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SCIENTIFIC AND INDUSTRIAL RESEARCH.—V

IN our survey of the strategy of research we have already noted that, in addition to their functions in training the research workers required by the nation, the universities have an essential place in the organization for research, especially in regard to fundamental research. We have still to consider the tactics by which the fullest use can be made of the universities in this organization without detriment to the highest traditions and ideals of the universities, either in teaching or in the intellectual and spiritual service of the community. Furthermore, in considering the broad objectives towards which our programmes of research should be directed we have seen the need for some co-ordinating authority in our research structure, competent to review the broad programmes, to assess their importance and relevance to national needs and to determine the gaps which may require filling or the sectors which may require strengthening, either from the point of view of scientific advance or of the needs of society.

We come now, therefore, to a fuller consideration of the type of organization which is required to serve our strategy and the tactical modifications or developments which may be desirable in the existing structure to fulfil our purposes more effectively. That existing structure has received strong criticism in recent months, and it is appropriate in the first place to consider that criticism in fuller detail. In the main such criticism has been concerned with the lack of co-ordination particularly with reference to the planning of research, as was pressed in the House of Lords debate last year and again in the debate on research and scientific knowledge in the House of Commons last April. Dr. P. Dunsheath urged in his Atkinson Memorial Lecture that industrial research requires a live central co-ordinating secretariat. That was also the main reason for the London Chamber of Commerce proposing, in its report on scientific industrial research, the establishment of a strong central research board to act as a co-ordinating and directing body for all research organizations and to be the link between the Government and the research activities of the country at large.

That criticism is also reflected in the statement of the Association of Scientific Workers, "A Post-War Policy for Science". The survey of the organization of science contained in this statement leads to four main comments. First, the latest developments in our war-time organization have not in many fields satisfactorily linked research to requirements. Secondly, lack of central direction has produced a lack of balance in the development of science, as shown by the entirely disproportionate lack of development of biology as compared with the physical sciences. Third, the same cause, and the practice of private industry, lead to unnecessary and wasteful use of scientific effort. Finally, the whole scale and scope of research appears to be inadequate to supply the country's needs after the War.

Some of these points are made also in the severe

criticism of the existing structure to be found in an article, "Research, Intelligence and Administration", by Prof. Harold J. Laski in a series of articles on "Post-War Machinery of Government" in *The Political Quarterly*. Prof. Laski argues that there is little co-ordination, no effective machinery for publicity, and no real attempt to integrate the work and needs of government departments with those of outside bodies. All major scientific institutions—the Royal Society, the Royal Institution, the university laboratories, the British Association—depend on private benefactions for their main opportunities.

Of the sixteen points in which Prof. Laski finds the present organization defective, some are clearly matters of tactics rather than organization, though they may be due partly to bad organization—for example, the inadequacy of the salaries and status of Government research workers. Mostly their relevance in this connexion is clear enough, and without necessarily accepting their validity they may be briefly summarized as follows.

The funds at the disposal of research are utterly inadequate. The pattern of administrative organization is awkward, lacking in integration and defective in comprehensiveness. The relation of research to administration is gravely defective, and the control of research is mostly in the hands of men with no serious acquaintance with the possibilities of either natural or social sciences. There is no properly thought out policy for long-term research or any planned attempt to use the universities or bodies like the Royal Society to conduct independent investigations into problems with which the community is concerned.

No proper method exists in any government department for securing awareness of relevant work achieved by scientific workers in foreign countries—a defect which is specially marked with regard to the U.S.S.R. The present system also sacrifices the endowment of research to the easy method of direct subsidy to industry, indicating a tendency to the short-term in place of the long-term view, which in such fields as nutrition is clearly detrimental to the national interest.

Relations between the Government and the social and natural sciences are in Prof. Laski's view dominated by the theological inheritance of our society and by the individualistic approach. Again, he takes exception to the age of those who are charged with the direction of these relations and he also points to the dangers in the implications of the relation between the administrator and industry in the existing system. Finally, he comments on the inherent inertia or desire of departments to let well alone, and on the slight opportunity for the research worker in the natural or social sciences to show his powers as an administrator save by accident: all the vital places are in effect reserved for the administrative grades of the Service.

Now that is a formidable list, and the gravamen of the indictment is increased by the fact that most of the criticisms are substantiated by comments in Parliamentary debates and in the numerous reports and papers on scientific and industrial research from different sources which have appeared during the last year or so. Prof. Laski's thought, however, is very clearly coloured by his political approach, as is evident from the nature of his observations on the major changes that are required. Furthermore, his preoccupation with the political—and it might be argued the party—aspect of the problem has led him to ignore the merits or advantages of the present system, and the principles which our consideration of the strategy and objectives of research has already led us to postulate.

Prof. Laski's conclusion indicates that he is concerned more with a political thesis than to elucidate the form of organization which will best serve the principles and objectives which have been adumbrated in our survey of the strategy of research. The validity of his particular criticisms may be admitted and measures must be adopted to guard against their effects in whatever type of organization of research may be set up. The nature of that organization, however, should not be dictated primarily by political considerations but by the requirements of research and the principles which in practice have best secured its effective implementation, even though the time may be ripe for impartial re-examination of the whole question of the structure of industry from the point of view of social and economic efficiency and research.

That is the main reason why, in spite of widespread recognition of many of the defects in the present organization, there has been little evidence of a demand for fundamental change. Prof. A. E. Trueman in his pamphlet "Science and the Future", for example, examines the situation far more objectively than Prof. Laski, and concludes that, so far as the planning of science is possible, it can suitably be achieved within the organization already available. The existing organization is loose and flexible, but provides a sound basis for extending a working combination of Government assistance and direction with the help of voluntary workers. While it makes possible a general control, it leaves a large measure of individual liberty, and in particular the intellectual and professional freedom which is vital.

The development or modification of existing institutions which within their respective spheres are effective is so in accordance with the tradition of British methods that strong reasons should be forthcoming before we proceed to discard them entirely and replace them by fresh instruments. No such reasons are forthcoming in Prof. Laski's criticism, which, it will be noted, is in the main of the administrative side. Much of it, moreover, is in keeping with the essential point in the criticism of the machinery of government to be found in the reports of the Select Committee on National Expenditure, in the *Planning* Broadsheets and in the earlier report of the Haldane Committee: we need effective machinery for the planning and co-ordination of general policy. In research as elsewhere, our organization must provide, in the words of the Haldane report, "for the organised acquisition of facts and information, and for the systematic application of thought, as

preliminary to the settlement of policy and its subsequent administration".

If a modified or developed organization meets this requirement we shall have met the main points of Prof. Laski's criticism, in so far as that is properly relevant to organization and is not concerned either with the quality or ability of administrative personnel or with the financing or endowment of research. There are, however, other and even more vital considerations to be taken into account before deciding on what form our structure of research should take, or what modifications may be required in the existing organization. Further, there are certain special problems at the present time which must be handled by that organization and for which new instruments may be required.

First, it follows from what we have already said regarding the precedence of personnel over organization, that our organization for research must be such that not merely does it secure the most effective use of research workers in furtherance of our research objectives, but also it maintains the enthusiasm and initiative and originality which are vital factors in creative work.

To keep the administrative side imaginatively alive to such issues and sensitive to trends of opinion may well involve further attention to the question of intelligence as part of our research structure, but that aspect can be more profitably considered with reference to the broader question of education and information in relation to the utilization and support of research. This question of freedom in relation to organization and planning is also of vital importance in considering some of those problems in the organization of research which are specially prominent at the present time, particularly in regard to the place of the universities. As has been pointed out in a recent article in *The Economist*, all the evidence points to a growing dependence of our universities upon State assistance as compared with fees or private and independent endowments.

That circumstance of itself would demand extra vigilance to ensure that there is no weakening of the independence of the universities and of the essential freedom of inquiry and of teaching. The desirability, if not the necessity, of relating the universities more intimately with the research effort of the country as a whole so as to facilitate the planning of that effort more effectively, and the obvious importance of some further measure of co-operation between the universities themselves so as to secure the adequate endowment and staffing of whatever additional schools of research or teaching may be required while avoiding redundancy, also compel consideration of new measures of reorganization from much the same point of view.

These are the reasons that have led to some attention being redirected to the constitution and functions of the University Grants Committee. That Committee, Mr. Attlee stated, has recently been reconstituted so as to permit the association with it of persons whose services are not actively engaged in connexion with a university. In the opinion of some, such as Sir Charles Grant Robertson, such a reinforced Committee should be able to sift the programme of development of each university and to analyse and value the needs not only of each institution but also of university education as a whole. It should probably also be competent to co-ordinate special departments so that there will not be avoidable duplication or overlapping, and a single university may be selected to be the institution where a particular subject can be most efficiently pursued.

That opinion is not universally shared. The British Association Committee has suggested that the University Grants Committee might function as a Committee of the Privy Council instead of, as at present, directly under the Treasury, but its report also proposed the establishment of a universities' advisory council, entirely free from Government control. That was also the proposal of the Parliamentary and Scientific Committee and of the Association of University Teachers, and has received some support in the more recent report, "Science in the Universities", issued by the Association of Scientific Workers. While, however, the Association of University Teachers visualizes the proposed council as possessing advisory functions only, some means of providing more effective central control appears to be required, as the Parliamentary and Scientific Committee and the Association of Scientific Workers clearly recognize.

The Association of Scientific Workers contemplates that the power of such sub-committees would be limited to advising when and where new departments were needed for the investigation of newly opened fields of knowledge. The University Grants Committee would normally act on their advice and provide funds accordingly, and the research committee which it is proposed each university should establish to watch over departmental activities and present a total research budget to the university for transmission to the University Grants Committee would also maintain contact with such sub-committees. This scheme would avoid rigid planning and divorce the direction of research activities from the Treasury, but it does not appear to provide a means of dealing effectively with the problem of present redundancy to which Sir Ernest Simon has so pointedly directed attention.

We may postulate, therefore, that in regard to the universities our organization for research must provide some effective means for consultation and co-operation between the universities themselves, whether through the development of the University Grants Committee, through a universities advisory council or in other ways. Next, it must establish right relations between the universities and public bodies in which the universities recognize that they are in large part public institutions with public duties to perform, in providing the education and producing the graduates the country requires. The means provided for both these purposes must safeguard the independence of the universities and of the fullest freedom of investigation and teaching while securing responsiveness to the creative forces at work in the nation as a whole.

In this question of contact between the universities and the community in the organization and planning of research, contact with industry is of special importance. We have stressed the importance of such contacts from the point of view of personnel, but more organized contacts are required from the point of view of the planning of research itself. That is the significance of the Joint Council set up by the University of Manchester and the Manchester Chamber of Commerce.

Looking at the sphere of research for which the Government may be held directly and primarily responsible, it has long been recognized that the work required to maintain accurate standards of length, time, weight, etc., is properly a Government responsibility. Research in such sciences as astronomy and geology also requires a large measure of Government security. Similarly, it is right that such specialized forms of industrial research as factory lighting and ventilation, and on industrial safety should be carried on largely under Government auspices and financed out of public funds. Much the same applies to research into questions of soil erosion, forestry, plant diseases, water supply and many other problems in the domain of agriculture or health which have a social as well as an economic bearing.

