noteworthy North American Phanerogams" and "An Enumeration of the Plants collected by Dr. H. H. Rusby in South America". About the year 1888, Britton became interested in botanical nomenclature, which was then becoming a subject of keen controversy. He was always a rigid adherent of the principle of 'priority of publication' and rejected the arguments based on 'convenience' which eventually led to the acceptance, by successive International Botanical Congresses, of the principle of conservation of well-known generic names. His nomenclatural views led to the publication of numerous name-changes such as those in the "Preliminary Catalogue of Anthophyta and Pteridophyta reported as growing spontaneously within 100 miles of New York City" (1888). These divergences in nomenclatural views between two different groups of botanists in the United States culminated in the rejection, by one of these groups, of the International Rules of Nomenclature (1905) and the formulation of a rival set of rules entitled "American Code of Botanical Nomenclature" (*Bull. Torr. Bot. Club*, 34, 167; 1907). It is now hoped that the changes introduced by means of friendly agreement into the third edition of the International Rules (now in the press) will make them acceptable to the vast majority of botanists. It is pleasant to record that though Britton seems to have retained his nomenclatural views unaltered until the end, he never allowed them to interfere with the cordial relations subsisting between the New York Botanical Garden and other institutions.

The third period of Britton's career was as director-in-chief of the New York Botanical Garden (1896–1929). Among the more important floras prepared by him are the "Illustrated Flora of the Northern United States, etc." (1896–98; second edition, 1913), "Manual of the Flora of the Northern States and Canada" (1901; third edition, 1907), "American Trees" (1908), "Flora of Bermuda" (1918), "Bahama Flora" (1920, with C. F. Millspaugh), and "Botany of Porto Rico and the Virgin Islands" (1923—, with P. Wilson). The lavishly illustrated monograph, "The Cactaceæ" (4 volumes, 1919–23), written in collaboration with the late Dr. J. N. Rose, was one of his most important pieces of taxonomic research. In connexion with the preparation of these works, Britton travelled extensively in the West Indies and elsewhere.

Britton also acted as editor of the *Bulletin of the Torrey Botanical Club* (1888–97) and as joint editor of the "North American Flora" (1905—). The new periodical *Brittonia* (1931—), issued by the New York Botanical Garden, was named in Britton's honour after his retirement from official duties.

On his retirement from Columbia University he was made emeritus professor and, among his many honours, he was elected a foreign member of the Linnean Society of London in 1925.

Dr. Britton lost his wife, Mrs. Elizabeth Gertrude Britton, on February 25 of this year, and her death must have been a great shock to him as they were very devoted to each other. Like her husband, she was a keen botanist and made a special study of the mosses her life work. She was one of the prime movers in organising the Wild Flower Preservation Society of America, and was also one of the principal members of the Torrey Botanical Club which promoted the establishment of the New York Botanical Garden, of which, after its incorporation in 1891, Dr. Britton became director-in-chief in 1896. Her valuable volunteer services in the care of the Moss Collection was recognised in 1912 by her official appointment as honorary curator of the mosses in the herbarium of the New York Botanical Garden.

T. A. SPRAGUE.

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WE regret to announce the following deaths:

Father Giuseppe Gianfranceschi, president of the Pontifical Academy of Sciences and director of the Vatican Broadcasting Station, on July 9, aged fifty-nine years.

Mr. H. O. Larsen, one of the founders of the Experimental and Research Station, Cheshunt, Herts, and a leading horticulturist, on July 3, aged sixty-four years.

Dr. Marion Newbigin, editor of the *Scottish Geographical Magazine* and author of numerous geographical works, on July 20.

Dr. Jakob J. Sederholm, director of the Geological Survey of Finland, on June 27, aged seventy-one years.

## News and Views

### Prof. H. S. Carslaw

PROF. HORATIO SCOTT CARSLAW, whose approaching retirement from the chair of mathematics, pure and applied, at the University of Sydney has just been announced, was appointed to that post some thirty-two years ago. Born in 1870, he is a son of the late Rev. W. H. Carslaw, D.D., of Helensburgh, a well-known writer on the martyrology of the Scottish Reformation and of the Covenants. After graduating at Glasgow, Carslaw proceeded to Cambridge, where, among other distinctions, he gained a Smith's prize and was elected to a fellowship at Emmanuel College. Prof. Carslaw has always taken advantage of the sabbatical years granted periodically by the University of Sydney to renew his connexion with his old college. On the last of these occasions Emmanuel College showed its appreciation of his eminence as a mathematician by re-electing him to a fellowship. The University of Glasgow, in which, before going to Australia, he served for five years as senior lecturer in mathematics, also took this opportunity of conferring on him the honorary degree of LL.D. Prof. Carslaw has been a prolific writer of mathematical papers and textbooks. His "Fourier's Series and Integrals", published in 1906, is regarded as a standard work. In later and amplified editions, this book has been divided, the part dealing with applications to the "Conduction of Heat" appearing as a separate treatise. In 1912 Carslaw published a translation of Bonola's "Non-Euclidean Geometry", and in 1916 he produced a textbook of his own on the same subject. Other writings include "An Introduction to the Infinitesimal Calculus" and a "Plane Trigonometry". To Prof. Carslaw increased leisure means opportunity for further researches ; the fruits of these activities are awaited with interest by his many friends.

### Aberdeen Meeting of the British Association

THE local honorary secretaries for the Aberdeen meeting of the British Association, which will be held on September 5–12, refer in our correspondence columns this week (p. 144) to a rumour that lodging accommodation is difficult to obtain in Aberdeen during the week of the meeting. The explanation of that rumour probably is that in the preliminary programme of the meeting it was intimated (as usual) that members wishing for hotel accommodation might find it more convenient to apply direct to hotels (of which a list was given) than to ask the help of the local committee in finding accommodation. Some members, having unsuccessfully attempted the first course, may have not availed themselves of the second ; if so, they need not hesitate to do this. Of all the duties which the Association imposes upon its voluntary helpers at the place of meeting, that of securing accommodation for visiting members is probably the most onerous, but it is always cheerfully undertaken, to the honour of the locality and to the lasting gratitude of the Association. There is not the slightest reason to fear that Aberdeen will fail to sustain the one, or to merit the other.

### New Arctic Expedition

A BRITISH expedition to Ellesmere Land left London on July 17 in the Norwegian sealer *Signalhorn* under the leadership of Dr. Noel Humphreys. Other members include the organiser, Mr. E. Shackleton, Mr. A. W. Moore, Mr. R. Bentham and Mr. D. Haig-Thomas. A sergeant of the Canadian Police, with wide experience of the Arctic, will also join the expedition. At Disko in Greenland, 70 dogs will be taken on board, and thence the ship will sail to Thule to embark two Eskimo families. It is hoped to pass north along Smith Sound as far as Fort Conger, the site of the Greely expedition of 1882–83 in Lady Franklin Bay at the north end of Kennedy Channel. Ice may prevent this, in which case winter quarters will be set up at Bache Peninsula further south. During the autumn, depots will be laid out as far north as possible in Grant Land, the northern end of Ellesmere Land. The ship will not winter. The main area of exploration will be the little-explored Grant Land of which the coasts are known chiefly from the work of Nares and Peary and a little of the interior from MacMillan's works in 1924. The geological discoveries promise to be of special interest in relation to the probable extension of Caledonian foldings in that area. The expedition hopes to return in the summer of 1935.

### A New American Ascent into the Stratosphere

NEWS has been received through Science Service, Washington, D.C., that arrangements for a new observation balloon ascent into the stratosphere are well advanced. This new attempt is being organised jointly by the National Geographic Society and the U.S. Army Air Corps. The pilot will be Major W. E. Kepner, who holds a long and distinguished record as aeroplane pilot and racing balloonist, whilst the observer will be Capt. A. W. Stevens, who is also an expert in long-range photography. A strong motive for the new flight is the breaking of the altitude record of 50 m.m. (62,000 ft.) held at present by *Stratostat USSR* made last year and the higher-claimed Russian flight of January this year, which ended disastrously. Generally, however, from the nature of the equipment included, which is said to weigh a ton, the aims of the projected flight are to investigate cosmic radiation with particular reference to the Steinke bursts. The instruments include spectrographs, air samplers and special cameras the records of which, if the weather is clear, will give heights by triangulation, wind direction and velocity. Barometers will be checked for height, and the influence of height on radio-transmission will be studied. The lessons of the past have been learnt. To safeguard the crew, a pneumatically controlled hydrogen release valve can be operated from the gondola, and in case of necessity the gondola can be

brought to the ground by parachute. The crew have personal parachutes and exit portholes. The balloon itself is three times as large as any previously built. It will contain 3 million cubic feet of hydrogen which will fill it to one tenth of its capacity on the ground. The flight is intended to be of twelve hours' duration, the take off being from a hollow in Black Hills near Rapid City, S.D., when the wind conditions are from the north-west.

### Museum of Science and Industry at Newcastle-upon-Tyne

A NOTABLE event for Tyneside, and indeed for the north of England generally, was the opening at Newcastle-upon-Tyne on July 20 of the Municipal Museum of Science and Industry. The ceremony was performed by Mr. R. J. Walker, President of the North East Coast Institution of Engineers and Shipbuilders, which has helped the scheme materially. The gift was accepted on behalf of the citizens by the Lord Mayor of Newcastle, Councillor J. Leadbitter. An institution to record and illustrate the many-sided scientific and industrial advances made in this district had long been talked of, but it was the exhibition held at Newcastle in 1929 which gave impetus to the effort which has culminated in the present Museum. It is housed in a building on the Town Moor, formerly part of that exhibition, and refitted for its present purpose by the Town Moor and Parks Committee of the Corporation. The task of collecting and arranging objects has been in the capable hands of Capt. E. W. Swan, acting with the above Committee. The aim of the Museum is to illustrate development, like the Science Museum, South Kensington, and its scope is similar, but restricted. Excellent progress has been made, in shipbuilding and electricity especially, as might be expected, but a great deal is still to be done. However, with the evident enthusiasm, the material available, more adequate funds, and willing helpers, the task should not be too heavy, and we wish the new Museum every success.

### Progress in Materia Medica

IN few provinces is it more difficult to define the direction of progress than in the province of materia medica. To eat your enemy's heart that you may add his courage to your own seems a relapse into a barbarism centuries old. Yet medicine has but recently rediscovered that raw liver or the scrapings of the stomach of the pig have a virtue in remedying deficiencies of those organs in man. In 1820, Paris ascribed "the revolutions and vicissitudes which remedies have undergone" to, among other causes, "Superstition, Credulity, Devotion to Established Routine, the assigning to peculiar substances Properties deduced from Experiments made on Inferior Animals, Ambiguity of Nomenclature, the application and misapplication of Chemical Philosophy". As Mr. C. H. Hampshire pointed out in his chairman's address to the British Pharmaceutical Conference at Leeds on July 17, "drugs are introduced on high authority and supported by expressions of clinical confidence, they flourish for a time and then sink into a position of relative unimportance and finally pass almost completely out of use". There is, nevertheless, a point on the circle which represents the best scientific and medical practice of the day, a point which Mr. Hampshire fairly infers to be represented by the "British Pharmacopœia, 1932", a fact which justifies use of that book as a criterion for determining the extent to which the pharmacopœias of other countries reflect what is best in modern medical and pharmaceutical practice.

### Modern Pharmacopœias

APPLYING the yardstick of the British Pharmacopœia to its contemporaries, he finds the Spanish Pharmacopœia of 1930 one of the most satisfying and instructive of the modern pharmacopœias, although still retaining some aroma of the past by the inclusion of castoreum and musk. The Swiss Pharmacopœia of 1933 is an excellent production pharmaceutically, although omitting modern methods of biological testing, through the absence of a public laboratory for performing these tests in Switzerland, comparable with that of the Pharmaceutical Society in Great Britain. The utility of the Yugoslavian Pharmacopœia, 1934, is limited by its being printed in Slavonian, a difficulty which the Hungarian Pharmacopœia, 1934, overcomes by the use of Latin, the scientific *lingua franca* of two hundred years ago and still current, though in a bastard form, where physicians and pharmacists work together. The language problem is one only of those disclosed by an examination of eight of the most modern of the European pharmacopœias, and the conclusion to which Mr. Hampshire is drawn is that the steps taken by International Conferences in 1902 and 1925 towards the international unification of the formulæ of potent medicaments should be actively followed up, a proposal which the innocent abroad with his prescription will endorse. His further proposal that there should be a permanent body charged with this duty is probably less likely to be welcomed by a generation grown sceptical of the activities of international committees and disinclined to put its hand in its pocket for the maintenance of yet another.

### Future Changes in Medical Practice

IN addressing the graduates in medicine at the graduation ceremonial at the University of Edinburgh on July 18, Prof. A. J. Clark pointed out that to-day the prevention of disease, or its cure at an early stage, is becoming the chief function of the doctor. It is more interesting to try to enable the human machine to work with full efficiency than to patch up human wreckage so that it can just continue to function, but undoubtedly the diagnosis and treatment of slight deviations from the normal present problems of exceptional difficulty. Another point worthy of notice when considering their future careers, is that the demands of the public will be further modified by inevitable changes in the composition of the population. The figures for the birth rates during the last few years show that the average size of the family in the near future will be nearer

two children than three. At first sight, it might appear that this diminution in the number of children will seriously curtail an important section of medical practice—obstetrics and the care of children. But the fewer the children, the more precious will they be, and though childbirth will be less common it will require more skilled assistance, hence these changes will not cause a proportionate decrease in the demands on the medical profession. The steady increase in the number of persons over sixty-five years of age, that has commenced already, is bound to have a very marked effect on medical practice, for the human body, though a marvellous machine, is not immune to the wear and tear of life and hence requires increasing attention in old age. One outstanding change in medical practice in the future is likely to be a rapidly increasing demand for skilled assistance to combat the minor disabilities of old age.

### X-Ray Equipment at the Sheffield Radium Centre

AN event of considerable interest was the opening by H.R.H. the Duchess of York on July 5 of the new Sheffield Radium Centre. It may be mentioned that the Royal Infirmary has been a National Radium Centre for some years. A noteworthy feature of the installation is a new deep X-ray therapy set which has been supplied by the Research Department of the Metropolitan-Vickers Electrical Co., Ltd., and the installation is unique. The equipment comprises two X-ray tubes and the necessary associated apparatus, operating at 200,000 volts. The arrangement is such that it is possible to treat two patients simultaneously, but the apparatus is designed so that this is done with a minimum of complications. The Metropolitan-Vickers Electrical Company's high-voltage X-ray tube for deep therapy treatment has only been rendered possible by the production in the Company's research laboratories of a range of low vapour pressure oils for use as working fluids in condensation pumps, thus enabling the highest vacua to be attained without the use of liquid air or other cooling media. These pumps had already been applied to evacuate dismountable valves, and a considerable amount of experience had been gained on their operation under commercial service conditions. The X-ray tubes possess two great advantages ; these are the ease with which filaments, targets, etc., can be replaced, the costly tube renewals necessary in a sealed-off apparatus being eliminated, and the fact that, once the tube has been conditioned, no great care need be taken in the application of the high voltage.

THE X-ray tube itself is of a robust design, and is continuously rated at 200 kV. D.C., 10 milliamperes. Adequate safety factors are provided ; for example, the external spark-over voltage is about 300 kV., while that for the internal parts is much higher. The target is at earth potential, and it thus becomes possible to cool it with water from the ordinary high-pressure mains ; experimental work has shown that a power of 6 kW. may be dissipated in 1 sq. cm. of a gold target cooled in this way. The whole equipment—X-ray tube, rectifiers and pumps—is completely automatic ; in all cases, the operation of a simple press switch starts a pumping sequence which ends, if the complete vacuum system is in normal operating conditions, with the switching on of the filaments. Vacuum relays are employed to control the electrical circuits in relation to the vacuum conditions, while illuminating diagrams are arranged to show continuously the state of both vacuum and electrical circuits.

### Gift of Handley Page Aeroplane to the Science Museum

THE Handley Page aeroplane *Gugnunc* was presented to the Aeronautical Section of the Science Museum on July 19. On behalf of Lord Londonderry, Sir Christopher Bullock, in presenting the aeroplane, said that this machine marks a very distinct period in aviation, namely, the point at which safety in the air became one of the prime considerations as distinct from speed and carrying capacity. Mr. Handley Page's *Gugnunc* was built to participate in the Daniel Guggenheim International Safe Aircraft Competition held in the United States in 1929. Sir John Siddeley also presented the 150 horse-power Siddeley *Mongoose* air-cooled radial engine which is fitted in the *Gugnunc*. The aeroplane embodies the principle of the Handley Page slot which has been one of the most valuable contributions of British designers towards the security and safety of those who travel by air. The great enemy of the pilot, particularly in large machines, has been the 'stall', that is to say, there is a point at which the machine may be so far tilted backwards that it loses its power of lift and falls, sometimes uncontrollably, towards the earth. The great benefit derived from Mr. Handley Page's slot is that it enables the machine to fly at a much lower speed than normal before this danger point is reached. In fact, even after the machine has stalled, the pilot can retain control, and he does not fall into a dangerous dive or spin, but the machine sinks on a level keel. The slot has been adopted for the very large majority of aircraft used in the Royal Air Force as well as for private and commercial aircraft. In addition, 34 other countries use the device on military and civil aircraft. The designers have not yet exhausted the possibilities of the principle which is embodied in the Handley Page slot, and the technical staff both at the Handley Page works and at the Air Ministry have for a long time been engaged on research into the various possibilities arising out of this principle. The other two full-size machines in the Section are Wilbur Wright's machine, in which the first flights were made, and Alcock and Brown's *Vimy* which flew the Atlantic.

