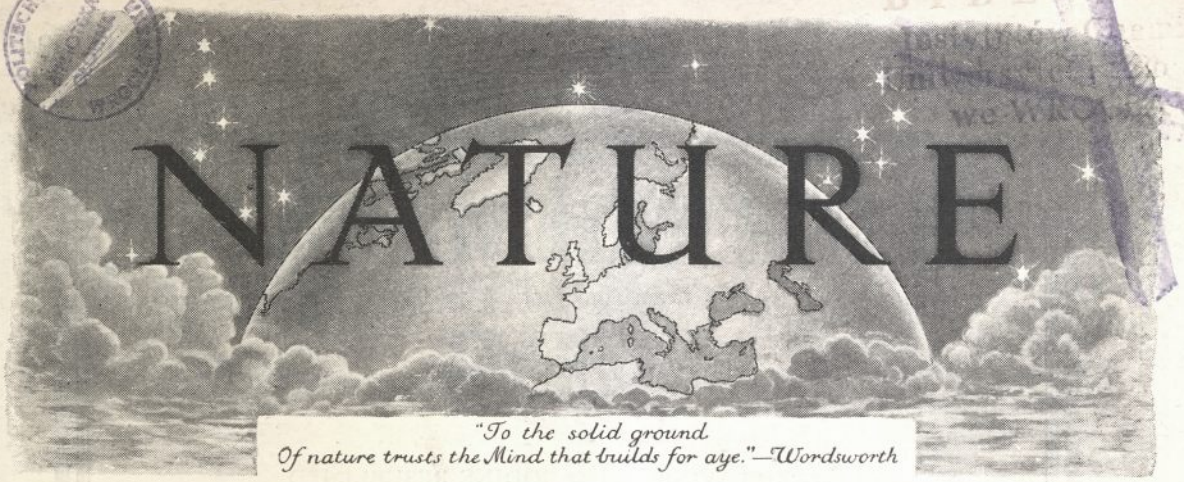

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CONTENTS

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WELFARE OF YOUTH

ONE of the most remarkable developments that the War has brought has been the concentration of interest on the so-called youth movement. This has been due in large measure to the increasing attention that is being devoted to the question of maintaining good standards of health during the periods of early and late adolescence in order that the valuable work performed by the school medical services might not be undone before maturity is attained. The transitional period marking a young person's introduction to industrial life is properly regarded as being critical from the health point of view, and every attempt at improving those facilities which promote the cultivation of positive attitudes towards health and conduct is bound to receive sympathetic consideration as an effective means in the building of character. Unfortunately, many individuals who bear the responsibility for safeguarding the interests of youth, and particularly some who have voluntarily undertaken work in the various youth organizations, have become extremely suspicious that the attention which is being given to the fourteen to twenty age-group has been artificially engendered with the sole object of providing recruits of a better standard of fitness for the armed forces, and that the continuance of the interest is unlikely to survive when the peace comes (see p. 647 of this issue). This must never be ; the object of any youth movement must be to produce citizens worthy in mind and body of a worthy heritage.

Yet the circulars, "The Service of Youth" and "The Challenge of Youth", issued by the Board of Education during the past year, have, in a few cases, served to strengthen this suspicion because of the emphasis given in them to physical education. Where the circulars have been read in the spirit with which they were written, however, all doubts on this point are readily dispersed. The Board of Education must be credited with having made a genuine attempt to point the way towards the development of a youth movement which should not only become well established during the War, but would also form a highly significant and invaluable means of reconstruction in the peace which is to come.

A more widely held suspicion on the part of youth leaders relates to the steps which the Board of Education has taken in order to encourage interest in questions pertaining to youth. The setting-up of the National Youth Committee soon after the outbreak of War was greeted with acclamation by the many but with very real apprehension by a vociferous minority. The latter regarded this pronouncement as but the first of a series which would lead eventually to what they imagined would be the compulsory regimentation of youth and gradually to the superceding of all voluntary activity and initiative. In no way does one wish to subscribe to this point of view, but it must be said that the situation has been allowed to continue in such an atmosphere of doubt and uncertainty that the National Youth Committee has, by its own unbroken reticence, contributed in great part to the present state of confusion. The position needs immediate clarification if the services of many of the already active youth leaders are to be retained, and if, as is so urgently required, we are to see the extension of the youth programme according to a national policy.

The function of the National Youth Committee appears to have been as carefully concealed as has

been its constitutional powers and terms of reference. From time to time statements from individual members of the Committee appear in the educational Press but little evidence is forthcoming that the Committee is actively working. The statements themselves are usually of a complacent nature, and express considerable satisfaction at the way the voluntary youth organizations are promoting activities which will guide the young people of the country to fuller and richer lives. One cannot fail to accord a grateful sense of appreciation for the work being carried out by the voluntary organizations; but many of their own workers are seeking both the direction in which the youth policy is to proceed and means to promote the efforts required. This was expressed very clearly recently in a journal devoted to the interests of a boys' movement, when a writer remarked that the only certain fact about our national youth policy was its non-existence. The difficulties confronting those individuals who are only too anxious to undertake service for youth demands confronting with a resolution born of imagination and matter-of-fact realism. In both respects the National Youth Committee could do more to retain and improve the active support of youth workers.

The problem of dispelling doubts about regimentation is one that will demand the use of considerable tact and discretion. In a recent statement in the House of Commons, the President of the Board of Education stated categorically that the last development he wished to see was a centralized movement with rigid uniformity and standardized practice, which placed older boys and girls under the control of some super-functionary in the central Government. Mr. Ramsbottom's disclaimer about militaristic interpretations of the youth scheme was equally strongly worded. It is to be hoped that the action taken, based on these utterances, will serve to dispel the fears of youth workers and to secure their continual and ungrudging support. Probably much of the existing confusion about regimentation lies in the lack of distinction between freedom and discipline. Nevertheless, to establish this distinction to the satisfaction of democrats is not so easy. The main aim should be to fuse the two. Lack of discipline will obviously lead to chaos, and on the other hand absolute freedom is undesirable for it implies freedom of action, expression of opinion, etc., whether right or wrong. Much time is often wasted by the expression of conflicting opinions concerning a problem which to a balanced mind is already settled. There can be few more exasperating than he who claims his freedom to express his opinion merely in order to argue for argument's sake.

The plight of many youths of both sexes who are 'free' to walk aimlessly about or lounge at corners or in queues with no sense of meaning or purpose in life is too well known to need further comment. The most conservative estimates suggest that at least 60 per cent of our young people have no connexion with any single organization, educational, social, or religious. War work has given most of them employment but has not solved their leisure problems and, in some cases, has only intensified them. Their difficulties will not be entirely solved by the extension of the physical fitness scheme on the lines proposed by the Board of Education, nor even by the provision of opportunities for extending their social and cultural interests. Youth needs a sense of significance in life for the individual and the community; suspicions about regimentation need offer no excuse for lack of guidance. The necessity for imaginative planning and disciplinary action is clearly indicated. Already, many youth leaders are advocating compulsory attendance for all young people at some kind of youth organization. At the moment, the execution of such a proposal is probably unwise and equally impracticable; but, as a matter which will inevitably grow in intensity, merits earnest consideration. Its proponents have the fact of compulsory school attendance up to the age of fourteen years to strengthen their case. They are asking, almost with passionate conviction, why, in the most formative years of their lives, when they are acquiring those habits of body, mind and spirit which determine their whole usefulness to themselves and to the community, the majority of our future citizens should be left to the influence, good or bad as it may be, of their surroundings. Whatever the policy adopted it is essential that the spirit of the voluntary organizations with its enthusiasm and informality should be retained and used as the basis for all future developments.

Another matter upon which clearer light might be thrown relates to the activities of local youth committees. Apart from one or two recalcitrant authorities, who may need disciplinary action to call out their initiative in planning for the welfare of the youth of their area, it appears that these committees have now been formed under the ægis of each local education authority. Their con-

stitutional powers, aims, and methods of working have been left to local incentive. Already there is ample evidence that, owing to the cautious utterances of the Board of Education, a great sprawling organism is being formed, both unwieldy and uncontrolled. In some cases these youth committees have been constituted merely in an advisory capacity to the local education committee and themselves possess no statutory powers. In others, sub-committees of local education committees have been formed with full statutory powers, while in yet others entirely independent committees have been created. Whatever the method of constitution, it would seem essential for smooth and successful working that these committees be given sufficient elasticity to allow them to develop their planned programmes without being held too tightly under the control of the education committee. At least one secretary-organizer to each committee would appear the necessary minimum for administrative supervision, while it should be strongly urged that religious leaders with experience in youth work should be given greater representation than has hitherto been apparent. Discreet guidance, combined with more dynamic leadership from the central government, would do much to unify the existing diversities and would serve to stimulate retrograde or passive committees into action which is so urgently required.

The calling into being of these youth committees appears to have proceeded so smoothly—albeit scarcely rapidly—that the complacent references in the Press appear to be well merited. In practice, many local authorities have travelled no farther on the road towards the service of youth than was evident a year ago. Credit must be freely given to those authorities who for some months have been actually promoting youth work. Their enthusiasm and progress should serve as a salutary reminder to the greater number of youth committees, who, up to the present, have functioned in name only. The proposals outlined by the Board of Education a year ago should have been carried to a riper stage than has been reached to-day.

Co-operative understanding between youth committees and the voluntary organizations should do much to promote the welfare of youth. On their side, the youth committees should play their part in seeing that emphasis must never be placed on the consolidation of youth work but on its extension and development. The challenge to the youth organizations will be in seeing that the quality of local work is such that it cannot fail to stimulate youth committees to increasing and active support. In many areas, prominent educationists have been self-confessedly amazed at the quantity and quality of youth work that has been carried out in their own areas for some years past without their knowledge. With the collaboration of the educationists, far-reaching measures can be taken to secure the extension of instructional, cultural, and social facilities of all kinds. Vigorous co-operation with the youth committees should allow the voluntary organizations to become doubly active in promoting courses for the equipment of potential youth leaders. The youth leaders themselves should be continuously engaged in pursuing enquiries as to the needs, interests, industrial occupations, home and surrounding conditions, as well as the usual leisure activities of youth. (In this connexion the parts played by the public cinemas and radio as educative processes must not be forgotten or minimized.)

The need for the carrying out of scientific surveys—similar to the one in progress in Manchester and Salford at present—is of overwhelming importance. Where these surveys are not being envisaged, however, youth leaders can, by discreet inquiry, secure information that will become of increasing value if carefully collated. When the nature and extent of the youth problem has been established, it is to be desired that an intensive drive should be launched to persuade boys and girls unattached to youth organizations to become active participants in youth centres. This drive may eventually become one of personal recruitment before the adolescent has left school. A considerable augmentation of existing youth services would be needed to cater for this project.

One factor which inevitably must serve to promote greater effort in the youth field would lie in a better appreciation by society at large of the amount of work already achieved by the national voluntary organizations. A deeper realization on the parts of educationists, men of science, and all other members of the community that the work in boys' and girls' clubs, etc., is no mere side-issue carried out by zealous individuals with little else to do, would contribute greatly to the extension of youth welfare. The comprehensive development of the national youth movement will rest upon the rapidity with which its absolute necessity and importance becomes impressed upon the mind of the general public.

WORLD BIBLIOGRAPHY

The Subject Index to Periodicals, 1939

Issued by the Library Association. Pp. xi + 270. (London : The Library Association, 1940.) 77*s*.

HOW seldom do those engaged in developing a new idea for the national effort pause to consider the patient drudgery expended daily in the production of the bibliographical guides whereby to cull the information recorded about that idea. Still less often do they inquire whether these bibliographical aids to research are organized to provide the whole of the relative information recorded. We realize the necessity of finding the best brains for war-time research ; but we fail to understand the basic value of a complete index to scientific and technical knowledge. Nor do we appreciate the facts that such an index is not to hand, and that we are wasting time and human lives in repeating work already on record, if we could but find it. The bibliographical work and its organization are accepted as a matter of course. Nothing less than their sudden death seems likely to awaken the necessary interest ; though, in war-time, special arrangements have to be made to prevent this calamity, while completeness of the work becomes especially needful.

In regard to the latter desideration, there are two methods by which the fifteen thousand scientific and technical periodicals containing useful articles, published currently in Great Britain and abroad, can be scrutinized regularly and have their worth-while papers abstracted or indexed. Each periodical can have its articles dealt with, working from the beginning to the end of each number as it appears ; or, the whole mass of periodicals can be searched from the point of view of each particular branch of knowledge, and those articles relative to each branch picked out. The former method insures that every article is noted ; the latter involves greater labour and the risk of missing articles on each subject that appear in periodicals devoted to other subjects, remotely related.

The former method was adopted by the International Catalogue of Scientific Literature. It is the method that appeals to librarians in seeking to catalogue the literature in their libraries. This is the method chosen by the Library Association for the "Subject Index to Periodicals", edited by J. Rowland Powel, of which the 1939 volume is before us. The periodicals indexed in this volume comprise a selection of 577 English and foreign journals and transactions of societies, filed in a number of libraries all over the British Isles, the names of which are quoted in the 1937 and 1938 volumes of this index. The current volume contains some 40,000 references, referring in the main to articles of scientific and technical interest. Verse and fiction are not included. Brief annotations are added to titles not sufficiently indicative of the subject of the articles.

With certain exceptions, journals covered by some of the more important abstracting services are not indexed. Therefore, this work forms a useful supplement to the works of reference published by these bodies and becomes, itself, a necessary adjunct to the library. No praise is needed for the care taken in the preparation of this work now so well known and so much appreciated. The one criticism that many will make is that, like the majority of abstracting and indexing periodicals, it makes use of the alphabetical system of arrangement : a system that scatters, without reason, information on similar subjects, prevents the possibility of incorporating the index as part of a comprehensive index to scientific and technical information and hinders collaboration between the many agencies engaged in this important work of making information available. In the realm of science and technology alone, there are some three hundred abstracting and indexing journals, four fifths of which are arranged alphabetically by different systems and in different languages. These have to be selected and searched separately, volume by volume, and part by part to find what has been recorded about any particular subject, thus multiplying the labour of every inquiry.

When we consider the number of periodicals it scrutinizes and the aggregate of references included, the volume under review represents a great deal of patient labour. What the compilers of most of these works of reference do not consider is the fact their own particular volume contains only a fraction, in this case one twentieth, of the yearly total output of scientific and technical articles, or, say, one thousandth of the references to useful articles published in the last fifty years, and that, necessarily, serious readers must use other works of reference as well. It is important to study how to make each index the most efficient contribution to a comprehensive index to knowledge, in which all the references to any particular topic come together, no matter when or where they were published.

Such an index can, and will, be achieved by the co-operation of indexing agencies. Since its foun-

dation in 1928, the British Society for International Bibliography has worked to secure such collaboration. A National Committee of Representatives of Abstracting and Indexing Services has now been formed by the Society. This committee will investigate and solve the problems involved in indexing every useful article in the world's output of scientific and technical literature, and the associated services will work in free co-operation to produce a comprehensive index. In order that a standard system of indexing may be made available, the British Standards Institution has arranged to publish the fourth edition of Universal Decimal Classification as a British standard. In accordance with the practice of that Institution, each section of the classification will be produced in collaboration with institutions, societies and individuals specially interested, so that the classification will have the approval of expert opinion. The Library Association is represented on the Publication Committee and will give its valuable aid to this great work. Thus there is, at last, good hope that a comprehensive index to knowledge will be achieved and in the most efficient form.

THERMODYNAMICS AND CHEMISTRY

(1) Thermodynamics and Chemistry

By Prof. F. H. Macdougall. Third edition. Pp. ix+491. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

(2) Thermodynamics

For Chemical Engineers. By Prof. Harold C. Weber. Pp. vii+264. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 19*s*. 6*d*. net.

(1) PROF. F. H. MACDOUGALL'S book was recognized in its two previous editions as particularly suited to the needs of students of chemistry, and in the new edition, which has been extensively revised since the appearance of the second edition in 1926, this feature is again maintained.

Apart from minor but useful changes in various parts of the text, the main alterations comprise a much more detailed treatment of fugacity and activity and of the modern theory of strong electrolytes than was contained in previous editions. The last chapter contains a brief but clear account of the methods of calculating thermodynamic functions by statistical methods, and this should serve admirably as an introduction to the larger works on this subject. Examples are given at the ends of the chapters but unfortunately no answers are provided, which seriously diminishes their utility to both students and teachers. As in previous editions, an appreciable part of the book is concerned with phase rule diagrams, and although this provides a welcome break for the student by leading him through easy paths before taking him into the more difficult part of the book which follows, it is doubtful whether this matter is not better dealt with in a separate treatise.

The whole book is carefully written and the standard is high; many rather obscure points which are either not mentioned at all in other works or are not sufficiently explained are here clearly elucidated. As is to be expected, particular emphasis is laid on electrochemistry, since this has contributed so largely to modern research in the fields with which the book deals. Every advanced student of chemistry could read this book with profit.

(2) Prof. H. C. Weber's book strikes a new note in the literature of thermodynamics. The engineer has long made use of the thermodynamic functions but is probably not very familiar with the chemical applications of the subject, and although the chemist has very recently become aware of the immense utility of thermodynamics, he has usually very little knowledge of those parts of the subject which do not deal with systems in equilibrium of the type which he aims at setting up in the laboratory. Such subjects as the flow of fluid, refrigeration, the various types of power-cycles, and the thermodynamics of steam and internal combustion engines, are outside the scope of books devoted to the chemical aspects of thermodynamics. They are, however, vitally important to the chemical engineer.

The present book attempts to correlate these two branches of the subject. It deals with the engineering aspects in a way calculated to attract and inform the chemist, and with the chemical aspects in a form which the engineer would do well to assimilate. In the second field, there are chapters on fugacity and activity, equilibrium constants, partial molal quantities, electrochemistry, and the so-called third law. The book thus lays the foundations of a treatment of thermodynamics which is particularly suited to the chemical engineer. There are good numerical examples at the ends of the chapters but, as is so often the case with American books, no answers are provided.

J. R. PARTINGTON.

FOOD FROM PRODUCER TO CONSUMER

Britain's Food Supplies in Peace and War

A Survey prepared for the Fabian Society by Charles Smith. Pp. x+290. (London: George Routledge and Sons, Ltd., 1940.) 10*s*. 6*d*. net.