It is, of course, not easy to draw precise limits as to the extent of Government responsibilities. Already a number of Government research stations, such as those concerned with building, fuel, food, agriculture, are in effect carrying out industrial research, but generally speaking it may be said that this applies to industries which are fundamental to the life and well-being of the nation. It is to be expected that the Government will always have a special interest in the industries serving these fundamental needs, and that there should be adequate provision of research into such problems under Government auspices, especially when the industries concerned are not easily able to organize such research themselves.

From this point of view the Department of Scientific and Industrial Research has unquestionably proved its value and should be retained in our structure of research. But over a far wider field the Government should be constantly on watch for new developments in scientific knowledge which may be of economic or social value to the nation. It was very noticeable in the House of Commons debate last April that research into medical and health problems, even where they closely affect economic productivity, was largely overlooked. Nor was anything said of economic and social research, and particularly the use of scientific methods in the study of relations between human beings.

It is clear that even from the point of view of the organization of research under direct Government auspices some means of ensuring a wider view and of effectively correlating the work of the Advisory Council for Scientific and Industrial Research, the Medical Research Council, the Agricultural Research Council and the Colonial Research Council is essential, and this must cover also the whole social and economic field and provide the Government with the best impartial scientific advice on all matters of industrial development on the application of scientific knowledge. Obviously such an organization capable of supplying the necessary central direction must be related to the Cabinet and to the policy-making bodies of the various sections of the Government if it is to be aware of the national problems concerned.

These could well be the essential functions of the Scientific Advisory Committee of the War Cabinet, and Dr. Haden Guest's proposal that this should form a permanent part of our machinery of Government might in principle meet the need, though its terms of reference as set forth in the White Paper on Scientific Research and Development must be enlarged and the details will require elaboration. The Association of Scientific Workers has suggested the establishment of a National Research and Development Council responsible to the Lord President of the Privy Council. The suggestion of a Ministry of Science is unlikely to be as satisfactory for reasons which were well stated by Mr. Attlee in a reply to Mr. Wootton-Davies in the debate. Co-ordination is not the same as centralization, and it is important to retain as much flexibility as possible in our organization and to aim at the permeation of all Departments of State with some understanding and appreciation of the scientific method and outlook.

When we have thus provided for the effective organization of research in the universities and under direct Government auspices there will remain a large field of applied research to be undertaken by private industry. It must be recognized that here there can be no question of formal organization from outside, any more than there can be such organization of fundamental research at the universities. In the discussions on industrial research during the last two years, while it has been clearly recognized that the Government has certain responsibilities in this field and that neglect of research has been an important factor in the depressed condition of some industries, with consequences in the national economy which no Government can wisely ignore, there has been no suggestion that the Government should do more than provide the most favourable conditions for stimulating research, whether in its fiscal and taxation policy and by the allowances made for obsolescence or by its attention to the supply of scientific workers through an adequate policy of scientific education. The essential function is that of encouragement, and the Nuffield College statement firmly rejects the idea of direct financial aid to the research expenditure of private firms, beyond what may be granted in the form of tax remissions.

One reason for rejecting any such proposal is that no such concession would be made on general lines without extending public control over the research thus aided, and such control over industrial research in the direction of the discovery of new products and new processes or on the improvement and simplification of existing processes and the discovery of new raw materials would probably be both unwelcome and impracticable. None the less, industrial research must be included within the general framework of the nation's organization for research, partly because of this recognized responsibility of the Government

for encouraging such research in appropriate ways, partly also because of the State's responsibility for seeing that the field is adequately covered, and partly for the reason that the invaluable interchange of personnel between pure and applied research and the contacts which are so stimulating cannot be secured without some regard on the part of the State to the general conditions of industrial research.

There is another reason for some closer consideration of applied or industrial research by the State. We have already seen that in certain industries fundamental to the national welfare the Government has already in its own research stations assumed direct responsibility for much of the research required. Suggestions have also been made that there is need in Great Britain for institutions of the type of the Mellon Institute of Industrial Research or the Massachusetts Institute of Technology to provide either an organization in which research workers can be delegated to study specific industrial problems or to cover problems which are common to many industries but the concern of none in particular, as, for example, chemical engineering.

The problem is well put in the Nuffield College statement, but that statement makes no recommendation that public funds should be applied to this purpose. Clearly any such project must be carefully examined from the point of view of existing research stations or research associations and their development, and also in regard to developments at the universities. No decision on such a point could well be reached except at the level of such a Scientific Advisory Committee as we have already adumbrated.

The place of the research associations demands a little further attention. Doubts have frequently been expressed as to the extent of their effectiveness, but in view of the number of small units in many industries and the growing cost of equipment, co-operative research of this type must probably find a more or less permanent place in our research organization. Large laboratories may be required for research both of the convergent or divergent type, and it may also be advantageous for some of the smaller industries to attach themselves to research institutions maintained by larger industries which are technically related to them. Moreover, consideration must also be given to the question of the extent to which the research associations themselves would be responsible for some of the fundamental research required, thus supplementing that in progress at the universities.

The assistance or encouragement which the State may be expected to give to industrial research will thus vary with the nature of the industry and with the size of the constituent firms. It is thus imperative that our organization should be flexible and that the Government policy should be as fully informed as possible—a further and fundamental reason for a co-ordinating secretariat and information centre for industrial research. No scientific advisory council can function effectively unless it is provided with adequate and efficient fact-finding instruments upon which its policy can be based.

FOSSILS AND ROCK CHRONOLOGY

Index Fossils of North America

A New Work based on the complete revision and re-illustration of Grabau and Shimer's "North American Index Fossils". By Prof. Hervey W. Shimer and Prof. Robert R. Shrock. Pp. ix + 837 (303 plates). (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1944.) 20 dollars.

A CENTURY and a quarter have passed since William Smith's "Strata Identified by Organized Fossils" (1816–19), with its figures of some 160 British fossils, made the long-delayed announcement of the discovery indicated in its title. The subsequent correlation of sedimentary rocks throughout the world has largely depended on the application of this discovery. Included microfossils now often enable the oil geologist to ascertain the horizon of the smallest sample from one of his borings; coal seams may be identified by fossil shells in the associated shales. In such ways has the study of fossils become of great practical help to mankind.

There is no doubt, however, that the field geologist is now very diffident about attempting to deal personally with any fossils he may collect, so extensive is the literature and so intricate are modern schemes of classification. The work under review is a notable attempt to remove such difficulties by presenting an epitome of modern knowledge of American invertebrate palæontology. Although nominally a revised edition of Grabau and Shimer's "North American Index Fossils" (1909–10) it contains so much new matter that it may well claim to rank as a distinct work. Many leading American palæontologists have collaborated in its preparation.

An index fossil, we are informed in the introduction, is "one which identifies and dates the strata or succession of strata in which it lies", but since ideal index *species*—forms with restricted stratigraphical range and broad geographical distribution—are comparatively rare, "a *genus* which has narrow stratigraphic range and rather broad geographic distribution is now considered an index fossil". Notwithstanding its title, however, the work is by no means restricted to genera of limited range, for "some genera with long vertical ranges have been selected, not because of any particular value as index fossils but because they are common", and it has, moreover, "been thought proper to give some representatives of each of the main taxonomic groups which may be encountered in the field".

The primary object of the work is thus to serve as a guide to the identification of genera, although it will enable many species, some of use as stratigraphical indexes, to be named incidentally. By its aid it should be found possible to ascertain to what formation any assemblage of American fossils should be referred, but in subdivided formations it is no guide to the very precise horizon. Detailed zonal work, such as has been carried out at many horizons of the stratigraphical sequence by the intensive study of such groups as the graptolites of the Lower Palæozoic and the ammonites of the Mesozoic, receives no mention. The inclusion of a glossary or table of formational terms adopted in the work would have been useful, for most non-American (and probably many American) readers will probably be as ignorant of the positions of such formations as

the "Kinzers", "Hosselkus", "Steamboat", and "Pinecrest" as is the reviewer.

Grabau and Shimer's work consisted of two volumes totalling 1,762 pages; its successor contains more subject-matter, but consists of a single volume of 837 pages. The reduction, probably enforced by war-time paper restrictions, has been accomplished by the adoption of a larger format and more closely spaced type (in double columns), and by the grouping of all illustrations in plates. Considerable additions have been partly provided for by the omission of artificial keys to genera and species (such keys seldom prove of much use to the palæontologist), by the curtailment of specific descriptions, and by the omission of chapters of a general character. Owing to their comparatively insignificant type, names of orders and suborders unfortunately appear subordinate to the generic names. The illustrations, 9,400 in number, occupy no fewer than 303 plates, and their general standard is excellent. Their profusion, even if it has meant the sacrifice of a certain amount of text, is amply justified. In no other work will the palæontologist find assembled a series of figures illustrating so many genera of all groups. The figures are partly new and partly reproduced from standard monographs.

The search for oil in many parts of the world during recent years has given an impetus to the study of many groups of organisms, particularly those of microscopic size, the value of which as stratigraphical indexes was formerly unsuspected. The Foraminifera are a case in point. In the much enlarged section dealing with this group J. A. Cushman describes the smaller forms, L. G. Henbest the Fusulinidæ of the Upper Palæozoic, and W. S. Cole the Orbitoids of the Upper Cretaceous and Tertiary. In other new sections E. B. Branson and M. G. Mehl deal with the Conodonts and a group of specialists with the Ostracods. Although fossil plants as a whole do not fall within the scope of the work, a concluding chapter contains notes on a few such remains, particularly Charophyta, likely to be found in rock samples searched for other microfossils.

Far-reaching changes in classification must always present a problem to writers of reference books. Kiderlen's inclusion of the Conularida in the Cœlenterate class Scyphozoa, although far from convincing, is accepted, but the important work of Kozlowski on the affinities of the Graptolitoidea (which he transfers from the Cœlenterata to the class Pterobranchia of the Hemichorda) is ignored, as is also Withers's separation of Turrilepas and its allies from the Cirripedia as a new group, the Machæridia.

A new section on the Crinoidea, the work of R. C. Moore and L. R. Laudon, is one of the outstanding features of the work; particularly notable are its clear line-drawings illustrating generic morphology. G. A. Cooper's section on the Brachiopoda, also new, deals mainly with the Palæozoic genera, those of the Mesozoic receiving scant mention. The section on the Pelecypoda has been curtailed with only slight revision. Some genera (for example, Ptychomya) of real value as index fossils are now omitted. Much more might have been said about the stratigraphical value of the Rudists (of importance in Texas and Mexico) and of certain groups of Trigonia. Among the genotypes cited that of Anthracomya ("*Naiadites elongata* Dawson") is incorrect, that of Pecten ("*P. adscensionis* Osbeck") very debatable, and that of Janira ("*J. niternudia*" [? *intermedia*]) hopelessly misprinted. Revision of the Gastropoda section has mainly affected the Palæozoic forms, dealt with by J. Brookes Knight. The section on the Trilobita, in which several authorities have collaborated, gives descriptions and figures of a large number of new genera founded in recent years.