### Water Supplies and the Drought

IN an article on "Water Supplies and the Drought" in the *Quarterly Review* of July, it is stated that the severe drought has found most urban water undertakings in a sound condition, with reasonable provision for emergencies. They should, however, thoroughly review their position in the light of recent experience, though they should be careful to avoid

the wastes of panic expenditure. Complete reserves for very exceptional droughts are unnecessary so long as they are adequate for other emergencies and plans are prepared for surmounting the difficulties of exceptional drought. Long views must be cultivated, since large water schemes take years to carry out. Where neighbouring areas have common interests, needs can best be met and expenditure saved by the formation of regional committees. Since water is so much a matter of local provision, and it is so important for democratic government to avoid excessive centralisation, water authorities must shed their parochialism and work out regional policies which, when dovetailed, will provide a national policy of the best sort, namely one fashioned from the needs of the areas which have to be served. If they do not co-operate in this way, compulsion may have to be applied. For rural supplies, help must be, and has been, provided. But rural consumers must pay their fair proportion towards the cost. If all parties do their share, the back of the rural problem can be broken with the million of money made available by the Government.

### Bacteriological Examination of Water

IN a report recently issued by the Ministry of Health, a routine procedure is described for the bacteriological examination of water supplies (Reports on Public Health and Medical Subjects, No. 71. London : H.M. Stationery Office. 9*d*. net). Hitherto, almost every laboratory has employed its own technique, so that reports by different analysts on the same samples of water may show considerable variation and discrepancies. In a quantitative procedure like water analysis, it is especially important that all workers should employ the same methods, otherwise results, and the interpretation thereof, must vary from one laboratory to another. The procedure described in the present report, drawn up by an influential committee which included the late Sir Alexander Houston, if generally adopted, should go far to ensure more uniformity than formerly. The Committee, while describing in detail the general procedures, allows considerable latitude for the determination of the various indexes of excretal pollution. One of the principal innovations is the substitution of agar for gelatin medium for the count at 20° C., and tables are provided by which the most probable numbers of *B. coli* in 100 ml. may be determined. Standards are suggested, and precise details are given for the taking of samples.

### Finds in the Kharga Oasis

AT the British Museum, exhibits from the Libyan Desert have been arranged at the head of the main staircase, primarily for the International Congress of Anthropological and Ethnological Sciences which is being held on July 30–Aug. 4, but the exhibition will remain open until the autumn. Under the auspices of the Royal Anthropological Institute, the expedition was conducted by Miss Caton-Thompson, the geological work being undertaken by Miss E. W. Gardner. The oasis is an area below the general level of the desert about 120 miles west of Thebes and 400 miles from the Mediterranean ; and the most prolific sites on the floor of the Depression were fossil springs, which forced up sands and clays and formed mounds with the help of vegetation, such as palms and reeds. The mounds contain St. Acheul types of flint implements, with Aterian (Upper Palæolithic) after an interval. There is a general likeness to specimens from Palestine, and typical Levallois artifacts include several plunging flakes. The remarkable gloss, like porcelain, on many hand-axes is here accounted for by the friction of sand-charged water. On the scarp of the Depression Tufa deposits have yielded a number of flint implements ranging from St. Acheul to a phase preceding the Sebilian of the Nile Valley. The deposits include three species of fig, with land and freshwater shells all of living species. The rainfall can be studied from the combined evidence ; and the exhibits include specimens of raw material roughly shaped, a fine series of arrow-heads from the surface, and contemporary beads of ostrich egg-shell. Finally, there is an object-lesson in patination, flints of a single culture showing at least three kinds of surface alteration.

### Panama Earthquake of July 18

THE first movements of a great earthquake were recorded at Kew Observatory on July 18 at 1 h. 48 m. 29 s., G.M.T., the record indicating that the centre was at a distance of about 5,800 miles, probably in the Pacific Ocean off Ecuador. On the same day, a series of severe earthquakes occurred in the isthmus of Panama, one of which was strong enough to cause such damage in Ciudad David, in the extreme west of Panama, that it will have to be almost entirely rebuilt. No serious injury, it is said, occurred in the canal itself. From the first brief accounts, it would seem that the origin may be connected with that of the Colombia earthquake of January 31, 1906 (about 135 miles west of Esmeralda), possibly also with that of the Ecuador earthquake of last October 2 (NATURE, **132**, 779, Nov. 18, 1933), though perhaps to the north or north-west of both.

### National Institute of Agricultural Botany

AT the annual general meeting of fellows of the National Institute of Agricultural Botany at Cambridge on July 19, the chairman of the Council, Sir John Russell, in the course of his address stated that the year 1934 is one of the most important in the history of British agriculture for it is the year in which great schemes of organisation are being attempted. Gluts are good for no one, and it is far better to obtain supplies by definite organisation than by trusting to luck. For successful organisation, the best materials are essential, and the Institute, though not concerned with schemes for the organisation of marketing, is concerned with technical problems connected with improvement of agriculture. Its activities cover three broad fields. It helps the farmer by advising him as to the best varieties : it helps the scientific worker by telling him whether a new variety is worth marketing : and it helps the

seed trade by forming a link between the genetical laboratory and the industry. The Institute is marketing this autumn a new oat, Resistance, which has yielded 32 per cent more than Grey Winter in the Institute's 1931–2 and 1932–3 trials; but this new variety requires clean, rich soil, and early autumn or February sowing in situations which are not too exposed, if its high yielding capacity is to be fully exercised. Sugar beet is another crop on which the Institute has done valuable work. The average yield for Britain is about 8 tons per acre. Many farmers, however, obtain 12–15 tons per acre. From this, it is apparent that the average yield can be, and will be, considerably increased if farmers grow the right strain.

### Beit Fellowships for Scientific Research

THE following Beit Fellowships for Scientific Research at the Imperial College of Science and Technology, during the Academic Year 1934–35, have been awarded: New Fellowships for one year, renewable for a second year, to Mr. H. I. Stonehill, of East London College, for research into the applicability of the modern theories of strong electrolytes due to Debye, La Mer, Bjerrum, Davies, etc., the experimental work taking the form of measurement of the E.M.F. of certain cells, under Prof. J. C. Philip; Mr. J. R. Tillman, of the Imperial College, for research on electron diffraction, both from the point of view of studying crystal forms and the mechanism of diffraction, under Prof. G. P. Thomson; Mr. J. Bell, of the Imperial College, 1927–34, for a spectrographic investigation of hydrocarbon combustion, under Prof. W. A. Bone. Extensions of fellowships already satisfactorily held for one year have been awarded to Dr. K. Bailey, for research on seed mucocellulose and its relation to the chemistry and hydration of the plant cell wall; Mr. M. Blackman, for research in mathematics on the several different properties of crystal lattices with particular reference to the specific heat; and Mr. S. F. Boys, for research in chemistry and particularly a review of the theoretical work on optical rotatory power.

### Beit Memorial Fellowships for Medical Research

IN announcing the awards made this year of Beit Memorial Fellowships for Medical Research, the trustees state that they were influenced by a special desire to promote research in relation to mental disease. The following elections were made, the subject and place of the proposed investigation being indicated after the name: *Fourth Year Fellowships* (£500 per annum): Mr. R. Hill, to continue his research on the properties of hæmoglobin and cytochrome (Dunn Institute of Biochemistry and Molteno Institute, Cambridge); Dr. L. H. Stickland, to continue work on the metabolism of the strictly anærobic bacteria of the genus *Clostridium* (Dunn Institute of Biochemistry, University of Cambridge). *Junior Fellowships* (£400 per annum): Dr. S. Zuckerman, experimental study in animals of the neurovascular control of reproductive functions (Department of Human Anatomy, University of Oxford); Mr. H. W. Fullerton, etiology and treatment of hypochromic anæmia of women of the poor classes (Department of Medicine, University of Aberdeen, and Rowatt Research Institute, Aberdeen); Mr. E. M. Lourie, chemotherapy in protozoal disease (Liverpool School of Tropical Medicine); Mr. J. S. Mitchell, effects of radiation on thin protein films (Laboratory of Colloid Sciences, University of Cambridge); Dr. D. E. Green, effect of hormones and vitamins upon metabolism of individual organs (Institute of Biochemistry, University of Cambridge); Dr. G. A. Grant, metabolism of galactose and the physiological synthesis of lactose by the active mammary gland (Lister Institute of Preventive Medicine, London); Mr. S. L. Cowan, to continue study of the chemical exchanges occurring in crustacean nerve, as a result of stimulation and oxygen want; to study the blood flow through the kidney during diuresis (Pharmacology Laboratories, University of Cambridge); Dr. M. Jowett, metabolism of the central nervous system with reference to the effects of narcotic and basic amines in cases of mental disorder (Biochemical Laboratory, Cardiff City Mental Hospital).

### Thunderstorms and Lightning

PROF. B. F. J. SCHONLAND, of the University of Cape Town, has recently given an interesting account of recent advances in our knowledge of thunderstorms (Science Service of June 19). The first noticeable point is that the quantity of electricity stored up in the average thunderstorm is surprisingly small. It is only about twenty coulombs, that is, the quantity of electricity that flows through an electric glow lamp in a minute. The thundercloud generates this quantity in five seconds, and after maintaining it at this value for some time it is forced to let it disappear as a lightning flash at a pressure of about 5,000 million volts. It is this enormous pressure that makes the discharge so spectacular and so dangerous. The thundercloud machine is continuously generating electricity at this high pressure. The author estimates that a single cloud can develop three million kilowatts of power. The motive power behind this great electrical machine is the wind, which blows up from below the cloud with tremendous force, like a gale up a chimney. It is this upward current of air which supports the cloud which may contain 300,000 tons of water, and sometimes hailstones of considerable size are suspended by it. The photographs taken of flashes in South Africa by slow-speed photography show that at first a little tongue of light stretches earthwards about 50 yards from the cloud. The light then pauses and fades out for the ten thousandth part of a second. It then reappears and stretches another 50 yards and so on until the ground is reached. Branching tongues may come from it, but the instant the leader touches the ground the main part of the stroke begins. A brilliant flame sweeps upward from the ground towards the cloud retracing the path blazed by the leader. This second stroke is much quicker, lasting only about fifty millionths of a second. The full explanation of the mechanism of this phenomenon is not yet understood.

### B.D.H. Medical Products

AMONG the pamphlets recently received from the British Drug Houses, Ltd., London, N.1, is a series describing their vitamin products, Radiostol, Radiostoleum and Radio-Malt. It is pointed out that the proof that pure vitamin D (calciferol) cures human rickets has recently been furnished by the work of J. C. Spence (*Lancet*, 911, Oct. 21, 1933). This investigation forms the concluding chapter of the series, which began with the discovery of vitamin D, and includes the discovery of the effect of ultra-violet light upon ergosterol and the final isolation of the vitamin in the pure state. Another compound which has recently found a use in clinical medicine is glycine or amino-acetic acid. It is employed in large doses by the mouth in certain diseases of the muscles, since there is evidence of a disturbance of the metabolism of creatine and creatinine in these conditions, and it is now known that creatine plays an important part in muscular contraction in the form of phosphagen or creatine-phosphoric acid. Glycine B.D.H. is a white crystalline substance with a sweetish taste readily soluble in water; up to 30 gm. can be taken daily with safety. In some of these cases greater improvement is observed if ephedrine is also given.

### International Congress on Alcoholism

THE twentieth International Congress on Alcoholism will be held at the Imperial Institute, South Kensington, S.W.7, under the presidency of Lord Astor on July 30–August 3, when the following papers among others will be read: "Licensing Legislation in Europe", by Dr. R. Hercod of Lausanne; "Legislation on Inebriety", by Dr. E. Gabriel of Vienna; "Alcohol Consumption and Specific Male Mortality", by Dr. R. Bandel of Nuremberg; "Alcohol in the Treatment of Disease", by Dr. J. D. Rolleston of London; "Alcohol and Eugenics", by Prof. H. Gachot of Strasbourg; "The Causes and Treatment of Inebriety", by Dr. A. E. Carver of Caldecote Hall; "The Toxicological Aspects of Alcohol and Drug Addiction", by Sir William Willcox of London; and "The Teaching of Hygiene in Schools", by Sir George Newman. The Congress will be attended by representatives of the following Governments: Austria, Denmark, Finland, France, Mexico, Poland, U.S.S.R., and Switzerland. Membership tickets, price 10*s*., can be obtained from the Secretariat, Room H, Imperial Institute, South Kensington.

### Announcements

MR. W. F. HILTON has been awarded the Armourers and Brasiers' Company's research fellowship in aeronautics. Mr. Hilton will carry out his research work at the Imperial College of Science and Technology, London.

IT is announced that the library of the Geological Survey will be closed on July 23 during transfer to the new Museum at South Kensington. It is expected that it will not be reopened for two months. During the interim, members of the public who wish to consult the published Geological Survey maps and memoirs may do so at the Library of the Geological Society, Burlington House, Piccadilly, W.1.

AT the invitation of the Council of the Pharmaceutical Society of Northern Ireland, the British Pharmaceutical Conference will be held in 1935 in Belfast. The following officers have been elected: *Chairman*, Dr. F. W. Crossley-Holland; *Treasurer*, Mr. T. E. Lescher; *General Secretaries*, Mr. C. E. Corfield and Mr. G. R. Boyes.

A SCIENTIFIC society for the study of anæsthesia was founded last month in Paris on the initiative of Dr. Robert Monod. The society, the number of whose members will be limited to 100, has already admitted 6 chemists, 6 physicians, 30 surgeons, 6 otorhinolaryngologists, 5 physiologists, 2 neurologists, 2 obstetricians, 2 stomatologists and 1 physicist from France, Belgium, Italy and Switzerland.

AT a meeting of the Indian Association for the Cultivation of Science held in Calcutta on June 19, Sir Nitratan Sircar, consulting physician, and formerly vice-chancellor of the University of Calcutta, was elected president in place of Sir C. V. Raman, and a new committee of management was appointed. At the same meeting, Mr. J. N. Basu, Dr. Birbal Sahani, Dr. Ganesh Prashad, Dr. Bimala C. Law and Dr. J. N. Mukerji were elected vice-presidents; and Dr. S. K. Mitra was appointed secretary in place of Dr. K. S. Krishnan.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mechanical engineering at the Municipal Technical College, Hull—The Director of Education, Education Offices, Guildhall, Hull (Aug. 1). A lecturer in applied mathematics at the United College, University of St. Andrews—The Secretary (Aug. 1). Two chemists at the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Central Office, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (Aug. 4). A headmaster of Middle Street Central Technical School, Newcastle-upon-Tyne—The Director of Education, Education Office, Northumberland Road, Newcastle-upon-Tyne (Aug. 4). A lecturer in physics at the Norwich Technical College—The Principal, Norwich Technical College, St. George Street, Norwich (Aug. 4). A principal of the Carlisle Technical School—The Director of Education, Education Offices, 19, Fisher Street, Carlisle (Aug. 8). An aircraft inspector in the Civil Aviation Directorate of the Government of India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Aug. 11). An assistant organiser of agricultural education for West Suffolk—The Chief Agricultural Officer, West Suffolk, Shire Hall, Bury St. Edmunds (Aug. 11). A reader in industrial hygiene and medicine in the University of Birmingham—The Secretary (Sept. 1). An assistant lecturer in biochemistry in the University of Birmingham—The Secretary (Sept. 1). A temporary demonstrator in botany in the University of Leeds—The Registrar (Sept. 17).

## 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.*]

### Structure of the Azide Group

IN the account in NATURE of May 26, p. 802, of the recent discussion on dipole moments held at Oxford by the Faraday Society, reference is made to the probable linearity of the arrangement of the nitrogen atoms in the azide group. An X-ray examination of cyanuric triazide made by Miss Knaggs in the Davy Faraday Laboratory shows that this hypothesis is correct. I gave a short account of her work in a lecture at the Royal Institution at the end of last year. The arrangement bears a curious resemblance to the arms of the Isle of Man, a row of three nitrogen atoms lying in the position of each leg from knee to ankle.

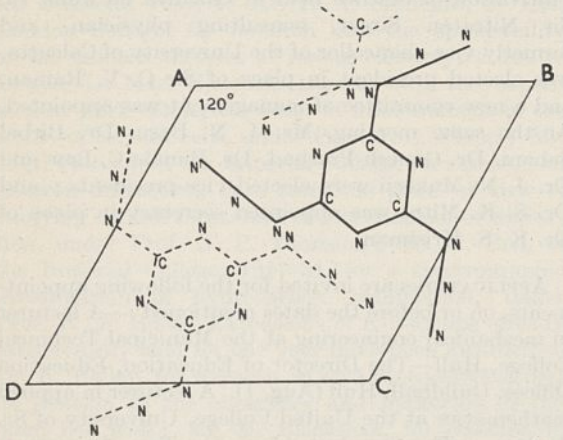


FIG. 1. Crystal cell of cyanuric triazide. AB=CD=8·73 A. Broken lines represent molecules separated from that represented by continuous lines by 2·98 A. parallel to the hexagonal axis of the cell.

Miss Knaggs has now nearly completed a Fourier analysis of the electron distribution in the molecule, which confirms her preliminary determination of the structure. It is a 'layer structure' and resembles that of graphite, but the arrangement in the layers is very different. The molecules are distinct and planar. The layers are closer together than in graphite, being only 2·98 A. apart as against 3·41 A. in graphite. The structure is interesting because it furnishes the data of distances between nitrogen atoms, and between nitrogen and carbon atoms, both in the same molecule and in neighbouring molecules.

Cyanuric triazide is highly explosive, which fact may be connected with its high density, 1·71, which is unusually high for an organic compound.