THIS book opens with a brief and sound chapter on the need for a food policy. It includes, in separate chapters, data on bread, milk and milk products, eggs, meat, bacon, fish, vegetables and fruit, tea and sugar. The foundation for a food policy must be requirements for health, and the general standard used is the amount required when consumption in lower income groups in Orr's "Food, Health and Income" is raised to that of Group IV, higher groups continuing as before. For milk, the higher scale recommended by the Ministry of Health Advisory Committee on Nutrition is used. These detailed discussions are followed by general chapters on agriculture, distribution, food in war and the improvement of nutrition.

The main interest of the book lies, not on the strictly nutritional side, but in its presentation in concise and clear form of valuable data on the marketing and distribution of food, the structure of food prices and the way in which both production and consumption of essential commodities are controlled by a relatively small number of powerful combines of processing and distributing firms. The extent to which this is the case may surprise the general reader. It is good that he should understand the position. Government attempts at interference have, in some cases at least, strengthened this control.

There is not much reason to expect an important rise in consumption of bread if the price is reduced; rather will money be set free for buying other foodstuffs. That is true and might have been put even more strongly. Among the poor, a rise in the price of bread means more consumption, not less, because bread is the basic energy food against which all others compete. The production of bread is dominated by the millers, chiefly the Millers' Mutual Association which mills 80 per cent of the flour, and the co-operative societies. The price of bread is fixed, within a prescribed scale, by local bakers' associations which, by an extraordinary system of threats of stoppage of flour supplies, arranged apparently with the millers, prevent bakers from selling below that level. The efficiency of the baking industry is often low, and the cost of distribution is extravagantly high. The controlling part played in other industries by groups of processing and distributing firms is equally interesting.

The book is open to criticism on several heads. The text is marred by minor peculiarities, and inconsistencies in the figures quoted occur without comment. It is more disappointing that the author has so often failed to trace the implications of his policy of expansion of production beyond the first stages. For example, when he envisages an expansion of milk production to meet his stated liquid milk requirements and at the same time to maintain a butter and cheese industry in competition with that of New Zealand, he does not appear to appreciate the difficulty under which the dairy industry in Great Britain, with its intensive feeding practice, would compete with that of New Zealand with its extensive system of pasturage. He does not make clear whether he wishes supplies of dairy products from sources outside the Empire to be eliminated. If so, this alone would mean doubling our milk production, and, if we also competed with the Empire on the butter and cheese markets, doubling (with substantial improvements in average yield per cow) or possibly trebling our cow population. In such a case, is he prepared to see the beef market supplied only or chiefly with home-fed cow beef and veal, or would he eliminate imported chilled meat? Expansion of home production of dairy products raises both primary and subsidiary problems of disposal and world price elsewhere. A country which imports two thirds of its food cannot solve the very numerous problems of price and purchasing power which arise by adjustment within its own borders alone. He touches on the problem of the low standard of living in India and the West Indies when he discusses tea and sugar, but neglects it in connexion with the supply of oil-seed concentrates for cattle. To discuss such problems would, however, possibly require a second volume.

In any event, there are plenty of problems within the country which call for solution. It can scarcely be questioned that the country cannot afford the very expensive services of the combines which organize so much of our food supply. The proposals made here cannot be considered as solving more than a small part of the problems and, in particular, not the main problem of adjustment of the earnings of different productive industries, including agriculture, so that they are balanced against each other. But they do direct attention to a number of important points at which economies

could be made, even without tackling the bigger problems. The chief of these is the "socialisation" of processing and distribution. There is little room for argument as to the desirability of control. The question of how much of the possible saving should be passed on to the consumer and how much should revert to the producer raises all the attendant issues already suggested.

NUTRIENT SOLUTION CULTURE OF PLANTS

Soilless Culture Simplified

By Prof. Alex Laurie. (Whittlesey House Garden Series.) Pp. xiii + 201 + 14 plates. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 12*s*. 6*d*.

MUCH interest has been aroused in this subject by virtue of the publicity afforded it by the popular Press and by a number of publications, many of which contain statements and claims which are unwarranted. It is refreshing, therefore, to find that the aim of the author of this book is "to present the actual status of the subject; to disabuse the average person, the enthusiastic gardener or the commercial grower of false notions; and to discuss the real possibilities that the field of chemical plant culture promises".

Prof. Laurie considers that before successful soilless culture can be accomplished, the grower must possess a thorough understanding of cultivation in soil. Accordingly, more than a half of the book is devoted to this latter aspect with chapters headed "The Soil and the Functions of Elements", "Nutrient Deficiency Symptoms of some Horticultural Crops", "Fertilisation of Crops in Soil and the Effect of Overdoses", and "How Plants Grow". Whilst there are many interesting details regarding flower culture within these chapters, their presence means that the title of the book does not correctly describe its contents.

From the point of view of nutrient solution culture, there are sections on the growing of crops in sand, growing of plants in "water", growing of crops in gravel and soilless gardening for the amateur.

The author, who is professor of floriculture in the Ohio State University, is mainly concerned with flower cultivation throughout the book, and the technique of growing carnations, sweet peas and other flowers in sand is described. It is noteworthy that satisfactory cropping has been obtained at Ohio when the fertilizer mixture (a complete fertilizer of the 15–3–15 type plus magnesium sulphate) has been applied *dry* to the surface of the sand bed at regular intervals. Such a method obviates the necessity of making up a nutrient solution and the bed requires water only in between fertilizer applications.

Little space is devoted to growing plants in "water", or "tank culture" as the method which has so fired the public imagination is sometimes called. Prof. Laurie points out that most unjustifiable comparisons have been made between plants grown in tanks of nutrient solution and those grown in soil, and is faithfully fulfilling his mission when he states that "No convincing evidence has yet been presented where on a large scale production in the greenhouse, crops grown side by side, one group in water and the other in soil, differed greatly in yields". For the inquiring amateur full details of this particular method are given, and it is pleasing to note the stress laid upon the need for adequate aeration of the nutrient solution when using this technique.

In the Floriculture Department of Ohio University, the sub-irrigation system involving the periodic flooding and draining of beds of gravel with the nutrient solution has found most favour. Consequently, Prof. Laurie gives authoritative details of the many aspects of this method and specific instructions for the growth of a number of flower crops. It is disappointing that in this section, which is the longest chapter on nutrient solution culture in the book, there is no reference to the growing of vegetable or other food plants. Much useful information is included on the construction and use of equipment including pumps and growing media, the formulæ of a number of nutrient solutions and their use, the testing and control of the *p*H of the solution, and the simple determination of some of the elements present.

The book ends with a chapter on soilless gardening for the amateur, and in bold relief is the author's own conclusion that as a hobby it is an interesting and absorbing subject, but that it is not yet ready for development on a large scale by commercial growers who need to look beyond the novel. That excellent flower crops can be grown in purely inorganic media and solutions is well demonstrated, and as Prof. Laurie points out when dealing with the sub-irrigation method "it should be noted that organic matter—so important when plants are grown in soil—becomes unnecessary because its functions are taken care of automatically, and the nutrients are presented in such form as to be readily available to the plant". If this book assists the reader to view in clearer perspective the role of organic matter in relation to the growth of plants, no mean service will have been performed.

W. G. Templeman.

THE ORMSKIRK POTATO RESEARCH STATION

By Dr. Redcliffe N. Salaman, F.R.S.

FROM the moment of its inception, the National Institute of Agricultural Botany included the potato as one of its major interests. However, before the Institute had time to formulate a constructive programme the Ministry of Agriculture handed to its care an orphan baby of doubtful parentage but intriguing personality, its wart trials at Ormskirk.

Since 1913, John Snell, a servant of the Ministry of Agriculture, had been conducting potato trials at Ormskirk on behalf of the Ministry, and in close co-operation with the local farmers who, alarmed by the rapid spread of wart disease in the north-western counties, had of their own initiative taken steps to test existing and new varieties of potatoes for immunity to wart disease.

These trials were conducted in the highly infected kitchen garden of the Ormskirk Workhouse. In 1917, Sir Lawrence Weaver, controller of supplies in the Food Production Department, learnt of these trials and obtained Ministry support for an extension of their scope, which was urgently needed. In 1918, Miss Johnston, later Mrs. Snell, joined the staff as chief assistant and remained until 1920.

In 1920 the National Institute of Agricultural Botany, which had itself only come into being in January 1919 took over the wart trials, together with the staff, which was enlarged by the accession of Mr. H. Bryan, formerly horticultural inspector to the Ministry of Agriculture, and Miss Whitehead, later Mrs. McDermott.

In 1920, John Snell died and Mrs. Snell retired. Harold Bryan was appointed in his place ; Miss Whitehead, who had been Snell's secretary, now became Bryan's chief assistant. These two officers have been responsible, under the Council, for all the work carried on at Ormskirk until this year, when the Ministry decided to close down the field wart tests. Throughout this entire period Mr. Sharrock, the farm foreman, ably seconded them in all their work.

With the susceptibility trials abolished, the National Institute of Agricultural Botany felt that the Station's *raison d'être* at Ormskirk had also ceased. It was realized that work to which the Council attached the highest importance, such as yield and maturity testing, and the selection of promising seedlings, which Ormskirk had made its own, could, in fact, be conducted to greater advantage in an uninfected area nearer to London and Cambridge. The break with Ormskirk, so far from marking the end of the National Institute's potato work, merely records the close of one stage, successfully accomplished, and the opening of another.

Mr. Bryan, who had been ailing for some time, died in August last, and Mrs. McDermott has been temporarily seconded to the Midland Agricultural Station, where her expert knowledge of varieties will find further, and it is to be hoped an extended, usefulness.

Although the Ministry of Agriculture handed over to the National Institute of Agricultural Botany the task of controlling the testing for wart disease, the expenses of which it defrayed, it still retained the exclusive right of registering immune varieties which had been declared distinct by the Synonym Committee. The consequence has been that for twenty years co-operation between the Ministry and the Institute has been of the closest.

The primary work of the Ormskirk Station was to test all established varieties, both English and foreign, for their reaction to wart disease. At the same time opportunity was offered to breeders to send their seedlings to Ormskirk at an early stage so that their susceptibility might be ascertained and those subject to disease in the field eliminated.

The survey of existing varieties immediately brought to light a state of affairs the existence of which had scarcely been realized and the magnitude of which outstripped the wildest imagination. I allude to what has been called, perhaps somewhat clumsily, the problem of synonymity. The meaning of this term is, according to the Oxford English Dictionary, simple enough, namely, "the identity of nature of things having different names". Thus a variety the original name of which is, let us say, 'Golden Splendour', is, when first put on the market, identified by certain clearly recognized characteristics. Its maturity, skin colour, shape, depth of eye, and the like, together create a picture which lends it an identity of its own and ensures its recognition. We soon found that scores of so-called distinct varieties, bearing every sort of name other than "Golden Splendour", but yet identical with the authentic type, were being sold by seedsmen large and small, with but a few notable exceptions throughout the kingdom.

Snell initiated the battle of the synonyms, but died before the work had got thoroughly under way. The National Institute of Agricultural Botany now took over the task and appointed a

committee of experts in 1919 to carry out the work, of which I have been chairman since its inception. The extent of the evil may be gauged by the fact that we found in existence some two hundred synonyms for the variety Up-to-date, and more than ninety each for Abundance and British Queen, whilst many seedsmen's catalogues recorded in glowing terms the superiority of the synonym to the mother stock, with which it had not infrequently shared the same sack in the store-house. In general, the synonym was priced at anything from 20 to 50 per cent or more higher than the original.

To-day the whole nexus of potato synonyms in Great Britain has, practically, been swept away. Much of the credit belongs to the Ormskirk staff; the fight was fierce at first, but such bitterness as there was, was sublimated in the form of newspaper articles and facetious poems addressed to me. Considering its magnitude and universality, the trade must be congratulated on the rapidity with which, when once its eyes were really opened, it rid itself of the evil. If the work at Ormskirk needed any justification, the abolition of potato synonyms alone would be enough, so far-reaching have been its repercussions throughout the whole of the horticultural and agricultural seed trade of Great Britain.

In order to determine the identity of the many hundreds of potato varieties which found their way to Ormskirk, it was necessary to build up as large a collection of existing varieties as possible, a task in which we were greatly assisted by the Scottish Board of Agriculture. This living museum, which contained some sorts which had been in cultivation more than a hundred years, will be preserved. It has been of great service in the training of inspectors to recognize "rogues" in the field.

The reaction to wart disease in the field of the great majority of existing varieties was tested during the first few years of the Station's existence, with the result that Ministry and farmer were henceforth in a position to know which varieties were fit to be grown in infected areas. At once it was evident that a veritable revolution in potato growing was inevitable; so many of the leading favourite varieties were susceptible and hence excluded. Ashleaf Kidney, Epicure, Duke of York, Sharpe's Express, Ninetyfold and Early Regent fell among the earlies, British Queen and Eclipse amongst the second earlies, Up-to-date, President, Magnum Bonum, Fortyfold, King Edward and Northern Star among the lates, to mention but a few of the most widely grown and best-known favourites of the first two decades of this century. Indeed, few really first-class varieties were left in any of the maturity groups.

The discovery of varieties immune to wart disease, first brought to light by Gough in 1908, provided at Ormskirk the basis of a new varietal selection whilst stimulating at the same time breeders in their efforts to fill the yawning gap in the choice of suitable sorts which the official exclusion of susceptible varieties had occasioned in the great wart potato-producing areas of Cheshire, Lancashire and the neighbouring counties.

Foremost among the breeders of new resistant varieties was, and still is, Mr. Donald MacKelvie, who, with others such as Mr. Watson of Messrs. McGill and Smith, Mr. Waight and the late Mr. Lasham of Messrs. Sutton and Sons, have consistently made the fullest use of the Station. Indeed, so great was the output of new seedlings, that it was soon found necessary to institute special seedling susceptibility trials to cope with them. At the same time Mr. J. W. Lesley and myself made use of the Institute's ground and experts, to test the susceptibility of seedlings raised at Barley, Herts, in the course of our research on the genetic inheritance of susceptibility and resistance to wart disease, the results of which were duly published, and gave further guidance to the breeders, many of whom were conversant with the new Mendelian principles.

From the first, Snell, with his magnetic personality, his wide experience and, not least, his gift of the 'winged word', created at Ormskirk an atmosphere hitherto unknown in the 'potato world'. Members of the trade and growers from all parts of the United Kingdom in the autumn flocked to visit Ormskirk and hear Snell, and later Bryan, on whom Snell's mantle fell in rich measure, go round the plots, criticizing and appraising the old and the new. It was realized that with them no sort of interest other than that of the public good and the truth had any weight, and although reputations might be made and lost in one of these visits, during the whole twenty-one years of the Institute's activity there has never been a doubt raised in the mind of any as to the sincerity of the criticism offered, or the integrity of those who uttered them.

Prior to these early Ormskirk days, the potato had been regarded as a useful if rather dull article of food, any interest in which was, in the main, confined to the profits which might accrue in its exploitation. True, the monotony of normal trading might occasionally be broken by some financial boom, the most notorious of which occurred a few years before the Ormskirk activities began. On this occasion an inferior stock of an inferior variety was renamed Eldorado and sold for its weight in gold to a public only too ready to be beguiled. The excitement, the credulity, the folly and the fraud, together with the final dénouement resembled the South Sea Bubble in

miniature. The advent of Snell and his successor Bryan, with their candid, not to say caustic, expression of the naked truth, put an end, it is to be hoped for good, to this kind of activity.

A number of circumstances combined to make the first ten years of the post-War period at Ormskirk notable. The stimulus to scientifically inspired breeding, which the presence of wart disease evoked, no less than the forceful personalities first of Snell and then of Bryan gave producer, trader and consumer, a confidence hitherto undreamt of. The genetic and virus research, which from the start found a welcome, induced an atmosphere of scientific and serious endeavour at the Station, whilst its close association with the Committee of Ormskirk Farmers ensured a due appreciation for the strictly practical exigencies of the producer, without which agricultural research in Great Britain need expect but short shrift. It is not too much to say that Ormskirk in these years became almost a place of pilgrimage, the Mecca of the potato-minded. Nor has it been supplanted in the esteem of its frequenters by any other centre. Until to-day, Ormskirk has remained the focal point of the varied interests concerned; what has happened is that those immediate interests have, so to speak, been saturated, and no fresh revolutionary force, with which Ormskirk might be fitted to deal, has arisen. How this saturation has been achieved must now be told.

Two memorials exist which epitomize two aspects of the work so far described, the strictly practical and the applied scientific: I refer to the Lord Derby and the Snell Memorial Medals. In 1915 Lord Derby gave a Gold Medal to be awarded annually by the Ormskirk Potato Society to the raiser of the potato variety best suited to local conditions. The trials took place on the Institute's ground and the merits of the varieties entered were adjudged by the Ormskirk Potato Society alone. In 1924 the Ormskirk farmers invited the National Institute of Agricultural Botany to co-operate with them. Since that time, the trials have become increasingly exacting, and the scope enlarged to include varieties suitable to all potato-growing areas. In particular, the award is no longer based on superiority of yield alone, but much attention is paid to tolerance to virus infection and palatability. The medal has done much to encourage the production of new varieties. Experience has certainly not justified all the awards, whether made before or since 1924. Indeed, it has been found desirable to extend the trials over a period of two years in order to reach a more reliable decision. In regard to both the potato and the medal, the adage that "All is not gold that glitters" has a special lesson, which it has taken many years of painful experience to acquire.

In 1921 the Council of the National Institute of Agricultural Botany decided to strike a Silver Medal to commemorate the pioneer work of John Snell. It was to be given to those who had done outstanding work whether as raiser, cultivator or scientific worker. The recognition of the latter's services is of interest because it covertly discloses the larger and more catholic attitude which the advent of the National Institute has brought about in this particular branch of horticultural endeavour.

In 1922, Spieckermann and Kotthof in Germany, and Miss Mary Glynne in England, developed the method of growing wart tissue *in vitro* with the view of developing controlled experiments on the infectivity of the wart organism and the susceptibility of potato varieties. These methods were further elaborated at Ormskirk in order to carry out rapid susceptibility tests for the convenience of breeders anxious to curtail the two years official field test which hitherto had been considered necessary. Mrs. McDermott devoted much time and attention to this work, and she and Bryan developed a most efficient and economic system of testing. The value of this work was greatly enhanced by the fact that parallel tests were carried out in every case in the field. This practice allowed of a very close comparison of the findings obtained by both methods. In addition they had the advantage of being able to refer specimens in cases of difficulty to Miss Glynne for histological examination. The work of the last twelve years in which every field test at Ormskirk has been duplicated in the glasshouse, has resulted in the complete calibration of glasshouse and field methods. Indeed, it is this very success of the indoor test as developed at Ormskirk which has been the main factor in inducing the Ministry to abandon the Station.