The high price of the work no doubt results from the profuseness with which it is illustrated. European palæontologists will find it most valuable for reference notwithstanding its purely American scope.

L. R. Cox.

THE CONSEQUENCES OF FRUSTRATION

Frustration and Aggression

By John Dollard, Neal E. Miller, Leonard W. Doob, O. H. Mowrer and Robert R. Sears, in collaboration with Clellan S. Ford, Carl Iver Hovland and Richard T. Sollenberger. (International Library of Sociology and Social Reconstruction.) Pp. ix+150. (London: Kegan Paul and Co., Ltd., 1944.) 10*s*. 6*d*. net.

EIGHT members of the Yale Institute of Human Relations have co-operated to produce this book. The result is not a mere juxtaposition of uncoordinated viewpoints but a unity of aim and consistency in presentation which make the multiple authorship almost undetectable. Whatever judgment one may make about the value of the hypothesis elaborated in the book, there can be little doubt that the intimate collaboration of a team of specialists, each with a distinctive training, is a profitable way of examining a problem which has no clear-cut frontiers and which does not fall neatly into one of the conventional compartments of social study.

The authors begin by indicating the many diverse forms of aggressive behaviour ungeneralized under any one explanatory principle, and to meet this apparent need they set up a twofold hypothesis, first, that frustration always leads to aggression and, secondly, that aggression is always due to frustration. They proceed then to show how the theory provides one conceptual framework for a variety of human phenomena including the process of socialization in infancy and childhood, the adjustments necessitated in adolescence, criminal behaviour, the effects of differences in political organization and the structure of a primitive society.

The frustration-aggression hypothesis, in one form or another, is not new. This is recognized by the authors, who attempt to go farther than earlier theorists by giving special prominence to what they regard as the inevitable consequence of frustration on one hand and the sole cause of aggression on the other and then scrutinizing the explanatory value over a wide field of a hypothesis stressing this two-way relation.

Apparently, it was considered less important for the purpose to examine the validity of the assumptions underlying the hypothesis than to deduce corollaries which follow from it. Since the hypothesis is presented not with any finality, but tentatively, to stimulate and guide further research, this attitude can be justified. Nevertheless, the effect will be to make many readers regard the book as an exercise in deductive rather than inductive reasoning without giving them sufficient confidence in the inductive foundations on which it is based.

To make premature deductions from a generalization insecurely founded inductively leads to difficulties. Thus, on the principle that aggression is a catharsis that reduces instigation to all other acts of aggression, together with the principle of displacement, it is deduced that various forms of aggressiveness should vary inversely if original frustration is held constant. One has difficulty in reconciling this with the continued aggression in many directions of aggressor nations whose original frustration has presumably remained unchanged. Aggressive acts frequently seem to have a way of reinforcing the instigation to other such acts rather than to operate in inverse relation to them.

Until fairly recently the belief that aggression is determined by a primary instinct was widely accepted. This instinct was regarded as existing, as it were, in its own biological right and manifesting itself, so to speak, autonomously. Thanks to a growing understanding of the nature–nurture issue, aggressiveness is now thought of more as an acquired characteristic rather than as an inborn tendency. The authors' view that all aggressive behaviour is due to the impact of the environment upon the individual may therefore be welcomed in that, as a theory, it is subject to verification and tries first to exhaust the possibilities of explaining in terms of known before resorting to unknown categories.

However, certain objections to the traditional theory of aggressiveness as an innate tendency still hold against the theory under consideration. For these objections were usually based on the observed variability of behaviour in different environments, inexplicable genetically, and not in accord with a conception of mind as a rigid set of predetermined dispositions. The present hypothesis retains this element of rigidity although it abandons the notion of innate aggressiveness. Now while there is doubtless some relation between frustration and aggression, many may wonder whether it is justifiable to lay it down even as a hypothesis that frustration *always* leads to aggression. Such a theory implies an essential biological connexion holding between the two processes. But may not the relationship be culturally rather than biologically determined ? If so, it is an 'accidental' rather than a necessary association. Before this possibility can be wholly excluded, it needs to be demonstrated that no individual can respond to frustration unaggressively such as would seem to be the case, for example, in maternal conduct in general or possibly in 'turning the other cheek' or in masochistic behaviour. The eagerness to find a 'law of Nature' has evidently tempted the investigators to presume, too hastily, the existence of a necessary relationship. Since perfect interdependence of two variables rarely, if ever, seems to be encountered in human measurement, this alone would suffice to cast doubt on the validity of the hypothesis as it stands.

There is yet another difficulty. According to the view put forward, frustration and aggression appear to be opposite ends of one continuous event or experience with an arbitrary line of division between them, for if the relationship between the two processes is invariant, who is to say when the experience of frustration terminates and the impulse of aggressiveness begins ? It is doubtful whether anything is gained by defining aggression 'independently' of frustration and whether it is logically justifiable to do so.

The limited scope of the hypothesis is brought out most, perhaps, in the relatively little light it throws upon the most obvious and important kind of aggressive behaviour of all, namely, collective aggression or warfare. An early promise (p. 19) of the authors to bring "wife-beating and war" within a common universe of discourse appears to be overlooked in subsequent pages. The only serious reference to the subject is the familiar observation (p. 64) that in view of the process of displacement of aggression from in-group to out-group, "one, though only one, of the conditions of avoiding war is to diminish intra-social frustration". It may be noted in passing that there are weighty considerations against any view which sees in a group phenomenon like modern warfare merely a summation of the effects of the frustrations of individuals. For that matter, it is exceedingly doubtful whether individual frustration or, indeed, any process of individual behaviour as such, can be given any primary significance in explaining an organized group phenomenon like modern war.

The authors' treatment of criminality calls for a few words of comment. They regard the incidence of crime as a function of the discrepancy between frustration, on one hand, and anticipation of punishment on the other. If both these factors are of high or if both are of low degree, or if the former is low and the latter is high, then crimes will tend to be few ; if, however, frustration is high and anticipation of punishment is low, then crimes will tend to be many. The difficulty here, as indeed with the subject as a whole, is to find some measuring scale for the basic variables. What is a unit of aggression or of frustration ? Can we ever say that one person is twice as frustrated or twice as aggressive as another ? This difficulty is fundamental and lies at the root of mental measurement. So long as the investigator is content with statistical units or abstract frames of reference for classifying human behaviour, the difficulty can be evaded even if the results are psychologically not very satisfying. But the authors here are more ambitious. They wish to find a few common psychological denominators under which to embrace all the diverse phenomena of crime. They try to do this in an indirect way which is not very convincing. Crime is assumed to be a species of aggression simply because it is supposed to be a response to frustration. This supposition is, in turn, based on correlations between the incidence of crime and economic, vocational and educational status, intelligence, age, health, physical appearance and other factors. To use these latter observations and their interpretation as evidence of the frustration–aggression hypothesis is to beg the question. Moreover, a large proportion of crimes such as larceny or offences against property without violence do not fall under the authors' definition of aggression as "an act whose goal-response is injury to an organism (or organism surrogate)".

The fact that the divorced population provide a disproportionate number of convicted persons is regarded by the authors as "the most dramatic demonstration of all of the role of frustration in the causation of criminality" (p. 91), the assumption being that divorce is usually a frustrating event. It seems to be overlooked that divorced persons are a selected and possibly maladjusted group and, hence, whatever factors lead to the break-up of their marriages may also contribute to their increased criminality.

While feeling that the main hypothesis has not been adequately formulated, the reader will be amply rewarded by the many illuminating remarks scattered

through the pages, particularly in Chapters 4 and 5. One example may be mentioned. The authors point out that the cathartic effect of aggressiveness which follows frustration serves only to reduce the secondary instigation produced by frustration not, as is commonly assumed, the strength of the primary instigation which suffered frustration.

The frustration–aggression hypothesis, even with limited scope, is not simply of academic interest. All those charged with the care and upbringing of children, with the management of personnel in the various spheres of industrial and social life are frequently confronted by individuals in their charge who react in a hostile manner to unavoidable frustrations. This clear discussion of the problems of adjustment which individuals must face in any society should be of much practical value. Further verification of the theoretical basis will be welcomed.

JOHN COHEN.

BERKELEY'S PHILOSOPHICAL NOTES

Philosophical Commentaries, generally called the Commonplace Book

By George Berkeley, Bishop of Cloyne. An editio diplomatica transcribed and edited with Introduction and Notes by Prof. A. A. Luce. Pp. xlii+486. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1944.) 73*s*. 6*d*. net.

THE manuscript generally, but inaptly, called "Berkeley's Commonplace Book" is a document of unique interest in philosophical literature. Berkeley took his B.A. at Trinity College, Dublin, in 1704 at the age of nineteen. In 1709 and 1710 he published his "New Theory of Vision" and his "Principles of Human Knowledge", the two works on which his philosophical fame has always rested. Berkeley's ideas were novel, but very clear and articulate, and skilfully argued in these books. The only thinkers to compare with him, who advanced so far so quickly, are Descartes and Hume. It is most fortunate that we can examine the notebook in which he recorded his philosophical reflexions during this short period of intense mental activity. Prof. Luce considers that the notes were written during 1707–8, and that Berkeley probably had before him a preliminary draft of his theories. Thus the "Commonplace Book" shows how his first thoughts were altered and improved until they attained their first published form, never greatly altered alterwards.

The manuscript was discovered by Campbell Fraser and published in 1871 in his edition of Berkeley's works. Unfortunately, Fraser failed to notice that the two notebooks Berkeley used had been bound together in the wrong order, so that his text is confusing. G. A. Johnston's edition of 1930 corrects the principal error in chronological order. Prof. Luce, however, finds that Johnston has still got some entries misplaced. There are also other inaccuracies in the two earlier texts. Moreover, the original document was damaged by sea water when Berkeley had it with him on his travels. Parts were difficult to decipher in Fraser's day and are now much worse. Prof. Luce has therefore undertaken to produce a complete type-facsimile of all the entries of philosophical interest, with erasures, alterations and later remarks all in place. In addition he has provided copious and very necessary notes, cross-references and indexes. The value of these can be seen by taking an example at random. Entry No. 526 reads: "Locke says the modes of simple Ideas besides extension and number are counted by degrees. I deny there are any modes or degrees of simple Ideas. What he terms such are complex Ideas as I have prov'd by Green". This is cryptic enough. However, given the correct reference to Locke, to several other entries in the "Commonplace Book" and to Berkeley's published work, we can then see how Locke's tentative, stumbling but very suggestive analysis of perceptual processes stimulated Berkeley's more precise mind; how Berkeley gradually clarified his own thinking and terminology to produce a different, far more definite (perhaps more erroneous) statement. Prof. Luce provides a guide to these interconnexions that will save readers much hard work and many misunderstandings.

Students of Berkeley for many generations to come will be grateful to Prof. Luce for this fine piece of work, to his publishers and printers who have shown that good craftsmanship is still possible after nearly five years of total war, and to Trinity College, where Berkeley's thinking was fostered and where his memory is still honoured as it should be.