Fig. 1 shows the size of the cell, which is hexagonal, and the arrangement of the molecules belonging to it. The completed Fourier analysis will give the exact positions of the atoms.

W. H. BRAGG.

Royal Institution,
London, W.1.
July 3.

### Orientation of Molecules in the *p*-Benzoquinone Crystal by X-Ray Analysis

K. S. KRISHNAN and S. Banerjee[1] have recently deduced the orientation of the molecular planes in this crystal by a study of the magnetic susceptibilities. The structure is an interesting one because they find that the plane of the benzene ring is almost coincident with the $(20\bar{1})$ plane of the crystal.

Cases of this kind in which all the atoms of an organic compound are coincident or nearly coincident with a simple crystallographic plane are unfortunately very rare, so it is worth while to inquire to what extent this relationship is an exact one. The magnetic results indicate that the plane of the molecule is inclined about 3° from the $(20\bar{1})$ towards the *c* axis.

A quantitative X-ray investigation of this structure has now been carried out, and the results are in agreement with the magnetic measurements, but go further, in that the complete orientation of the molecules can be determined, as well as the inclination of their planes. The results show that the small departure of the molecular planes from coincidence with the $(20\bar{1})$ is quite definite, and also that they are inclined in such a way that the planes of adjacent molecules are not quite parallel. Thus the measured values of $F$ for the first three orders of the $(20\bar{1})$ reflection are 51, 24, and 5·5, as compared with calculated maxima of about 60, 29, and 14, which would apply if all the atoms were in phase. The large falling off in the case of the third order can best be explained by some departure of the atoms from exact coincidence with this plane. Further, any structure placing the atoms strictly in the $(20\bar{1})$ plane would give the orders of the (200) reflection the same geometrical structure factors as the orders of the (001), whereas there are actually considerable differences.

The crystal is monoclinic, $a=7\cdot03$, $b=6\cdot79$, $c=5\cdot77$ A., $\beta=101\cdot0°$, space group $P2_1/a$, with two centrosymmetric molecules per unit cell. Assuming a planar model with the oxygen atoms at 1·2 A. from the benzene carbon, the following orientation is found to give a reasonable quantitative explanation of the intensities of more than seventy reflections which have been measured. The line joining the two oxygen atoms in the molecule makes 79° with the *a* axis of the crystal, 37·5° with the *b* axis, and 54·5° with the normal to the (001). The line at right angles to this, also in the plane of the molecule, makes 70°, 127°, and 44° with these crystal directions. As the dimensions and scattering power of the two oxygen atoms in the molecule are somewhat uncertain, it would be unsafe to estimate the possible error in these figures at less than 3° or 4° at present. But it seems quite certain that the molecular planes depart from parallelism with the $(20\bar{1})$ by between 3° and 7°.

Starting from the above approximation, the experimental measurements are now being subjected to a Fourier analysis by which it is hoped to obtain more precise information regarding the structure of the molecule.

J. MONTEATH ROBERTSON.

Davy Faraday Laboratory,
Royal Institution,
London, W.1.
June 22.

[1] NATURE, 131, 653, May 6, 1933.

## Supraconductivity and the Hall Effect

IN connexion with the recent discovery of several new supraconductors[1], a re-investigation of zinc was undertaken, in development of the previous work of this laboratory[2]. In polycrystalline zinc, the $R\sigma$ value is so big that the recent discovery of supraconductivity in this metal should be considered as an exception to our previously established rule. But zinc crystallises in the hexagonal system and possesses a very definite anisotropy of physical properties. For this reason we decided to investigate monocrystalline zinc. Two kinds of plates of it were prepared: in one, the main axis lies in the plane of the plate, the primary current being parallel to the direction of the axis; in the other, the plane of the plate is perpendicular to the main axis. For both orientations the Hall coefficients have been determined, the corresponding conductivities parallel to ($\sigma_1$) and perpendicular to ($\sigma_2$) the axis, being taken from the tables. We obtained the following results:

$$|R\sigma|_1 = 14$$
$$|R\sigma|_2 = 300.$$

Thus it is seen that the violation of our rule in this case is only an apparent one. *Zinc seems to belong to the group of supraconductors in one particular crystallographic direction only*, and it supports strongly our rule.

It should be very important to determine the supraconductivity phenomena in different crystallographic directions. From the experimental point of view, such an investigation is, however, likely to meet very considerable difficulties, especially concerning the interpretation of the experimental results thus obtained.

B. LASAREW.

Physical Technical Institute
of the Ural,
Sosnovka 2, Leningrad, 21.
June 4.

[1] W. Meissner, *Z. Phys.*, **87**, 206; 1933—Supraconductivity of vanadium. W. H. Keesom, *Proc. Amsterdam*, **36**, 381; 1933—Supraconductivity of aluminium. W. H. Keesom, *Physica*, **1**, 123; 1934—Supraconductivity of zinc.
[2] Kikoin and Lasarew, NATURE, **129**, 57, Jan. 9, 1932. *Phys. Z. Sowjetunion*, **3**, 351; 1933. Dorfman, *Metallwirtschaft*, **12**, 221; 1933. Lasarew, *Phys. Z. Sowjetunion*, **4**, 567; 1933.

## Nature of a Magnetic Field

IN a paper read before Section A of the British Association last year, I gave some account of experiments made by Dr. Norgrove and myself on cylindrical magnets and solenoids spinning about their axes. These experiments forced us towards the conclusion that even in the strongest permanent magnet there was no evidence of any attachment between the metal and the system of tubes of induction to which it is supposed to give rise. All our tests then and since have only confirmed Faraday's words as to the "singular independence of the magnetism and the bar in which it resides".

It has occurred to me recently that, apart altogether from the tests referred to above, accepted theory also supports our view as to the stationary magnetic flux. Zeleny and Page[1] have shown that no current circuit, even if it passes in part through the magnet, can exert a torque about the axis of symmetry of a symmetrically magnetised cylinder. This is entirely in accord with our experiments. It follows that the torque exerted on the magnet by the current can only be due to the interaction between the field and current within the magnet. If this be admitted, the question as to whether the tubes of induction are attached to the metal of the magnet is at once settled. Consider a horizontal section of a vertical cylindrical magnet through which the flux of induction $\varphi$ is upwards. If now current $i$ pass radially inwards at the equator, the torque is $i\varphi/2\pi$, and the magnet tends to turn in the positive direction viewed from above. To produce this couple, if one of the components $i$ or $\varphi$ is assumed to be attached to the particles of the magnet, the other must be independent thereof. But the direction of the twist shows us which is which. For if the tubes of induction were attached to the molecules of the metal, while the current sheet remained independent and stationary, the motion of the magnet would be in a direction *opposite to that which is found by experiment to exist*. The conclusion, therefore, is unavoidable that the magnetic field is the independent and stationary quantity, the drag on the metal being due to the deflection of the moving electrons forming the current which must in their turn, either by collisions or by attractions, act upon the atoms of the metal.

Two further results follow. First, if a current is led into and away from a rotating bar of metal of any kind, more power will be needed to cause the rotation when the current is flowing than when it is switched off. Second, in an electric circuit made up of stationary conductors and a spinning magnet, the generation of the E.M.F. takes place in the magnet itself, and not in the stationary conductors.

WILLIAM CRAMP.

The University,
Edgbaston, Birmingham, 15.
July 5.

[1] *Phys. Rev.*, Ser. 2, **24**, 544.

## Measurement of Ultra-Violet Light

IN measuring the amount of ultra-violet light reaching the earth from sun and sky, it is customary to expose the acetone methylene blue tube in the vertical position. Since more ultra-violet light is received from the sun itself than from the whole of the rest of the sky put together, the vertical position seems unsuitable, for the amount of ultra-violet light received by the contents of the tube will be too low during the time of day and year when the sun is most nearly overhead. The horizontal position has occasionally been used, but this is open to the opposite criticism.

The Oxford University Expedition has recently been measuring the ultra-violet light in the New Hebrides, in the tropical Pacific. If we had used the vertical position for the tube, then, on the two days of the year on which the sun passed directly overhead, the tube would have received practically no ultra-violet light from the sun at the very time (midday) when the irradiation was likely to be at its greatest. We therefore always exposed both the quartz tube and the control glass tube on a simple wooden stand (Fig. 1) kindly made for us by my brother, Mr. S. J. Baker. This stand was set up so that the ends of the tubes always pointed north and south, and their inclination was changed each month so that the rays of the sun always fell approximately at right angles upon them. (Weekly changes could

easily be made, if it were thought advisable.) The movable part of the frame is marked with the names of the months, and each month it is turned slightly on its axis so as to bring the name of the new month opposite a mark on the stationary part of the frame. Fig. 1 shows the instrument inclined for the month of October in latitude 15° S., the north being to the right of the picture. The shadows show that the rays of the sun are striking the tubes approximately at right angles. It is, of course, necessary to mark the names of the months on the instrument according to the latitude in which it is to be used.

It is easy to show the importance of a correct exposure of the tubes by exposing a second pair in the vertical position at the same time.

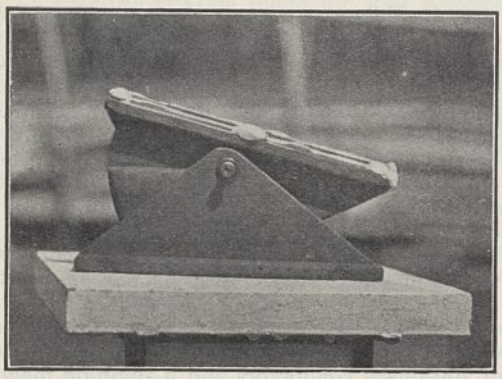

FIG. 1. Frame for exposing acetone methylene blue tubes.

My brother suggests the following alternative to my method of exposure. The tubes could always be exposed parallel to the axis of the earth, and a correction applied to the resulting figures to compensate for the varying obliquity of the rays during the different months of the year. Another plan would be to use spherical instead of tubular containers for the acetone methylene blue.

The expedition to the New Hebrides was supported by the University of Oxford, the Royal Society, the Royal Geographical Society and the Percy Sladen Trust. Ultra-violet light observations are still being made in the New Hebrides by members of the expedition. All the meteorological results will be published in full when a year is complete.

University Museum, Oxford.
June 15.

JOHN R. BAKER.

## New Features of the Nitrogen Afterglow

A STUDY has been made of the nitrogen afterglow formed by passing nitrogen containing 0·25 per cent of oxygen through an uncondensed discharge produced by a 25,000-volt transformer.

For the same type of discharge tube at 0° C. the relations for velocity, pressure, and voltage are quite similar to those found for hydrogen afterglow by Van Cleave and Grubb[1]. When the critical voltage is reached, a greenish yellow glow appears in great intensity. At certain adjustments of pressure, velocity, and voltage, the afterglow shows many of the colours of the aurora. These colours are all visible at the same time, but at different distances from the discharge, the blue being the farthest removed. If the discharge tube is immersed in a bath at 30° C., the glow disappears, but if the temperature is lowered to −20° C., the glow is intensified.

The spectrum in the visible consists of first positive, second positive, first negative and nitric oxide bands. A line appears at λ5577 which confirms the observation by J. Kaplan[2]. The plate also shows a first negative band at λ4780 which is not reported by T. R. Merton and J. G. Pilley[3]. This band appears to be λ4779 observed in the aurora by Vegard[4]. Other bands of the first negative system are superimposed upon the β bands, which results in a different order of intensity than reported by Johnson and Jenkens[5]. The band λ4059 of the second positive system is also quite intense.

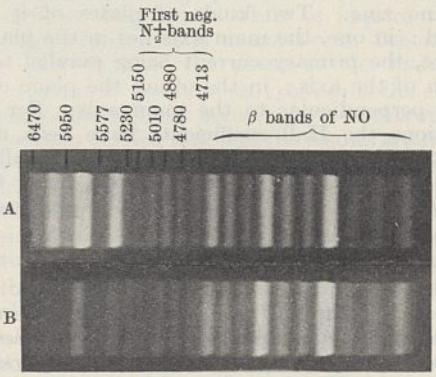


FIG. 1. A: Nitrogen afterglow; primary 50 volts, pressure 10 mm., flow 4 litres/hour. B: Afterglow in nitrogen with 0·01–0·05 per cent sulphur dioxide; primary 50 volts, 110 watts, 2·4 amp.; 4 litres/hour; eight hours.

The upper spectrogram of Fig. 1 shows the bands of the afterglow taken under conditions such that the afterglow showed traces of green and blue. The lower spectrogram shows the bands of the afterglow with 0·05 per cent of sulphur dioxide added to the nitrogen before passing the gas through the discharge. The alpha and the first negative bands are considerably quenched while the beta bands are enhanced.

If the nitrogen is bubbled through concentrated sulphuric acid before passing through the discharge, the yellow afterglow is replaced by a blue glow. The blue glow shows a few of the prominent beta bands in the violet and a continuous spectrum in the blue. This is a very striking proof that bubbling a gas through concentrated sulphuric acid contaminates the gas with oxides of sulphur.

Details of this work will appear in a subsequent publication.

H. A. JONES.
A. C. GRUBB.

Chemistry Department,
University, Saskatchewan.

[1] NATURE, **132**, 1001, Dec. 30, 1933.
[2] *Phys. Rev.*, **33**, 154; 1929.
[3] *Phil. Mag.*, **50**, 195; 1925.
[4] *Phil. Mag.*, **46**, 198; 1923.
[5] *Phil. Mag.*, **2**, 621; 1926.

## Production and Planning

To the now rapidly growing number of students of monetary reform, the leading article of July 7 will appear to be profoundly unscientific.

The abundance which is at present being produced below cost, and the outstripping of demand by production of the primary commodities, are viewed as phenomena not of over-production, but of under-consumption.

Real wealth is a matter of goods and services—

money is but a token for real wealth—a convenient method of representing its exchangeable value. These tokens cost practically nothing to produce; their value depends on the goods the exchangeable value of which they represent. Means of producing real wealth have enormously increased. There has been no corresponding method evolved by orthodox finance of insuring that, as production increases, the tokens for goods shall also increase in a like proportion.

Hence the entirely unscientific procedure of *reducing* the production of real wealth (in primary commodities) in order to balance an artificially restricted purchasing power due to a deficiency of tokens, and the tragic blunder of burning wheat in one country while millions are starving in another, and shipping personnel (who would gladly carry the wheat where it is wanted) are unemployed.

What is needed is surely not "salesmanship", or "to stimulate export trade between nations" (the world export trade is but an insignificant item in comparison with national trades) but a better understanding of the nature and function of money, and a scientific method of the issue of money in accordance with the ability of the community to produce *all* the goods which they would be glad to consume, plus a surplus which can be exchanged (directly or indirectly) for such raw materials or specialised products as they require, but cannot produce.

In Great Britain we could easily double our present rate of goods production, and double our consumption, so as to raise the standard of material well-being of our community; we could also feed ourselves.

The present monetary system would, however, have to be altered so that purchasing power equivalent to increased producing power was given to the community.

R. A. S. PAGET.

1, Devonshire Terrace,
Lancaster Gate, W.2.
July 9.

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WE could not possibly find space in our correspondence columns for a discussion of monetary systems; but we may say at once that we find ourselves quite unable to agree with Sir Richard Paget that planning is unscientific. Admittedly a great responsibility rests on the planners, but there is no practicable alternative at the moment to planning. In the present temper of the world, national needs have to be served first, but we must see to it also—and here science can help—that the planning is eventually international. So long as proper prices are obtained for the goods produced in Great Britain it is possible to pay satisfactory wages, salaries and dividends and so to enhance the spending power of everyone. When the goods manufactured are sold at or below the cost of production, as the result of competitive overproduction, wages and salaries are depressed to a minimum, dividends disappear, and the purchasing power of the nation sinks to mere sustenance level. We fail to understand how the production of goods below cost is the equivalent of real wealth; surely it has the contrary effect. No juggling with monetary systems will obviate this state of affairs; indeed, where the experiment has so far been tried it has not been exactly attended with success.

THE WRITER OF THE ARTICLE.

## Electrical Conductivity of Salts in Anhydrous Hydrogen Cyanide

AN accurate determination of the conductivity of salts in anhydrous hydrogen cyanide is of considerable interest in view of the high dielectric constant of this solvent. Indications of high values for the equivalent conductance were obtained by Centnerszwer[1], Kahlenberg and Schlundt[2], and, more recently, by Fredenhagen and Dahmlos[3]. These investigators confined their measurements to relatively concentrated solutions, and came to the conclusion that hydrogen cyanide is but a poor dissociating solvent in spite of its high dielectric constant (119 at 18° C.)[3].

We have undertaken a systematic investigation of this subject, and have first determined the conductivities of a considerable number of uni-univalent salts in the concentration range 0·0001–0·005 *N*, since it is in this range that the Debye-Hückel-Onsager equation may be tested. The preliminary measurements have been made among the chlorides, bromides, iodides, nitrates, perchlorates, thiocyanates, and picrates of lithium, sodium, potassium, ammonium, tetramethyl ammonium, and tetraethyl ammonium.

The results may be briefly summarised as follows:

Most of the salts obey the Kohlrausch empirical relation $\Lambda_c = \Lambda_0 - x\sqrt{c}$ over the whole concentration range investigated, and the values of $x$ found are in fair agreement with those calculated by means of the Debye-Hückel-Onsager equation.

It appears that for the alkali metal ions there is an increasing tendency to ionic association in the order $K^{\cdot} < Na^{\cdot} < Li^{\cdot}$, which is the reverse order to that in water, although, as in water and the other hydroxylic solvents, both the chlorides and nitrates of these metals show association more than the other salts.