The testing for susceptibility to wart disease brought other advantages in its train: thus, it provided the opportunity of recording accurate descriptions of the botanical characters of the varieties examined, of which full advantage has been taken.

The activities so far described have all been either the direct, or indirect, results of the wart susceptibility trials, but there has been another and distinct line of research which the National Institute of Agricultural Botany has made its own. I refer to the accurate, statistically controlled, trials for the determination of yield and maturity of new and old potato varieties. The procedure underlying these trials was elaborated at Ormskirk and has become general wherever such trials are carried out. Each year several trials for yield or maturity or both, are carried out at Ormskirk and for many years they have been duplicated at Cambridge, Kirton, or elsewhere. In recent years

the same trials have been repeated in a second year. The results from all these stations and of each year are carefully correlated. The twenty years of the Ormskirk trials, the results of which are to be found in the Institute's *Journal*, allow of a more or less complete comparison of the chief varieties in use to-day both as regards their yield and maturity.

The yield trials of first earlies have been further elaborated so as to estimate the relative capacity of individual varieties to bulk their tubers early. Such information is of considerable use to the producer who can, if he wishes, grow the variety which will render him the biggest crop at the moment when the markets are offering the highest prices.

Research on the control of eelworm under Prof. R. T. Leiper, of the London School of Tropical Medicine, has been pursued for many years at the Station; for this, however, the National Institute of Agricultural Botany has no official responsibility.

The Station at Ormskirk has a record rich in achievement to its credit; if its closure has brought a measure of disappointment to those who have served it so well, they would do well to take heart in the confident knowledge that the advantages which Ormskirk alone could offer have been exploited to the full, and that the lessons there learnt will assuredly bear even richer fruit when transplanted to another soil.

THE SEARCH FOR TRUTH*

By Prof. H. S. Allen, F.R.S.,
University of St. Andrews

Truth

"'WHAT is truth,' said jesting Pilate, and would not stay for an answer."

The word has, of course, acquired more specialized meanings, but the root idea is that there should be *agreement* between some statement or belief and some fact or set of facts.

It is consequently not surprising that science has been called the search for truth, but some qualification is desirable, for religion also may be regarded as the search for truth. The mere fact that we hear of the *conflict* between religion and science suggests that we are concerned with two different spheres of thought and activity.

Logic

Logic has been called the science of reasoning or 'the art of thinking'. It was Aristotle who first elaborated this method of examining the reasoning process, a method which is concerned not so much with matters of fact, the things reasoned about, as with the mental operations that are involved in 'thinking'. If, for example, we say, 'All professors are absent-minded', the pure logician has no occasion to decide whether this statement is in accordance with fact. He is concerned only with the abstract form of this proposition. It is because the hypotheses made by the logician are not necessarily in accordance with the facts of experience that many men of science feel suspicious of the results obtained by these methods of reasoning. Readers of Samuel Butler's allegorical and satirical book "Erewhon" will remember that "the Erewhonians were quick to offer up commensense at the shrine of logic".

Two methods of reasoning employed in logic are frequently mentioned in scientific work. They are 'deduction' and 'induction'. The former is described as the method in which reasoning proceeds from generals to particulars, and it is associated with the Greek philosophers who assumed that starting from certain 'innate' ideas it should be possible to deduce particular consequences. The term 'induction' implies reasoning from particulars to generals, that is to say the requisite materials of knowledge are brought to the mind and then analysed.

In these days, when the experimental method of scientific investigation has brought about such astounding revolutions in the life of man, there are very few who would assert that they adhere solely to the deductive process. Even on this old-time 'conflict' a word of caution may be given. A somewhat cynical American physicist has said: "Facts are messy things, which everyone believes except the man who made the experiments; a theory is clear-cut and definite but no one believes it except the man who put it forward".

The Spirit of Research

The motive power of research—to paraphrase Prof. Whitehead—is a conviction that there is a secret, but "a secret which can be unveiled". Now

*Based on an address to the Mathematical and Physical Society of the University of St. Andrews.

we see in a glass—in a mystery—but then face to face. There is a belief in the mind of every scientific man that there exists a uniformity in Nature, that every occurrence, every phenomenon, "can be correlated with its antecedents in a perfectly definite way", and that the connexion illustrates general principles. The discovery of such correlations is what is meant by the term 'explanation'.

When, however, we turn to the examination of these explanations, we find that the influence of preconceived ideas is often overwhelming. For example, in the days of Galileo the following argument was put forward (to quote Chiaramonti) to rebut the movement of the earth round the sun :

"Angels cause Saturn, Jupiter, and the Sun to move, and the Earth also, if it does move must be moved by angels in its centre. But in that centre of the Earth dwell devils. Therefore devils would have to move the Earth—which is impossible".

Here is an extract from a remarkable letter written by Galileo as a reply to a momentous letter from his old pupil, Castelli, at that time professor at Pisa.*

"Holy Scripture and Nature are both emanations from the Divine Word : the former dictated by the Holy Spirit ; the latter, the executrix of God's commands. Holy Scripture has to be accommodated to the common understanding in many things which differ in reality from the terms used in speaking of them. But Nature, being on the contrary inexorable and immutable, and caring not one jot whether her secret reasons and modes of operation be above or below the capacity of men's understanding : it appears that, as she never transgresses her own laws, those natural effects which the experience of our senses places before our eyes, or which we infer from adequate demonstration, are in no wise to be revoked because of certain passages of Scripture which may be turned and twisted into a thousand different meanings. For Scripture is not bound to such severe laws as those by which Nature is ruled".

It is interesting to compare the spirit of this letter with the attitude of one of the greatest of scientific investigators, Michael Faraday, of whom Tyndall once said that when he opened the door of his oratory, he closed that of his laboratory. The candid historian of science, in the nineteenth century at least, cannot afford to overlook the fact that many of the most prominent investigators in Great Britain were men who were brought up in a devout atmosphere, and of these, several professed their belief in religious principles.

* The correspondence is quoted in full in C. R. Gibson's "Heroes of Science" (Seely, Service and Co., 1913).

Scientific Explanation

It used to be said that "any solution of a physical problem which satisfies *all* the conditions is *the* solution". In these days we should be more cautious in making such a statement. For example, in dealing with the problems of quantum mechanics three different mathematical methods have been applied with success : the method of matrices, the method of quantum algebra as developed by Dirac, and the method of wave mechanics due mainly to Schrödinger. It may be said that these are only mathematical variations ; but before the modern developments had been reached, few would have ventured to prophesy that such far-reaching results could be obtained by such apparently different methods.

There is, however, another objection to the dictum which says that the solution must satisfy *all* the conditions. In general it is difficult, or perhaps impossible, to state what are the exact conditions that must be satisfied. Such a statement would be possible only for an omniscient being. An excellent illustration is the attempt to form an estimate of the age of the earth. I quote from a recent lecture by Prof. W. Peddie.

At the time of Kelvin's calculation of the age of the earth "only one sufficient source of the earth's internal store of heat was known ; and he showed, by conclusive dynamical reasoning, that the resulting age of the earth could not exceed a few hundred millions of years. When the heating effect of the radioactive substances present in the rocks forming the crust of the earth became known, a large extension of the age of the earth, sufficiently large to satisfy geological specialists, became available. At once an outcry arose regarding the supposed failure of Kelvin's dynamical reasoning and conclusions. There was no failure. Sir Oliver Lodge pointed this out, and the clamour at once ceased. Although at the time of Kelvin's work there was not the faintest idea of the possible existence of any other sufficient source of heat than that considered by him, nevertheless, careful as Newton, Kelvin prefixed his calculation by a clear statement of his postulates—If no hitherto unknown source of energy exists. No one knew better than he that assumption lies at the root of all philosophy. His perception of a possibility constituted practically a successful prediction".

Conflicts of Science

Although theology has been called the divine science, it will be convenient for our present purposes to take the more familiar use of the word science and use it to describe our knowledge of the physical or material world. Prof. Whitehead points

out that during the last half century the results of science and the beliefs of religion seem to have come into a position of frank disagreement, but he directs attention to the fact that this is no new thing. "In the first place, there has always been a conflict between religion and science; and in the second place, both religion and science have always been in a state of continual development."

"Science is even more changeable than theology. No man of science could subscribe without qualification to Galileo's beliefs, or to Newton's beliefs, or to all his own scientific beliefs of ten years ago."

"Galileo said that the earth moves and that the sun is fixed; the Inquisition said that the earth is fixed and the sun moves; and Newtonian astronomers, adopting an absolute theory of space, said that both the sun and the earth move. But now we say that any one of these three statements is equally true, provided that you have fixed your sense of 'rest' and 'motion' in the way required by the statement adopted."

Another example may be taken from the theories as to the physical nature of light. "Newton's theory was that a beam of light consists of a stream of very minute particles. . . . Huygen's theory was that light consists of very minute waves of trembling in an all-pervading ether." "To-day there is one large group of phenomena which can be explained only on the wave theory, and another large group which can be explained only on the corpuscular theory. Scientists have to leave it at that, and wait for the future, in the hope of attaining some wider vision which reconciles both." This was written in 1925 not long after Louis de Broglie had introduced those new ideas which have led to the development of wave mechanics. He wrote: "If, then, we boldly assume that waves and corpuscles are always closely associated in Nature, then the motion of any corpuscle must always be associated with the propagation of a wave. . . ." This general theory of the connexion between corpuscles and their associated waves is the foundation on which wave mechanics has been built up.

According to Prof. Niels Bohr, we must employ "complementary" descriptions to account for phenomena on the atomic scale. For example, the corpuscular picture and the wave picture "are certainly complementary, but at the same time, taken strictly incompatible". Each description is an "idealization" permitting us to represent certain aspects of the nature of light, but not all the aspects at the same time.

Shall we adopt the corpuscular picture of light of the wave picture, the quantum theory or the classical theory? In his presidential address to the British Association at Glasgow in 1928, Sir William Bragg suggested that the student of physics might adopt the one hypothesis on Mondays, Wednesdays, and Fridays and the other on Tuesdays, Thursdays, and Saturdays. If we accept Heisenberg's 'principle of indeterminacy' the position is changed. This may perhaps be illustrated by the story of a distinguished Edinburgh professor who met a colleague on the South Bridge and engaged in earnest conversation. At the end he asked "Can you tell me which way I was going when I met you? I forget whether I have had my lunch". The professor of physics who sets out to determine the energy of an electron accurately on Monday morning may soon be at a loss to know whether he is experimenting on Monday or Tuesday; if he wishes to secure *very* great accuracy he may be in a fog as to whether it is 'this year, next year, some time or never'. Energy and time are 'complementary' magnitudes, and when we gain accuracy with respect to the first we lose it with respect to the second.

Science and Religion

If, and when, we are inclined to stress the apparent conflict between religion and science, we should carefully bear in mind that in science itself there has been one outstanding example of a conflict dating back at least to the days of the Greek philosophers. This is the problem of continuity and discontinuity. How is it possible to reconcile the existence of individual elements—atoms, electrons, protons—which are regarded as indivisible and capable of being counted, with our intuitive ideas about time and space which we have regarded as continuous? It is only within the last few years that light has been thrown on this crucial problem by the work of Heisenberg summed up in his Principle of Uncertainty or Indeterminancy, and by that of Bohr expressed by the word 'complementarity'. We are compelled to use in physics conceptions that are essentially contradictory, but we must use them in an appropriate and limited sphere. It should therefore occasion little surprise if in questions of æsthetics, ethics or religion we meet with other conflicts.

In his Gifford Lectures entitled "The Faith of a Moralist", Prof. A. E. Taylor said: "In an age in which scepticism—a languid scepticism—about the 'certainties' of science, not so long apparently the most assured of all 'certainties' has become the favourite intellectual attitude of the 'educated public', our most crying intellectual need, perhaps, is the need of men who will by their robust assertions, arouse us, not from our 'dogmatic', but from our lazily anti-dogmatic 'slumbers'. There was

something heroic about the temper of the 'Mid-Victorian' time, with its cry of

> It fortifies my soul to know
> That though I perish, truth is so."

In our search for truth we shall not succeed if we bandy about catch-words and slogans. Let us beware especially of all -isms, whether political or religious, such terms as socialism, capitalism, communism or Victorian liberalism and conservatism. Even the word 'democracy' is unsatisfying and does not suggest a sufficiently high ideal. It *may* be used as a cloak to conceal a plan for the domination of minority by a majority. Let us get back to the simple and fundamental ideas embodied in some degree in all religions worthy of the name. Freedom is better than slavery, mercy is better than cruelty, righteousness is better than injustice, good is better than evil.

REACTIONS PRODUCED BY NEUTRONS IN HEAVY ELEMENTS*

By Prof. Enrico Fermi,
Columbia University

THE nuclear reaction produced by neutron bombardment in heavy elements can be conveniently described, according to Bohr, with the assumption that, as soon as the bombarding neutron strikes the nucleus, it is incorporated into the nuclear structure with the formation of the so-called compound nucleus. This is a relatively stable system in the sense that its life-time is very long compared with the frequencies of nuclear particles ; in an absolute sense, however, the life-time is very short, being sometimes of the order of 10^{-12} sec. and sometimes much less.

The ultimate result of the nuclear reaction depends upon the way in which the compound nucleus disintegrates. This mode of further disintegration depends in its turn, for any given nucleus, essentially upon the energy content of the compound nucleus. When the bombarding neutrons are slow, the energy of the compound nucleus is equal to the binding energy of the neutron in the nucleus. Apart from irregular fluctuations from nucleus to nucleus, this binding energy has a general variation with the atomic number and is a maximum for elements of atomic weight about 40, where it is on the average about 9 Mev. From there on it decreases more or less regularly up to the heaviest elements, where it attains an average value of about 5 Mev. If the bombarding neutrons are fast, their kinetic energy must be added to the binding energy to obtain the total excitation energy of the compound nucleus.

The compound nucleus can lose its excitation energy by emission of a particle (neutron, proton, alpha particle or photon) or, in the case of the heaviest elements thorium, protoactinium and uranium, it may disintegrate by fission into two approximately equal parts. Apart from this latter case, the most probable processes for medium weight and heavy elements is the emission of photons and of neutrons. Emission of protons and of alpha particles requires a much greater energy on account of the Gamow potential that the particle must overcome before coming out of the nucleus. Furthermore, in a nucleus containing one hundred or more particles, even when this energy is available, it is unlikely that it should all be concentrated in one single alpha particle or proton in order to give to it sufficient energy to escape from the nucleus. It is much more probable that a neutron would be emitted instead, since a much lower concentration of energy is sufficient in this case.

The relative probability of the emission of a photon or of a neutron depends mainly on the energy. When the energy is barely larger than the binding energy of the neutron, as in the case of bombardment with slow neutrons, a photon is usually emitted. If, instead, the energy of the compound nucleus exceeds by a considerable amount the binding energy of the neutron, as in the case of bombardment with fast neutrons, the emission of a neutron from the compound nucleus becomes the most probable process. Even when the excess of energy is very large, it is improbable that the outcoming neutron carries away all the energy that is available ; indeed one would expect theoretically that the escaping neutron has a small probability of coming out with an energy in excess of 2 Mev. In most cases, therefore, the nucleus remaining after one neutron has been emitted by the compound nucleus will still be in

* A paper presented in a symposium on "Nuclear Physics" held on September 19 during the Bicentennial Conference of the University of Pennsylvania.

an excited state. The emission of one or more photons or, when the residual excitation energy is sufficient, of a second neutron (n, $2n$-reaction) will then occur before the nucleus reaches a stable configuration.

Compound nuclei of the very heaviest elements may also disintegrate by fission. This form of disintegration is made possible by the large amount of energy released by splitting a heavy nucleus into two approximately equal parts. In this respect we may say that all heavy nuclei are unstable. Their practical stability is, however, insured by the fact that the two fission fragments must overcome a practically impassable Gamow barrier for separation. In the case of uranium and thorium, the height of this barrier is no longer so great, and what prevents spontaneous fission is probably the large mass of the fission fragments, which gives a very low penetrability even to a barrier which is not very high. The relatively low excitation due to the arrival of a neutron is sufficient in these cases to excite the compound nucleus into a state above the top of the potential barrier or so near the top that the fission process becomes possible. It should be noticed in this respect that the bare extension of the Gamow mechanism of the potential barrier is probably not the only one that is responsible for the high stability of uranium with respect to the fission process; probably also other factors, as, for example, the low probability that the nucleus should take such a configuration as to make possible the transition into two fragments, play an important part in ensuring this stability.

It follows from this discussion that the most probable types of nuclear reactions in heavy elements under neutron bombardment are the following: (n, γ), produced especially by slow neutrons; (n, $2n$), produced only by very fast neutrons; fission produced only in the heaviest elements by fast and, in one case, also by slow neutrons.

Uranium is a typical example of this behaviour, because in this element all three types of reactions are observed. The (n, γ) reactions was discovered by Hahn and Meitner, who recognized that among the active products produced in uranium by neutron bombardment, one, with a period of 23 minutes, produced by a typical resonance process is carried by an isotope of uranium. The assignment of the atomic weight of this isotope as 239 has been confirmed by direct experiment by Nier, Booth, Dunning and Grosse. U^{239} disintegrates into an isotope of element 93, which is also radioactive with a period of 2·3 days, as proved by the investigation of Abelson and McMillan. When uranium is bombarded with very high energy neutrons, an (n, $2n$)-reaction may take place, the final result of which is the formation of an isotope 237 from the main isotope 238 of uranium. This nuclear reaction has been recently reported by Nishina, and others by McMillan; they found for this isotope a period of 7 days.

The most interesting reaction produced by neutrons in uranium is the fission process which occurs both in the isotope 238 and in the rarer isotope 235. Since the fission process has been already the object of many discussions, I shall limit myself here to the consideration of only one aspect of this phenomenon. The chemical investigation of the radioactive products of fission has proved the existence of a very large number of radio-elements, indicating that the fission can occur in a number of different ways. We are thus led to the conclusion that, after the compound nucleus is formed by adding a neutron to uranium, the actual splitting of the nucleus may lead to different pairs of fragments; each one of them gives rise to a chain of radioactive elements having on the average three or four elements.