A. D. RITCHIE.

AN ASTRONOMICAL TEXT-BOOK

Elementary Mathematical Astronomy

By C. W. C. Barlow and Dr. G. H. Bryan. Fifth edition, revised by Sir Harold Spencer Jones. Pp. viii+388. (London: University Tutorial Press, Ltd., 1944.) 12*s*. 6*d*.

THIS book belongs to the peculiar class intermediate between the popular work on astronomy on one hand and the serious technical treatise on the other. The scope of the class is otherwise not easily defined in precise terms. Sir Robert Ball, who made a distinctly elegant contribution to it, confessed that the effort had caused him great and apparently unexpected difficulty. Simon Newcomb, whose work on the popular side had been as conspicuously successful as his labours in mathematical astronomy were of the most distinguished, once ventured into a similar field belonging to neither. In acknowledging frankly an error brought to his notice he showed himself-conscious of a pitfall to which the expert is liable in the attempt to make a statement adapted to the intelligence of readers less gifted than his usual audience.

Neither of the two original authors of the present text-book belonged to the ranks of the professional astronomer. That it possessed merits of a distinct kind is attested by the fact that it has outlived half a century, during which it has reached a fifth edition, while the number of impressions demanded has been far more numerous. The third edition (1923) received the revision of Dr. A. C. D. Crommelin. But it may be suspected that the survival of the book is due in no small degree to the English mania for examinations and the demand fostered thereby. It has now received a fresh lease of life at the hands of a most eminent editor who has done his work well. Yet there remain traces of that aridity which is a natural outcome of its origin. It may be hoped that when war-time restrictions are removed an editor so eminently qualified will see his way to expound the subject with greater freedom in his own manner.

In 1892, when the book first appeared, astronomy seemed to have reached a peculiarly static position, in reality the unsuspected precursor of an outburst of creative activity. In particular, the Nautical Almanac seemed to have attained a settled form unlikely to be changed for years to come, and with it the outlook of the student was bounded accordingly. Now the conditions have changed, including the definition of time; the Nautical Almanac itself is not the same, and it has been supplemented by the abridged edition for the use of seamen and the Air Almanac for the special needs of air navigation. Moreover, the students are not the same; their interests are professional and no longer merely academic. Thus the opportunities which face the instructor in astronomy are vastly more interesting than existed half a century ago, and they are different in kind.

The more spectacular modern changes in the subject-matter of astronomy itself may seem to be associated with the introduction of physical methods and ideas. But the Astronomer Royal has confined his revision to bringing up to date the exposition of those fundamental principles on which the whole subject depends, to rearranging related sections and to providing a sound introduction to the methods of sea and air navigation now in use. An enlarged table of astronomical constants has been added. But in the main the substance of the work remains as in earlier editions. In abstaining from incursions into astronomical physics the editor is doubtless justified by the proved success of an existing model. Even without transgressing the limited ideas of the nineteenth century some relief to the purely goniometric line of argument might be found in the conception of radial velocity and in the rectangular co-ordinates appropriate to photographic projections. Without going so far the Astronomer Royal has greatly improved the structure of the work and made many necessary alterations within its familiar framework. But if in happier days a fresh edition is contemplated, one is tempted with all respect to exclaim with Hamlet, "O ! reform it altogether". In short, let it be a new work inspired with the aim of serving as the master, not the servant, of the examiner. H. C. PLUMMER.

CHEMISTRY OF WHEAT

The Constituents of Wheat and Wheat Products

By Prof. C. H. Bailey. (American Chemical Society Monograph Series, No. 96.) Pp. 332. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1944.) 6.50 dollars.

THE object of reviewing a book is to give readers some information on the author and his authority for writing on the particular subject, to indicate the scope of the book and to give an impartial evaluation of the value of the work. This is not a particularly difficult task in this case.

C. H. Bailey, professor of agricultural biochemistry in the University of Minnesota, is one of the foremost cereal chemists in the world. His work, often with a band of devoted students and postgraduate workers, is well known to all workers in that field. His contributions, both in quantity and quality, to cereal chemistry probably exceed those of any other worker. He was awarded the highest honour that can perhaps be given to a cereal chemist, namely, the Osborne Medal of the American Society of Cereal Chemists, in 1932. He has practical experience of book-writing in that he published in 1925 a book entitled "The Chemistry of Wheat Flour", which was No. 26 of the Monograph Series of the American Chemical Society, of which the present book is No. 96. Nobody, therefore, is better fitted to undertake the task of collecting together in book form the known facts on the constituents of wheat and its products. With characteristic painstaking thoroughness, Prof. Bailey has for years been working on a card index system to collect the necessary facts for the present book.

The book has a definitely restricted scope. It does not deal with the processing of wheat and its products, the chemistry of such processing such as the changes which occur in milling and bleaching, or in the making of bread or confectionery goods. It is hinted in the preface that a further book dealing with these and allied matters may be issued later. So far as it is possible to make such an arbitrary division, the present book is concerned with exactly what the title states, namely, the nature of the various constituents, such as the proteins in wheat and its products, the character of the starch, sugars, gums, lipids, minerals, pigments, etc., present, and particularly the vitamins which are now known to exist in the various portions of the grain. The vitamin chapter is typical of the whole book in that it gives a comprehensive account of practically all the important work which has been done, especially the recent work. What will be particularly appreciated is the fact that this chapter covers not only B_1 and its distribution in the grain, but also all the known facts with respect to the presence of riboflavin, nicotinic acid, pyridoxine, pantothenic acid and other vitamins in the whole grain, in various types of flour and in offal, including germ.

The book comprises sixteen chapters. Practically the first half, namely, up to p. 139, is concerned with the protein and other nitrogenous constituents. This part is particularly full, but contains much of the earlier work, now known to be of little value but which is presumably retained as of historical interest and to give the background for the more recent work. The book is not intended as a text-book for the various industries concerned. There is little general discussion and it consists essentially of a record of published scientific investigations. It will therefore be of particular value to future research workers. The book is well balanced and there are relatively few omissions to work that matters. The comprehensiveness of the book, although only of 332 pages, is seen from the fact that there are approximately eight hundred names in the authors' index, and the references to published papers approach 2,000. The book appears to be singularly free from errors and misprints, although it was observed that in Table 112 the last column should presumably have been mgm. per 100 gm. and not mgm. per lb. Incidentally, the variety of ways in which vitamin results are recorded, such as μgm./gm., mgm./100 gm., mgm./lb., etc., are always confusing, and it is convenient to have the relationship table given on p. 282 of the book.

The book not only fulfils a real want but also fulfils that want well. There is a scarcity of good books on the chemistry of wheat and its products, and this is true of any language. We have no hesitation in recommending this book to all advanced workers in this field—in fact, they cannot afford to be without it. D. W. KENT-JONES.

Endocrine Man

A Study in the Surgery of Sex. By Dr. L. R. Broster. Pp. xi+144. (London: William Heinemann (Medical Books), Ltd., 1944.) 12*s.* 6*d.* net.

IT is impossible to review this book in the space available. It is full of ideas, records of experimental work and stimulating discussion. Every page of it counts. The author is a surgeon at the Charing Cross Hospital, and his broad thesis is a discussion of the origin and evolution of what he calls the instinctive tripod, namely, self-preservation, growth and sex, all of which are classified as instincts. The chapter leading to his discussion of instinct is a remarkable summing up of the development of animals. Like the final chapter on the nature of man, it reveals the author's wide knowledge and outlook.

The chapters on the evolution of species, on the physiology of the autonomic nervous system and on the functional evolution of the endocrine system are no less valuable. The last-named chapter introduces the author's study of virilism, feminism, intersexuality and other more obscure conditions due to disorders of the adrenal, the pituitary and the genital glands, which he has been conducting with his collaborators at the Charing Cross Hospital for the last fifteen years. The book reveals some of the remarkable results which have been achieved by the surgical treatment of these disorders and discusses their biological significance. The quality and trend of this discussion may be gathered from the author's suggestion, based upon his experience and clinical observation, that, whatever the genetic (chromosomal) constitution may be, this may be overridden by hormonal influences.

In his last chapter the author suggests that slight adaptations resulting from nervous and endocrine control (he has already discussed the interplay between hormones and the functions of the brain) could be "inscribed in the framework of the germ cells". This view visualizes the vital role of the endocrine system in the integration of development and also suggests that "variable factors may be introduced into the germ plasm through its hormones to account for influences which, on the whole, have consistently led to the progress of mankind". Sir Peter Chalmers Mitchell contributes an interesting foreword and there is a valuable bibliography. Everyone will hope that the work of this team, interrupted by surgical war service, will be resumed as soon as possible.

G. LAPAGE.

Human Reproduction and Venereal Disease

By Dr. John Drew. Pp. 124. (London: Faber and Faber, Ltd., 1944.) 3*s.* 6*d.* net.

THIS layman's guide to the venereal diseases is wider in scope than the title suggests. It covers human anatomy, the venereal diseases and their treatment, their relation to sterility and their sociological implications. The descriptions of diseases are accurate, but as the author has gone to so much trouble to give the medical terms for the lesions he describes it would have been wiser to avoid all possibility of misinterpretation in the case of "condylomata" and have called them "condylomata lata". Many people have condylomata but only some are also syphilitic. Some purists might quibble at the guides to pronunciation given for treponema (treppon-nee-mar) and gumma (gum-mar).

A book for laymen is scarcely the place to indulge in discussions about criteria of cure in syphilis. Even if biological cure cannot be attained, clinical cure is possible in nearly every case of early syphilis if the patient will co-operate, and this is all that it is necessary to say. A more hopeful note could have been sounded on the length of treatment for syphilis in these days when intensive treatment is widely used and penicillin is just over the horizon.

Sheffield Burns

By Dr. W. H. Hatfield. Pp. 213. (Sheffield: J. W. Northend, Ltd., 1943.) 7*s.* 6*d.*

SHORTLY before his unexpected death, Dr. Hatfield, whose name is closely associated with the development of special steels, had completed some reflexions on people and things, inspired by the sight of the great conflagration in Sheffield during the air raids of 1940. Dr. Hatfield was a devoted son of Sheffield, and his aim in writing was to help in its restoration. The little book contains reminiscences of the author's contacts with scientific men and other notable people at home and abroad, brief accounts of visits to industrial centres in other countries, and expressions of personal opinion on matters of public interest. His views on economic questions, based on experience in large-scale industry, lean strongly to the side of private enterprise, while his remarks on scientific and industrial research and its organization gain weight from his own marked success in stimulating co-operative research in the iron and steel industry, and from his earnest advocacy of a similar policy for industry in general. Any profits from the sale of the little book are to be devoted to St. Dunstan's.

The Statesman's Year Book

Statistical and Historical Annual of the States of the World for the Year 1944. Edited by Dr. M. Epstein. Eighty-first annual publication, revised after Official Returns. Pp. xxxvii+1484. (London: Macmillan and Co., Ltd., 1944.) 30*s.* net.

IN spite of current difficulties, the new issue of this valuable reference volume maintains its scope and size. Revision of statistics has been difficult and for many States impossible, but the latest available are given. For many parts of the British Commonwealth and the United States figures are of a recent year. The section on the armed forces of the United States has been extended. Other additions include a short account of the British Council and its aims, the Middle East Supply Centre, and, under Australia, an account of the Australian Capital Territory. The introductory tables of comparative production of various commodities have had to be omitted, but there is still a section on the League of Nations. A coloured map shows the extent and boundaries of Poland at various periods in the history of that State. The useful book-lists for each State have been fully revised.