The $\Lambda_0$ values have been obtained by extrapolation of the straight line portions of the $\Lambda_c/\sqrt{c}$ plots. The values are about three times as great as those in water; for example, potassium chloride in water at 18° gives $\Lambda_0 = 129{\cdot}8$, whilst the value in hydrogen cyanide is 363·0. The $\Lambda_0$ values are in agreement with the 'law of independent mobilities of ions', and thus support the conclusion that all the salts are almost completely dissociated at the dilutions employed:

| | $Br'$ | $I'$ | $NO_3'$ |
|---|---|---|---|
| $K^{\cdot}$ | 363·4 | 364·2 | 353·5 |
| $Na^{\cdot}$ | 344·0 | 344·3 | 333·7 |
| $l_{K^{\cdot}} - l_{Na^{\cdot}}$ | 19·4 | 19·9 | 19·8 |

As yet, no data are available for the calculation of the absolute mobilities of ions in hydrogen cyanide, but according to the $\Lambda_0$ values we may place the ions in order of increasing mobilities:

Cations: $Na^{\cdot} < Li^{\cdot} < NEt^{\cdot}_4 < K^{\cdot} < (NMe^{\cdot}_4, NH^{\cdot}_4)$
Anions: Picrate $< NO_3' < ClO_4' < CNS' < Cl' < Br' < I'$.

A complete description of the experimental procedure, and a discussion of the results obtained, will be published elsewhere shortly.

J. E. COATES.
E. G. TAYLOR.

Chemistry Department,
University College, Swansea.
June 15.

[1] *Z. Phys. Chem.*, **39**, 220; 1902.
[2] *J. Phys. Chem.*, **6**, 447; 1902.
[3] *Z. anorg. Chem.*, **179**, 77; 1929.

## Concentration of Heavy Water by Spontaneous Evaporation

IT has been stated that deuterium can be concentrated much more efficiently by the spontaneous atmospheric evaporation of water than by boiling[1]. This suggestion is based on an experiment in which Poznań water, by spontaneous evaporation to 1/40 of its volume, gave a residue claimed to contain 1·65 per cent of deuterium. The experiment would appear to be incorrect, however, for even assuming 'semipermeable membrane' separation ($\alpha = \infty$) the proportion of deuterium in Poznań water would, according to this experiment, have the highly improbable value 1/2,500. Of course, the separation coefficient, $\alpha$, cannot be infinity: under ideal conditions it could amount to the isotopic vapour pressure ratio. Taking $\alpha = 1{\cdot}15$ as an outside figure, the deuterium content of Poznań water, according to the reported evaporation experiment, becomes 1/100.

E. D. HUGHES.
C. K. INGOLD.
C. L. WILSON.

University College,
London.
July 13.

[1] T. Tucholski, NATURE, **134**, 29, July 7, 1934.

## Constitution of Vasicine

SPÄTH and Nikawitz[1] have investigated the behaviour of a base, $C_{11}H_{12}ON_2$, termed peganine, which the firm of E. Merck (Darmstadt) isolated from the mother liquors of the alkaloids of *Peganum harmala*. A little later, Späth and Kuffner[2] found that peganine is identical with the base vasicine isolated from *Adhatoda vasica*, Nees, by Sen and Ghose[3] and more recently studied by Ghose, Krishna, Narang and Rây[4]; the name peganine therefore becomes superfluous.

The formulation of vasicine by Späth and Nikawitz as 4-hydroxy-3-allyl-3 : 4-dihydroquinazoline (*A*) did not appear satisfactory to us on the basis of the evidence submitted. This constitution is that of the carbinol base of an alkylquinazolinium salt, and it would be highly surprising if such a substance could, like vasicine, be converted into a volatile chlorodeoxy-base or acetyl derivative. It was scarcely more credible that such a carbinol base would form normal salts *B*, HCl instead of the usual *B*, HCl–$H_2O$, and yet many vasicine salts of the first-cited form have been described. Admittedly these considerations are not infallible guides, and substances do occasionally exhibit totally unexpected properties; fortunately, however, the validity of the Späth–Nikawitz suggestion can be quickly tested experimentally, because the synthesis of (*A*) may be effected without difficulty.

Allyl iodide and quinazoline combine with formation of 3-allylquinazolinium iodide and this salt (or the corresponding chloride), reacting with alkalis in aqueous solution, yields the carbinol base (*A*), which crystallises from benzene in well-formed colourless prisms, m.p. 130° (vasicine, m.p. 208°–210°) (Found: C, 70·4; H, 6·4; N, 14·6. $C_{11}H_{12}ON_2$ requires C, 70·2; H, 6·4; N, 14·9 per cent).

A further description of this and analogous bases will, it is hoped, be published in another place.

It is apparent that vasicine cannot be correctly formulated in accordance with the proposal of Späth and Nikawitz. Of the alternative formulæ rejected by these authors in the course of their discussion, that numbered VI (*loc. cit.*, p. 48) seems to fit the facts best, but it is not wholly satisfactory for several reasons including the optical inactivity of vasicine.

The final sentence of the memoir of Späth and Kuffner is the following: "Über Einzelheiten der Vasicin-Literatur wollen wir gegenwärtig nicht das Wort ergreifen, sondern die weiteren Ergebnisse der indischen Forscher abwarten." May we be allowed to follow this excellent example, bracketing, however, our Austrian with our Indian colleagues.

T. M. REYNOLDS.
R. ROBINSON.

Dyson Perrins Laboratory,
University, Oxford.
June 26.

[1] *Ber.*, **67**, 45; 1934.
[2] *ibid.*, 868.
[3] *Quart. J. Ind. Chem. Soc.*, **1**, 315; 1924.
[4] *J. Chem. Soc.*, 2740; 1932.

## Synthesis of Vitamin C by the Infant

THE presence of vitamin C in human urine has been recently shown both by tests with the Bezssonoff reagent and dichlorphenol-indophenol[1] and also demonstrated by animal experimentation[2]. We designate as U.H. the unit of violet coloration produced in 1 c.c. of water by 1/1,000 mgm. of hydroquinone, in the presence of the Bezssonoff reagent ($MoO_3$) ($WO_3$)$_{17}$($P_2O_5$) ($H_2O$)$_{24}$. A solution of pure vitamin C, *N*/100,000, gives a coloration of 1 U.H. This was verified with samples of ascorbic acid received from Micheel, Szent-Györgyi and Reichstein. We have actually tested, by this reagent, the urine of infants of 2–23 months in age, submitted during 48 hours to a diet deprived of vitamin C. The following are the results (Fig. 1):

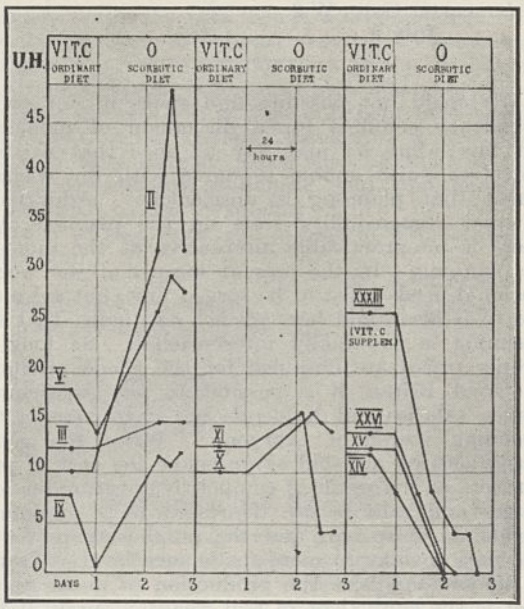


FIG. 1.

The curves indicate the variation of amount of vitamin C in the urine; the age of the infants, in months, is given by Roman numerals.

Like the rat and the bird, the human infant possesses the faculty of producing vitamin C. This faculty, markedly evidenced up to the age of 5 months, is afterwards diminished and disappears in infants of 14 months or above. It should be mentioned that the excretion of vitamin C in the urine often ceases in sick or dystrophic infants.

PAUL ROHMER.
URSULA SANDERS.
N. BEZSSONOFF.

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June 8.

[1] N. Bezssonoff and A. Delire, *C.R. Acad. Sci.*, **197**, 1774; 1933. N. Bezssonoff and H. Van Wien, *C.R. Soc. Biol.*, **115**, 1277; 1934.
[2] M. Van Eekelen, A. Emmerie, B. Josephy and L. Wolf, *Klin. Wochenschr.*, **13**, 564; 1934.

## Isomerism of Sucrose and Iso-Sucrose

ALTHOUGH an adequate constitutional formula for sucrose has been developed, attempts to verify this structure by synthesis have led to no success, the only crystalline product isolated being an isomeric disaccharide termed *iso*-sucrose. Presumably the isomerism resides in the α or β configurations of the glucose and fructose residues present in this disaccharide; and, if so, both sucrose and *iso*-sucrose should behave in parallel fashion when subjected to the methylation process.

We have effected the complete methylation of *iso*-sucrose by the use of liquid ammonia as a solvent in the final stages of the process. The octamethyl *iso*-sucrose thus obtained was converted by hydrolysis into an equimolecular mixture of tetramethyl glucose and tetramethyl γ-fructose. The two sugars were separated by condensation with methyl alcohol under conditions in which the methylated fructose alone reacted and the resulting mixture was then benzoylated. In this way tetramethyl γ-methyl-fructoside and tetramethyl benzoylglucose were formed and were thereafter readily separated. In the one case, debenzoylation gave tetramethyl glucose and, in the other, mild hydrolysis yielded tetramethyl γ-fructose.

The result is conclusive and shows that *iso*-sucrose is a stereoisomeride of sucrose in the sense that it is a gluco-fructose containing a normal glucose residue coupled with a γ-fructose residue. The research is being extended.

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July 7.

## Mechanical Twinning in Bismuth Crystals

SINGLE crystals of bismuth are stated by many authors[1] to exhibit mechanical twinning on the planes of type (110). The twinned part has the form of a thin lamella parallel to the twinning plane. On the (111) cleavages they appear as narrow stripes along which the surface is slightly inclined to the (111) face. These inclined faces are of the $(11\bar{1})$ type. Therefore the atoms which formed the (111) plane before the twinning occurred, form after twinning—at least partially—the $(1\bar{1}1)$ plane.

In compression tests with bismuth crystals made by the Bridgman method, another kind of mechanical twin appeared. The most important features of it are: The change in shape and size of the crystal is much bigger than that due to a (110) twin. The twinned lamella is always comparatively thick, of the order of millimetres. The lamella lies along one of the $(7\bar{5}1)$ planes. If one cleaves a crystal which contains such a twinned lamella the (111) cleavage runs perfectly through the twinned part—of course, in a changed direction. This change in direction differs slightly from one crystal to another, owing to slip in the twinned part, as such twins only occur at comparatively high stresses. From its appearance, one can conclude that the cleavage through the twinned part is the (111) plane of the twinned structure. The atoms of the (111) planes therefore remain atoms of the (111) plane in the twin. Thus one is able to find the position of the twinning plane.

Measurements indicate $(7\bar{5}1)$ as the twinning plane, one individual being the mirror image of the other with respect to this plane. In a hexagonal system of axes, which is sometimes used for bismuth, it is the $(22\bar{4}1)$ second order pyramidal plane. In this notation the usual twinning plane (110) in the rhombohedral system of axes becomes the $(10\bar{1}2)$ first order pyramidal plane.

It is remarkable that a plane of so low atomic density can be the twinning plane. However, a quite simple movement, which consists essentially of slip in the usual plane of slip (111), suffices to explain the formation of the twin.

Rather large specimens of the twins on the (110) planes were observed when a tensile test at higher temperature was applied to a bismuth crystal. I have already pointed out[2] that bismuth crystals slip in tensional tests at room temperature only if they contain gas. At higher temperatures (250° C.), however, even crystals without gas exhibit slip in tensional tests. An 'after elongation thread', such as occurs on zinc[3], of appreciable length was observed which was due to slip in a rather big twinned portion of the crystal. The twinning plane was the (110) plane. No other kind of twins was seen in these tests.

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June 15.

[1] Compare H. T. Gough and H. L. Cox, *J. Met. Inst.*, **48**, 227; 1932.
[2] NATURE, **133**, 831, June 2, 1934.
[3] H. Mark, M. Polanyi and E. Schmid, *Z. Phys.*, **12**, 58; 1922. Also C. H. Mathewson and A. J. Phillips, *Proc. Inst. Met. Div. Amer. Inst. Min. Eng.*, 143; 1927.

## Wasting Disease of Eelgrass (*Zostera marina*)

IN NATURE of December 30, 1933, a letter appeared on the disease of the eelgrass (*Zostera marina*) in Danish waters based on investigations which I made in the summer of 1933. I am now able to give further details concerning this disease. The destruction of the leaves was continued during the winter, but young shoots formed in the early spring were generally without infection. Infection of the leaves reappears at the beginning of the summer.

At the same time also, a fructification, a formation of spores, in the rhizomes is nearly completed. During the winter and the spring the rhizomes are frequently found to be infected with mycelium referred to in my previous letter and now in June I have found, in the northern Kattegat, in the rhizomes *in situ*,

abundant perithecia resembling organs (evidently true perithecia) which produce long spores. The new infection in the leaves is evidently due to these.

So far as I can judge, there has been, and still is, in Danish waters a high maximum of a fungus in the eelgrass and a wasting disease, connected with in several places a nearly total extinction of this plant. It is therefore suggested that the fungus here is the cause of the disease.

The systematic position of the fungus is not yet clear. The spores are long and flexible and in shape similar to the ascospores of *Ophiobolus*, but they do not seem generally to fall into fragments; also the ascus walls are dissolved very early. It may be *Ophiobolus maritimus* Sacc., but if so, this species should be referred to another genus.

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June 23.

## Importance of Carbohydrate Supply in Legume Symbiosis

EXPERIMENTAL evidence, which has been accumulating for a number of years, but especially more recently, emphasises the importance of carbohydrate in nodule development and nitrogen fixation in leguminous plants inoculated with effective bacterial strains. There are, however, certain facts well known to plant physiologists which deserve greater emphasis in this connexion: (*a*) An abundant supply of nitrogen is conducive to top growth while a wide carbohydrate-nitrogen ratio favours root growth. The carbohydrate-nitrogen relations may be altered by changing the conditions for photosynthesis, by varying the nitrogen additions to the culture medium, and by supplying sugars to the roots. (*b*) During active photosynthesis a sugar concentration gradient[1], decreasing downward, commonly exists between the leaves and roots of higher plants. These synthesised sugars usually[2] do not remain long in this form; a considerable portion, 20 per cent or more, is required for respiration, while the remainder is either used for growth or is stored largely as starch.

If these facts, which apply rather generally to higher plants, are borne in mind in connexion with legumes, it is believed that many observations and experimental facts reported in the past in connexion with the nodulation of these plants, may be more satisfactorily explained.

The failure of nodules to develop normally in the presence of an abundance of fixed nitrogen is a good example[3]. In this case, where the carbohydrate-nitrogen ratio is narrow, most of the photosynthetic carbohydrate is used for top growth and only a small percentage reaches the roots. The condition in this case is similar to that existing in plants grown at low light intensities on soils containing only the usual small quantities of soluble nitrogen. In both cases the carbohydrate supply in the roots is so low that only a limited growth occurs. A high carbohydrate concentration is not essential for bacterial entrance into the root, but abundant nodule development takes place only provided the carbohydrate supply is adequate for good root growth. The frequent observation that root and nodule growth are favoured to a remarkable extent by additions of sugar emphasises the importance of this factor.

Nodule location on plants, uniformly inoculated, may also be closely correlated under many conditions with available carbohydrate supply in the root at the time of nodule development. Normally, nodules on annual legumes are located chiefly near the upper parts of the main root system, nearest the source of carbohydrate supply. On the other hand, they are usually widely scattered where the plants are grown either in water cultures, or in a nitrogen-free atmosphere, or in the presence of increased carbon dioxide, and when produced by ineffective strains. In all these cases, carbohydrate is usually abundant almost to the root tips.

The limited data dealing with the energy requirements for the chemical process of nitrogen fixation in the nodule, as distinguished from the respiration and growth requirements of the bacteria and host, can now be interpreted with a greater degree of certainty. These fixation requirements appear to be negligible. The bulk of the carbohydrate is consumed in respiration and growth, chiefly of the host.

The intimate relations existing between the nodule bacteria and their hosts now seem less complicated than formerly supposed. In the past, various theories, involving such ideas as immunity and relative vegetative energy of the symbionts, have been advanced. The newer evidence, together with the old, tends to place much greater emphasis on carbohydrate nutrition, so far as effective bacterial strains are concerned. If the carbohydrate supply is adequate, nodules usually develop and nitrogen fixation roughly parallels the growth of the higher plant; if the supply then becomes deficient, the bacteria sometimes remain dormant, or in other cases may attack the tissues of the host to obtain food, as investigators at Rothamsted have repeatedly pointed out.

This communication summarises several of the more important ideas considered more fully in a manuscript entitled, "Carbohydrate Supply as a Primary Factor in Legume Symbiosis", to be published shortly.

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[1] Mason and Maskell, *Ann. Bot.*, **48**, 119–141; 1934.
[2] Arthur, Guthrie and Newell, *Amer. J. Bot.*, **17**, 416–482; 1930.
[3] Allison and Ludwig, "The Cause of Decreased Nodule Formation on Legumes Supplied with Abundant Combined Nitrogen", *Soil Science*, in Press.

## British Association: Aberdeen Meeting, 1934

HAVING been informed that in some quarters it has been stated that the lodging accommodation available for members at the meeting of the British Association in Aberdeen on September 5–12 next is limited, we hasten to take the earliest opportunity of assuring members who propose coming to the meeting that there is ample accommodation available.