It was early recognized that the simple theory of the fission process fails to represent the detailed results, in so far as the splitting does not occur into two equal fragments, but rather into fragments in which one is somewhat lighter and one is somewhat heavier. We have therefore to distinguish between a light and a heavy group of fragments. Presumably a fragment belonging to the light group and a fragment belonging to the heavy group are emitted in the same act. The problem arises now to determine what percentage of the fissions of uranium gives rise to the formation of a certain radioactive product, or rather of a certain radioactive chain. Since it is expected that in every fission a chain belonging to the heavier group and a chain belonging to the lighter group are formed, we would expect a total percentage of 100 for each of the two groups, except for the improbable direct formation of a stable fragment.

Since very little quantitative information is available as to the relative intensities of the various fission products, Anderson, Grosse and I undertook last spring a systematic investigation of this problem. Our purpose was to make a preliminary survey, and the results obtained so far cover most of the known radio-elements of the heavy group. The method used consisted in comparing the intensities of various radioactive products obtained by chemical separations from uranium samples irradiated under standard conditions and for a known length of time with the Columbia cyclotron. A known fraction of each radio-element was separated and brought near a counter; the activity was deduced from the number of counts, corrected in order to take into

account the absorption by the counter walls and the various geometrical factors. We have thus been able to assign the percentage of fissions of most of the chains of reactions belonging to the heavy group. They vary from a minimum of about 0·1 per cent to a maximum somewhat more than 10 per cent. The percentages found so far for the heavy group do not add up to 100, but are about one half of that. Apart from experimental errors, which can be quite considerable in measurements of this kind, this fact is probably due to the incomplete chemical investigation of this group. Probably some more radioactive elements of the heavy group, possibly belonging to the rare earths, have yet to be discovered and analysed.

THE TOTAL SOLAR ECLIPSE OF OCTOBER 1

By Dr. H. Spencer Jones, F.R.S.,
Astronomer Royal

THE weather conditions throughout the belt of totality in South Africa at the time of the total eclipse of October 1 were favourable and came up to the highest expectations. Dr. J. Jackson, H.M. Astronomer at the Cape, who made observations at Calvinia, described the eclipse as the best of the four that he had seen, and a perfect one in every way for astronomical observations. The sky was cloudless throughout and there was not even a breeze to shake the instruments. The conditions in the clear dry air of the arid regions of the Lower Karroo had promised to be so good that, before the War, extensive preparations had been made for observations to be made in this area by parties from Great Britain, Holland, the United States and elsewhere. It is unfortunate that the plans were almost completely upset by the War and that at a time when theoretical advance is dependent upon information that the eclipse observations were expected to provide, so favourable an opportunity has in large measure been lost.

The eclipse attracted much popular attention in South Africa. Railway traffic to the eclipse area was very heavy, many special trains being run. The few main roads leading to the belt of totality were congested with many thousands of cars. The limited accommodation in hotels and boarding houses was fully booked, but most of the spectators camped in tents on hills and rising ground where they could see the eclipse to the best advantage. The Prime Minister of the Union, General Smuts, who is a member of the Astronomical Society of South Africa, spared time from his many duties to fly from Pretoria to Cradock to view the eclipse, which he saw under excellent conditions. The most favoured place for watching the eclipse as a spectacle was from the escarpment of the plateau above Van Rhyns Pass, where the high plateau falls away abruptly and without warning to the Namaqua plain 2,300 ft. below. The scene was described as follows in a letter from a correspondent in South Africa :

"We climbed to the top of the Pass, 2,300 feet, and there found on the Plateau a vast encampment : tents, camp fires, hundreds of cars (which grew into thousands), flags, lorries of oranges (for the orange season is in full swing and the scent of blossoms showered into the dusty road as we passed along, for the trees are at all stages), a red cross hut, an A.A. van, even the road scraper with a red flag at each corner had crept up to see the sight. The next morning there were many more cars, and a steady stream, nose to tail, creeping up the Pass, those still on the long road across the plain below lost in a continuous cloud of dust. The heat was grilling. The strata of the mountains is horizontal and resulted in a series, flat topped, even more sheer against the skyline than Table Mountain. It is a savage, dry, primitive place. We looked across the plain, seeing some forty miles distant from our vantage point. A plan, flat as a table, not an acre of cultivation in sight, dun coloured silt it appeared, with markings on the surface, like a picture of the moon without the craters. It was very still, a quite perfect day for all the astronomers wanted to do. A thread of cloud, a whiff, low on the horizon, that was all. After the eclipse had begun we did not notice for some time any appreciable diminution of light and heat. Then, at last, the drama really began. At its height the mountains were inky black, a pale star or two appeared, a great shadow moved stealthily across the plain, a rim of orange light appeared above the horizon and pale yellow above it, and gradually this new dawn rose. We saw the details of the mountains again and the watching thousands. A little wind which had risen, lay down again as the sun progressively emerged. We watched the endless stream of cars passing down the Pass, the dust cloud grew and grew until we could only define the road by the stream of dust, far across the plain and round the farthest mountain."

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The darkness at mid-totality is described as not being so great as had been expected, and the light exceeded that of the full moon. The astronomers, however, found the eclipse a darker one than usual. Dr. H. E. Wood, the Union Astronomer, who observed the eclipse at Cradock, described the sky as a dark grey. He states that the planet Mercury, and Antares, the Southern Cross and its pointers and Arcturus could be seen. The corona appeared as a pearly white halo, almost devoid of colour, with long streamers of shimmering silver grey. Three streamers showed on the lower left-hand side of the sun, at least two and a half times the diameter of the sun in length ; other long streamers reached upwards. The keen-eyed noticed faint pink prominences, but most of the watchers failed to detect these. Dr. Jackson attributed the general lack of colour to the exceptional clearness of the atmosphere. Totality is stated to have been two seconds shorter than was expected. A national broadcast commentary on the eclipse was made from Cradock by the South African Broadcasting Corporation, English and Afrikaans commentaries being broadcast simultaneously on different wave-lengths.

The party from the Cape Observatory, under the direction of Dr. Jackson, made observations of the Einstein deflection. Two instruments were used. One was a portable equatorial stand, which had been sent out from the Royal Observatory, Greenwich, on which was mounted the 13-in. objective and breech-end of the astrographic refractor of the Cape Observatory. With this instrument, the eclipse field and a specially selected adjacent field were photographed on the same plate ; the eclipse plates are to be compared with plates of the same fields obtained three months previously. The eclipse field on this occasion was far from being ideal, but it was expected that exposures of fifteen seconds of the eclipsed sun and five seconds on the adjacent field, with the objective stopped down to an aperture of 7 inches, would show sufficient stars for a reasonably good determination of the displacement. The adjacent field is used to fix the scale of the plates and this scale is then used for the eclipse field to determine the displacement. The advantage of this method is that the stars in the two fields are at about the same distance from the plate centre, so that optical distortion effects, which depend on distance from the plate centre, are eliminated. With this equipment, the three months interval between obtaining the comparison plates and the eclipse was used by Dr. Stoy, of the Cape Observatory, in a photometric programme of observations for direct comparison between photometric standards in the northern and southern skies.

The other instrument was a horizontal camera with a 7-in. photographic lens of 17-ft. focus, fed by a coelostat with a Pyrex mirror. The plates cover a large field and with this instrument the usual procedure of using the distant stars essentially for fixing the scale of the plate and the close stars for determining the Einstein deflection was followed. The complicating factor in this method is that the optical distortions are different for the two sets of stars. The results are not yet available but information has been received from Dr. Jackson that the plates show considerable fogging. As the stars in the eclipse field are faint, the accuracy of measurement will unfortunately be impaired. But even though the observations do not provide any improvement on earlier determinations of the Einstein deflection, the experience gained of the method of photographing two fields on the same plate during the eclipse should be of value. The writer had planned to use this method at Christmas Island in 1922, but cloud prevented any observations being obtained, and the method has not since been tried.

Spectroscopic observations with a moving plate camera were made, also at Calvinia, by Dr. R. O. Redman, of the Radcliffe Observatory, Pretoria, assisted by the Radcliffe Travelling Fellow, Dr. H. Zanstra, of the Netherlands. The moving-plate camera, which was to have been used by the party from the Solar Physics Observatory, Cambridge, was sent out to South Africa for use by the Radcliffe observers. The purpose of the observations was to photograph the transition from the Fraunhofer to the chromospheric spectrum. In order to eliminate disturbing effects caused by the fall in temperature during the progress of the eclipse, the spectograph was set up in a pit 10 ft. deep, in which the temperature changes were small. The cabled information is that Dr. Redman is pleased with the observations obtained, so that some results of value may be expected when the photometry of the spectra has been completed.

Two instruments were used by Dr. C. W. Allen, of the Commonwealth Solar Observatory, Canberra. With a spectrograph designed to give high light-collecting power, the flash and coronal spectra were photographed. A polarigraph was also used, with which the corona was photographed through blue and red filters, in order to determine the degree of polarization in the corona with a view of throwing fresh light on the important question as to the nature of the reflecting particles in the corona. Successful observations, with which Dr. Allen is pleased, were obtained.

Though, therefore, a much reduced programme of astronomical observations was possible, the perfect conditions under which these observations were made give hope that results of importance

will follow and that these will prove of value in the theoretical study of the sun's chromosphere and corona. All these observations have been made possible by grants from the Government Grant Fund, administered by the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies. The Government of the Union of South Africa also made a contribution towards the expenses of transport of the equipment in South Africa.

In addition to the astronomical observations, Mr. Higgs of the Commonwealth Solar Observatory made radio observations at Victoria West, throughout the eclipse, at intervals of $2\frac{1}{2}$ minutes by means of an automatic recording equipment, to obtain P'–f data, with the aid of a grant from the Radio Research Board of the Australian Council for Scientific and Industrial Research. Radio investigations had also been planned by Dr. B. F. J. Schonland of the Geophysical Institute of the University of the Witwatersrand, but no information about these has yet been received.

OBITUARIES

Sir Robert Hadfield, Bart., F.R.S.

THE death of Sir Robert Hadfield in his eighty-second year on September 30 removes a notable figure from the world of science and of industry. To the outside public he was probably better known than any other metallurgist, while his striking personality and capacity for making friends, together with his activity as a writer and as a correspondent, made his circle of colleagues exceptionally wide.

Robert Abbott Hadfield came of a Derbyshire family long associated with Sheffield. His father, Robert Hadfield, after gaining experience in several branches of the steel industry, set up a works in 1872 for the production of steel castings, at that time a somewhat bold experiment. The business was successful, and the castings, which included hydraulic cylinders of large size to replace the much heavier cast iron, gained gold medals at several international exhibitions. Robert Hadfield died in 1888 when only fifty-seven, after several years of failing health. His son, who had been trained as a chemist and had worked for a time in the firm of Jonas, Meyer and Colver, set up a laboratory in his father's works, and took control of the undertaking when only twenty-four years old. On succeeding his father, the business was converted into a limited company. Steel castings have always remained a speciality of the firm, but even in its early days attention was given to the manufacture of steel projectiles, formerly obtained from France. In time, the undertaking grew to be one of the greatest of armament works, although its products covered a much wider range.

Hadfield's interest in alloy steels arose from reading a publication by the Terre Noire Company on alloys of manganese. In the systematic way which characterized all his work, he studied the effect of progressive additions of manganese on carbon steels. It was known that small additions hardened the steel, but that when the manganese reached about 3 per cent the alloys were so brittle as to be useless. This was confirmed, but the research was carried further, with the surprising result that when 12–13 per cent was reached, an alloy having entirely novel properties was obtained. This new steel was made softer instead of harder by quenching, was non-magnetic, and presented an extraordinary resistance to wear, becoming hard on the surface under abrasion. This, the 'manganese steel' of to-day, was discovered in 1882, a full scientific account of it being given to the Institution of Civil Engineers in 1888. It came into extensive use for railway and tramway crossings, crushing machinery, etc., a well-known application being the protective helmets introduced in the War of 1914–18. The steel is now known to be of the austenitic class, but certain of its properties are still anomalous.

In the same systematic manner, Hadfield examined the influence of silicon, and this research led to the introduction of the low-carbon silicon steels, which proved to have valuable electrical properties, including high resistance and low hysteresis. Their use made a marked saving in the weight of transformers. Later, Hadfield made similar surveys of the alloys of iron with nickel, chromium and tungsten, providing much valuable information but without leading to any alloy of entirely novel properties. He continued his studies of manganese steels over many years and published a number of further papers.

In the early controversies on the hardening of steel, Hadfield took an active part, supporting Prof. Arnold in his insistence on the influence of carbon against those who laid the chief stress on the allotropy of iron, and he lived long enough to see the true elements in both views incorporated into the modern theory.

The direction of a great industrial undertaking, of which he was chairman from 1888 onwards, did not check Hadfield's devotion to the scientific side of metallurgy. He made many friends among scientific men at home and abroad, and was able to interest them in problems concerning metals. Thus he published papers in collaboration with Sir William Barrett, Prof. W. Brown and Sir Ambrose Fleming on the magnetic properties of alloy steels, and with Sir James Dewar and also with Prof. W. J. de Haas on the properties of metals at very low temperatures. He was keenly interested in the history of metallurgy, and besides making a fine collection of old metallurgical books, he examined and described such

typical ancient objects as the famous iron pillar at Delhi, his most exhaustive investigation in this field being that of the alloys of iron prepared by Faraday and preserved at the Royal Institution. This was published in book form in 1931.

Sir Robert Hadfield received many honours. He was knighted in 1908 and received a baronetcy in 1917. He became a fellow of the Royal Society in 1909, and was an honorary member of a great number of technical societies, many of which conferred on him their highest honours. He was president of the Iron and Steel Institute in 1905–7, and of the Faraday Society from 1913 until 1920, and those societies with which he was connected have reason to remember the keen attention which he gave to his duties and his boundless hospitality. Few men have worked so hard and with such system throughout a long life. He was an enlightened employer and a good citizen of Sheffield, where he occupied the position of Master Cutler in 1899–1900, being the second of his family to hold that office. He was a generous benefactor to the University of Sheffield and to other institutions, and gave much kindly encouragement to younger research workers. Shortly after the War of 1914–18 he put forward a scheme for an Empire Development Board, to which he gave much thought and energy. In 1894 he married Frances Bett, daughter of Colonel Samuel M. Wickersham, of Philadelphia. Lady Hadfield, who was created C.B.E. in 1918, worked from 1914 onwards in a hospital which she and her husband founded at Wimereux, and this work was continued during the present War as the Hadfield-Spears Ambulance. C. H. DESCH.

Dr. William Bowie

WILLIAM BOWIE, who died on August 28, aged sixty-eight, was best known in Great Britain perhaps as one of the most significant personalities of the International Union of Geodesy and Geophysics. For fourteen years he was the president of the Association of Geodesy, for three he was president of the Union itself, and at the last General Assembly (Washington, 1939) he undertook the duties of the general secretary, who had been recalled to England on the outbreak of war. His influence upon the Union was not confined to his mastery of geodesy or to his eminent work in isostasy, widely known and appreciated as these are. It rested just as much upon an enthusiasm and a strength of purpose which compelled co-operation and stifled the minor jealousies which are apt to clog the wheels of international work. It was a difficult matter to succeed the late Ch. Lallemand who led the Union so brilliantly for fourteen years, but Dr. Bowie did, in fact, add to, rather than diminish, the significance of that post, because his geophysical interests were unusually wide and he could envisage no future in which geodesy did not work hand in glove with geophysics.

The United States Coast and Geodetic Survey has earned the gratitude of all surveyors. It has given us the 'figure of the earth' now used in all international work. It has followed and greatly enlarged upon, the fine record of the Survey of India in developing isostasy. It has shown how geodesy may be subjected to mass production without losing precision. Even its observing towers and lamps came as something refreshing, efficient, simple, and practical. Dr. Bowie was the colleague of, and successor to, John F. Hayford in all these matters, and in our minds is also successor to Alexander Ross Clarke and Everest.

Dr. Bowie entered the U.S. Coast and Geodetic Survey in 1895 and served for forty-two years, of which twenty-eight were as chief of the Division of Geodesy. During the War of 1914–18 he served in the Engineers as a major in the mapping division, and this association with army and with mapping matters lasted until his death. He served on the federal "Board of Surveys and Maps" from 1920 onwards. Probably no one of his generation has more practically and strenuously studied and forwarded a mapping suited to the administrative, economic and industrial development of his country.

In 1919 the American Geophysical Union was founded. Dr. Bowie was its general secretary and, later, president. In his hands it grew in membership from fifty to thirteen hundred, and spread its influence over every territory of the United States. His services to that Union are commemorated by the William Bowie Medal, of which the first award fell, appropriately, to himself.

It would serve small purpose to list the twelve societies over which Bowie had presided or the even longer list of honours and awards which his own country had given to him. He had been honoured also by Belgium, Holland, and Yugoslavia. Edinburgh admitted him, in 1936, to the degree of doctor of laws. More even can be said of him as a strong, able, single-minded man devoted to the advancement of science, and, withal, a singularly likable friend. H. ST. J. L. WINTERBOTHAM.

Rev. Dr. W. G. Ivens

WE regret to record the death of the Rev. Dr. Walter George Ivens, well known as an authority on the languages and ethnology of Melanesia.

After graduating at the University of New Zealand, Ivens joined the Melanesian Mission and laboured as a priest in Melanesia for a period of forty years. During this time he became widely known among scholars for his wide and profound knowledge of the numerous languages of Melanesia, as well as for his intimate acquaintance with their manners, customs, religious beliefs and observances. His "Melanesians of the South-East Solomon Islands" (1927), excellent in many respects, was followed three years later by the far more weighty "The Island Builders of the Pacific" (1930), in which, though it deals with a specialized form of culture, a certain breadth of philosophic outlook provokes reflection.

Dr. Ivens held the degree of Doctor of Letters of the Universities of New Zealand and Melbourne. During 1924–28 he was a research fellow of the University of Melbourne and during 1928–35 travelling secretary of the Melanesian Mission. He was a lecturer at the School of Oriental Studies in the University of London in 1936.