Brompton Hospital Reports

A Collection of Papers recently published from the Hospital. Vol. 12, 1943. Pp. vii+163. (London: Brompton Hospital, 1944.) 8*s.* net.

THE papers in this volume are reprints of recent work by members of the Brompton Hospital staff. Most are concerned with diseases of the chest. In an interesting statistical survey on "The Health of the Doctor", Dr. A. Hope Gosse challenges the title of 'the doctor's disease' often given to coronary thrombosis.

METEORITES OR SPRINGS AS GEOLOGICAL AGENTS?

By DR. E. B. BAILEY, F.R.S.
Geological Survey of Great Britain

DOUGLAS JOHNSON'S recent death is mourned by a wide circle of friends and admirers on both sides of the Atlantic. Johnson delighted in interpretation of scenery and showed to equal advantage in choice of subject, plan of attack and clarity of exposition. In his latest monograph[1], which includes forty-six illustrations, mostly air-photographs, he dealt with a problematical erosion form represented by tens of thousands of parallel, oval, marshy hollows pitting the coastal plain of America. The area affected measures some 25,000 square miles, and ranges through South Carolina into neighbouring States. Here marshes of any shape are commonly called 'bays', perhaps, it has been suggested, because bay trees flourish in them. This local practice accounts for the title selected by Johnson for his book, "The Origin of the Carolina Bays". Johnson alternatively speaks of the oval hollows as craters. They are shallow basins, measuring anything from a few hundred feet up to four miles in length, and averaging about 50 ft. in depth, when allowance is made for partial infilling with peaty silt. Usually they are more or less completely encompassed with white sandy rims.

The parallel oval hollows are patchily distributed over a terraced plain which, eighty miles inland, rises to a maximum elevation of 300 ft. above sea-level. According to C. W. Cooke's account, the surface consists of a veneer of Pleistocene marine sands, sandy loams and clays, often less than 50 ft. thick. These rest unconformably upon various Tertiary and Upper Cretaceous formations, which effectively conceal a depressed floor of ancient crystallines. The oldest of the Cretaceous formations, the Tuscaloosa, is still in the condition of sand with interstratified clay. Along with several of the later formations, it carries abundant water, sometimes under artesian head. True artesian, overflowing wells are a commonplace throughout the region.

The peculiar oval form characteristic of so many of the Carolina hollows was first brought to the notice of scientific men in 1895 by L. C. Glenn. He regarded it as produced under coastal or sea-bottom conditions; but I think we must follow Johnson in attributing the ovals definitely to the post-emersion history of the plain. Glenn's descriptions attracted little attention until reinforced by aerial photographs, taken for forestry and other purposes. Then in 1933 came a dramatic paper by F. A. Melton and W. Schriever, claiming the oval hollows as scars of a prodigious shower of meteorites. The main basis of this hypothesis was the amazing tendency to parallelism exhibited by the ovals of any particular district.

Melton and Schriever's appeal to heaven met with a mixed reception. Cooke and Johnson were early opponents. In the volume under review, Johnson devotes four chapters to its criticism, from which I select a few points which seem to justify his unbelief: (1) the parallelism of the ovals is not regional, for near the border of North and South Carolina the general orientation is south-east, whereas near that of South Carolina and Georgia it is south-south-east—here in passing it may be remarked that in the former locality the ovals are mostly elliptical, and in the latter egg-shaped, with the small end pointing south-south-east; (2) if the hollows were meteorite scars, they would almost certainly have to be attributed to meteorite explosions; but an explosion is necessarily quasi-instantaneous and therefore has a strong tendency to give a circular, not an elongated crater; (3) anyhow, the rims consist of clean, washed sand, in contrast with the loamy sand of the plain upon which they rest—they cannot be interpreted as made of plain sand thrown out by explosion; (4) no fragments of meteorites have been found in much the greater part of the region—though we must remember that no fragments of the great Siberian meteorite have been recovered and also that iron is soluble; (5) magnetometer search for buried meteorites has given unpromising results.

Cooke and Johnson, in attacking the meteorite hypothesis, agreed that every oval hollow held a lake during some formative stage of its career, and that the associated sand rim is in a sense a beach coupled with dunes. The rims are conspicuous in air photographs, because they carry very little vegetation. On the other hand, they seldom rise more than 10 ft. above the plain, though occasionally spreading outwards for several hundred feet across it. They are not infrequently multiple. So far, I think that Cooke and Johnson are correct; but, when they go on to claim wind-operated water as a main shaping agent of the ovals, I think they are mistaken. At first both authors invoked a longitudinal wind to account for the elongation and parallelism of the ovals; but eventually they abandoned this particular conception. Here in outline are their subsequent strongly divergent views.

Cooke thinks that a steady wind blowing across any lake with yielding shores tends to set up a rotating current, and that this current would assume a circular path if only the earth were standing still. Under existing conditions of earth rotation, he claims that the current tends to become elliptical with its major axis directed north-west in the northern hemisphere. He further considers that the ideal resultant ellipse would have an axial ratio equal to the sine of the latitude; and he quotes a number of Carolina ovals conforming with this quantitative plan. I confess that after reading what Johnson has to say on this subject, and Cooke's own recent reply[2], I think the latter's argument is faulty.

Johnson devoted the last seven chapters of his book to what he called his "hypothesis of complex origin". In it, wind-driven currents and waves are given much less importance than in his previous hypothesis. In fact he was prepared to hand over the making of the hollows, their elongation, parallelism and the rough shaping of their oval form to springs controlled by underground conditions. The only essential service he asked of the wind was to smoothe the shores of the ovals by removing headlands and embanking bays, with concurrent development of sandy rims. Even so, I think it possible to demonstrate that he trusted too much to the wind and too little to the springs.

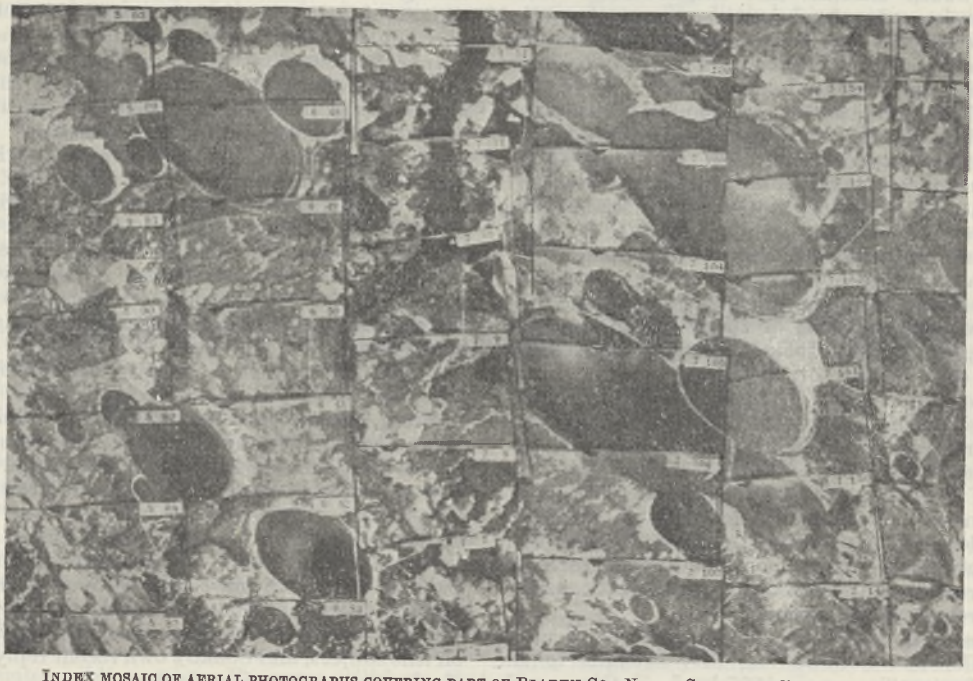
I think that Johnson paid too little attention to the phenomena of intersecting ovals as illustrated, for example, in the figure here reproduced. Surely one is bound to ask how, on Johnson's hypothesis, was the wind persuaded to leave intact cuspate headlands at the points of intersection of two contiguous ovals; and how was it educated to connect such headlands with a bar of drifted sand, which, continuing faithfully the curvature of the shore of one oval, utterly

disregarded the contour of the other. Clearly the formation of oval basin and oval rim was an operation one and indivisible. The rim sand can be called a beach if so desired, but it was thrown out, not drifted along. In this important matter, Melton and Schriever seem to me to have come nearer the truth than Johnson. I do not mean to say that the phenomena of intersecting ovals rehabilitate the meteorite hypothesis, but I do think that they entail a more violent use of Johnson's springs than their author thought necessary or at all desirable.

Before leaving the subject of wind, I may say that Johnson has convinced me that wind has often co-operated in important matters of detail. I refer especially to a frequent slight exaggeration of the curvature of the ovals on their eastern sides and a corresponding marked accentuation of rim development in the same direction. It looks to me as if, when the hollows were formed by spring action, a westerly wind was usually blowing.

Let us now turn to consider Johnson's spring hypothesis. One of his main ideas is the eruption of an artesian spring through impermeable cover. This would result underground in a water-rise, the inverse of a waterfall; and Johnson thought that a water-rise must have a strong tendency to migrate up-dip through backward erosion of the impermeable obstacle that it has breached. Accordingly, he held that artesian springs at the surface in any particular locality will migrate parallel with one another in a direction contrary to that of the dip of the underground strata. Continuing, he pointed out that a stationary spring may be expected to develop a circular pool, if it emerges through a superficial deposit of loamy sand, because of removal of continually agitated material, in solution if soluble, or in suspension if of a clayey nature. Such a process would leave a residue of quartzose sand to be eventually collected together to form a rim—here it may be noticed that the rim sand outside any Carolina hollow is always of much less volume than the hollow itself. Johnson also considered that a circular pool thus formed would expand considerably through slumping of the loamy sand forming its banks. Finally, returning to his hypothetical migrating springs, he argued that at the surface they would act in all particulars like stationary springs, except that they would give elliptical instead of circular pools.

I consider that we must modify Johnson's spring hypothesis in certain particulars before we can adopt it. There are two main reasons: (1) it is extremely doubtful whether artesian springs show any marked tendency to migrate up-dip; (2) Johnson derives his oval hollows through intersection of successive circular hollows. Let us examine this last point. We have seen that intersection of oval hollows is characterized by cuspate headlands often connected by a well-developed rim. Intersection of circular hollows should be similarly advertised if it had really taken place.



INDEX MOSAIC OF AERIAL PHOTOGRAPHS COVERING PART OF BLADEN CO., NORTH CAROLINA. NOTE ELLIPTICAL FORM AND SOUTH-EAST TREND OF THE DARK MARSHES KNOWN AS 'BAYS'. NORTH IS AT TOP. THE LARGE 'BAY' SOUTH-EAST OF CENTRE IS THREE MILES IN LENGTH. FROM FIG. 29 OF "THE ORIGIN OF THE CAROLINA BAYS".