While it is true that most of the hotel accommodation, with the exception of some double bedrooms, has already been booked up, the Local General Committee has in hand a large reservation of private lodgings of a suitable type and reasonable tariff.

We may state that the local arrangements are well in hand, and that members of the Association coming to Aberdeen are assured of a cordial welcome and an interesting programme.

E. W. WATT.
H. M. MACDONALD.
Local Hon. Secretaries.

Town House,
Aberdeen.
July 12.

## Research Items

**Behaviour of the New-born Monkey.** Observations on eleven new-born monkeys in the Carnegie colony of the Department of Embryology, Carnegie Institution of Washington, are recorded in the Year Book (No. 32, 1933). Additional data were derived from subsequent pregnancies in this colony and from one of another species of macaque born in the Yale colony. The full-term macaque baby opens and closes his eyes, cries, reaches out and grasps objects with his hands before he is completely delivered. At birth his flexor muscles are more precocious than his extensors, and their principal function appears to be the seeking of bodily support. By the second day there is a tendency to climb upward. By the end of the first week all the sensory mechanisms show evidence of functioning and the sensory-motor co-ordination develops much more rapidly than in the human infant. Play activities, such as romping, jumping, attempts to leap upon and seize objects, appeared during the second and third weeks but co-ordination of eye and hand and distance perception were quite imperfect. In the relationship of mother and baby much of the behaviour is subject to mechanistic explanation. Equipped with his grasping tendencies and the associated ventro-ventral position, the nosing and mouthing activities of the infant result in the discovery and seizure of the nipple, unaided by the mother. If the baby, through immaturity, lacks sufficient strength and co-ordination to accomplish these ends himself, the mother instinct is inadequate for the predicament, and he perishes.

**Temperature Range in Rats.** Alexandrine rats (*Rattus rattus alexandrinus*) found in dwelling-houses in Tokyo, were used by N. Yagi and J. Shimoizumi in experiments to determine the limits of body temperature which could be tolerated (*Sci. Rep. Tokyo Bunrika Daigaku*, 1, No. 22; 1934). The body-temperature was measured by the thermocouple method. Normal body temperature ranged from 36·85° to 37·45° C. Lethal low temperature was found to lie between 12·45° C. and 14·6° C., and lethal high temperature 42–43° C. Almost no relationship was discovered between the range of the lethal temperatures and the body weights of the rats, but male rats had a slightly longer range of tolerance at both ends of the scale, the average lethal low temperature being 13·41° C. for males, 13·76° C. for females; and the average lethal high temperature 42·68° C. for males, and 42·19° C. for females. The numbers of rats used in the experiments were 18 (10 males, 8 females) for lethal low temperature, and 18 (11 males, 7 females) for lethal high temperature.

**A Fish New to the British Fauna.** Prof. W. M. Tattersall (*Ann. and Mag. Nat. Hist.* (10), 13, No. 75, March 1934) records *Ruvettus pretiosus*, Cocco, for the first time from British waters. This fish was caught in September 1933 by one of the Cardiff trawlers in lat. 52° 20′ N., at a depth of 180–200 fathoms. This is due west of Co. Kerry in Ireland, and lies within the British area. Inhabiting the Atlantic at about 400 metres depth, *R. pretiosus* is common near the Canary Islands and Madeira and off the coasts of Spain and Portugal. It has been recorded from the Mediterranean and in the waters round the West Indies; also from Hawaii and Japan. The present specimen measures 3 ft. 7 in. in length, the largest known being 6 ft. It is apparently a straggler from warmer waters, although inquiries into the temperature from the nearest station of the Irish Fishery Board to the locality at which the fish was taken show that while the surface temperatures exhibit considerable variation over several years, the water at 400 metres has not varied more than half a degree over the whole series of years covered by the data. As the author states, "It would seem therefore that the temperature of the water at the bottom could not have been a factor influencing the distribution in any marked way, and cannot be brought into account for its presence off W. Ireland this year and its apparent absence in other years".

***Uronectes fimbriatus*, a Fossil Crustacean.** Dr. W. T. Calman (*Ann. and Mag. Nat. Hist.*, (10), 13, No. 75, March 1934) gives a detailed description of this interesting Permian fossil which was the first to be discovered of those fossil Crustacea now generally grouped together with the recent *Anaspides* and its allies under Packard's name *Syncarida*. There are a few specimens in the Geological Department of the British Museum (Natural History) from Lebach, near Saarbruck, the type locality. One of these is unusually fine, and from this the present description is mainly taken. A very good photographic plate is given of this, which lies on its side, and a second, ventro-lateral, of one from the same locality from the Geologisch-palæontologisches Museum der Universität, Bonn, presented by Dr. Jordan who, with Meyer, described this fossil (as *Gampsonyx*) in 1847. The close affinity between the Permian *Uronectes* and the carboniferous *Palæocaris* is confirmed by the identity of shape, position and even state of fossilisation of the appendages that are attached to the bases of the legs. The two genera are distinguished only by the enlargement of the second and third pair of thoracic limbs in *Uronectes*. In *Palæocaris* these limbs are similar to the following pairs. Further consideration of the precise relationship between the recent and fossil Syncarida must wait for a decision as to the nature of the basal appendages of the thoracic limbs in the fossil forms. Although there are probably exopods, they differ from those of the recent forms in absence or paucity of segmentation and lack of setæ.

**The Scarlet Tulip of the East.** A paper by Sir Daniel Hall in the *Gardeners' Chronicle* of June 16 and 23 clears up many difficulties of nomenclature connected with the scarlet tulip which flowers freely in countries of the Near East. Tulips which bear general resemblances to the scarlet eastern tulip have been variously described as *Tulipa oculus-solis*, *T. praecox*, *T. Boissieri*, *T. cuspidata*, *T. Stapfii*, *T. montana*, *T. undulifolia*, *T. lanata* and *T. Hoogiana*. Sir Daniel considers that these should all be classed as forms of one Linnean species—*T. oculus-solis*—with the possible exception of the triploids *T. praecox* and *T. Boissieri*. The specific characters of diagnostic importance are a woolly coating between the bulb and its tunic, an upright stem with usually a 'leg' of about 2 inches before any leaves emerge, and leaves which are somewhat glaucous and narrow pointed. The flower varies considerably in form and colour, but a central black or dark olive disc is almost universal, though even this is not of absolute diagnostic value.

**Early Chrysanthemum Blooms.** The fact that some plants bloom when the daily period of light is short, in spring and autumn, whilst others flower only in the long days of summer, was established on a sound practical basis by Garner and Allard in 1920. Since that time, horticulturists have been exploring the possibilities of a commercial application of the principle, and a recent publication by Mr. Kenneth Post reports considerable success in this direction ("Production of Early Blooms of Chrysanthemums by the Use of Black Cloth to reduce the Length of Day". *Bull.* 594, *Cornell Univ. Agric. Exp. Stat.*, Ithaca, New York, April 1934). Large box-shaped screens of black sateen were constructed to fit over chrysanthemum plants growing within a greenhouse. The screens were placed in position at 5 or 6 p.m. and were removed at 7 or 8 a.m., in order to provide a daily period of light of 10 or 11 hours. Large-flowered and Pompon types were caused to flower up to seventy days before their usual times. Treatment must be commenced whilst the plant is in the vegetative state, and is apparently ineffective when the flower buds have once formed. The publication under review reports the results of experiments on the effects of various lengths of day, the part of the plant affected, the time of day of treatment, the types of protective cloth, the dates of propagation and of last pinch, and the effect of short and long days alternated. There seems to be little practical difficulty in producing early chrysanthemum blooms; can they be marketed when grown?

**Sexuality in Basidiomycetes.** A useful paper dealing with sex in two members of the Basidiomycetes has recently appeared in *La Cellule*, **42**, fasc. 3, pp. 249–266; 1934 ("Sexuality of *Polyporus ostreiformis* and *Polystictus hirsutus*" by Prof. S. R. Bose). Monosporous cultures of several strains of each of the two fungi were made on various nutritive media, and it was established that both were bisexual and heterothallic. Mycelia of both sexes remained stable when exposed to wide variations of temperature and light, and when treated with small amounts of chemical poisons. When haploid mycelia of different strain were sown on the same medium, a line or space of aversion was often formed where the two mycelial masses met, but diploidisation occurred and clamp connexions were formed. Diploid fruit bodies produced spores in abundance, but a few haploid fruiting organs which appeared either shed only a few spores for a short time, or produced none at all.

**Re-Surveys in Earthquake Areas.** In the United States, a sum of 10,000 dollars has been allotted annually for several years for geodetic surveys in regions of seismic activity. During the past year, an arc of close triangulation has been carried out from San Fernando to Bakersfield, California, 110 miles in length and crossing five major zones of active faulting. Another arc along the Californian coast will be of use in determining future movements along the San Andreas fault. The U.S. Coast and Geodetic Survey is now engaged on a plan for covering the whole country with arcs of triangulation and lines of level of first order, and it is estimated that it may be finished in five or six years. Eventually, when the networks of triangulation and levelling, with the 25-mile spacing of arcs and lines, are finished, it will be possible to measure vertical and horizontal displacements of the crust close to any region in which an earthquake may occur (Carnegie Inst., Washington, Year Book, No. 32, 362–364; 1933). In Japan, the bench-marks are about 2 km. apart, but even this distance may be too great to detect the movements of small crust-blocks. Prof. A. Imamura has studied the tilting of a crust-block only $4\frac{1}{2}$ km. across in the Kyoto-Osaka district by means of a series of eleven new bench-marks only half a kilometre apart. The block is bounded to the east and west by well-marked faults. Up to 1928, it was tilted to the west at the rate of $0{\cdot}5''$ a year. Since then, the tilting has been reversed, though the rate remains almost the same (*Tokyo Imp. Acad. Proc.*, **10**, 69–72; 1934).

**Magnetic Survey of Sweden.** In *Kungl. Sjökarteverket, Jordmagnetiska Publikationer*, No. 9 (Stockholm, 1934), Dr. Gustaf Ljungdahl gives an account (in English) of the origin, methods and results of the first systematic and comprehensive magnetic survey of Sweden, which was made by the Hydrographic Service in the years 1928–30. Very great care was taken in the selection of the stations (86 in number), choice being made of such as were likely to remain available indefinitely in the future for repeat observations to determine the secular variation; also the variation of the vertical force in the neighbourhood of each station was examined by means of a Schmidt local variometer, in order that the stations adopted should be as free as is possible (in a country so magnetically disturbed as Sweden) from rapid local gradients of the magnetic field. All three magnetic elements were determined at each station using a combined magnetometer and earth inductor (Carnegie Institution of Washington type). The reduction to the mean epoch of 1929·5 was made by reference to the continuous magnetograph registrations of the Swedish observatory at Lovö, the Danish observatory at Rude Skov, and that of Finland at Sodankyla. The methods and results are fully described, and set out in tables and maps. The latter give isomagnetic lines, both 'terrestrial' (or smoothed) and 'true', and there is also a map showing the deviation of each element at each station, from the computed 'terrestrial' value.

**Graphical Determination of a Flight Course.** Recent research into the effect of meteorological conditions upon the performance of aircraft at considerable altitudes, carried out at the California Institute of Technology (Science Service, April 25), have resulted in the development of an extremely useful graphical method of rapidly determining the most efficient flight course for an aircraft under any given conditions. The theoretically optimum flight of an aeroplane of definite performance for a given distance can be found to consist of a combination of a period of climb at a reduced speed, followed by a prolonged gradual dive at increased speed. Full advantage of this can be taken by making use of modern developments in supercharging the aero engine and using a variable pitch airscrew, which makes it possible to maintain a desired speed at any height, within reasonable limits. The meteorological variables in this calculation are wind velocity, its change with altitude, and its angle to the course, and with the development of the technique of examining these, and the organisation for the rapid distribution of this knowledge, it has become possible to obtain it quickly and accurately enough to make use of it

previous to starting a flight. The scheme proposed by Mr. W. C. Rockefeller of the California Institute consists of a combination of charts and tables to be used systematically in such a way that the best flight path can be determined in fifteen minutes, without the necessity for any extensive knowledge of the theoretical principles involved. Thus the flight can be made in the shortest possible time, or alternatively, if working to a time table, with the lowest expenditure of power for the trip. The accuracy of the result naturally depends upon the maintenance of the assumed meteorological conditions during the flight. There are many technical reasons for limiting the time of an economic commercial flight to about 4 hours and the distance to the order of 500 miles, and within these the above assumption is reasonably correct.

Raman Spectrum of Water. I. Ramakrishna Rao (*Phil. Mag.*, June 1934) has gone over the very extensive work on the Raman spectrum of water in various phases, including some new experimental work of his own. He has compared the Raman frequencies with the infra-red frequencies and obtained some fresh light on the molecular constitution of water. The Raman spectrum of liquid water shows for each exciting line a broad band in which the author finds three maxima. The spectrum with ice showed a band with only two components, and that of water vapour shows one sharp line corresponding to the infra-red absorption band. Water of crystallisation in a number of crystals also shows one or more diffuse bands. A marked change in the Raman spectrum corresponding to the liquid-vapour transition is characteristic of polar molecules, and may be due to the interaction of molecules or to polymerisation. The three-component structure of the liquid water band is ascribed to polymerisation, and preliminary work has shown that the relative intensities of the maxima change with temperature. Thus correlation between the infra-red and Raman spectra of liquid water does not seem very certain. The frequency characteristic of the vapour molecule is entirely absent in the ice spectrum.

The Imperial Standard Yard. When Queen Elizabeth in 1584 took action which resulted in a British system of weights and measures, the most accurate method of comparing lengths was by beam compasses, and the Exchequer yard was an end standard. The micrometer microscope made the distance apart of fine lines a more accurate measurement, and the reconstructed Imperial standard yard of 1855 was defined as the distance apart of two fine lines on two gold plugs near the ends of a certain bronze bar at 62° F. Messrs. Sears and Barrell, of the National Physical Laboratory, have been engaged for several years in determining the yard in terms of the wave-length of the red cadmium line in vacuum, and their methods and results are embodied in two memoirs in the *Transactions of the Royal Society*, vols. A, 231 and 233. Two tubes of invar about 10 cm. long are closed at each end by half silvered glass plates, and the distances apart of the silvered surfaces determined in terms of the wave-length. One of these tubes is then compared in length with one of 33 cm. length by placing them in series and obtaining Brewster's fringes. The 33 cm. tube is then compared by the same means with one about a yard long. The final result is that the Imperial standard yard is 1,419,818·31 wave-lengths of the red cadmium line in vacuum. The value obtained by Dr. A. E. H. Tutton in 1931, and published in his *Phil. Trans.* paper in that year, was 1,420,209·8 wave-lengths.

Isomers of Carotene. From the annual report of the Carnegie Institution of Washington, Year Book No. 22, 1933, it would appear that an active attack upon the complex problems presented by the yellow leaf pigments is continuing in the Division of Plant Biology under the general direction of Dr. H. A. Spoehr. It is now clear that at least two isomers of carotene are usually present in the plant source, α-carotene, characterised by its optical activity, and β-carotene, which is optically inactive. The carotene prepared from leaf sources by the Carnegie workers has always been the optically inactive form, though leaf sources for optically active carotene have been found by Japanese and German workers. Dr. Smith has succeeded in preparing a highly purified preparation of α-carotene from the carotene mixture obtained from carrots. His method consisted mainly in the differential absorption of the optically inactive form by a mixture of 'norit' and siliceous earth, after this had been previously heated to 500° C. *in vacuo* and then allowed to cool in an atmosphere of nitrogen or carbon dioxide. The absorption spectra, solubilities, etc., of both isomers are under study and some evidence has been found of the presence of yet another yellow component, though as a rule the behaviour of the pigment extracts is compatible with the existence of two components in solid solution. A further study of the degree of unsaturation confirms earlier work, and every form of carotene appears to absorb eleven molecules of hydrogen per one molecule of pigment. These studies are of vital importance in view of the significance of carotene in vitamin studies.

Spectra of Wolf Rayet Stars and Novæ. Observations of the contours of emission bands in the spectra of Wolf Rayet stars and novæ have been made by C. S. Beals (*Pub. Dom. Astrophysical Obs.*, **7**, No. 9) with the view of testing the author's theory of the origin of these bands. This theory assumes the continuous ejection of atoms from the surface of a star, and will explain any symmetrical band contours by postulating a suitable frequency distribution of ejected atoms. Flat-topped contours would result when there are no velocities in the vicinity of zero. The author gives a useful account of the method of calibrating stellar plates for spectrophotometric purposes by means of a neutral tint absorbing wedge placed in front of the slit of a spectrograph, and also of a new type of microphotometer used for the intensity measurements. The results show that flat-topped bands are present in the spectra of Nova Aquilæ and Nova Cygni, but in the case of Wolf Rayet stars such contours are exceptional, indicating a very different frequency distribution of the ejected matter. An important by-product of this investigation is the advance made in the classification of Wolf Rayet stars, through the measurements of total intensities in 64 emission bands. It appears that they may be divided into two sequences, called the 'Carbon Sequence' and the 'Nitrogen Sequence'. These are approximately parallel (as regards ionisation level) and the presence of both neutral and ionised helium in each of them has hitherto masked their separate character. The intensities are also used in a brief discussion of the temperatures, using Zanstra's method. Approximate values of 50,000°–100,000° are obtained for Wolf Rayet stars, 65,000° for Nova Aquilæ, and 20,000° for *P* Cygni.

# The Atmospheres of the Giant Planets

By DR. ARTHUR ADEL and DR. V. M. SLIPHER, Lowell Observatory and the University of Michigan

THE present paper is concerned with the results of an investigation carried out to ascertain the extent to which the methane molecule ($CH_4$) is responsible for the spectrum of the major planets.