NEWS AND VIEWS

The Right Hon. Neville Chamberlain, M.P., F.R.S.

THE death of Mr. Neville Chamberlain on November 9, occurring at so short an interval after his retirement from political life, has afforded him little opportunity for the enjoyment of that leisure that he had earned by his strenuous life as industrialist in the West Indies and in Birmingham, and as a politician and member of His Majesty's Government under several administrations as well as during his own tenure of office as Prime Minister during 1937–May 1940. Mr. Chamberlain entered upon the administration of national affairs at a disadvantage. His work for social betterment and in municipal affairs in Birmingham, which led up to his election as Lord Mayor in 1915, attracted the notice of those in authority in the conduct of national affairs during the War of 1914–18. They called him to a wider field ; but his acceptance of office as Minister of National Service in 1917 resulted only in frustrated effort and resignation owing to the fact that he occupied no seat in Parliament. His entry into the House of Commons at the General Election of 1918 determined his activities for the remainder of his life, the greater part of which from that time was passed in office.

Like his father, Joseph Chamberlain, Neville Chamberlain was a striking example of the successful business man to whom the organization of his commercial or industrial interests affords, or did afford, leisure in middle or later life to engage in public affairs—as Bagehot noted, a characteristic peculiar to English public life. In estimating the value of Chamberlain's work as statesman and as a contribution to the welfare of the people of Great Britain, his fame might well rest assured on his tenure of office for five years as Minister of Health under Mr. Baldwin. He passed no fewer than twenty-eight Bills through Parliament in this period—measures dealing with housing, slum clearance on a national scale, old age pensions, rating and valuation, local government reform, and the like. This achievement, however, was overshadowed by subsequent events. As Chancellor of the Exchequer from 1931 onward he took in hand the Herculean task of setting the finances of the country on a sound basis in face of a world-wide economic collapse. When he became Prime Minister in 1937 the financial standing and integrity of Great Britain was as high, or even higher than ever before in the estimation of the world.

The tragedies of the three years 1937–40 need no recapitulation. The death knell of the League of Nations as a political force had already sounded when Mr. Chamberlain accepted office as Prime Minister, and he turned to the policy of 'appeasement' and the formation of a 'peace front'. The policy achieved its greatest success with Mr. Chamberlain's almost superhuman effort at Munich which was "to secure peace in our time"—and it was its greatest failure. The cynical sale of Russia's influence to the highest bidder destroyed the possibility of a peace front in eastern Europe ; the tragedy of Czechoslovakia and the treacherous onslaught on Poland showed the futility of faith in the promises of the dictators. Notwithstanding the criticisms of Chamberlain's achievement at Munich and the disappointment at his misunderstanding of his opponents' true character, it is safe to predict that from this very failure his reputation as a great representative of all that is best in the English people will grow. As is shown by his record in peace-time, he was a practical idealist with an inextinguishable enthusiasm for the betterment of the human lot and a belief in the fundamental integrity of the individual. It is to such men, and not to the doctrinaire, that we must now look for the practical measures which will bring about the reconstruction of a post-War world ; and in this the example of Chamberlain's work of social reform will endure. If he failed to secure peace it was because, being an honest and upright man, untrained in the methods of gangster diplomacy, he failed to appreciate the possibilities of treachery in those who use promises and solemn undertakings as counters to secure ignoble ends.

ALTHOUGH the career of Mr. Neville Chamberlain was political, a considerable amount of his time was devoted to amateur natural history. In his younger days, about 1902, he was a keen member of the old Birmingham Entomological Society, and he used to exhibit at its meetings which were held at Avebury House, Newall Street. He was usually in company with his uncle, Alderman George Kendrick, a well-known local entomologist, and Mr. Chamberlain made a special study of the camouflage of pug moths which he collected from the railings of his father's house, "Highbury", at Moseley. He also made extensive collections of the Geometræ. In later years in London he maintained this interest in entomology and recorded the wood-leopard moth in the garden in Downing Street ; but then his interests were more devoted to ornithology and he contributed to the annual report on the bird sanctuaries in the Royal parks, published by H.M. Stationery Office, 1936, noting pied wagtails in St. James's Park and large flocks of redwings during the frost. St. James's Park was his special venue, where his early morning walks during his office as war-time premier were reminiscent of the walks of the late Lord Grey of Fallodon during the War of 1914–18. In addition to the pied wagtail and the redwing, Mr. Chamberlain recorded the lesser black-backed gull, the carrion-crow, the swift, the kestrel, the grey wagtail and the wheatear in St. James's Park. He also recorded a melanic form of pied wagtail in Downing Street, and in the garden common to No. 10 and No. 11 he maintained a bird table and bird-boxes, inducing the blue tit to nest there, and blackbirds and song thrushes to become resident. He also shared Lord Grey's fondness for fly-fishing.

Earthquake in Rumania

Early on the morning of November 10, a very intense earthquake shook nearly all Rumania, and was also felt in Sofia, Belgrade, and many other places in the Balkan States. It will be recalled that a strong double earthquake was felt for about 30 seconds in Bucharest on October 22 (see Nature, Nov. 9, p. 615), and that this was at the time thought to be the precursor of a stronger shock. Evidently the supposition was correct, though the time interval between the premonitory shock and the now much stronger one was greater than anticipated.

Although small earthquakes and tremors are by no means unknown in Rumania, that country has in the past not been so severely hit by these catastrophes as other Balkan States such as Greece. The shock of October 22 may have had its epicentre near Barlag, though some damage was done in Bucharest, the capital. The present shock again severely affected the capital, where many famous buildings are reported damaged and destroyed, and where the casualties are probably high. From other towns, including some in the region of the oil wells, damage and casualties are also reported. A further earthquake, said to have caused enormous damage and many casualties, included among whom were rescue parties working amid the debris of the first earthquake, occurred early on November 11.

Youth Service Corps

In a circular to local authorities (H.M. Stationery Office, 2*d*.) the Board of Education sets out a new scheme for the physical training of youth between the ages of fourteen and twenty. The ultimate aim is not the creation of a new movement but the co-ordination of already organized local units, the resulting corps to be run by the young people themselves. Arrangements have been made with the War Office for the gradual release, so far as military requirements allow, of experienced leaders, organizers and certain physical training instructors. All available premises, such as gymnasia, halls, playing-fields, sports grounds and swimming-baths, will be utilized. The supply of suitable clothing is also considered. Suggestions concerning methods of appealing to the youth of the country are also given; these include appeals to those leaving school, old scholars' associations, evening institutes, youth rallies, the "Fitness for Service" scheme, contact with industrial workers, and general publicity. A badge scheme is also outlined.

The Suez Canal

Nature seventy-one years ago (1, 81; 1869) recorded the opening of the Suez Canal "in presence of emperors, kings, princes, and potentates; of eminent engineers, famous warriors, and distinguished *savants* invited from the East and from the West". The question of the canal has, however, dated back to a much earlier period. Tradition has it that Alexander first discussed its feasibility, but decided against it on account of the difficulty of the mouth of the canal becoming silted up. After other projects, the first Napoleon revived the idea, and from that time the question of a ship canal became a standing topic. With progress in the sciences, especially those of immediate bearing such as geology and engineering, the possibility became more and more convincing, and culminated in the opening on November 17, 1869, the result of one of the greatest of modern engineering feats. It may be well to think of the difficulties faced by science at the time, which in the "pre-scientific age rendered man's contests against the works of the winds and sea perfectly hopeless" but with the aid of science were now conquered.

Greece

The Greek Mathematical Society has sent an appeal for help and sympathy to the whole brotherhood of mathematicians, in the name of "the birthplace of mathematics, the country of Pythagoras, Plato, Euclid, Archimedes and Apollonius". Not only the mathematician, but also every scholar and scientific man should answer to the call. Of those five great men it so happens that one was born in Sidon and another in Damascus, another in Perga, and the greatest of all in Sicily; nevertheless Greece has a right to claim and speak for them all. In her golden age they contributed to her glory, and her language has preserved their teaching for the world. Greece herself has had five distracted centuries since Byzantium fell, and her fugitive scholars brought the Renaissance into Europe. Even the last hundred years, since Byron and his Philhellenes fought for her independence, have been hard and troubled times. But in the last few years order has reigned, and much has been done. The University of Athens has quickly become a flourishing institution. Her laboratories are busy, her own library and other lesser libraries are rich, the museums there and elsewhere are well kept and beautiful. We may think not only of what she did two thousand years ago, but also honestly admire her part in the art and science and letters of to-day. Great Britain is again on Greece's side, and the readers of Nature not least of all.

The Next Total Solar Eclipse

With the October 1 total eclipse of the sun now past (see p. 642 of this issue), and observations in South America at least ruined by clouds, some astronomers will now be looking forward to their next chance. This will come on September 21, 1941. Plans are uncertain at present, because the best place from which to see it will be on the coast of China, between Foochow and Wenchow, as well as farther inland, at Hankow and Nanchang. Whether certain foreign astronomers will be able to set up their instruments there by next September is perhaps rather questionable. The tip of the moon's shadow next September 21 will first touch earth at sunrise in Russia near Astrakhan. Then it will cross the Caspian Sea, the Aral Sea, Turkestan, Tibet and China. After that it will pass across the western Pacific Ocean, including the American island of Guam. Here the sun will be blacked out for about two and a half minutes, or fifty seconds less than in China, but this would still give time for many valuable observations.

The Earl of Rosse (1840-1908)

AMONG the noblemen who during the nineteenth century devoted themselves to scientific pursuits, few were better known than the third and fourth Earls of Rosse. The former constructed the famous reflecting telescope at Birr Castle, King's Co., Ireland, and from 1848 until 1854 was president of the Royal Society, while the latter carried on his father's observations on nebulæ, made investigations on the heat radiated from the moon and held important offices in Ireland. Sir Laurence Parsons, the fourth Earl, was born at Birr Castle on November 17, a century ago, and was the eldest of six sons, of whom the youngest was Sir Charles Parsons, of steam turbine fame. Educated partly at home, he graduated from Trinity College, Dublin, at the age of twenty-four, and three years later, on his father's death, succeeded to the title and estates. From early manhood he took a part in public life, and in 1885 was made chancellor of the University of Dublin ; in 1887 he became president of the Royal Dublin Society and in 1895 president of the Royal Irish Academy. He was a fellow of the Royal Society and of the Royal Astronomical Society from 1867.

Among engineers Lord Rosse was known for the unswerving support he gave his brother in the difficult pioneering work on the steam turbine, and was a director of the Marine Steam Turbine Company formed in 1894 to construct the historic *Turbinia*. In Mr. Rollo Appleyard's biography of Sir Charles Parsons are many letters to Lord Rosse relating to the steam turbine, which he lived to see adopted for the *Dreadnought*, the *Mauretania* and *Lusitania*. A man of wide interests, a generous employer and a philanthropist, Lord Rosse died at Birr Castle on August 30, 1908. By his will he left a sum of money for the upkeep of the telescopes and instruments made famous by his father.

Dr. James Finlayson

DR. JAMES FINLAYSON, an eminent Glasgow physician and medical historian, was born on November 22, 1840, at Glasgow, where he received his medical education and qualified in 1867 with a thesis on "The value of quantitative methods of investigation in medicine and the allied sciences". In 1871 he was elected fellow of the Faculty of Physicians and Surgeons of Glasgow and a few years later its honorary librarian, in which capacity he served the faculty for more than a quarter of a century. In 1875 he was appointed physician to the Glasgow Western Infirmary, where he taught medicine until his death, and from 1883 until 1898 he was physician to the Glasgow Royal Hospital for Sick Children. In 1899 he was elected vice-president and in 1900 president of the Faculty of Physicians and Surgeons, and made an honorary LL.D. of the University of Glasgow. His writings covered the whole range of medicine, but his chief work was his "Clinical Manual for the Study of Medical Cases", of which the first edition appeared in 1878 and the fourth and posthumous edition in 1926. He also wrote the chapter in Keating's Cyclopædia on the diagnosis of children's diseases (1889). He took a lively interest in the history of medicine, and from 1892 to 1895 gave a number of bibliographical demonstrations on Hippocrates, Galen, Celsus, Herophilus and Erasistratus. His most important historical publications were the "Account of the Life and Works of Maister Peter Lowe (1889), the founder of the Faculty of Physicians and Surgeons, Glasgow", and the "Account of the Life and Works of Dr. Roland Watt, author of the Bibliotheca Britannica" (1897). He died suddenly on October 9, 1906.

Morbidity and Death-Rates in Great Britain

THE issue of the *Lancet* of November 2 contains an instructive article on this subject by Dr. Percy Stocks, medical statistical officer to the General Register Office, who shows that the standardized death-rate from all causes was not so large in the March quarter of 1940 as in the severe winter quarter of 1929, but it was above that of any intervening quarter. Very high rates were returned in several large towns. The adjusted death-rate in those great towns which served as reception areas, after a temporary increase probably due to influx of many infirm persons, has fallen relatively to that in Greater London and the evacuation towns. During the autumn and winter when schools were closed in evacuation areas and partly closed in neutral areas, the diphtheria notification indices among children in London and the evacuation towns were only half those of a previous year compared with a decline of 17 per cent in the reception and 22 per cent in the neutral towns, but there was no equivalent reduction in the death-rate. In the June quarter when schools reopened the contrast between evacuation and reception towns ceased.

The scarlet fever notification index during the March quarter in the evacuation towns was less than half that of a previous year, compared with a fall of 31 per cent in the reception towns, and this position did not change when the schools reopened in the June quarter. Measles and whooping-cough deaths during the March and June quarters amounted in the evacuation towns as well as in Greater London to a very small fraction of the numbers in the previous years ; the reception towns showed little change, and the neutral towns a moderate fall. The measles notification rate per 1,000 children under 15 in the evacuation towns was only 6 in the March quarter, rising to 25 in the June quarter when the schools reopened, compared with 59 and 48 respectively in the reception towns. The whooping-cough notification rate was half as great in the evacuation towns as in the reception towns in both quarters, the neutral group being intermediate. The cerebrospinal fever notification rate at all ages and the death-rate at ages over 15 during the March quarter were higher in the reception towns than elsewhere, but this was not maintained in the June quarter.

Scientific Training and Administration

AT a meeting of the Institute of Fuel held on October 17, an address was delivered by Mr. W. H. Selvey, who has been acting president during the

absence in the United States of Colonel J. H. M. Creenly. Among other matters, Mr. Selvey spoke of scientific invention and its application to the life of a country. He said that it is generally twenty years or even longer before scientific knowledge produces practical applications which enter into the common life of the country. We should consider what kind of men should ultimately compose that small inner coterie, existing in every country, which has the power and responsibility of putting great forces into action. Those men to-day are primarily educated in what is called the 'humanities', a form of education which leads to an astute knowledge of how to govern men through their lesser qualities, sometimes even their weaknesses. The growing reaction against this form of education of some of the finest minds has led, not to a change in their education but in replacing them by representatives of the 'people', mostly great-hearted men, but possessing this in common with colleagues of the former type, that in discussions of any grave difficulty they can always brush aside questions which demand answers by saying that they are purely technical.

It is a surprising state of affairs that, in a world which is fast becoming wholly technical, those possessing power and responsibility seem almost to boast of their ignorance of technical questions. There are countries, however, where those in real power are technically trained as a basis for their future activities, educated to a certain extent in the scholastic field of knowledge, but totally devoid of morals when acting as functionaries of the State. The jibe that technologists do not make successful administrators will, so long as government turns on the management of men by their foibles, always contain an element of truth. The matter must be dealt with at an earlier stage. It is not more difficult to distinguish between young technologists than among young classical graduates, which men are likely to develop into administrators. There is a growing consciousness that something must be changed before it is safe to put further powers evolved by scientific workers and technologists in the hands of those governing the political fortunes of the State. But men of science and technologists must go on; therefore they must themselves delve deeper into those questions which they, in turn, have been equally amiss in shelving as political, moral, ethical and religious.

British Empire Naturalists' Association

SINCE the suspension of *Country-Side*, the quarterly journal of the British Empire Naturalists' Association, due to the War and paper shortage, its duplicated quarterly *Branch News* has considerably extended its circulation and has become the official war-time organ of the Association under the editorship of the organizing secretary, Mr. Leslie Beckett, and it is still produced and issued from 22 South Drive, Ruislip, Middlesex. The new October issue outlines a scheme by which this duplicated news-sheet will be circulated to all who desire it in return for four stamped addressed envelopes a year. This will reduce the heavy clerical work as well as the expense. The current sixteenth issue records the rare crimson variety of *Erica cinerea* and *Orchis purpurea* in mid-Kent, the black redstart successfully nesting in London near Westminster Abbey and singing in Piccadilly, elephant hawk moth larvæ feeding on orange balsam in Surrey, an adult male Montague's harrier, green-, wood- and curlew-sandpipers, ruff, little stint, garganey, greenshank, pochard and shoveller among the autumn passage birds at Slough Sewage Farm, Bucks, while a summary of the British Empire Naturalists' Association's summer field meeting held in the Ludlow district of Shropshire notes the pied flycatcher and the sandpiper found nesting and hundreds of plants of *Astrantia major* found in full bloom. It is hoped to arrange the usual midsummer meeting in 1941. A request is made to collect certain herbs to aid botanical drug importers faced with the stoppage of imported Continental supplies; but these will be plants abundant everywhere and not likely to injure the flora of the countryside. Although many of the branches are finding difficulties from air raids and war-time duties of members hindering their meetings, activity is still being maintained and meetings held by the branches for London, Middlesex, Merseyside, Norfolk, mid-Kent, south Devon, Derbyshire and north Lancashire.

Traditional Culture and Individuality in Britain

A STUDY of "The Celtic West" by Prof. H. J. Fleure (*J. Roy. Soc. Arts*, **88**, Oct. 4, 1940) will add strength to the arguments of those who urge that the lowering of national barriers in the interests of co-operation in international affairs should not be allowed to obliterate those cultural differences and diversity of ideas by which intellectual advancement largely has been promoted in the past. "The value of personality," says Prof. Fleure, "is now felt to be the essential for which we are fighting, and, in this respect, we can learn a good deal from the Celtic west." He points out, indeed, that although "the Celtic race" is a term both unscientific and in point of historic fact incorrect, the tradition of the Celtic west conserves a pattern in which are woven strands of many ages, some perhaps 4,000 years old. The purpose of his argument is to show that this traditional pattern has contributed to the cultural life of Great Britain something which is lacking in the English-speaking regions of the country.