Personally I accept Johnson's conception of spring action with linear application determined by some structure in an impermeable layer through which the water has risen; but I think that appearances prove that the spring of our hypothesis made a simultaneous attack all along the line, instead of starting at one end and gradually migrating to the other. This clearly indicates guidance by joints in the impermeable layer rather than by dip. Dip can, however, probably be retained as a factor of local importance. In some districts, as already stated, the ovals are egg-shaped. This would be expected if the top of the impermeable, jointed layer has a fairly pronounced dip in the direction of an opened joint that gave passage to rising water. It is clear that the water, issuing nearer the surface at one end of the joint than

at the other, would produce an asymmetrical result. I imagine the pool would narrow in the direction of dip.

It will be noticed that I have proposed a drastic reduction in Johnson's time-table. This involves a greatly increased call upon water supply, measured in gallons per hour. A little further thought shows, however, that the supply was maintained only for a very short period. The water which made a hollow with rim complete cannot have continued to flow on anything like the same scale after it had done this work. Otherwise it would have cut an escape channel of dimensions comparable with those of the spring pool. Many of the depressions do have escape channels, but these are on a scale commensurate with that of certain artesian springs which are occasionally to be identified in the marshy bottoms.

The sudden cessation of the springs of our modified hypothesis removes them at once from the artesian category. Such transient springs must depend on load pressure for their activation. When an earthquake shakes an alluvial district it generally leads to discharge of sand and water from numberless craterlets. I imagine the cause must be a repacking of wet sand into patches, some of compacted sand comparatively waterless, others of loose sand lubricated with water and incapable of sustaining load pressure unless furnished with outside support. As a result, almost immediately after an earthquake has occurred in a suitable locality, sandy water spurts up a few feet into the air from craterlets and fissures, and soon ceases to flow, seldom persisting for more than a few hours. I am inclined to think that some such subterranean re-arrangement of sand and water was responsible for delivery of water at the surface during the formation of the Carolina hollows. It would account among other things for the frequency with which activity shifted from one site to another. An area of underground sand, once repacked with extrusion of water, would likely remain stable in later recurrences of stress.

There are striking resemblances connecting the Carolina region with familiar fields of earthquake hydro-eruption, such as those of the Mississippi (New Madrid), 1811–12, Assam, 1897, and Bihar-Nepal, 1934. There are equally striking contrasts. I hesitate to suggest that the Carolina hollows are earthquake craters, but I do hold that the idea is worth serious consideration. Among resemblances is the vast area over which sanding from numberless craterlets may occur after an earthquake. J. A. Dunn, J. B. Auden and A. M. N. Ghosh have found this effect scattered throughout 18,000 square miles in connexion with the Bihar-Nepal earthquake[3]. The differences concern in part the relatively small size of known earthquake craterlets. An elliptical blow-hole at Muzaffarpur, measuring 25 ft. by 10 ft., is quoted as a large example (*loc. cit.*, p. 35). The craterlets seem to make up in number for what they lack in measurement. "In places the surface was riddled with sand vents, sometimes so completely that small areas up to an acre or so in extent, might be compared with boiling porridge. . . . The universality of the sand in some places, and the closeness of the vents, suggest no great depth for its origin, since the greater the depth of the channels leading up to the vents the more localised and separated would they probably be" (*loc. cit.*, pp. 34, 36).

Perhaps a more serious difficulty presents itself in regard to regional, as opposed to local, parallelism. Earthquake craterlets are often strung along fissures (furnishing possible composite homologues with individual Carolina ovals), and earthquake fissures may themselves be opened up into craters. This introduces a pronounced element of local parallelism, for earthquake fissures tend to be parallel with their contemporaries and predecessors in any small district. Recurrence of parallel fissuring is well illustrated in Charles Lyell's account of how the inhabitants of the New Madrid area, which shook again and again during a period of several months in 1811–12, felled trees at right angles to the fissure direction to serve as bridge-refuges for use should later tremors give warning of approaching trouble. On the other hand, many earthquake fissures are orientated on a strictly local basis parallel to topographical features, whether negative as in the case of the banks of a river or pond, or positive as in the case of a road embankment or heavy building. In the Bihar-Nepal earthquake, fissures on flat country "rarely showed any constancy in direction; more generally they occurred as an irregular network" (*loc. cit.*, p. 32). M. L. Fuller, however, found matters otherwise in the New Madrid area[4]. He recognized, indeed, that many fissures had been controlled by topography, but added: "the second class, or the simple fissures of the sandblow areas seem to have a tendency toward a definite arrangement, along northeast-southwest lines (averaging N. 30° E.), although where the blows are scattered the arrangement is not always very apparent. The fissures of the sand sloughs are in general parallel to the depressions and are even more commonly aligned in northeast-southwest directions". One must remember also a suggestion made long ago, and never so far as I know refuted, that much of the parallel jointing of rocks in general is an earthquake phenomenon. It is to be hoped that the next great ejective earthquake will be followed by a careful air survey.

[1] "The Origin of the Carolina Bays." By Prof. Douglas Johnson. (Columbia Geomorphic Studies, No. 4.) Pp. xii+342. (New York: Columbia University Press; London: Oxford University Press, 1942.) 30s. net.

[2] Cooke, C. W., *J. Geol.*, 51, 419 (1943).

[3] Dunn, J. A., Auden, J. B., and Ghosh, A. M. N., *Mem. Geol. Surv. India*, 33 (1939).

[4] Fuller, M. L., *Bull. U.S. Geol. Surv.*, No. 494, 49 (1912).

PAVLOV'S WORK ON HIGHER NERVOUS ACTIVITY AND ITS DEVELOPMENT IN THE U.S.S.R.

By FREDA M. THOMAS
London School of Medicine for Women

NEWS has recently been received from the U.S.S.R. of the work of Prof. Maria Petrova, who has been awarded the Order of the Red Banner of Labour by the Soviet Government for her work on problems connected with higher nervous activity*. Since she joined Pavlov's laboratory at the Institute of Experimental Medicine in Leningrad in 1910, she has carried out countless experiments in this field and even refused to interrupt her experiments during the recent siege. Prof. Petrova is typical of the majority of Pavlov's pupils, who, after his death in 1936 at the age of eighty-six, determined to carry on his work, and in the words of Prof. Frolov "to occupy

* All the recent information in this article has been obtained from cables sent by the Academy of Sciences of the U.S.S.R. For the use of this material I am greatly indebted to Sir John Russell, of the Anglo-Soviet Scientific Collaboration Committee of the British Council, and the Ministry of Information.

themselves with organizing new experiments so that by their collective labour the breach in their ranks might be made good"[1].

Before proceeding to the subject-matter of the cables concerning Prof. Petrova's work, it would seem fitting to give some account of the magnificent work of her master, Pavlov, the fundamental value of which, as was pointed out in one of his obituary notices[2], is shown by the fact that so much of it is now regarded as common knowledge.

Pavlov graduated from the Military Medical Academy in St. Petersburg in 1879 and worked as assistant to Tsion, the discoverer of the depressor nerve, until in 1884 he went to Leipzig to work under Ludwig, from whom he probably acquired some of his precision in observation. He then worked under Heidenhain at Breslau, absorbing some of his enthusiasm for science, and developed the technique of permanent fistulæ and isolation of parts of the gastro-intestinal tract. He returned to St. Petersburg in 1886 and was soon put in charge of Botkin's experimental laboratory, where he showed his talent for the organization of research. In 1890 he was made professor of pharmacology in the Military Medical Academy and five years later succeeded to the chair in physiology.

Throughout his work, Pavlov took pains to have conditions as normal as possible: for example, when working on the circulation, he endeavoured to accustom the dog to the insertion of a cannula, and in the construction of the 'Pavlov pouch', part of the stomach was isolated with negligible interference with the nerve supply. He emphasized the importance of surgery in experimental research, and of having healthy, well-cared-for animals, which he treated as human patients with regard to anæsthesia, asepsis, narcosis and care after operation. It was probably as a result of his work that scepticism arose as to the applicability to medical practice of results obtained from narcotized or decapitated animals. In 1891 he organized the surgical department of the physiology laboratory in the new Institute of Experimental Medicine, the first of its kind in the world, founded and financed by the Prince of Oldenburg, and it was here that he carried out most of his work on digestion, for which he received the Nobel Prize for Physiology and Medicine for 1904[3]. As Anrep pointed out in an obituary notice[4], most of the facts relating to digestion as it is now known either had their origin, or were established, in Pavlov's laboratory.

By 1906, Pavlov had transferred his investigations to the brain, but he used similar methods, still striving towards normality, carefully isolating his variables and keeping all other conditions constant. He focused his attention on the correlation between external phenomena and the reactions of the organism as a whole, and he followed the lead of Claude Bernard in regarding the animal body as an unstable system which constantly maintains its equilibrium with its environment; and for the maintenance of this equilibrium he was struck by the importance of conditioned reflexes.

As a result of his investigations into the so-called psychic flow of some of the digestive juices, Pavlov had become convinced of the futility of subjective methods of inquiry; he objected to psychologists applying their own experiences to the brain of the dog and asked: "to understand these phenomena, are we obliged to enter into the inner state of the animal, to fancy his feelings and wishes as based on our own?" His sham feeding experiments had shown that simultaneous excitation of organs of sight, hearing, taste or smell influenced the activity of gastric glands, and thus the idea of a complex subjective sensation was transformed into what he described as "a concrete factor of the physiological laboratory".

By gradually establishing conditioned reflexes through the simultaneous application of an 'essential' and an 'unessential' stimulus, Pavlov was able to substitute a more nearly normal animal for the study of behaviour than could be obtained by acute experiments involving artificial stimulation of different parts of the brain; and in Pavlov's life-time their study had made many important contributions to an understanding of the nature of sleep, neuroses and temperament.

The response selected for study was the secretion of saliva in dogs of which the salivary duct had been brought to the exterior of the cheek so that the quantity of saliva secreted in a given time could be measured. Pavlov pointed out that this choice, although originally accidental, satisfied the fundamental demand in scientific investigation for beginning with the simplest case; it also had the advantage of being easier to assess and less likely to cause complications than a motor response. The 'essential' stimulus was the giving of food, but the reflex could be conditioned to an infinite variety of stimuli such as the ticking of a metronome, the flashing of an electric lamp, the appearance of certain figures with varying intensities of illumination, a trumpet or telephone, rhythmic contact of blunt or sharp instruments with the skin, or warming and cooling particular parts of it. By these means, therefore, it was possible to learn much about sense organs and powers of discrimination, such as limits of audibility, distinction between metronome speeds, musical intervals and combinations of musical sounds, as well as much about the general and localized functions of the cortex.

Pavlov showed that association was a simple analysis followed by synthesis, then generalization, and finally analogy; since a dog could not only differentiate an interval in one part of the musical scale but also would respond to all such intervals in other parts of the scale. The fact that conditioned reflexes were lost if the cortex was removed confirmed earlier findings by Goltz that decorticated dogs showed no initiative, would only eat if food was placed in their mouths, and generally lacked the power to adapt themselves to changes in their environment. Pavlov and his workers increased the knowledge of the map of the cortex by establishing certain conditioned reflexes and finding whether or not they persisted after removal of different parts of the cortex, although it was shown that in time compensation occurred and some parts of the cortex could replace others.