In order to secure intensities of absorption comparable with those obtained in the planets, a path-length of two thousand metre-atmospheres was employed. The spectrum of a source of continuous radiation shining through the gas was secured with a glass Hilger *E*-I spectrograph, and the photographs cover the region from the violet to the infra-red.

A survey of the band spectrum of gaseous methane is above all characterised by the prominent overtone sequence of the $\nu_3$ fundamental at 3·3$\mu$. This sequence coincides precisely with the outstanding group of absorption bands in the spectra of the giant planets. The latter is shown in Fig. 1, in which the series of bands $5\nu_3$, $6\nu_3$, $7\nu_3$ and $8\nu_3$ are immediately discernible. It is especially gratifying to observe that the band which is superimposed upon $H_\beta$ is included amongst the members of this group.

The harmonic nature of the above sequence is nicely displayed by the curve of Fig. 2. Extrapolation shows that planetary absorption may be expected at about 4410 A. (extremely weak) and at about 11,540 A. (extremely intense). The 4410 A. band is with very little doubt to be identified as the Neptune band reported by Slipher[1] at 441m$\mu$. This is the ninth harmonic of $\nu_3$, and Neptune alone amongst the major planets has sufficient methane in the absorbing layers of its atmosphere to register it.

In virtue of the fact that this sequence of rotation-vibration bands is the most prominent in the entire band spectrum of the molecule, it is to be expected that its members will combine with the other fundamental vibrations ($\nu_1$ = 2,915 cm.$^{-1}$, $\nu_2$ = 1,520 cm.$^{-1}$, $\nu_4$ = 1,304 cm.$^{-1}$) in the production of the system of absorption bands $n\nu_3 + \nu_i$, where $i$ may equal 1, 2 or 4; and that these bands will be amongst the next strongest in the spectrum. This is indeed the case, for the bands which appear in the laboratory and planetary spectra of methane (other than the group $n\nu_3$) are for the most part members of this system of combination bands. Not all of the methane bands showing in the spectrum of the outer planets have as yet been detected in the laboratory, however, inasmuch as the absorption columns in Neptune and Uranus are an order of magnitude greater than the laboratory path-length described above. In conformity with expectation, the planetary bands of the type $n\nu_3 + \nu_i$ which have been duplicated in the laboratory involve the smaller values of $n$. The present absence of complete duplication is, of course, no obstacle to the identification of the planetary bands. The fact that there exist but four normal modes of vibration of the methane molecule, and that the selection rules governing the band spectrum prohibit the appearance of the frequencies $p\nu_1 + q\nu_2$, means that there is a minimum of overlapping in the consequential spectral regions, and therefore but very small uncertainty in the correlation. The astronomical data employed in the analysis are those of the extensive investigations of V. M. Slipher of the Lowell Observatory. Reference should be made to the *Lowell Observatory Bulletins*, and the *Monthly Notices of the Royal Astronomical Society* for descriptions and illustrations of the absorption bands in the remarkable spectra of the giant planets[2]. The spectrum has been recorded into the infra-red as far as 10,000 A.[3].

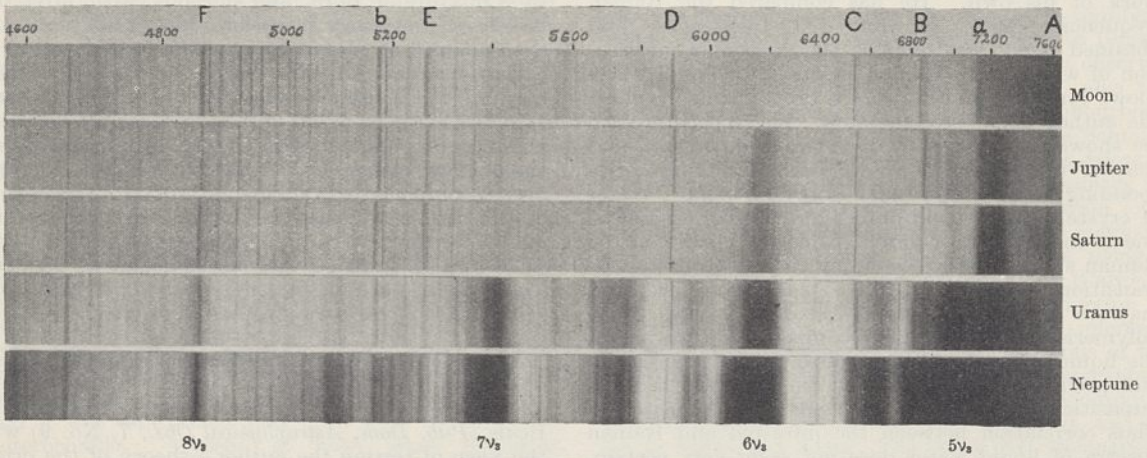


FIG. 1. Spectra of the giant planets.

In the identification given below, the bands which have thus far been duplicated in the laboratory are followed by asterisks.

Identification of the Planetary Methane Bands of the Type $n\nu_3$

| $n$ | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|
| Band position (m$\mu$) | 886* | 725* | 619* | 543* | 486* | 441 |

Identification of the Planetary Methane Bands of the Type $n\nu_3 + \nu_i$

| | | | | | |
|---|---|---|---|---|---|
| $i = 1$ | $n$ | 3 | 4 | 5 | 6 |
| | Band position (m$\mu$) | 861* | 702* | 595 | 521 |
| $i = 2$ | $n$ | 4 | 5 | 6 | |
| | Band position (m$\mu$) | 782* | 656 | 568 | |
| $i = 4$ | $n$ | 5 | 6 | 7 | 8 |
| | Band position (m$\mu$) | 668* | 576 | 509 | 459–460 |

$\nu_4$ is a very low frequency oscillation, and therefore

only its high harmonics will invade the photographic region of the spectrum. Consequently, we should expect the methane bands $m\nu_4$ in the planets to be weak ones. This is indeed the case. The harmonic nature of the sequence is strikingly brought out in Fig. 3.

Identification of the Planetary Methane Bands of the Type $n\nu_4$

| $n$ | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|
| Band position (m$\mu$) | 874* | 788* | 720* | 662* | 614 | on blue edge of $6\nu_3+\nu_4$ | 534 |

An idea of the complexity of the fine structures of the methane absorption bands may be gained

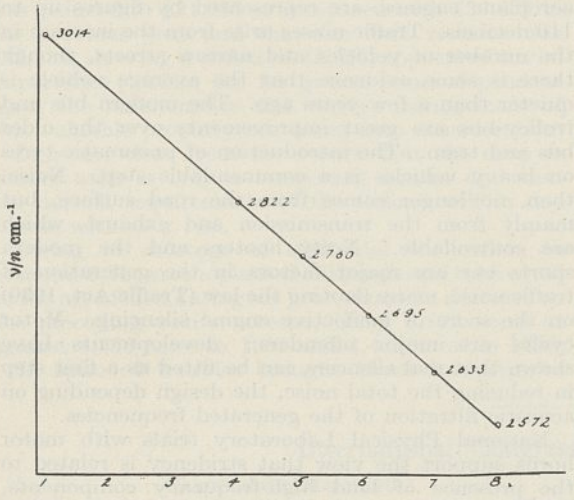


FIG. 2.

from the following examination of the harmonics of $\nu_3$.

The $\nu_3$ mode of vibration of the methane molecule possesses three degrees of freedom. An analysis by Dennison and Ingram[4] based upon this fact in conjunction with the tetrahedral symmetry of the molecular force field has shown that the vibrational energy levels $n\nu_3$ are multiple with a multiplet separation which is very small in comparison with the fundamental frequency; in fact, of the same order of magnitude as the rotational structure. Thus, when $n$ is the order of the harmonic, approximately $\frac{1}{4}(n+1)(n+2)$ bands superpose to form a single composite absorption band $n\nu_3$. Consequently, such a band as the $7\nu_3$ one in the planets is actually a superposition of some eighteen bands. It is not surprising, therefore, when such a band proves difficult of resolution.

*A predominantly hydrocarbon nature* seems not at all unlikely for the giant planets. Aside from the above very probable identification of methane, this conclusion is also indicated by the fact that the mean densities of the giants are in a class with the densities of most organic liquids. Furthermore, it is not surprising that methane should stand out so prominently, inasmuch as its vapour pressure at the extremely low temperatures which prevail in the atmospheres of the outer planets is far in excess of the vapour pressures of any of the other hydrocarbons apt to exist there.

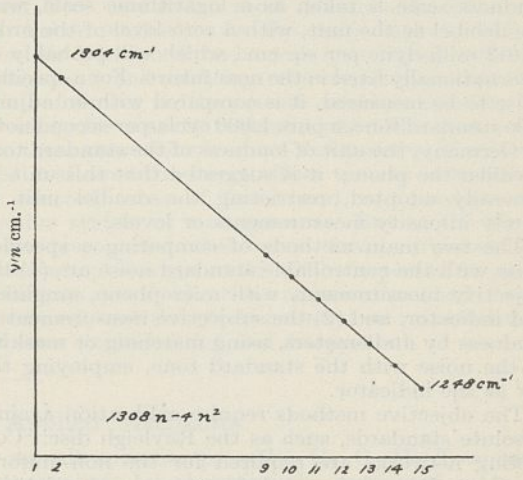


FIG. 3.

It is a curious and noteworthy fact that the two constituents, of the existence of which in the planetary atmospheres we are now fairly certain, namely, methane and ammonia, are saturated with hydrogen. This fact, taken in conjunction with the very stable natures of these two compounds, may signify that collision reactions in the atmospheres of the giant planets have continued over vast periods of time in a progression of the atmospheric constituents towards maximum stability relative to the physical conditions which prevail in the planetary atmospheres.

[1] *Lowell Obs. Bull.*, No. 42.
[2] *Mon. Not. Roy. Ast. Soc.*, **93**, No. 9; 1933.
[3] *Mon. Not. Roy. Ast. Soc.*, **93**, No. 9, Plate 15, Fig. 3; 1933.
[4] *Phys. Rev.*, **36**, 1451; 1930.

## Scientific Studies of Noise*

THE subject of noise control is being actively studied scientifically at the U.S. Bureau of Standards, the Heinrich Hertz Institute in Berlin, and at the National Physical Laboratory in Great Britain, while a number of firms have developed noise-measuring apparatus, means for reducing noise-levels, and materials and methods for isolating vibration. Literature tells us that the noise problem is by no means new, but in addition to the old sources of noise, civilisation brings in new sources; there is evidence of a growing noise-consciousness in the public, possibly due to increased nerve strain and reduced tolerance, and increased sense of the social value of noise reduction.

The problem is being considered by a Committee of the British Standards Institution, with the view of arriving at an acceptable definition of noise and methods of measurement.

From the general point of view, any type of noise may annoy someone, the nuisance value depending on the marginal or 'last straw' effect, the latter being largely personal. Although considerable noise can be tolerated, particularly when self-generated, Bartlett is of the opinion that the cumulative effect of some slight adjustments by a worker may in time produce

* Summary of an address delivered by Dr. G. W. C. Kaye, superintendent of the Physics Department, National Physical Laboratory, before the Science and Noise Section of the Conference of the Anti-Noise League held at Oxford on July 14.

fatigue of industrial significance. The Industrial Health Research Board recently obtained evidence of the effect of a noisy environment on industrial output. Thus, weavers gave a significantly higher output when provided with ear defenders; and a similar result was obtained with typists using noiseless typewriters. In addition, there are many examples of noise, depending on time and place, which offend the great mass of people. Scientific investigation can here form the basis of legal control, if desired by an enlightened public.

The scientific measurement of the minute acoustic power which appears as a loud noise is greatly assisted by microphone and amplifier technique. The loudness scale is taken as a logarithmic scale, with the decibel as the unit, with a zero-level of the order of 0·3 milli-dyne per sq. cm., which will probably be internationally fixed in the near future. For a specified noise to be measured, it is compared with an adjustable standard tone, a pure 1,000 cycle-per-second note. In Germany, the unit of loudness of the standard tone is called the phon; it is suggested that this unit be generally adopted, restricting the decibel unit to purely intensity measurements or levels.

The two main methods of comparing a specified noise with the controllable standard noise are (1) the objective measurement, with microphone, amplifier, and indicator, and (2) the subjective measurement of loudness by audiometers, using matching or masking of the noise with the standard tone, employing the ear as the indicator.

The objective methods require calibration against absolute standards, such as the Rayleigh disc. Correcting networks are required for the non-uniform response of the system with frequency, and weighting networks are required for the simulation of the differential frequency sensitivity of the ear. The objective method is well suited for the rapid estimation of noises of similar type. Objective meters also permit a ready demonstration of the component frequencies in a sound, thus permitting the source of specified frequencies to be traced and controlled.

Subjective methods, by masking or matching, are likely to be standardised between the leading countries, the balancing to be done with both ears, with the observer facing the source of sound. Such methods require trained observers for uniform results. It has been noticed that the adjustment with audiometers should be from the loud side, rather than the reverse, or both. Audiometers are not well adapted for short-period or fluctuating noises. A simple type of audiometer is a tuning fork, struck in a specified manner, and having a known rate of decay.

Surveys have recently been made by the National Physical Laboratory. Ordinary conversation registers about 50 decibels, a tube train about 80, while the loudest sounds, such as from riveting, pneumatic road-drills, steamship sirens, printing presses and aeroplane engines, are represented by figures up to 110 decibels. Traffic noises arise from the increase in the number of vehicles and narrow streets, though there is some evidence that the average vehicle is quieter than a few years ago. The modern bus and trolley-bus are great improvements over the older bus and tram. The introduction of pneumatic tyres on heavy vehicles is a commendable step. Noise, then, no longer comes from the road surface, but mainly from the transmission and exhaust, which are controllable. Noisy hooters and the modern sports car are major factors in the generation of traffic noise, many flouting the law (Traffic Act, 1930) on the score of ineffective engine silencing. Motor cycles are major offenders; developments have shown that real silencers can be fitted as a first step in reducing the total noise, the design depending on acoustic filtration of the generated frequencies.

National Physical Laboratory trials with motor horns support the view that stridency is related to the presence of loud high-frequency components. Hooting is to be regulated. Abroad, many cities have adopted nocturnal freedom from hooting.

In the control of noise-levels, industry as a whole seems to be becoming active, since the welfare of the worker is involved. Much has been done in aircraft silencing, particularly in the cabins, by the improved disposition of the engines and the use of isolating wall construction. In the field of quiet housing, new equipment has been installed at the National Physical Laboratory for the systematic investigation of building materials.

## The Forests of Kenya

THE annual report of the Forest Department of the Protectorate and Colony of Kenya up to December 31, 1932 (Govt. Printer, Nairobi, 1933) reflects the present position of most of the forest departments of the Protectorates and Colonies under the Colonial Office. The report opens with the sentence, "The world-wide economic depression continued to affect the Colony and to an even more serious extent than in the previous year, with the result that revenue continued to decrease and further economies became essential". It is of course unavoidable that the heads of the forest departments should concern themselves primarily, even at the expense of professional practice, with the revenue receipts from the forests under their charge. For it is apparent that certain of the governors and their advisers are only able to envisage the forests and a forest policy from the point of view of the monetary return that can be extracted from the forest estate.

As is well known, in countries in Europe where a forest policy and forest administration have for long been working hand in hand, those responsible for the professional management of the forests assume that revenue shall exceed expenditure, and that the department shall be one of the revenue resources of the State. In the case of ill-developed areas of forest with considerable potential possibilities, the effort to obtain revenue at the expense of real efficiency is, in the long run, inevitably disastrous.

Kenya is not the only Colony which is now suffering from a similar policy. In the immediate post-War years (if we omit the pre-War period and possibility of development in some Colonies) a broad forest policy coupled with a bold expenditure devoted to enumerations of the growing stock of unexplored forest areas and opening out the most accessible ones, would have assuredly placed the various forest departments on a sounder basis, and have enabled them to withstand better the depression of the last few years. The vacillating policy adopted left the departments in the most cases undermanned and weak, with the result that they have suffered probably to a greater

degree from the severe cuts in establishment and so forth which have been their lot during the past few years—an action which will delay the development of the valuable forest estates under their control, and the consequent revenue to be derived from these estates, by a decade.

This being the position of affairs, it is not surprising to find the Conservator of Forests of Kenya devoting the opening paragraphs of his report to the financial position of his Department.

The Kenya forests are probably, in the interests of the economic development of the Colony, of so great a value that the statement that expenditure was reduced to £31,691 as compared with £36,237 in the previous year and that the cash revenue was £26,156, showing a deficit of £5,353, appears of trivial importance; when the far graver issues dependent upon the maintenance and correct management of this valuable property are taken into consideration.

It seems clear from the report that the drop in timber sales is only a temporary matter and that the normal requirements of the Colony will in due course witness a rise.

Owing to shortage of staff and the orders to economise, the area replanted, although said to be equal to the area felled during the year, showed a decrease on the preceding year's acreage, being 3,892 acres as against 4,756 acres in 1931 and 4,429 acres in 1930.

In spite of troubles brought about by irregular rainfall and locusts—the Colony has experienced bad invasions of this pest for several years past—it was estimated at the end of the year that 73 per cent of the area planted was completely established, 26 per cent was fair and 1 per cent only had failed—a record sufficient to satisfy the most ardent planter. Improved organisation and increased economy of working is shown in this planting work, the average cost falling from 8·86*s*. to 7·13*s*.; this figure includes the cost of work in 1931 in preparation for the 1932 planting but does not include supervision or nursery costs.