In England there has been a failure to afford the skill of the rural worker opportunities to adapt itself to modern conditions—a verdict which will be endorsed by all who have watched the decay of rural arts and crafts in our country districts. In the Celtic west, however, something of the old life of the peasantry survives. It is manifested not merely in adaptability to a variety of manual tasks, but also intellectually in an abiding interest in the deeper and more spiritual sides of life—"a peasant heritage that is even now struggling to escape destruction". It is in this aspect in particular that Prof. Fleure finds the lesson of the culture

of Wales, which he points out has afforded the people opportunities for the expression of their individuality in the fields of oratory, poetry and song. Through these our common British life has gained vastly from the spring of an ancient cultural tradition. By this tradition even the miners of South Wales have been preserved from the worst evils of industrialism. How to keep this contribution to our common life from submergence, Prof. Fleure concludes, is a problem worthy of much study.

Aerial Ropeway in Central Sweden

AN aerial ropeway of exceptional length is being built in Central Sweden for the purpose of conveying limestone from quarries to a new cement factory. From a description given in *Engineering* of October 18, we learn that the ropeway is 28 miles in length, and will be capable of transporting 700,000 tons of material per annum. The running, filling and emptying of the 550 skips used is carried out entirely automatically. The construction work is now well advanced; the supporting towers have been erected along the entire route, and the work of placing the cable in position has now begun. Several difficult problems have been successfully solved. One of these was the best way to convey the ropeway across two wide waterways. In one case this has necessitated the suspension of the ropeway at a height of 22 metres to enable ships to pass freely underneath. In addition to carrying the line across a lake, concrete towers, 147 ft. 7 in. in height, have had to be built in the water. It is anticipated that the installation will be completed by the end of the present year.

Mental Hygiene of Old Age

IN a recent paper (*Mental Hygiene*, **24**, 734; 1940) Dr. Nolan D. C. Lewis, director of the New York State Psychiatric Institute and Hospital, New York City, makes the following recommendations for avoiding or relieving the mental troubles of old age. In the first place, the senile individual should be used economically by arrangement of changes of work and frequent rest periods. The individual should be relieved so far as possible from worry, mental strain, anxiety and feelings of financial insecurity. With the gradually devitalizing processes in mind, special care should be taken to avoid physical discomforts, vitiated air, infections and over-eating. The senile patient should also be protected from injuries, as they may produce or increase a tendency to hypochondria. It is important to avoid any heavy burden on the sense organs through which exhaustion of the central nervous system may occur. The younger and more able associates of the senile individual should make allowances for the occasional lack of acuity in dealing with situations which require fine discrimination and tact. Tolerance and understanding should be used with the aged person who shows a marked egoism together with uneasiness, restlessness and a tendency to harp on his difficulties.

Folk-lore of the U.S.S.R.

THE Academy of Sciences of the U.S.S.R. is to issue a new work entitled "Soviet Folk-lore", into the compilation of which has gone much effort on the part of many expeditions to different parts of the Soviet Union. An expedition sent out to the Stalingrad Province by the University of Leningrad has collected much interesting material relating to the folk-lore of the Don Cossacks. In the villages and farmsteads of that province the expedition recorded 110 folk-tales, 550 Cossack songs, as well as numerous proverbs and legends. Among the songs are some about Stepan Razin, Yermak, Peter the Great and the War of 1812. This expedition has also collected interesting material relating to the new Soviet folk-lore of the Don Cossacks. Records were made of songs and tales on the subjects of Stalin, Voroshilov, Budenny, the Civil War and the collective farm.

Adams Prize: Subject for 1941–42

THE Adams Prize, which is open to the competition of all persons, including women, who have at any time been admitted to a degree in the University of Cambridge, is awarded for an essay, the subject proposed for the period 1941–42 being "The theory of the elementary physical particles and their interactions". The essay may contain a discussion of the properties of some or all of the elementary physical particles and of their associated fields; the theory of cosmic rays and the structure of nuclei come under the scope of the subject. The value of the Prize is about £288, but may be increased, when it seems desirable to the adjudicators, on occasions when the prize is divided. Provision is also made for the award of extra Adams Prizes in suitable cases. The essays must be sent to the Registrary of the University on or before December 31, 1942.

Comet Okabayasi

HARVARD College Observatory Card 539 reports the discovery of a comet of magnitude 11 on October 4 by Okabayasi. *Card* 540 gives the following elements and orbit computed by Miss Scott at Berkeley:

T	1940 August 11·979		
ω	320° 40′	}	1940
Ω	125 59		
i	131 25		
q	0·9730		

Announcements

MR. FRANCIS DRUCE has resigned the honorary treasurership of the Linnean Society after serving for nearly ten years. On November 7 the Society elected as his successor Major F. C. Stern.

THE Rockefeller Foundation, the Carnegie Corporation and other United States bodies have guaranteed £125,000 to take to America a hundred leading scholars who have fled from Germany.

ERRATA. In the article on "Early Explorers of Southern South America from the United States" in NATURE of August 17, p. 238, line 5, for "Stongington" read "Stonington", and line 8 for "Jerimiah N. Reynolds" read "Jeremiah N. Reynolds".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

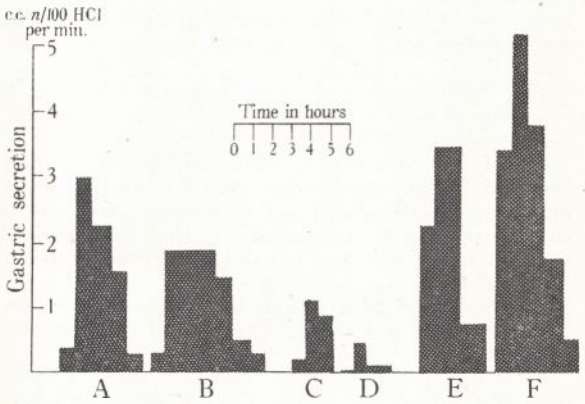
IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Activity of Carbonic Anhydrase in Relation to Gastric Secretion

IT has been shown recently by Davenport[1] that the gastric mucosa of mammals is very rich in carbonic anhydrase, which seems to be localized in the parietal cells. According to Davenport, this observation together with some other considerations suggested the possibility that carbonic anhydrase takes part in the secretion of hydrochloric acid. According to this view, carbonic anhydrase catalyses the hydration of carbon dioxide to carbonic acid, which ionizes to H^+ and HCO_3^- ions. The H^+ ions are concentrated and secreted while HCO_3^- ions pass into the blood to replace the chloride ions which accompany hydrogen ions. "If carbonic anhydrase in the gastric mucosa were inhibited the chain of reactions would be interrupted, and the mucosa would be unable to secrete acid"[2]. This clearly suggests that the validity of this theory of gastric secretion can easily be tested by means of a suitable inhibitor of carbonic anhydrase.

It is obvious that substances such as potassium cyanide, hydrogen sulphide and sodium azide which strongly inhibit carbonic anhydrase cannot be used for this purpose, because being unspecific they inhibit also the activity of several other important catalytic systems of cells. It has been demonstrated, however, by Davenport that thiocyanate ions inhibit to about the same degree both the activity of carbonic anhydrase and the gastric secretion of hydrochloric acid induced by histamine. These observations have been brought forward by him as strong additional evidence supporting the view that carbonic anhydrase plays an important part in the gastric secretion of hydrochloric acid.

It was shown recently by Mann and Keilin[3] that carbonic anhydrase is very strongly inhibited by sulphanilamide and that this inhibition is reversible and highly specific. Moreover, the inhibition of this enzyme by sulphanilamide is of a much higher order of magnitude than that by thiocyanate. Sulphanilamide forms, therefore, a most valuable reagent in the study of the physiological significance of carbonic anhydrase in the blood and in the gastric mucosa. In the present communication we shall deal, however, only with the problem of the interrelationship between carbonic anhydrase and the gastric secretion of hydrochloric acid.



GASTRIC SECRETION OF HYDROCHLORIC ACID IN SIX CATS INDUCED BY INJECTION OF 0·5 MGM. HISTAMINE PER KGM.: *A* AND *B*, CONTROLS; *C* AND *D*, AFTER INJECTION OF SODIUM THIOCYANATE; *E* AND *F*, AFTER INJECTION OF SULPHANILAMIDE.

Our experiments were carried out on cats starved for about 15 hours. Under ether anæsthesia, the brain was pithed from an opening made in the second vertebra. Artificial respiration was then applied while the administration of ether was discontinued. The cardiac end of the stomach was ligatured and a cannula was tied into its pyloric end, taking special care to preserve the normal blood circulation of the stomach intact[4]. Sodium thiocyanate (0·2 gm./kgm.) or sulphanilamide (1 gm./kgm.) were injected intravenously one to two hours before the subcutaneous injection of histamine dichloride (0·5 mgm./kgm.). The stomach was washed, filled with 20 c.c. of warm saline solution which, every 40–50 minutes, was removed, titrated for free hydrochloric acid and replaced with fresh solution.

Cats		Gastric secretion of			Gastric mucosa	
		Free acid (c.c. *m*/100 HCl)	NaCNS mgm.	Sphmd. mgm.	NaCNS (*M.*)	Sphmd. (*M.*)
Controls	*A*	379				
	B	291				
Injected with sodium thiocyanate	*C*	29	4·4		$2·7 \times 10^{-3}$	
	D	96	7·0		$1·8 \times 10^{-3}$	
Injected with sulphanilamide (Sphmd.)	*E*	443		287		$7·2 \times 10^{-3}$
	F	736		174		$2·3 \times 10^{-3}$

Thiocyanate and sulphanilamide were estimated in the successive samples of saline solution removed from the stomach (see accompanying table) and in samples of blood, where their concentrations until the end of the experiment were never lower than $4 \times 10^{-3}\,M$ and $6{\cdot}4 \times 10^{-3}\,M$ respectively. At the end of the experiment the blood vessels of the stomach were perfused with saline solution, the stomach removed, the gastric mucosa separated from the muscular coat, ground with sand and ten volumes of water and centrifuged. The opalescent extract collected was estimated in the usual way for the activity of carbonic anhydrase and for the contents of thiocyanate or of sulphanilamide. Control cats were treated in the same way except that they were not injected with either thiocyanate or sulphanilamide.

The main results of these experiments, typical examples of which are shown in the figure and the table, can be summarized as follows:

(1) Both thiocyanate and sulphanilamide are excreted by the gastric mucosa and reach a fairly high concentration within the mucosa itself. It is therefore reasonable to assume that they have reached the carbonic anhydrase and had time to react with it.

(2) Thiocyanate, while it strongly depresses the gastric secretion of hydrochloric acid stimulated by histamine, is not a strong inhibitor of the carbonic anhydrase.

(3) Sulphanilamide, on the contrary, while it either does not affect the secretion of hydrochloric acid stimulated by histamine, or even increases it, inhibits completely the activity of the gastric carbonic anhydrase.

The results of these experiments do not seem therefore to support the view that carbonic anhydrase catalyses directly the gastric secretion of hydrochloric acid. This does not exclude, however, the possibility that the enzyme may yet have an indirect connexion with the gastric secretion of HCl, considering that this secretion is known to be accompanied by an increase in the total base of the serum[5,6]. That the carbonic anhydrase takes part in the acid-base metabolism of the body is moreover indicated by the well-known disturbance in the acid-base equilibrium which follows the administration of sulphanilamide.

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Oct. 30.

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[2] Davenport, H. W., *Amer. J. Physiol.*, **129**, 505 (1940).
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Blood Groups of Anthropoids

Candela[1] has collected previous data on the blood grouping of 137 anthropoids, and added 11 more of his own, based on urine tests. 99 of the animals are chimpanzees, in which only groups *O* and *A* have so far been found. In the orang, gorilla, and several gibbon species all members belong to groups *A*, *B* or *AB*. This distribution in them is shown in the accompanying table.

Genus	*O*	*A*	*B*	*AB*	*AB* (calc.)
Orang	0	8	10	5	11·41
Gorilla	0	6	3	2	5·09
Gibbon	0	2	7	2	4·36

The last column gives the numbers of *AB* animals expected if there were random mating within the genus the members of which are grouped together. For in the absence of group *O* we can be reasonably sure that all, or almost all, *A* and *B* animals were homozygous, if the genetics of blood groups are the same in apes as in men. Thus of 46 orang chromosomes 21 carried *A* and 25 *B*. If mating were at random we should expect a frequency $\frac{2 \times 21 \times 25}{46^2}$ of *AB* among orangs, or 11·41 out of 23. The total of *AB* found is 9, as compared with 20·86 calculated. The difference is 3·6 times its standard error, and certainly significant.

The non-randomness of mating may be due to the existence in these genera, as in man, of different blood group frequencies in different areas, or to inbreeding, or both. A fairly intense degree of inbreeding would be needed to halve the expected proportion of heterozygotes. This would, for example, occur if 80 per cent of all matings were between brother and sister, the rest being at random. It is at least equally probable that the distribution of blood groups in these genera varies geographically at least as much as in man. Unfortunately many of the papers in the literature do not even give the species or subspecies of anthropoid investigated, and very few if any give the place of capture or those of the wild ancestors.

Hence no conclusion on this matter is possible. It is of importance that these data should be given in all future work, if only because their results may throw light on the origin of the differences between human races as regards blood group membership. The chimpanzee, of which 99 have already been grouped, seems to be much the most hopeful animal for this purpose. It is the object of this note to direct the attention of workers in this field to so important a desideratum.

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Oct. 28.

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Function of Nicotinic Acid in the Metabolism of the Colon-Typhoid Group of Bacteria

We have already[1] presented data indicating that nicotinic acid does not act as a specific 'growth factor' in the limited sense, but as a part of an activator of glucose fermentation. In the semi-synthetic medium used, growth of *S. paratyphi* A. and *Shigella dysenteriæ* Shiga occurred in the absence of nicotinic acid; however, when glucose was added to this medium, active fermentation took place only

when nicotinic acid was added. In order to test the validity of this conclusion, these studies were extended to include other fermentable substances under a variety of conditions. The full results will be published elsewhere, but we wish to direct attention now to a number of points of special interest.

(*a*) Using the photo-electric colorimeter for measuring growth density (a more accurate method than naked eye observation and much simpler than the plate-count method) we noted the following paradoxical effects : (i) Glucose added to our medium free of nicotinic acid inhibits growth ; growth was better in the absence than in the presence of glucose. This inhibiting effect was produced by all sugars fermented by the organisms used in the experiments, with the exception of maltose ; and conversely it was not produced by sugars such as sucrose not fermented by these organisms. (ii) Similarly, nicotinic acid added to the medium in the absence of a fermentable sugar or acid (lactic or acetic) inhibits growth. The inhibitive effect of the nicotinic acid is produced by such minimal concentrations as are still effective in influencing fermentation when fermentable sugars are present.

These effects are illustrated by typical results given in Table 1.

TABLE 1. GROWTH DENSITY IN THE BASIC MEDIUM AND WITH THE VARIOUS ADDITIONAL SUBSTANCES ADDED.

Without nicotinic acid		With nicotinic acid	
Medium	Growth density*	Medium	Growth density
Sterile medium	100	Sterile medium	100
Basic medium	84	Basic medium	90
,, + glucose 0·01%	97	,, + glucose 0·01%	77
,, ,, 0·05%	97	,, ,, 0·05%	63
,, ,, 0·20%	97	,, ,, 0·20%	65
,, + maltose 0·2 %	88	,, + maltose 0·2 %	70
,, + sucrose 0·2 %	84	,, + sucrose 0·2 %	90

* The numbers indicate the relative growth density ; the highest numbers represent least turbidity, and conversely.

(*b*) The addition of nicotinic acid to media containing a fermentable sugar or acid (lactic or acetic) is followed by active fermentation leading to a breakdown of the substance : (i) When glucose is used, lactic and acetic acid and carbon dioxide are the principal products. (ii) When sodium lactate is used, the end products depend on whether or not nicotinic acid is present. In the latter case, a small part of the lactic acid is oxidized to acetic acid, but the process goes no further ; in the former case, that is when nicotinic acid is added, complete oxidation of the lactic acid results and the acetic acid is converted to carbon dioxide, that is, carbonates. In lactic acid – containing media to which a suitable indicator is added, no change in reaction occurs in the absence of nicotinic acid, while a marked alkaline reaction is developed in the presence of nicotinic acid. The density of growth parallels the intensity of fermentation.

(*c*) By means of dehydrogenation experiments by the Thunberg procedure with washed cells (using lactate as donator), it was possible to show that organisms grown in glucose or lactate media with nicotinic acid reduced methylene blue, while those grown in media without nicotinic acid failed to reduce methylene blue. If the washed organisms used in the system were grown in the presence of glucose or sodium lactate, together with even minimal amounts of nicotinic acid (0·005 γ/c.c.), they reduced methylene blue fairly promptly. If the washed bacteria were grown in the absence of nicotinic acid, and then nicotinic acid added to the respiration system, the reduction was delayed and occurred only after an incubation time which was at least twice that required by the control culture grown in the presence of nicotinic acid. It seems, therefore, that the nicotinic acid is first converted into a codehydrase (cozymase ?) before it can act. Some typical data are shown in Table 2.

TABLE 2. REDUCTION TIME IN RESPIRATION EXPERIMENT WITH WASHED CELLS OF BACTERIA GROWN IN MEDIA CONTAINING SODIUM LACTATE WITH AND WITHOUT NICOTINIC ACID.

Source of cells	Substances added to system	Time for complete reduction of methylene blue (1:5000)*
Medium + 0.005 γ N. acid	Nic. acid, 10 γ	98 minutes
,, – ,,	,, ,, 10 γ	193 ,,
,, + 0·005 γ N. acid	Nothing	163 ,,
,, – ,,	Nothing	No reduction
,, + 0·005 γ N. acid	Cozymase 0·2 c.c.	50 minutes
,, – ,,	,, 0·2 c.c.	50 minutes

* *M*/20 lactate served as donator.

These data explain some discordant results in the literature[2,3]. It has not previously been suspected that glucose (in the absence of nicotinic acid) inhibits growth ; even 0·01 per cent glucose is sufficient to give this effect. It also appears that in the absence of a fermentable carbon compound minimal amounts of nicotinic acid exert an inhibitive effect on growth.