Pavlov paid great attention to the welfare of his experimental animals, and minimized all experimental errors by mechanical appliances and by isolating his animals so that even the observer and operator were in an adjoining room. He was at one time in charge of three laboratories and sometimes had more than sixty people each working on a different problem, but he himself remembered the details of every investigation. His recognition of the value of the division of labour led to the organization of research teams, of which there are now so many in the U.S.S.R., the United States and Great Britain.

Pavlov's new laboratory at the Institute of Experimental Medicine in Leningrad was built with

funds from the Ledenzov Society for the Advancement of Experimental Sciences and their Application.

At Koltushy, now Pavlovo, a village twenty miles north of Leningrad, the Soviet Government built for Pavlov an establishment which combined laboratories with a rest-home for scientific workers. The buildings bore the inscription: "Experimental Genetics of the Higher Nervous Activity" and on the tower was Pavlov's watchword: "Observation and again Observation". Each animal had a separate dwelling-place and there was a hospital, exercising hall and maternity centre for the bitches. His two chimpanzees, Rafael and Rose, presented by Prof. Voronov, also had their own buildings.

Early in his study of conditioned reflexes, Pavlov showed that stimulation of the cortex produced excitation. This first spread over a large area and was described as irradiation, and would be followed by concentration, which would be accompanied by inhibition such as occurs where antagonizing muscles are concerned. He was engaged on this work when Maria Petrova, who had just graduated from the newly opened Women's Medical Institute in St. Petersburg, joined his laboratory in 1910. Her thesis for a doctor's degree in 1912 was entitled "Processes of Irradiation and Excitation in the Cortex of the Brain", and together with Krasnogorsky she performed many experiments on excitation and inhibition. She also studied sleep, which, as the result of their experiments, Pavlov was led to regard as generalized inhibition extending to some sub-cortical areas, just as he regarded hypnosis as localized or partial inhibition. She later participated in the work on experimental neuroses which were produced by causing interference between the two opposing processes, excitation and inhibition, leading to rupture or breakdown of the cortical mechanism. They studied animals with different types of nervous systems; and by producing experimental neuroses in dogs, in some of which inhibition predominated, whereas in others excitation was most pronounced, obtained conditions resembling easily recognizable psychical disorders in man. They made extensive use of caffein and bromides in carefully graded doses in the investigation and subsequent cure of these conditions[5,6], and Prof. Petrova recently received the Pavlov prize for her book on this subject. During the last years of Pavlov's life, he became increasingly interested in the applications of his work to psychiatry, and both Krasnogorsky and Petrova devoted much time to these problems. Although Pavlov stressed the importance of the objective approach to psychology, he pointed out the help which physiology might derive from the study of clinical cases. He therefore made use of psychiatric data and visited clinics and talked to the patients. He maintained a lively interest in therapeutic measures, and in his last year initiated the treatment of schizophrenia by prolonged sleep.

Petrova has also continued the work which Pavlov began on the relation between the endocrine organs and higher nervous activity. For example, they found it difficult to establish conditioned reflexes in thyroidectomized or senile dogs, and relatively easy to produce experimental neuroses in castrated dogs. Pavlov also showed the influence of the cortex on some endocrine activity; for example, a conditioned reflex was repeatedly reinforced by administration of thyroid extract; then, when the extract was no longer given, an increase in metabolic rate was obtained in response to the secondary stimulus.

In a cable from Moscow, Prof. Krikor Kekcheyov records that after Pavlov's death in 1936, Petrova joined Pavlov's oldest colleague and successor, Leon Orbeli, at the Institute of Physiology of the Academy of Sciences of the U.S.S.R. Her work there has included a study of the part played by the nervous system in the origin of malignant tumours, the production of experimental neuroses by the use of strong irritants of the nervous system, and in 1943 she established the connexion between the severity of disorders of higher nervous activity and the development of eczema and various tumours.

A cable from Petrova herself says that she has never left Leningrad for an hour since the War began as she knew that her great master Pavlov would not have done so. She gives a vivid description of conditions in that city and makes many bitter comments on the tyranny of the German invaders. During the siege, which lasted nine hundred days, she refused to leave the city in spite of being repeatedly urged to do so, and she says she found satisfaction in working sixteen hours a day and wrote twelve scientific papers, of which she mentions the following: "Conditioned Reflexes as a Method of Throwing Light on Mental Traumata and the Origin of Various New Processes, in particular Cancer", "Influence of Fear-inducing Factors of Military Operations on Higher Nervous Activity in Dogs with Differing Types of Nervous System", "Causes of Old Age and Prophylactic Measures against Premature Old Age". As a specialist in higher nervous activity, she was able to observe the psychology of her fellow citizens and records with pride that the harder life became in the besieged city, and the more savage grew the German persecution in the form of hunger and bombardment, the more clearly did she perceive the people's firmness, unbending will, 'comradeliness' and habit of mutual assistance. The Pavlov Institute of Physiology was among the many important buildings damaged by bombs and shells, but in spite of these attacks, research was not interrupted, and scientific workers in Leningrad also spared no effort to defend their city. For months the daily ration of the people was 125 gm. of bread containing only 50 per cent flour.

Pavlov considered that a certain degree of discomfort is good for a fertile mind, and that a shortage in apparatus and material trains resourcefulness. It is interesting to compare Prof. Petrova's description of work under the conditions of this War with an account of one of Pavlov's assistants of their work during the War of 1914 and the Revolution. "It was often very difficult to get to the laboratory at all, because, besides other things, there was often shooting and fighting in the streets"; but Pavlov was generally present even if he was the only one, and he severely criticized any late-comer if there was an experiment to be done. He continued his work in the laboratory on short winter days by the light of wood torches and used a kerosene lamp for lectures, in which there was no break either at the Military Medical Academy or the Institute of Physiology.

Pavlov was convinced that only science could lead the human race to a bright future free from war, revolution and catastrophe, and at the opening of the fifteenth Physiological Conference in Leningrad in 1935 he said, "War is by its nature a bestial method for solving the difficulties of life, a method unworthy of the human mind with its immeasurable resources", and he placed great faith in the efforts of the Soviet Government with Stalin at its head in its struggle

for world peace. In that year Cannon remarked that the outcome of the efforts, which were being encouraged by the Soviet Government, to use Pavlov's methods to condition the cortex in new ways and thereby to bring about a reformation of conduct would be watched with supreme interest[7]. Pavlov himself, in a letter to young scientific workers shortly before his death, said: "It is a matter of honour for the youth, as well as for all of us, to justify those great hopes which our fatherland places in science".

Pavlov has been accused of over-simplifying a remarkably complex subject, but his theories have provided useful working hypotheses and they have stimulated effort and increased the extent of careful experiments by those who agreed as well as those who disagreed with his views. He himself considered theories as worth while only for finding new lines of attack and accumulating facts. He stressed the importance of repeated tests to establish the reproducibility of results, and he shrank from making general conclusions. His work affords a striking example of true scientific method, and it is satisfactory to learn that his colleagues in the U.S.S.R. have been able to develop it still further in spite of the difficulties of war conditions.

[1] Frolov, "Pavlov and His School" (London: Kegan Paul, Trench, Trubner and Co., Ltd., 1937).
[2] *Proc. Roy. Soc. Edin.*, 56, 264 (1935–36).
[3] Pavlov, "The Work of the Digestive Glands", translated by W. H. Thompson (London: Charles Griffin and Co., 1902).
[4] Anrep, Royal Society Obituary Notices, 2 (1936).
[5] Pavlov, "Conditioned Reflexes" (Oxford: Univ. Press, 1927).
[6] "Lectures on Conditioned Reflexes", Pavlov. Vol. 2, translated and edited by W. Horsley Gantt (International Publishers, 1941). See also Vol. 1.
[7] Cannon, W. B., "Ivan P. Pavlov", *Res. Bull. Sov. Union* (1935).

THE ROYAL NAVAL SCIENTIFIC SERVICE

DURING the War of 1914–18 technical progress went ahead, as has again happened in this War, at a vastly increased rate in all the Services. In order to compete with the demands for new weapons and counter-measures, the help of numbers of men of science from the universities and technical men from private firms was enlisted, and these men were employed in naval establishments all over Great Britain. They were employed very largely on new methods for detecting and destroying enemy submarines and on developments in radio, new types of mines, methods of mine-sweeping, work on underwater explosions, torpedoes and navigational devices and the like. The work of these men was of immeasurable value to the Navy, and directly after the War the Admiralty decided, as a result of its experiences during the War, to set up a civilian scientific research department under a civilian Director of Scientific Research. The first Director of Scientific Research in the Admiralty was appointed at the beginning of 1919. He was Sir Frank Smith, who had himself during the War been largely concerned with the development of a type of magnetic mine which can be regarded as a forerunner of the German magnetic mine, which was used against Britain during this War. The Admiralty also set up its own research laboratory under the Director of Scientific Research for the conduct of the more fundamental types of scientific investigation.

Gradually during the years of peace the civilian scientific and technical staffs employed in the Naval Establishments were put under the general administrative control of the Director of Scientific Research, instead of being separately administered as they had been during the War. These staffs were embodied in the Admiralty Scientific, Technical and Chemical Pools, and this arrangement ensured a greater measure of uniformity in the conditions of service in the different establishments, and among people engaged on different types of research and development work, and it also ensured common methods of selection and entry into the scientific, technical and chemical services of the Admiralty. During the years of peace also, the Air Ministry and War Office set up civilian scientific research departments, which were modelled very largely on the Admiralty organization.

The steps outlined above were steps in the right direction, but there is no doubt that the Navy, and indeed the other Services, suffered a good deal because the conditions of service of the civilian technical staffs were not such as could attract the best types of men from the universities and other sources upon which the Admiralty depended. Apart from pay and promotion prospects, the lack of opportunity for publication and loss of outside recognition, as well as rather rigid research programmes, were against the Services in their need for first-rate men.

Some of the men of science and engineers who entered the Admiralty Service in the War of 1914–18 are still there, and it is to the work of these men and to those who entered the Service during the years of peace that we owe our state of preparedness, such as it was, to meet the onslaught of Germany. During the present War, the permanent Admiralty staffs have again been greatly strengthened in numbers and in quality by men of science and engineers drawn again from the universities, research institutions, private firms and other sources. The great advances which have been made in almost every form of technical weapon and in counter-measures are largely due to this body of people, working in the closest daily association with industry and outside men of science and engineers, including those of the United States and the Dominions, with the naval technical departments, and with the divisions of the naval staff, who decide in broad outline what are the Service needs.

The announcement of the formation of the Royal Naval Scientific Service is an indication that the Admiralty, having been the first Service department to take the then epoch-making step of setting up a civilian research department within its organization, still recognizes the vital importance of taking yet further steps to ensure that scientific research and technical development for the Navy shall not lag behind during the future years of peace.