The Conservator appears to be concerned with the timber being cut in the small forests still existing on private land which "was often sold for anything it would fetch and had a most demoralising effect on the timber market". In the early days in India, when Sir Dietrich Brandis was introducing a forest management and selecting reserves, he regarded the felling of timber on the private estate as assisting in providing for market requirements. His view was that these operations were an assistance to the State since it allowed the forest officer time to consolidate his selected areas of forest and to introduce an effective system of management. But at the time, it was recognised that some forest divisions or conservators' charges could not be expected to yield a revenue until effective organisation had been introduced, and the cheap material on private lands had been exploited and had disappeared.

## International Congress for Applied Mechanics

### CAMBRIDGE MEETING

THE fourth International Congress for Applied Mechanics was held in Cambridge under the presidency of Prof. C. E. Inglis on July 3–9. About 320 members attended, including representatives of twenty-three countries. More than 140 papers were read, in four sections dealing respectively with general mechanics, hydrodynamics, strength and properties of materials, water waves.

Besides these sectional papers, seven general lectures were delivered by invitation describing recent progress in some of the main fields of science covered by the Congress. The general lecturers were Prof. V. Bush on analysing machines, Prof. A. Caquot on the elastic limit in isotropic materials (in French), Prof. J. P. den Hartog on vibrations in engineering, Prof. Th. v. Kármán on turbulence, Prof. E. Schmidt on heat transference (in German), Prof. G. I. Taylor on the strength of crystals, Prof. H. Wagner on bodies gliding on the surface of water (in German). This list gives some idea, though by no means a complete one, of the range of subjects covered by the Congress.

The subject which perhaps attracted the greatest amount of attention was turbulence in fluids. There were present at the Congress most of the principal workers in the subject in the world. Prof. L. Prandtl spoke on the application of the laws of turbulent flow to the general circulation of the atmosphere. Dr. Schlichting gave an account of experiments at Göttingen on flow through a tunnel which was heated from above so that turbulence was reduced owing to a stable gradient of density. Dr. H. L. Dryden and Mr. Waltendorf spoke of measurements of turbulence made with hot wires at the Bureau of Standards, Washington, and at Pasadena. From the National Physical Laboratory, Teddington, Mr. A. Fage described his measurements of turbulence by an ultramicroscope; Mr. H. C. H. Townend, measurements by observing the motion of spots of air heated by a succession of sparks; and Mr. E. F. Relf, the effects of turbulence on force measurements made in the new compressed air wind tunnel. From Cambridge, Prof. B. M. Jones described measurements made on an aeroplane in flight of the region behind the wing where the flow is turbulent. From the laboratories of Prof. H. Benard and Prof. D. Riabonshinsky in Paris, work on vortices in fluids was described.

Owing to the large number of the scientific papers presented, it was impossible to publish them in full. In most cases they have been, or will be, published elsewhere, but abstracts were printed for the use of members at the meetings, and these will be reprinted in a volume which will also contain the seven general lectures, printed in full, and a short general account of the Congress. This volume, costing £1, will be ready in a few months' time and will be obtainable from the Secretary, Fourth International Congress for Applied Mechanics, Engineering Laboratory, Cambridge.

The Congress was entertained at evening receptions by the Mayor of Cambridge and by St. John's College, at a conversazione and exhibition of instruments and demonstrations by the Engineering Laboratory, at a garden party by Christ's College, at dinner by the Organising Committee and Trinity College and afterwards by Sir J. J. and Lady Thomson, and by the Provost of King's at a concert.

International Congresses for Applied Mechanics are held every four years. The first three were at Delft, Zurich and Stockholm, respectively. The fourth was at Cambridge, England, and the fifth will be held in 1938 at Cambridge, Massachusetts, under the auspices of Harvard University and the Massachusetts Institute of Technology.

## Habitat Selection in Birds

THE afforestation of the Breckland heath with young pines provided David Lack (*J. Animal Ecol.*, Nov. 1933) with the opportunity of studying the changes in avifauna. Until the trees are some four years old, only the heathland birds occur, but within the next five years these disappear and are replaced by a new avifauna. The most marked features are the steady decrease of the skylark and the meadow pipit, and the appearance and rapid increase of the willow warbler.

Deficiency of nesting sites explains a few changes in the distributions; thus the wheatear, common on open heaths and nesting exclusively in rabbit burrows, does not occur in afforested areas, which are rabbit-proof. Food, though clearly important in controlling the total bird population, does not appear to limit the distribution of any species investigated. The question of enemies can be ruled out, since man has destroyed almost all bird and egg-eating animals of the district. The most important appears to be the psychological factor, which is emphasised by the absence of certain species from areas, otherwise suitable, which do not supply them with a singing perch. Thus the requirements of the meadow pipit and the tree pipit are the same, but the latter occurs only in localities with fairly tall trees, or even in places with a single tree. Often, in the cases of closely related species, there appears nothing in the environment to cause the difference in distribution, and the remaining possibility is again the psychological factor.

When instinct appears to control such complex matters as nest building, it would be surprising if it did not control the type of ground selected by a bird for a breeding territory. The psychological nature of this instinctive habitat selection is often indicated by the fact that the height and not the nature of the vegetation is the determining factor. At times birds may successfully break away from the ancestral habitat.

Habitat selection may have some bearing on evolution. It is known that the passerine species of the north temperate region tend to occupy distinct but adjoining habitats, affording the same essential requirements, but differing in conspicuous features. Perhaps in this way two groups become isolated and eventually split into two species, as in the case of the meadow and the tree pipits.

## University and Educational Intelligence

CAMBRIDGE.—The Michael Foster studentship, offered annually for the encouragement of research in physiology, valued at 100 guineas, has been awarded to C. M. Fletcher, of Trinity College. The Wrenbury scholarship for study and research in economics, valued at £100, has been awarded to R. B. Bryce, of the University of Toronto and St. John's College.

At Clare College, the following elections to research studentships have been made: minor research studentship of £100 for two years, A. Marriage; Denman Baynes studentship of £50 for one year for chemistry, R. M. Barrer; Denman Baynes studentship of £50 for one year for physics, B. M. Crowther; reearch studentship of £50 for chemistry, I. Kemp.

EDINBURGH.—At the graduation ceremonial on July 18 the Cameron Prize in practical therapeutics was awarded to Sir E. Sharpey-Schafer, emeritus professor in the University, in recognition of the advances in therapeutics arising out of his discoveries in endocrinology.

LEEDS.—Mrs. Bolton has presented to the University a telescope and other scientific instruments belonging to her late son, Mr. Scriven Bolton, of Bramley, who began his astronomical career at the University Observatory.

Mr. K. Mitchell has been appointed assistant lecturer in applied mathematics as from the beginning of next session.

LONDON.—The University has received from the Carnegie Corporation of New York an offer to provide 22,500 dollars annually for three years to aid the Institute of Education in developing its relations with students from the Dominions and Colonies. The sum is intended to provide fellowships for short periods to selected students from the Dominions, and to enable the Institute to invite a senior university teacher from one of the Dominions to hold for a limited period the post of adviser to overseas students.

The following appointments have been made:—University chair of pharmacology (University College) (from July 1, 1935), Prof. J. H. Gaddum, since January, 1934, professor of pharmacology in the Egyptian University, Cairo. University chair of chemical pathology (London Hospital Medical College) (from October 1, 1934), Dr. J. R. Marrack, since 1919, lecturer in chemical pathology at the London Hospital Medical College. University readership in anthropology (London School of Economics) (from October 1, 1934), Dr. Raymond W. Firth, since 1933, lecturer in anthropology at the London School of Economics.

Proposals for the establishment of an Institute of Archæology, and for its scheme of management, have been approved by the Senate, and Dr. R. E. Mortimer Wheeler has been appointed honorary director of the Institute.

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BILINGUALISM presents educational problems in various parts of the world which have been dealt with in various ways, determined in not a few instances more by political than by purely educational considerations. In the United States, these problems have to some extent been solved or cut through by 'Americanisation' schemes. In general, the view has prevailed that children speaking a foreign language should be put as early as may be into school and, in so far as is possible, speak English only during the entire day. The use of the vernacular as a medium of education has been attempted experimentally at the San José School, which was reorganised as a training school for the use of the Education Department of the University of New Mexico in 1930, as part of a five-year programme of research in methods of education for Spanish-speaking pupils. Some account of this undertaking is given in *Bulletin* No. 11 of 1933 of the United States Office of Education, which reviews the whole subject of "The Education of Spanish-speaking Children in five South-Western States". This question has assumed in recent years a growing importance due to the rapid increase in these States of people of Mexican stock, the percentage of whom to the total population has increased from 1·9 in 1900 to 4·2 in 1910 and 9·6 in 1930.

## Science News a Century Ago

### Royal Geographical Society: Early Exploration Efforts

During the summer of 1833 the Council of the Royal Geographical Society had been actively engaged in promoting, with the countenance and patronage of His Majesty's Government, two exploring expeditions, leaving England, it was contemplated, in July of the following year, or near that date. The first of these was an expedition of discovery in South Africa by means of exploration up one of the rivers falling into Delagoa Bay. With the approval of the Society (which was chargeable with much of the expense) the task was entrusted to Capt. James Alexander, an adventurous young officer who in after life achieved much national fame. What sum of knowledge resulted from the project is a story revealing the uncertainties attending early geographical effort, however well planned in advance. The honorary secretary to the committee appointed to organise the expedition was Mr. W. Desborough Cooley, a fellow, and sometime first secretary, of the Hakluyt Society. In the opinion of Dr. H. R. Mill ("Record", Roy. Geog. Soc., 1930), Mr. Cooley was "an erratic genius". He had never, Mill tells us, travelled, but supported himself by writing about all parts of the earth. Devoting himself mainly to Africa, Mr. Cooley recorded and criticised the work of explorers, whilst upholding fantastic theories of the geography of the continent, even against the assertions of those who had actually traversed various tracts. However, much kindly appreciation was entertained finally, the Society securing for him a Civil List pension of £100, terminated in 1883 by his death.

The second of the two expeditions arose from the offer of Richard (afterwards Sir) Schomburgk, who proposed to explore the interior of British Guiana, with the financial assistance of the Society. A committee accepted his services, and following a strong appeal to the Government, a contributory sum was voted for the expedition, as well as for the Delagoa Bay project. Schomburgk's work proved to be of great geographical and botanical service.

### Elcot Park Garden: Heating Hot-houses

"This place is celebrated as the scene in which the mode of heating hot-houses by hot water was displayed, in 1823, to the British public; we will not say for the first time, because we have shown that it was exhibited in the hot-houses at Sundridge Park, by the Count Chabannes, in 1816; but we do say that it was from the apparatus displayed in this garden that this mode of heating first became generally known to the British public. We also believe that the late Mr. Bacon invented it at Aberaman in 1821, as Mr. Atkinson appears to have done in London in 1822. There is nothing uncommon in different persons inventing the same thing at nearly the same time, without any knowledge of each other's ideas. Inventions are more commonly results of the general state of science on a particular subject, at a given time, than of the character or degree of knowledge of an individual mind." (J. C. Loudon, *Gardener's Mag.*, July 1834.)

### Abolition of Slavery in British Colonies

As a result of an Act of Parliament passed on August 28, 1833, for the abolition of slavery in the British Colonies, for the promotion of industry among the manumitted slaves and for the compensation of slave-holders, on August 1, 1834, nearly 800,000 negro men, women and children in Jamaica, Barbadoes, Trinidad, Mauritius, South Africa and other places obtained their freedom. Thus culminated the self-denying efforts of a comparatively small group of men, who for half a century had advocated the claims of these unfortunate people. The event was commemorated with great rejoicings, many meetings were held in Great Britain, and on the day referred to the friends of the abolition of slavery held a dinner at the Freemason's Tavern, London, which was presided over by the Earl of Mulgrave, who for two years had been Governor of Jamaica in which were more than 300,000 slaves. In a speech on the occasion, he told how that as soon as it was known that the British Legislature had given emancipation to the black population he made a tour of the island to explain to the negroes the nature and the extent of the boon they had received. He was convinced, he said, that there was nothing in the negro mind to unfit it for the reception of moral and religious instruction, and he hoped the negro population of our Colonies would fulfil all the hopes and expectations of those who had so nobly stood forward to assert their rights, and raised them from the degradation of slavery to the proud elevation of British subjects.

### Meteorological Records for 1834

An interesting article on meteorology in the *Athenæum* of August 2, 1834, began: "The daily increasing interest that is felt in Meteorological Observations, the high rank that they have of late assumed in this department of physical science, the importance of the results which may be obtained from them by a cautious system of induction, and the absolute necessity, before such results can be announced as general principles, that the observations on which they are founded should be numerous, accurate and authentic, have rendered us for some time more than ordinarily anxious to meet the demand for information, in a manner at once full and satisfactory; and our readers will learn with pleasure that our exertions have been crowned with the highest success, in proof of which we this day present them *The Meteorological Journal* kept by order of the President and Council of the Royal Society, at their apartments in Somerset House." The number of August 2 accordingly contained the Meteorological Tables for the months of January–June 1834. Succeeding Tables were published monthly.

### The Entomological Society

On August 4, 1834, at a meeting of the Entomological Society, presided over by Lieut.-Col. W. H. Sykes (1790–1872), a report of a committee for investigating the nature of the ravages of the cane fly was read. The matter had been brought before the Society on July 7, when it was said that this insect, a minute species of the Cicada of Linnæus, was committing incredible mischief in Grenada and other West Indian Islands, having in some cases destroyed not less than two-thirds of the crops. A committee was therefore appointed to discover the precise mode of its attack, and if possible to suggest a remedy. In the report, a variety of suggestions were made and these were immediately forwarded to the Agricultural Society of Grenada. At the same meeting, Col. Sykes described some species of Indian ants.

## Societies and Academies

### DUBLIN

Royal Dublin Society, May 29. E. J. SHEEHY: Derangement of the digestive processes in the milk-fed calf, due to abnormal curd formation in the fourth stomach. The accumulation of dense curd in the fourth stomach which frequently causes ill-health and mortality among pail-fed calves may be successfully prevented and treated by the dilution of the milk diet with water. J. H. J. POOLE: A convenient method of measuring resistances of the order of $10^{12}$ ohms with a ballistic galvanometer. The rather obvious method of measuring the small current passing through the given resistance under a P.D. of a few hundred volts by means of a condenser and a ballistic galvanometer does not appear to be generally known. By allowing this current to charge the condenser for any convenient time, and then discharging it through the galvanometer, currents may be measured far below the limit of the same galvanometer for steady currents. Any well-insulated condenser will suit, since the P.D. across it never exceeds a fraction of a volt. This method, which allows very small currents to be measured with simple and comparatively robust apparatus, would also appear to be well suited for use with photoelectric cells in certain cases. T. J. NOLAN, J. KEANE, M. CASSIDY, N. E. DOLAN: The chemical constituents of lichens found in Ireland (1). The lung lichen, *Lobaria pulmonaria*, collected in the Powerscourt Demesne, Co. Wicklow, was found to contain two constituents, a neutral substance which has been identified as *d*-arabitol, and a lichen acid to which the formula $C_{18}H_{14}O_9$ is given. The acid contains one methoxyl group. T. J. NOLAN: The chemical constituents of lichens found in Ireland (2). The lichen *Buellia canescens* gathered in Killiney, Co. Dublin, is found to contain at least two materials. One of these is diploicin, previously found by Zopf in the same lichen. Diploicin contains chlorine, contains no methoxyl group, is not reduced by hydriodic acid, forms an acetate, and with alcoholic ammonia gives a product containing one nitrogen atom. The second product, m.p. 196° C., which was described by Zopf as atronorin, is not atronorin; it contains no methoxyl group. H. H. JEFFCOTT: The approximate determination of the vibration of beams and the whirling of shafts. Comparatively simple tabular and graphical methods have been worked out for finding by successive approximations the deflections of beams under moving and vibrating loads, including the effect of inertia and damping forces. Similar methods are used for finding the whirling speeds of shafts. Report of the Irish Radium Committee for the year 1933: The report includes detailed statements submitted by some of the largest users of radon supplied by the Committee, giving particulars of the treatment of 466 cases of disease, both malignant and non-malignant, during the year 1933.