The results show further that nicotinic acid acts only after it is converted by the cell into an activator (a codehydrase ?), and by making available a simple source of energy it affects a more accelerated and abundant growth. The function of nicotinic acid is, therefore, as a part of cozymase, a function which it probably fills also in the animal body.

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Sept. 13.

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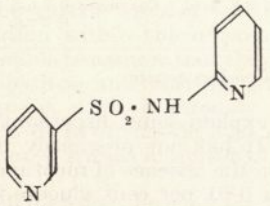
Pyridine-3-sulphon-(2-pyridyl)-amide ; a Note on the Modelling of Chemotherapeutic Agents

THIS compound (I) was prepared for the following reason : pyridine-3-sulphonic acid and its amide were found to inhibit bacterial growth, apparently by interference with nicotinic acid metabolism[1]. Sulphanilamide appears to act as a therapeutic agent by interfering with the utilization of *p*-aminobenzoic acid by the invading organisms[2], but the 2-aminopyridine derivative (*M. & B.* 693) is in many cases more effective. Following a rule of thumb method common in chemotherapeutic research, the *M. & B.* 693 analogue of pyridine-3-sulphonic acid, (I), was prepared

and its inhibitory powers compared with those of the parent acid and amide by *in vitro* tests analogous to those previously described[1,2]. The compound was found less active than the simple acid and amide.

In terms of the theory[3] on the basis of which pyridine-3-sulphonic acid was first investigated, which relates several inhibitory compounds to definite structures (for example, *p*-aminobenzoic acid, nicotinic acid) of importance to the organisms concerned, such failure to produce a more active compound can readily be understood. There is considerable specificity between the mutual effects of *p*-aminobenzoic acid and sulphanilamide, and between nicotinic acid and pyridine-3-sulphonic acid. *M. & B.* 693 is possibly related equally specifically to a derivative of *p*-aminobenzoic acid. Unless, therefore, the natural nicotinic acid derivatives are similar to those of *p*-aminobenzoic acid, it is unlikely that a group which enhances the activity of sulphanilamide will enhance that of pyridine-3-sulphonic acid.



I

Instances of failure to produce more active 'hybrids' in this manner are common in chemotherapeutic literature; for example, among sulphanilamide derivatives themselves, diethylaminoalkyl[4], quinoline[5], tropinone[6] and dihydrocuprein[6] derivatives are described as of relatively little activity, and hybrids between quinine and emetine[7] have not the activity of optimal members of the component series. It is suggested that the reason for such lack of success may be the same as in the case of the present pyridyl compound. Though corresponding essential metabolites are not in these cases known, it is not likely that they will be closely related to one another; known essential metabolites, for example, the vitamins, are very diverse in structure.

Preparation of (*I*). Pyridine-3-sulphonyl chloride (from 2·5 gm. of the acid) and 2-aminopyridine (1·5 gm.; I am indebted to Dr. A. J. Ewins for this material) were mixed in pyridine (5 ml.), warmed at 100° for ½ hr. and water (20 ml.) added. The product separated on cooling and was recrystallized from alcohol (60 ml.) yielding colourless prisms (1·8 gm.) m.p. 185° (found: C, 50·8; H, 4·0; N, 17·9; S, 13·5 per cent).

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An Electron Diffraction Study of the Surface of Magnesium attacked by an Aqueous Chloride Solution

IT is well known that magnesium is vigorously corroded by an aqueous chloride solution. However, previous investigations have always been macroscopic, and did not touch the mechanism of the phenomenon directly. The present study by electron diffraction may provide a fuller knowledge of this phenomenon than hitherto.

In the first stage of corrosion by a chloride solution, simultaneously with the evolution of hydrogen gas, the magnesium became covered with a black porous substance, and then the dark-coated surface in turn became coated with a white porous substance. Upon examining both the black and the white substances by the reflection method of electron diffraction, it was found that they are one and the same, consisting of crystals of magnesium hydroxide, $Mg(OH)_2$, and oxide, MgO; the hydroxide, according to the intensity of the diffraction rings, being present in a slightly larger quantity than the oxide.

Now it is known that magnesium is scarcely corroded in water, and it has been suspected that some sort of a protective film must exist on the surface. This surface film was detected by electron diffraction, which revealed the existence of a mixture of the $Mg(OH)_2$ crystals (large amount) and the MgO crystals (moderate amount). Therefore, the Cl^- ion plays the part of a catalyst in the reaction between magnesium and water, producing magnesium hydroxide and oxide. The diffraction rings from the surface substances produced in water are not so sharp as those from the substances produced in a chloride solution; hence the crystal size of the former is smaller than that of the latter. Using the equation for crystal size introduced by M. von Laue in 1926, that for the magnesium hydroxide is about 50 A., while that for the magnesium oxide is about 70 A.

It is a pleasure to acknowledge that this work has been done under the direction of Dr. Ichiro Iitaka.

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Sept. 24.

Blunted Teeth of Lymnæidæ

EXAMINATION of the anterior extremity of the radula of Lymnæidæ reveals a few 'blunted' teeth, but there are sometimes thirty to forty rows of worn teeth in an old mollusc, as seen among the late Prof. Gwatkin's material at the Natal Museum.

Older specimens also contain more rows of teeth than immature ones. New rows are added from the nascent posterior border and the number of tricuspid teeth is increased by coalescence of the cusps of marginal teeth.

Invertebrate teeth are more likely to grow than those of vertebrates which have erupted, and shedding of molluscan teeth is a less frequent process than is commonly supposed.

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RESEARCH ITEMS

Ancestral Longevity and the Sex Ratio

Material from family history records in the Department of Biology of the School of Hygiene and Public Health, Johns Hopkins University, has been used by Philip S. Lawrence to answer the question whether the children or grandchildren of long-lived progenitors exhibit on the average a higher male sex ratio than of those dying at a relatively young or average age (*Human Biology*, **12**, 3 ; 1940). It would appear that there is a positive association between the mean male sex ratio of children and the longevity of their parents, and further that this is more pronounced for the duration of life of the mothers than for that of the fathers. In the second generation, it is also higher when the grandparents died at advanced ages. Hence it is suggested that, on the average, the most vigorous part of the population produces the highest proportion of male offspring. At the same time, there is no suggestion in the present study that the sex ratio of offspring has any association, positive or negative, with the fertility of the parents. It is quite probable that where either one or both parents were long-lived, they had produced a greater mean number of children and grandchildren than when both were shorter-lived, but beyond the age of productivity. This indicates that individuals that possess the greatest amount of innate constitutional vigour are, by and large, the most highly fertile of the population. Experiments on *Drosophila melanogaster* strongly indicate that the offspring of parents that died at older ages have a higher average male sex ratio than the offspring of parents that died at younger ages. The association is particularly true with respect to the maternal organism. The data fail to show any regular association between fertility and the duration of life of fathers ; but for mothers an increase in longevity was accompanied by an increase in fertility both for production over the entire life-period, and also during particular portions of the life-span.

Evolution of the Mammalian Palate

The detailed investigation to which the skulls of fossil reptiles has been subjected in recent years offers new opportunities for the examination of mammalian homologies. Largely on embryological evidence, the mammalian vomer has been generally regarded as a development of the reptilian parasphenoid, but F. R. Parrington and T. S. Westoll regard the palæontological evidence as indicating the truth of the earlier view that the paired 'pre-vomers' of the reptile fused to form the mammalian vomer (*Phil. Trans. Roy. Soc. Lond.*, B, **230**, 305–355 ; 1940). Thus direct fossil evidence shows that the Triassic Theriodonta possessed vomers and palatine processes directly comparable with those of mammals, and that these were developed from the reptilian pre-vomers and premaxillæ respectively. Accordingly, the term 'pre-vomer' is really synonymous with vomer and its use should be discontinued. In the monotremes the 'mammalian pterygoid' and '*Echidna*-pterygoid' are shown to be homologous respectively with the pterygoid and ectopterygoid of the Theriodonts and other reptiles, and in ditrematous mammals the pterygoid includes the homologue of the reptilian pterygoid. In general, in the development of the mammals the snout region and the dentary have been comparatively little modified, but there has been a notable shortening of the post-dentary region, the posterior part of the pterygoids, and the orbitosphenoid, although this shortening does not extend to the roof of the skull.

Nesting Conventions of the Black-headed Gull

It has been stated by F. B. Kirkman that the territory of a black-headed gull (*Larus ridibundus*) has no fixed boundary, but subsequent observation leads him to modify that view (*British Birds*, **35**, 100 ; 1940). Measurement of the distance between a relatively small number of nests in a single colony showed that the minimum between nesting groups was 1½ ft., except in two cases when the distance was 2 or 3 inches less. Nests were moved closer than the 1½-ft. limit, and as a result of observing the reactions of their possessors towards their neighbours he comes to the conclusion that an 'inner territory' exists "that serves exclusively to determine its space relations with its next neighbours in its nesting group. Next neighbours may be some feet apart, but they must not, as a general rule, be less than 1½ feet". This inner territory is recognized as a prohibited area by the neighbours themselves, since they avoid intruding upon it, at any rate when the owners are present, and its biological value is said to be that, while allowing a certain proximity, it keeps nesting neighbours sufficiently apart to prevent contact and strife. A weakness of the paper lies in its failure to confirm the observations by measurement of the distances between a much greater number of nests and of nests in different colonies. Perhaps the author in further investigations may be able to correlate the reach or striking distance of a black-headed gull with the distance between nests.

New Termite Intercastes

A. M. Adamson has described intercastes of two species of termites (*Proc. Roy. Soc.*, B, **129** ; 1940). It appears that an individual of *Nasutitermes guayanæ* from Trinidad represents the only known termite intercaste combining important features of two castes. The head is soldier-like in most of its features but the compound eyes, ocelli and some other characters are those of the reproductive caste. The pronotum is intermediate between that of the soldier and reproductive castes, while the wing-buds bear resemblance to those of the reproductive nymph but with adult pigmentation of the wings. Two soldiers of *Microcerotermes arboreus*, also from Trinidad, with wing-buds, exceptionally large vestigial eyes and with the pronotum intermediate between those of the soldier and reproductive castes are also described. The significance of these intercastes is discussed, and they lend support to the opinion of A. E. Emerson and others that the worker caste arose phylogenetically from the soldier. The author concludes that the subject of the origin of the intercastes must await further studies on the general problem of caste determination.

Fructosans in the Monocotyledons

A LARGE number of fructose polymers, distinguished from inulin by their great solubility in cold water, have been found in recent years widely distributed in Monocotyledons. These substances form the subject of a useful review, under the above title, in the *New Phytologist* (**39**, May 1940). Owing to their mucilaginous and non-crystallizable nature, the isolation of these substances as chemical entities has seldom been achieved, and the establishment of their constitution by the methylation technique of Haworth has as yet made little headway. Seasonal changes in fructosan content in such a plant as barley indicate that under normal conditions there is an increase of fructosans in the whole plant until stem elongation is complete. Afterwards the amount of fructosan present diminishes, but it is not clear whether they are utilized in respiration, or synthesis of polysaccharides or proteins. The leaves contain only a small fraction of the total; the bulk is present in the stem and ears where they probably arise from hexoses, the latter themselves produced from the inversion of sucrose, the carbohydrate which is probably translocated to these regions. Seasonal changes in the fructosan content of Iris, Lycoris and Asphodelus suggest a similar storage role; they accumulate during the period of leaf activity, in leaf-base and rhizome, and are partially used up during seed production.

Studies of Meiosis

O. H. FRANKEL (*J. Genetics*, **41**, 419–34; 1940), C. D. Darlington (*J. Genetics*, **41**, 35–48; 1940), C. D. Darlington and L. La Cour (*J. Genetics*, **41**, 49–64; 1940) provide data from Fritillaria, Lilium and Tulipa which sheds some light on the factors governing pairing and chiasma formation. These factors would appear to be the position of the start of pairing, the length of time allowed for pairing to take place and the basic cause of chiasma-formation —believed to be torsion in the paired regions. Frankel shows that pairing starts practically always near the centromere in Fritillaria. A second contact point in the distal region shows its effect if the time allowed for pairing is sufficient. The time allowed for pairing also controls the amount of pairing of the chromosome. Bivalents with median centromeres are delayed in pairing as compared with bivalents with subterminal centromeres, and therefore show various differences in behaviour. It is believed that there is an inverse relationship between the extent of time for pairing and the degree of torsion. The statistical analysis of chiasmata in triploid Fritillaria and in the hybrid *Lilium testaceum* provides further evidence regarding the order of pairing and the ways in which this is interrupted. The higher chiasma frequency per configuration of a triploid is shown to be related to the change of partner and the increased number and distribution of contact points of pairing. Pairing proceeds at a more variable rate, and its average rate is lower in the hybrid *Lilium testaceum* than in the species.

A Chimæra in Sorghum

J. B. SIEGLINGER (*J. Hered.*, **31**, 363–364; 1940) has found a bilateral chimærical plant of Sorghum in the F_5 generation which was segregating for red and white pericarp colour. One half of the panicle contained white seeds which were striped red on the basal portion while the other half of the panicle bore the normal red seeds. The different types of seed produced similar progeny, thus indicating that the embryonic tissue was not influenced by the mutation which gave rise to the striped pericarp.

Interatomic Forces and Helium in Rocks

UNDER this title, N. B. Keevil discusses (*Proc. Amer. Acad. Arts and Sciences*, **73**, 311–359; 1940) the fate of the helium atoms generated in rocks from radioactive elements, with special reference to the factors which might permit some diffusion of helium through rocks during the vast extent of geological time. Consideration of the dimensions of the helium atom and construction of potential energy curves involving helium show that the size is large compared to the structural 'holes' in common minerals. The chance of escape through distortion channels resulting from radioactive decay should be high in radioactive minerals, but small in ordinary rock minerals. Calculations indicate that an opening 1·2 A. wide would have to be formed before escape would be possible. If diffusion were possible through crystal structures the effect would be so extensive during geological time that a uniform concentration of helium throughout a given rock would by now have been attained. Discussion of several factors suggests that migration of helium in ordinary rocks should normally be less than about eight per cent. With imperfections due to strains during crystal growth or subsequent alterations greater losses may be expected. Helium may be expelled completely during recrystallization, but mild thermal metamorphism would appear to have no effect. It is concluded that while 'helium-ages' of rocks are usually considered as minima, this preliminary survey of the problem indicates that ages obtained on carefully selected minerals should not differ from the true values by more than the present experimental errors of measurement.

Polyisobutylene

Brill and Halle, in 1938, showed that when polyisobutylene was stretched the amorphous X-ray diagram was replaced by a fibre pattern analogous to the case of natural rubber. They determined the identity period and concluded that the stretched molecules are not planar zig-zag in shape but because of the methyl side groups are probably helical. C. S. Fuller, C. J. Frosch and N. R. Pape (*J. Amer. Chem. Soc.*, **62**, 1905; 1940) have re-investigated the substance and have generally confirmed these results. The chain molecules in the crystalline regions assume a coiled form and possess a 1 : 3 disposition of the methyl groups. The fibre identity period is found to be 18·63 A. and this is assumed to be the *c* distance of an orthorhombic cell, the *a* and *b* distances being 6·94 A. and 11·96 A. This is based on a very probable molecular scale model, but other models are not absolutely excluded. The one chosen is consistent with the X-ray results; it gives the chain configuration in isobutylene as that of a helix in which the successive methyl group pairs pack together in a staggered arrangement. This requires successive partial rotations of the methyl group pairs at an angle of 45° around the molecular axis, with coincidence after eight rotations. Diagrams of the models are given in the paper. The space symmetry group suggested is identical with that proposed by Meyer and Mark for natural rubber, but later work has modified this in favour of a less symmetrical space group.

WINDOW BREAKAGE BY BOMB-BLAST

THE October number of the *Journal of the Institute of Physics* contains a special article by Dr. H. Moore, director of research for Pilkington Brothers at St. Helens, dealing with some physical problems of war-time window breakage. The effects of bomb-blast were studied experimentally by using small 2-lb. charges of blasting powder exploded under suitable conditions. Instantaneous photography of 7-ft. square ¼-in. plate glass windows showed that typically, under blast, the damage occurs in two stages. In the first, during the compression period the centre of the glass is forced inwards as a diaphragm, and ring and radial cracks develop. In the second stage, before the pieces have time to separate, the 'suction' half of the wave comes into effect and the pieces fall towards the bomb. If the glass is very near to the bomb so that all the air is displaced by the gases from the explosive, the broken pieces are driven away from the bomb. Short of blocking up a window with brickwork or enclosing it in shutters of heavy timber or stout steel it is practically impossible to safeguard the glass against fracture.

Attention was therefore directed to studying methods of preventing personal injury from flying fragments of glass. Consistent with previous results, sheets of transparent cellulose or fabric are effective if firmly fixed to the glass and carried well over and securely fixed to the edges of the window frame. Complete coverings are always better than separate strips of the same materials. The adhesive must be chosen with care, but ordinary flour paste as used by paperhangers may be used with reasonable safety. Although sodium silicate or water-glass gives excellent adhesion the glass will be etched and left permanently 'greyed'. Toughened glass and panes reinforced internally with wire mesh stood up well to the effects of blast.

Unless the explosion is very near to the window, glass fragments due to blast usually burst outwards. Fragments of glass, debris or bomb casing may, however, still be thrown inwards. Some protection from these is secured by 'lengthening the time of the blow'. For this purpose leaded panes, thick curtains, two or three thicknesses of hessian or ½-in. wire netting stretched on wooden frames and hanging freely some 3–6 in. from the glass have all proved effective.

In the same article the problem of blacking-out roof lights is briefly discussed. One solution was the use of coloured sources of artificial light emitting only a restricted range of the visible spectrum. The windows and roof-lights were then painted with a varnish transmitting only the complementary visible range. When workers found difficulty in getting accustomed to the coloured lighting, the quick and cheap method of painting the glass with black paint was widely adopted. Reasoning showed that windows exposed to strong sunlight might crack unless they were painted upon the outside—or upon the inside, according to the argument used. Observation showed that the windows were liable to crack in strong sunlight, on whichever side of the glass the paint was put. A study of the conditions showed that cracking was due to temperature differences between different regions of the glass sheet, and not to differences of temperature through the thickness. Cracking was avoided when all parts of the glass, and particularly the edges, were exposed to the radiation in the same way as the centre and if the edges were constrained no more rigidly than in the ordinary fixing with putty.