### PARIS

Academy of Sciences, June 4 (*C.R.*, 198, 1953–2032). R. FOSSE, P. E. THOMAS and P. DE GRAEVE: Dextrorotatory allantoin. Its presence in the vegetable kingdom (*Platanus orientalis*). Using a method of extraction in which all rise of temperature is avoided, the authors have isolated for the first time dextrorotatory allantoin: this readily takes the racemic form. J. COSTANTIN: The problem of the rust of wheat, and mountains. A discussion of the probability of growing wheat at high altitudes lessening the tendency to develop rust. GEORGES CLAUDE: The treatment of air with the view of extracting krypton and xenon as essential products, and on the application of these gases to incandescent lamps. An apparatus has been constructed treating 800 cubic metres of air per hour, capable of collecting 2/3 of the total krypton and xenon. An electric light bulb containing krypton instead of argon stood 100 per cent over-voltage without appreciable heating. LUCIEN DANIEL: Variations of seedlings of *Helianthus Dangeardi* at the seventh sexual generation. J. DIEUDONNÉ: The zeros of the derivative of a rational fraction. J. LE ROUX: Systems of co-ordinates transformable by the Lorentz group. PIERRE LANGLADE. Helicoidal gears. J. GRIALOU: Certain fluid movements. A. LAFAY: The effect of vortices transported by the wind. In wind-channel experiments, marked differences in stability were found according as the air was drawn from the outside air or used again after circulation. The cause of this difference was traced to the existence of eddies. TCHANG TE-LOU: The instability of the indicator diagram and the composition of the combustible mixture. R. TREMBLOT: The spectrum and orbit of the double stars Auriga. From spectroscopic observations on this double star the duration of the eclipse was deduced as 40 days and the radius of the star *K*5 as at least 208 times that of the sun. L. LOISEAU: The general equations of mechanics and electromagnetism. L. BOUCHET: The detection of damped Hertzian waves by a dry battery with a solid radioactive electrolyte and ionised air. ST. PROCOPIU and T. FARCAS: The Curie ferromagnetic point for thin layers of nickel, electrolytically deposited. The Curie point is higher for thin layers of nickel, the average increase being 17° C. YEU KI HENG: Certain compounds of tartramide and of tartramic acid. Description of reactions with ammonium molybdate, alkaline borates, copper hydroxide, aluminium hydroxide. JEAN BECQUEREL, W. J. DE HAAS and J. VAN DEN HANDEL: The paramagnetic rotatory power of siderose. Measurements were made at temperatures 14·13 K, 15·95 K, 17·98 K and 20·36 K on two specimens of siderose from different sources. The variations between the two minerals are large. R. SCHWOB: The velocity of detonation of solid explosives. E. CANALS and P. PEYROT: The fluorescence of some pure substances. Data are given for some thirty organic compounds, the fluorescence being referred to water as a standard. Some hydrocarbons (hexane, benzene, toluene, xylenes) show no fluorescence: all the oxygen compounds examined were fluorescent, as also were the cyclanes and their derivatives. F. FRANÇOIS: The preparation of antimony iodosulphide in the wet way. Description of the preparation and properties of SbSI. MLLE. R. MENDES DA COSTA: Stereomutation and absorption of the β-anisylacrylic acids. A. E. FAVORSKY and MME. T. I. TEMNIKOWA: The reciprocal transpositions of methylbenzoylcarbinol and of phenylacetylcarbinol. A case of a new keto-anolic tautomerism. The new type of tautomerism studied is distinguished by the simultaneous migration of two atoms of hydrogen instead of one in the usual type, and is named anolic instead of enolic. MARCEL GODCHOT and MAX MOUSSERON: The passage from one ring to another by the deamination of 2-aminocyclanols. Nitrous acid, reacting with 2-aminocyclohexanol at 0° C., gives cyclopentyl-

formaldehyde: cyclohexylformaldehyde is formed by a similar reaction. CHARLES COURTOT and IZAAK KELNER: The existence of privileged substitution positions in diphenylene sulphide. R. PERRIN: Metamorphism. An application of the known changes occurring in slags during contact with the furnace walls to geological phenomena. ALBERT F. DE LAPPARENT: The trend of the Rognette synclinal. LOUIS BESSON: The influence of temperature and season on mortality. The number of deaths due to diseases of the respiratory organs in Paris is at a maximum in February, March and passes through a minimum in August. PIERRE CHOUARD: The characteristic structure of the bulb in *Scilla*, section *Euscilla*. Confirmation of the value of the method of classifying bulbous plants by the mode of growth of the bulb. J. CHAZE and M. M. JANOT: The chemical characterisation of the volatile alkaloids emitted by the hemlock. Definite proof of the emission of conine vapour from hemlock. J. BEAUVERIE: The individual resistance of micro-organisms, yeasts in particular, to ultra-violet radiations. MICHEL FLANZY: The presence of methyl alcohol in alcohols from wine, marc and fruit. All these alcohols contain naturally methyl alcohol. MLLE. PAULE LELU: The comparative digestive utilisation of albuminoid matter in various animal species. The pig has a higher coefficient of digestion than other animal species. B. S. LEVIN and C. PIFFAULT: The increase of the radioresistance of the Protozoa by lecithin in colloidal solution. CL. GAUTIER and R. RICARD: The spectrographic study of ox bile. Manganese appears to be one of the elements eliminated by the bile. ALBERT LAMBRECHTS: Appreciation of the quantity of phlorhizin in the liver and kidneys after intravenous injection in the dog. It is possible by the method of ultra-violet spectrography to detect and estimate phlorhizin in the liver and kidneys. RAPPIN: The microbial etiology of cancer.

### CRACOW

Polish Academy of Science and Letters, March 5. M. MIESOWICZ: The refractive indices of some liquids in the domain of the short electric waves. The wavelengths employed were 7·1 cm. and 6·2 cm., an interference method being used. In all the liquids examined except water, the same value was obtained as with very long waves: water, with the shortest wave, gave a slightly higher value. S. DOBINSKI: The viscosity of liquid phosphorus. The results of the measurements suggest that the molecules of phosphorus are associated below 49° C. K. DZIEWONSKI, J. MOSZEW, J. MAKSYMOWICZ and P. TRZESINSKI: A new method of synthesis of compounds derived from quinoline (5). An account of derivatives of 2-phenyl-4-aminophenylquinoline. K. DZIEWONSKI, L. KWIECINSKI, L. STERNBACH and ST. KAMMER: Studies on 1-phenyl-2-aminonaphthylketone. MLLE. O. MYRC: The high peat bog of Strutyn in the neighbourhood of Dolina. The results of a pollen analysis of the peat, with deductions. M. JANICKI: Contribution to the biology of *Dioctophyme renale*. J. ZACWILICHOWSKI: Researches on the innervation of the sensorial organs of the wings of *Phyllodromia germanica*. TH. VETULANI and ROB. SCHULTZE: The hypothesis of the small Polish horse representing the steppe 'tarpan' type, especially that of the sylvan 'tarpan' (3). J. KRUSZYNSKI: Cytochemical experiments on the incinerated nerve cell. Results obtained from the study of incinerated sections (spodogram) of nerve.

### LENINGRAD

Academy of Sciences (*C.R.*, No. 8). S. SOBOLEV: A new method for the solution of Cauchy's problem. G. SOKOLOV: A property of trigonometric sums. V. FOCK: A certain definite integral connected with the cylindrical function $K_v(X)$. D. EROPKIN and V. KONDRATJEV: The atmospheric bands of $O^{16}O^{18}$ in the solar spectrum. S. SHUBIN and S. VONSOVSKIJ: Contribution to the theory of exchange interaction. I. TAMM and S. ALTSCHULER: The magnetic momentum of neutrons. S. FRISCH and V. MATVEJEV: Properties of atomic nuclei of certain elements. J. M. TOLMACHEV: Qualitative and quantitative determination of lithium, rubidium and cæsium by spectroscopic methods. V. TCHULANOVSKIJ and M. MOCHNATKIN: Fine structure of the line He II, 1640 A. V. TCHULANOVSKIJ: The rotation structure of the band of the nitrogen molecule in the Schumann region. G. KRUTKOV: Linear problems of the theory of Brown's motion (1). I. KURCHATOV, G. SCHEPKIN, A. VIBE and V. BERNASHEVSKIJ: γ-Rays in the bombardment of boron with protons. A. BRODSKIJ and F. TRACHTENBERG: The application of the theory of Debye and Hückel to non-aqueous solutions. M. NEMTSOV and G. SIPOVSKIJ: Investigation of catalysts for destructive hydrogenisation (1). Hydrogenisation of naphthalene in the presence of molybdenum sulphide. V. SADIKOV, V. A. VADOVA and R. KRISTALLINSKAJA: Fractionation of protein catalysts with the help of organic extract substances (2). R. BELKIN: Studies in regeneration in Amphibia (1). Regeneration of legs on the back. B. ISATCHENKO, M. ONTCHUKOVA, A. PREDTETCHENSKAJA and T. LIPSKAJA: Spontaneous heating of grain. One of the main factors is the humidity of the grain. E. ASRATJAN: Systematisation in the work of the great hemispheres of the brain. O. WALTHER and M. LILIENSTERN: Contribution to the diagnosis of sex in hemp. The growth cones of hemp are biochemically differentiated in respect of sex and may be used for the diagnosis of sex in the early stage of the development of hemp. G. VERESCHAGIN: Thermal properties of running water.

### VIENNA

Academy of Sciences, April 26. JOSEF HOFFMANN: Radiation changes in the lead oxide series and also of various mixtures of metallic oxides or salts with arsenic. ANTON KAILAN: Chemical actions of penetrating radium radiation. (20). Action on aqueous solutions of glycerol, isobutyl and ethyl alcohols, and benzene. For the three alcohols named, the value of $m$—the number of equivalents of mono- or dibasic acid formed per second of irradiation period in excess of that given by the non-irradiated liquid—is of the same order of magnitude as $n$, the number of ion-pairs which would be produced in the vapour of the liquid by the part of the β- and γ-radiation absorbed by the liquid. The same holds for the aldehyde formed. With benzene, however, $m$ appears to be 0·1–0·01 times $n$. FRITZ ASINGER: Migration of bromine during the side-chain chlorination of bromotoluenes. No loss of bromine occurs during this migration, and it is assumed that the reaction depends on the formation of chlorine bromide. ANTON WACEK and HEINRICH LÖFFLER: The detection of certain volatile amines with the view of the investigation of biological processes. Various modifications have been made in Klein's method of detecting these amines. ERNST BEUTEL and ARTUR KUTZELNIGG:

Keratin: (1) the lead sulphide reaction. The action of light on horn and wool apparently converts part of the sulphur of the keratin into the sulphide ion. KARL SCHWARZ: The velocity in heavy water ($D_2O$) of the ester hydrolysis catalysed by hydrogen ions. As is the case with the inversion of sucrose, the velocity of hydrolysis of methyl or ethyl acetate in heavy water at 25° is greater by 50 per cent than in ordinary water. FRITZ KLUTKE: Relaxation vibrations and production of vibration. A new theory of so-called relaxation vibrations, making use of linear differential equations with step-wise alterable coefficients, is described. FRIEDRICH LAUSCHER and FERDINAND STEINHAUSER: Further investigations on the radiation in Vienna and its neighbourhood. JOSEF KEINDL: Geomorphological studies in northern Norway. LEONORE BRECHER: Location of the formation of tyrosinase in caterpillars (*Pieris brassicæ*, L.) prior to pupation. KURT EHRENBERG: Comparative investigations on the skull and teeth of the cave hyena and its living cognates.

May 3. ERNST KATSCHER and HANINA LEHR: Derivatives of symmetrical and asymmetrical *m*-xylenol. The constitutions of various derivatives are indicated. EGON JUSA and GEORG BREUER: Influence of the position of the mercapto or methylmercapto group on the colour of the monosubstituted α-naphtholazo dyes. In the 7-position the mercapto group has a hypsochromic, and in the 6- or 8-position a bathochromic effect. In all three cases methylation of the mercapto residue displaces the colour towards the blue. EGON JUSA and LEO GRÜN: Influence of position isomerism and methylation at the sulphur on the colour of mercapto-α-naphtholazo dyes. ANTON KAILAN and VALERIE KIRCHNER: Measurements of esterification velocities and viscosities in ethyl alcoholic hydrochloric acid, with and without added neutral salts or benzophenone. ANTON KAILAN and LEO JUNGERMANN: Esterification velocities of substituted fatty acids. The retarding effect of various substituents on the esterification velocity of acetic acid increases in the order, Cl, Br, $C_6H_5O$, I, CN. When a bromine atom replaces a hydrogen at an α-carbon atom, the retarding effect increases with the length of the carbon chain. FRANZ PATAT and HANS HOCH: Contribution to the determination of spin and statistics of the deuton nucleus from thermal data. The use for this purpose of two methods, namely, determination of (1) the constants of the equilibrium $H_2 + D_2 \rightleftarrows 2HD$ at low temperatures, and (2) the conversion of para- into ortho-deuterium, is discussed. KARL MAYR: Iteration of linear functional operations. FRITZ SÖCHTING: An approximation solution of Varignon's problem. FRITZ LIEBEN, LUISE LÖWE and BELLA BAUMINGER: Decomposition of highly polymeric carbohydrates, lactic and pyrotartaric acids in the light of the quartz lamp. MAX BEIER: Preliminary report of a zoological excursion to western Greece.

## Forthcoming Events

INTERNATIONAL CONGRESS OF ANTHROPOLOGICAL AND ETHNOLOGICAL SCIENCES, July 30–August 4. To be held at University College, London, W.C.1.

TWENTIETH INTERNATIONAL CONGRESS ON ALCOHOLISM, July 30–August 30. To be held at the Imperial Institute, South Kensington, London, S.W.7.

## Official Publications Received

### GREAT BRITAIN AND IRELAND

Micro-Chemical Methods suitable for General Analytical Practice. By Dr. H. V. A. Briscoe and Dr. Janet W. Matthews. (Two Lecture-Demonstrations.) Pp. 42. (London: Institute of Chemistry.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1574 (I.C.E. 959): Effect of Fuel Evaporation on Performance of a Centrifugal Supercharger. By G. V. Brooke. Pp. 15+7 plates. 1*s.* net. No. 1580 (T. 3387): Frictional Drag of Flat Plates below the Critical Reynolds Number. By A. Fage. Pp. 7+2 plates. 6*d.* net. (London: H.M. Stationery Office.)

Report of the Department of Agriculture of the University of Leeds and of the Yorkshire Council for Agricultural Education for the period 1st October 1932 to 31st March 1934. Pp. 20. (Leeds.)

Leeds University: Department of Pathology and Bacteriology. Annual Report by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research by Prof. R. D. Passey, 1933. Pp. 15. (Leeds.)

Board of Education: Welsh Department. Education in Wales: Report of the Board of Education under the Welsh Intermediate Education Act, 1889, for the Year 1933. (Cmd. 4610.) Pp. 20. (London: H.M. Stationery Office.) 4*d.* net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 6: A Convenient Method of Measuring Resistances of the order of $10^{12}$ Ohms with a Sensitive Ballistic Galvanometer. By Dr. J. H. J. Poole. Pp. 57–58. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d.*

### OTHER COUNTRIES

Cornell University Agricultural Experiment Station. Bulletin 580: Pruning and Training Tomatoes. By H. C. Thompson. Pp. 14. Bulletin 581: Factors Influencing the Occurrence of Potato Scab in New York. By F. M. Blodgett and F. B. Howe. Pp. 12. Bulletin 582: Relation of Cities and Larger Villages to Changes in Rural Trade and Social Areas in Wayne County, New York. By Harold C. Hoffsommer. Pp. 61. Bulletin 583: The Relationship of the Open-Country Population of Genesee County, New York, to Villages and Cities. By Edward A. Taylor. Pp. 59. Bulletin 584: Relationships of Open-Country Families of Onondaga County, New York, to Socio-Economic Areas, Villages and Cities. By Alfred Moore Paxson. Pp. 71. Bulletin 585: An Economic Study of the Marketing of certain Perishable Farm Products in Albany, New York. By Wilbert C. Hopper. Pp. 61. Bulletin 589: A Study of the Effect of removing Foremilk on the Fat Content of the Remainder of the Milking. By H. E. Ross and Helmuth Winther. Pp. 7. Bulletin 594: Production of Early Blooms of Chrysanthemums by the use of Black Cloth to reduce the Length of Day. By Kenneth Post. Pp. 30. Memoir 151: Manganese an Essential Element for Green Plants. By Edwin Fraser Hopkins. Pp. 40+5 plates. Memoir 152: The Relative Growth and Development of Corn Varieties of widely Different Maturity Dates during Successive Time Intervals throughout their Life Cycle. By R. G. Wiggans. Pp. 36. Memoir 162: Longevity of *Rhizobium japonicum* in relation to its Symbiont on the Soil. By J. K. Wilson. Pp. 11. (Ithaca, N.Y.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 35, Part 2: On the Ethereal Sulphate, the Essential Constituent of Agar-Agar. By E. Takahashi and K. Shirajama. Pp. 101–132. Vol. 35, Part 3: Supplementary Notes on the *Platypodidæ* of Formosa, IV. By Jozo Murayama. Pp. 133–150. (Tokyo: Maruzen Co., Ltd.)

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University. Čis. 185: Doba polovičních srážek a periodická amplituda ročního srážkového průběhu v Československu (Temps des demi-précipitations et l'amplitude moyenne de la période des précipitations atmosphériques annueles en Tchécoslovaquie). Napsal Bohuslav Hrudička. Pp. 22. Čis. 186: Aromatické sulfonany prvků druhé skupiny periodické soustavy (Salts of Aromatic Sulphonic Acids with the Elements of the Second Group of the Periodic System.) Napsali V. Čupr a J. Širůček. Pp. 23. Čis. 187: O stočených skupinách krystalů křemnených ze Švýcar (Sur les groupements tordus des cristaux du quartz de Suisse). Napsal Dr. V. Rosický. Pp. 31. Čis 188: Užití teorie homologie na teorii souvislosti, I (Applications de la théorie de l'homologie à la théorie de la connexite, I). Napsal Eduard Čech. Pp. 40. Čis 189: Příspěvek k studiu kladélkové pochvy bylinných vos rodu *Arge* Schrk. a *Schizocera* Lep. and Serv. (Beitrag zur Kenntnis der Sägescheide der Blattwespengattungen *Arge* Schrk. und *Schizocera* Lep. and Serv.) Napsal Emil Hachler. Pp. 11. Čis. 190: Detektory mechanických kmitů (Über die detektoren mechanischer Schwingungen). Napsal Josef Zahradníček. Pp. 26. (Brno: A. Píša.)

Spisy Lékařské Fakulty Masarykovy University. Svazek 13, Spis 125–131. Pp. 204. (Brno: A. Píša.) 30 Kč.

### CATALOGUES

Cambridge Automatic Regulators. (Folder No. 41.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

First Aid for the Car. Pp. 28. (London: Sternol, Ltd.)

B.D.H. 'Spot' Test Outfit. Pp. 4. (London: The British Drug Houses, Ltd.)

Books, Periodicals and Pamphlets on Entomology. (New Series, No. 35.) Pp. 44. (London: Wheldon and Wesley, Ltd.)

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