INDIAN FISHES OF ECONOMIC VALUE

SEVERAL interesting papers on Indian fishes are included in recent numbers of the *Records of the Indian Museum*. The most important of these are two on the Indian shad ("On Some Early Stages in the Development of the so-called Indian Shad", *Hilsa ilisha* (Hamilton) by K. Krishnan Nair[1] and "Further Observations on the Bionomics and Fishery of the Indian Shad", *Hilsa ilisha* (Hamilton), in Bengal waters by Sunder Lal Hora and K. K. Nair[1]). Hilsa is a clupeoid, closely related to the herring, and forms an important fishery. It breeds in the river throughout the year, and the two breeding peaks, large and small, are shown to be correlated with the flooding of the river owing to the monsoon and the nor'westers respectively. The young migrate down the river, and the upstream migration on which the main fishery depends is attributed to the monsoon and the state of maturity of the migrating individuals. A brief account is given of fluctuations in the year-to-year Hilsa fishery, and it is surmised that a five-year cycle exists in the fishery of this species. Hilsa can flourish well in confined fresh waters and even attain maturity. From the discovery of a regular fishery of young Hilsa in cold weather near Calcutta it has been suggested that more attention should be paid to the conservation of the Hilsa fisheries rather than to the establishment of hatcheries for the artificial rearing of the fish.

The collection and hatching of the eggs continues as a routine at Madras and, in Calcutta, owing to the continuation of biological investigations at the Pulta Waterworks by the Zoological Survey of India, a considerable amount of information on the bionomics of this fish has been collected. It was from this latter material that Nair made his observations on the larval forms, giving special attention to the number of vertebræ and changes in the relative proportions of the fish during growth.

T. J. Job ("On the Breeding and Development of Indian 'Mosquito-fish' of the genera *Aplocheilus* McClelland and *Oryzias* Jordan and Snyder"[2]) has investigated the life-histories of those fishes which are commonly used as mosquito controls. The genus Aplocheilus is the most important, and the breeding of three species of these is described; also that of *Oryzias melastigma*. The so-called 'killifishes' have

been found to be of immense value in the biological control of mosquitoes. These researches are important and very interesting. The development of Aplocheilus is rapid, and metamorphosis takes place in about three weeks after hatching; from this stage onwards mosquito larvæ are eaten. The eggs of all the species of this genus are laid separately and are attached by threads to weeds. In Oryzias the female carries her eggs in clusters, in some species throwing them off so that they become entangled in weeds. Thus there is a certain amount of parental care, and in *O. melastigma* they may or may not be carried until hatched. This species stays long in the larval state, and it may be one and a half months old before feeding on mosquito larvæ.

All these studies of life-histories are valuable, and it is hoped that more may be done on similar lines.

[1] *Rec. Indian Mus.*, **41**, Part 4 (1939).
[2] *Rec. Indian Mus.*, **42**, Part 1 (1940).

THE INORGANIC ELEMENTS IN NUTRITION

EXTENSIVE investigations made within recent years and demonstrating the importance to human nutrition of minute quantities of various mineral elements were reviewed by Prof. E. V. McCollum, professor of biochemistry in the Johns Hopkins University School of Hygiene and Public Health, in a paper read at the University of Pennsylvania Bicentennial Conference on September 17.

The early literature of nutritional research placed emphasis almost entirely on proteins, carbohydrates and fats, and gave little attention to the inorganic nutrients, in spite of the fact that Liebig, about 1830, had shown the importance of minerals as fertilizers for the growth of plants. However, it must have been dimly appreciated that, since the bones contain so much calcium phosphate, an adequate supply of these elements must be provided for growing creatures. The appetite for common salt was accepted as evidence for the need of sodium and chlorine. Isolation of hæmoglobin by Hoppe-Seyler in 1862 stimulated investigations of the role of iron in the body, and during the last quarter of the nineteenth century physiologists studied some of the fundamental problems relating to the physiological action of salt solutions, including the development by Ringer of his famous solution. By the beginning of the twentieth century research in the mineral elements of nutrition had made much progress, and it is now known that at least thirteen inorganic elements are concerned with biochemical processes and must be provided in adequate amounts in the diet.

More than thirty years ago Dr. H. C. Sherman, of Columbia University, showed that calcium is one of the elements in which the human diet is frequently deficient. Milk and leafy vegetables are the only foods commonly eaten by man which are rich in calcium, and the rather poor utilization of the calcium of several green vegetables is due to their high content of oxalic acid, which interferes with calcium absorption. The calcium problem in human nutrition was intensified by the perfection of milling machinery so that all the mineral-rich parts of the grain could be removed from the part which is sold as flour, and to the rise during the last century and a half of the consumption of sugar, which now stands at an average of more than one hundred pounds per capita per annum. The large fraction of the total food supply taken in the form of refined cereals and sugar, the latter entirely free from mineral elements, puts upon the remaining portion of the diet the burden of supplying almost the entire inorganic needs of the body.

The effects of calcium deficiency range from a decreased rate, or cessation of growth, to premature death. Many of the effects are due to the shortage of this element in the blood, which normally contains only 1 per cent or less, of all the calcium in the body, 99 per cent being in the bones and teeth.

Prof. McCollum referred briefly to the researches conducted around 1922 which showed that lack of vitamin D was a principal cause of rickets, a disease in which there is poor development of bones and teeth. Previous to 1922, the cause of rickets was unknown, although the disease had afflicted millions of infants and children in temperate regions throughout the world during many hundreds of years. Simply supplying calcium and phosphorus, the main ingredients of bone, was not sufficient. These minerals could not be built into bone, it was then found, without the assistance of vitamin D. It was Prof. McCollum and his associates who demonstrated this fundamental fact by noting that the sudden introduction of cod liver oil into the diet of a rat with rickets was followed by deposition of lime salts in the bone. The freshly deposited lime showed in the X-ray as a distinct line across the head of the bone, and became a test of the curative effects in treating rickets. It was later shown by a number of research workers that sunlight on the body or artificial irradiation of foods caused the formation of vitamin D in the body or foods and prevented or corrected rickets in children.

Next to the nutritional problems traceable to deficiencies of calcium and phosphorus and vitamin D (and these are now in great measure being prevented), anæmia due to deficiency of iron is perhaps the most widespread inorganic nutritional problem. Apparently about 50 per cent of the iron in cereal grains and certain other common goods is in the so-called 'hæmatin' form, in which it is not available for assimilation by man or animals. It has been noted that the utilization of iron by the system is impaired when the supply of ascorbic acid (vitamin C) in the diet is inadequate, and there are reports that anæmic persons on a low iron diet show a marked response in the number of red blood cells and the hæmoglobin percentage when ascorbic acid is given to them. Also iron tonics in certain cases have led to no improvement in the blood until fresh fruits or raw vegetables which are good sources of vitamin C are included in the diet. Prof. McCollum remarked that preventable or curable anæmia is so widespread and so common that these newer observations on the manner of assimilating iron are of great practical significance.

It has been shown also that copper is important in connexion with the utilization of iron, and that copper deficiency is fairly widespread among infants.

One of the most interesting mineral elements, in its behaviour in the animal body, is manganese. Rats given a diet deficient in manganese were unable to suckle their young, and they showed no normal maternal instincts. Many of the neglected young rats died within a few hours. Deficiency of manganese in chickens produces a condition known as 'slipped tendon', or perosis, in which the angle joint is displaced and the birds crippled so badly they usually die. Hens deficient in manganese lay eggs of very low hatchability, many of the chicks dying in the shell a few days before the time for hatching. These embryos are often deformed, having short, thickened leg and wing bones and globular heads. When manganese is injected into hens deficient in the mineral the eggs hatch normally and produce chicks with normal bones. At present there is no evidence concerning the occurrence of manganese deficiency in human beings.

Reference was also made by Prof. McCollum to the demonstration of cobalt deficiency as the cause of a blood disease in sheep and cattle known variously throughout the world as 'Denmark disease', 'coast disease', the 'pines', 'bush sickness', and 'salt sick'. The animals suffering from the disease were found to have been grazing on pastures the soil of which was deficient in cobalt. The investigations which proved the point constitute one of the classics of nutritional research. This disease, it will be recalled, has been the topic of articles and correspondence in NATURE during recent years.

AFFINITIES IN THE PUEBLO CULTURE OF ARIZONA*

DR. FRANK H. H. ROBERTS, JUN., continues his report on his archæological excavations of the Whitewater Anasazi or Basket-Maker-Pueblo remains in Eastern Arizona (see NATURE, **144**, 556; 1939) by an account of the pottery, and objects of bone, stone and shell which were found, as well as of the burials which were examined. From the burials skeletal remains of 150 individuals were discovered, but of these 15 only were sufficiently well preserved to permit of recovery, examination and report.

The objects recovered by the investigation permit of a very partial view only of the material culture of the inhabitants. Virtually the whole of the products of their industry made of perishable material is missing. A few potsherds bear the impress of basketry, while a few charred pieces of cord were found. The basketry was of the characteristic coiled form. There is no evidence of clothing, textiles or wooden implements, though these must have played a large part in their lives.

The specimens collected were found in the remains of houses, in the various refuse mounds, as offerings accompanying burials, in a few instances on the old occupation surface near dwellings and outside fire-pits. No articles appear to have been made specially for funerary purposes.

Most of the artefacts represent one stage, the Developmental Pueblo, though there are a few from the earlier stage, the Modified Basket-Maker, and the later, the Great Pueblo. Dated timbers from the various structures indicate datings ranging from the early part of the ninth century to the early years of the eleventh century A.D. Pottery sequences have been checked and confirmed by stratigraphic evidence.

True pottery first appears in the Anasazi province in the Modified Basket-Maker stage. Vessels were occasionally made of unfired clay tempered with shredded cedar bark or grass, the prototype of the later makes that came to play so prominent a part in the life and industry of the people. In some instances the bottoms were moulded in baskets, the walls or rims being formed of fillets of clay looped around the upper edges. Others were fashioned entirely by hand without basal support by a coiling process. The principal shapes were shallow trays and deep bowls. The unfired clay objects may be attributed to influences from regions to the south but the methods used seem to have been mainly indigenous, since the Basket-Makers were already adepts in the use of clay for architectural purposes, as for example in the jug-like necks of the tops of their granaries and the mud steps placed on granary walls. When firing of clay developed, the cedar bark binder was replaced by sand, which in turn was gradually replaced by powdered rock, and this in the Developmental Pueblo period by ground potsherds.

The Modified Basket-Maker phase had developed a variety of shapes in its pottery, while protruding particles in the paste gave it a characteristic irregularly stippled appearance. Decoration for the most part was confined to the interior of bowls and was produced by the use of carbon which was prevalent in north-eastern Arizona, and an iron, which was widely distributed over the remainder of the area. The designs are generally ribbon-like panels embellished with dots, zig-zags, and stepped line elements. The opening of the Developmental Pueblo period witnessed changes. New features were introduced and there was a marked expansion in the industry. Surfaces were carefully smoothed and the application of a step was introduced. A great diversity of form is shown with colour; plain grey, black on white, black on red, and brown with a brownish exterior and a slightly burnished interior. All types of vessel are decorated. There are two main groups of the light-coloured vessels ornamented with black, of which one occurs throughout the eastern part of Arizona centring about the Chaco Canyon area, and the other predominating in the west.

On the Whitewater site, stratigraphic tests show a definite progression in pottery forms and a certain sequence in the appearance of types. This is augmented by the association between ceramic styles and house remains and an indication of a certain

* Smithsonian Institution, Bureau of American Ethnology, *Bull.* 126. Archæological Remains in the Whitewater District, Eastern Arizona. Pt. 2. Artifacts and Burials. By Frank H. H. Roberts, Jr. With an appendix: Skeletal Remains from the Whitewater District, Eastern Arizona. By T. D. Stewart. Pp. xi+170+57 plates. (Washington, D.C.: G.P.O.) 50 cents.

time factor through the dendrochronological dating of some of the structures. The earliest type of pottery noted for the district is a form identifiable as late Modified Basket-Maker of the eastern variety—a type occurring across the plateau in western New Mexico to the San Juan and into the north-eastern San Juan basin. The second type in the series is one typical of the beginning stage of the Developmental Pueblo period through the greater part of the Anasazi province that was characterized by the Chaco cultural pattern. Afterwards, a new form appeared that gives strong evidence of Chaco influence but which seemingly comes from the area lying between the Puerco and Little Colorado Rivers —the Little Colorado style as it has been called. While this ware indicates an affinity with types found along the Little Colorado, the designs suggest a Chaco derivation. A third type of the Early Developmental Pueblo is the Kana—a black on white. Most of the ceramic developments during middle and late phases of the Whitewater occupation were an outgrowth from these three forms with some additions from the Little Colorado, the Upper Gila of New Mexico, and continued influence from the Chaco Canyon area in north-western New Mexico.

The significant feature about the pottery evidence is that it demonstrates an early south-west extension of influence from the Chaco Canyon area with a spread later toward the north-west from Little Colorado centres and towards the south-east from the Kayenta or Tusayan region—a movement contrary to that postulated by many south-western workers and tending to show that many traits appear in the Chaco that have been attributed to influence penetrating from the Little Colorado region, though they belong to the Chaco and were diffused from there towards the Little Colorado. Further, from evidence of the present material, there must have been a strong interplay of influence between the Chaco and Tularosa regions before the growth of that between Tularosa and Little Colorado.

Although the skeletal material examined by Dr. Stewart is not sufficient to give a broad view of the general characteristics of the people, certain interesting and important points emerge.

In the first place, further elaboration is given to Seltzer's view that the evidence does not justify the theory of a sweeping change in physical type during the transitional Basket-Maker-Pueblo period. This theory rests chiefly upon the unproved premise that cranial deformation among the Pueblos is accidental, but the predominance of lambdoid deformation in the Whitewater District and among the culturally related groups in New Mexico and Colorado lends force to the view that in general its use among the Pueblos was more than accidental, thus effectively masking the long-headed form of the natural skull. The evidence thus runs contrary to the generally accepted view that the beginning of the Pueblo period was marked by an infiltration of round-headed groups.

Secondly, the present group shows definite relationship to the Basket-Maker physical type as well as to other peoples having the Anasazi cultural pattern, the so-called "South West Plateau" physical type. Further, according to Dr. Stewart the 'lambdoid' type of deformation points to a relationship with peoples who occupied certain sites in the Chaco Canyon and south-western Colorado, "a feature which correlates nicely with the cultural evidence for a predominant Chaco influence in the [Whitewater] arts and industries".

FORTHCOMING EVENTS

Monday, November 18

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Prof. S. J. Davies: "Recent Developments in Internal Combustion Engines" (Cantor Lectures, 1).

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Miss Harriet Wanklyn: "The Rôle of Peasant Hungary in Europe".

Tuesday, November 19

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, S.W.1), at 1.30 p.m.—Mr. William Barnes: "Methods of Excavation Work at Home and Abroad" (Dugald Clerk Lecture).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

HEAD OF THE ENGINEERING DEPARTMENT OF THE SMETHWICK MUNICIPAL COLLEGE—The Chief Education Officer, Education Offices, 215 High Street, Smethwick (November 21).

ENGINEERING WORKSHOP INSTRUCTOR—The Principal, Twickenham Technical College, Egerton Road, Twickenham (November 23).

ASSISTANT MECHANICAL ENGINEER FOR THE ELECTRICAL BRANCH, Public Works Department of the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9346).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Electrical and Allied Industries Research Association. Technical Report, Reference W/T2: A Critical Study of the Application of Electricity to Agriculture and Horticulture. By C. A. Cameron Brown. Pp. 84. (London: British Electrical and Allied Industries Research Association.) 2*s*. net. [3010

London Shellac Research Bureau. Bulletin No. 4: Chemical Constants of Lac—Some Notes on the Acid, Saponification and Hydroxyl Values of Lac. By Dr. B. S. Gidvani and Mrs. J. M. Dobbie. Pp. 16. (London: London Shellac Research Bureau.) [411

Other Countries

Queen Victoria Memorial, Salisbury, Southern Rhodesia. Annual Report for the Year ended 31st March 1940. Pp. 8. (Salisbury: Queen Victoria Memorial.) [2210

Colony and Protectorate of Kenya. Forest Department Annual Report, 1939. Pp. 30. (Nairobi: Government Printer.) 2*s*. [2210

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 19, 1937. iv. Meteorologiska iakttagelser i Sverige, Band 79. Pp. xi+107. 7 kr. Årsbok, 21, 1939. i. Månadsöversikt över väderlek och vattentillgång. Pp. 78. 2.50 kr. Meddelanden, Band 7, No. 6: Temperaturmätningar i Vänern och Götaälv. Av Anders Ångström och Stig Jacobson. Pp. 20+12 plates. 2.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [2310

Smithsonian Institution: Bureau of American Ethnology. Bulletin 126: Archæological Remains in the Whitewater District, Eastern Arizona. Part 2: Artifacts and Burials. By Frank H. H. Roberts, Jr.; with an Appendix: Skeletal Remains from the Whitewater District, Eastern Arizona, by T. D. Stewart. Pp. xi+170+57 plates. (Washington, D.C.: Government Printing Office.) 50 cents. [2510

Pennsylvania State College: School of Agriculture and Experiment Station. Bulletin 391: The Utilization of Certain Feeding Stuffs by Cattle. By E. B. Forbes, John W. Bratzler and Cyrus E. French. Pp. ii+14. (State College, Pa.: Pennsylvania State College.) [2910

Proceedings of the American Philosophical Society. Vol. 83, No. 4: Symposium on Characteristics of American Culture and its Place in General Culture. Pp. 513–588. (Philadelphia: American Philosophical Society.) 50 cents. [2910

Proceedings of the United States National Museum. Vol. 89, No. 3094: The West American *Haliotis*. By Paul Bartsch. Pp. 49–58+plates 6–8. (Washington, D.C.: Government Printing Office.) [2910

Royal Observatory, Hong Kong. Meteorological Results, 1939, prepared under the direction of C. W. Jeffries. Pp. v+144+40+6. 3 dollars. Annual Report of the Director of the Royal Observatory, Hong Kong, for the Year 1939. Pp. F8. 30 cents. (Hong Kong: Government Printers.) [2910

Report of the Kodaikanal Observatory for the Year 1939. Pp. 6. (Delhi: Manager of Publications.) 2 annas; 3*d*. [111

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