The Admiralty desires to see the closest co-operation between the men of science and the uniformed officers of the Service, and it proposes giving fuller opportunities than have hitherto been regularly possible for civilians to become thoroughly versed in the ways and the needs of the Service. Further, the civilians will, by virtue of the arrangements which will be made for obtaining sea training and experience, come to feel that they are more than ever before an integral part of the Navy. The Fleet Order shows also that the Director of Scientific Research, as head of the Royal Naval Scientific Service, will have greater freedom than hitherto in arranging for transfers of staff between establishments, so that the outlook of the technical men will become broader and more enlightened than it is apt to be if men of science and engineers specialize too long or too early in

particular aspects of Naval warfare. The reference to conditions of service including pay and prospects of promotion is vague, but it must be accepted at present as an earnest of the good intentions of the Admiralty.

The Admiralty and Government policy towards research in post-war years aims at giving research and research workers—in the broadest sense—recognition and status which they have hitherto lacked in Great Britain. It is also hoped that the R.N.S.S. will be accounted an honourable career for men whose leanings are towards science and the sea; that prospects offered by the R.N.S.S. will attract men of the highest calibre to devote their minds and their lives to solving the great problems which lie ahead of the Navy; that, though the Government service cannot generally offer monetary rewards comparable with those of the highest walks of industry, yet the other advantages of a Naval technical career will offset the possible financial disadvantage; that the Admiralty will be enabled to keep after the War some of the brilliant men who are serving it temporarily now; that there will be greater freedom for individual research workers to follow up lines of investigation for which they are personally fitted, and that the Government will not be so much inclined to look for quick returns.

OBITUARIES

Sir Arthur Smith Woodward, F.R.S.

SIR ARTHUR SMITH WOODWARD, lately keeper of the Department of Geology, British Museum (Natural History), died on September 2 at the age of eighty.

Sir Arthur was a great student of vertebrate palæontology, the widest in his work and knowledge of his time. When he left Owens College, Manchester, as a very young man to take a post in the Museum, he recognized that the work of R. H. Traquair on palæozoic fish had introduced a new standard of investigation and a new outlook, and immediately applied them to the study of later fishes. He travelled extensively so that he saw nearly all the original materials in the world, and his extraordinary memory enabled him to recall immediately anything which could throw light on the fossils on which he was actually working. Thus his catalogue of the fossil fishes in the British Museum marks an epoch in the study of such things. It was the first completely general detailed work since Agassiz's "Poissons Fossiles" and it has had no successor, so that it remains the point of departure from which all subsequent work has proceeded. To him came collections of fossil fish from every part of the world, to be in turn described, placed in their position in the classification, and their geological horizon determined. Thus he became known to palæontologists everywhere, and was ultimately a foreign member of some twenty scientific societies.

But Sir Arthur's interests extended far beyond fish. He wrote on fossil Amphibia, reptiles, birds and mammals, doing something of interest in each of those groups, and finally he described the Piltdown man, actually himself finding part of the material at Piltdown.

His quality was well illustrated by the text-book of vertebrate palæontology which he published in 1900. This differed in every way from those which then existed; it was accurate, it dealt only with forms which were important morphologically, it was based entirely on materials which the author had seen, and it was readable.

When Sir Arthur entered the Museum the collections of fossil vertebrates, though large, had not been brought together on any considered plan. Under his influence and guidance they were expanded so that every important fauna in the world was represented, often by most admirable materials. But all were bought, sometimes after they had been sought for many years. Although Smith Woodward himself made a collection of fossil mammals at Pikermi, and Andrews explored the Fayum, no expedition was ever sent out at Museum expense; in consequence, during the past thirty years many foreign museums have exploited fossil faunas which are now inadequately or not at all represented in London.

But Smith Woodward always felt that he was a public servant. Everyone, British or foreign, had access to all the fossils in his charge, and was allowed to describe anything he wished. Thus the Museum gained because its collections were worked over by men from many countries, and palæontology gained because specialists could use its materials, as if they belonged to their own institutions.

So Smith Woodward became known and admired by the whole body of palæontologists, occupying a place no one can now fill, and leaving behind a great mass of admirable work, part of the foundation of modern palæontology. D. M. S. WATSON.

Prof. S. P. Mercer, O.B.E.

THROUGH the death of Prof. Stephen Pascal Mercer which occurred on August 18 at the comparatively early age of fifty-three, Northern Ireland has lost an outstanding figure in the field of agricultural education and one who played a prominent part in laying a sound foundation for the Faculty of Agriculture of Queen's University, Belfast.

S. P. Mercer (S.P.M., as he was known to so many of us) was a Staffordshire man—the son of Mr. Fred Mercer, the landscape painter—and was born at Abbots Bromley in 1891. His leaning towards the study of agricultural science became apparent at an early age and is confirmed by his career as a student at Harper Adams, the Botanisches Staatsinstitut, Hamburg, and the South-Eastern Agricultural College. He was a graduate in agriculture of the University of London, and held the National Diploma in Agriculture. Before coming to Northern Ireland, Prof. Mercer held appointments as lecturer in charge of the Department of Agricultural Botany at Armstrong College, adviser in agricultural botany for the northern counties of England, and divisional organizer for the Northern Province under the Food Production Department of the Ministry of Agriculture and Fisheries. During 1919–22 he was assistant director and chief research officer in the Seed Testing Station for England and Wales. It was while holding this appointment that he made his survey of seed growing in Great Britain, which is the best known of his earlier work.

On his appointment, in 1922, as head of the Seed Testing and Plant Disease Division of the Ministry of Agriculture for Northern Ireland, he threw himself energetically into the organization of the Northern Ireland Seed Testing Station, where his long experience

and intensive knowledge of seeds and seed testing allowed him to build effectively and have left their mark on this Station as it exists to-day. The study of seeds and allied problems provided his main interest on the research side, and his book, "Farm and Garden Seeds", which is remarkable for the accuracy and beauty of its hundreds of illustrations of seeds drawn in black and white and for the attractive style of its writing, portrays him at his best. His appointment as chairman of the Research Committee of the International Seed Testing Association established his claim to international reputation. His ability was soon recognized by the rye-grass seed-growing industry in Northern Ireland, and his loss will be keenly felt by all those engaged in seed production, who looked to him continually for good advice and wise counsel.

As professor of agricultural botany (1924), dean of the Faculty of Agriculture (1928) and senior technical research officer of the Ministry (1928)—which posts he occupied at the time of his death—S. P. Mercer will be remembered by colleagues and students alike for his width of vision as a teacher, for the conscientiousness of his effort to give sound advice and for his unfailing courtesy. He became dean of the Faculty within a few years of its formation, and during his tenure of this office he succeeded in establishing it on sound lines, and gained and retained the respect of all in so doing. His conspicuous services to agricultural education and research in Northern Ireland were marked by the award of the O.B.E. in 1943.

At the outbreak of war he undertook additional duties in connexion with the control of seed production and distribution in Northern Ireland, and here he was able to bring his knowledge and experience to bear in assuming his not inconsiderable share of "the war effort".

Mercer did not enjoy robust health; he worked under a handicap which few of us are asked to bear, and knowledge of this only serves to emphasize the greatness of his achievements. A lover of peace, prevented by indifferent health from fighting to secure that peace, artist and idealist as well as man of science, gentle and retiring of nature, blessed with constancy of affection, he would have achieved much more had the strength been his and had his span of life been longer. We, his colleagues, mourn the loss of a fine and ardent spirit, an upright and just man rightly disturbed on occasion by the blatant and consistent imperfections existing in our race and grieved at his powerlessness to do more to put wrongs right.

A. E. MUSKETT.

Prof. Leo F. Goodwin

WE record with regret the death of Lieut.-Colonel Leo Frank Goodwin, professor of chemical engineering at Queen's University, Kingston, Canada, on August 15, at the age of sixty-six. He was the elder son of the late Oscar Guttmann, author of "The Manufacture of Explosives" and of "Monumenta Pulveris Pyrii". Prof. Goodwin received his engineering training at the City Guilds Central Technical College and then took his Ph.D. in chemistry at the University of Heidelberg. He was a member of the Institution of Chemical Engineers and of the Engineering Institute of Canada and a fellow of the Institute of Chemistry. He became assistant to Sir William Ramsay at University College and held an assistant professorship for some years at the City College, New York, before taking up his chair at Queen's University. There he inaugurated the first comprehensive course in chemical engineering in the British Empire. An enthusiastic advocate of an undergraduate curriculum for chemical engineers, he probably turned out during the last thirty-five years a larger number of fully qualified and successful chemical engineers than the rest of the British Empire, exclusive of Canada.

His published work dealt mainly with large-scale chemical processes such as the manufacture of pulp for paper, acetone, causticizing and cement colouring, and he was employed as consultant to some of these industries.

Prof. Goodwin also had a distinguished military career, first in the squadron of the Inns of Court Rifles and then in the Princess of Wales Own Rifles, Canada, which he commanded for some years. In September 1914 he came to England with the 1st Canadian Division and served with them in France and Flanders during the critical 1915 campaign. After the battle of Givenchy he was seconded for service with the Canadian Munitions Board and rendered valuable technical service to the British and Allied Governments.

During the present War, Prof. Goodwin again served the Canadian Government in a military and technical capacity, and latterly supervised a number of selected research students engaged on Government sponsored research work. There is little doubt that his early demise was hastened by a long period of overwork.

Prof. Goodwin leaves a widow well known as an artist under the name of Helen Sinclair and a daughter now in the Canadian W.A.A.F. He will be greatly missed by a wide circle of friends here and in America.

R. ROBERTSON.

Dr. M. C. Mott-Smith

DR. MORTON C. MOTT-SMITH, writer in physics for Science Service, Washington, died on June 9. He was sixty-six years old. Although he joined the staff of Science Service less than three years ago, he had completed since then two important fundamental texts in physics for use in high schools and by soldiers and adult civilians. Of one of these—"Fundamentals of Electricity"—more than 650,000 have been printed, including editions for the use of the American Army and a translation into Spanish.

Dr. Mott-Smith was born in Hawaii on November 26, 1877. He graduated from the Massachusetts Institute of Technology in electrical engineering and obtained his Ph.D. in physics, philosophy and mathematics at the University of Halle, Germany. He was formerly professor of physics at Colby College and George Washington University.

WE regret to announce the following deaths:

Prof. J. C. W. Frazer, research professor of chemistry in Johns Hopkins University, on July 28, aged sixty-eight.

Sir John Jarmay, K.B.E., a director of Brunner, Mond and Co., Ltd., and of other chemical works, on August 22, aged eighty-seven.

Prof. D. E. Smith, emeritus professor of mathematics in Teachers College, Columbia University, on July 29, aged eighty-four.

Mr. H. F. Tomalin, formerly conservator of forests, Ceylon, on August 16, aged eighty-two.

The vacancies advertised in these columns are available only to applicants to whom the Employment of Women (Control of Engagement) Orders, 1942-3, do not apply.

MURDOCH TRUST

For the BENEFIT of INDIGENT BACHELORS and WIDOWERS of good character, over 55 years of age, who have done "something" in the way of promoting or helping some branch of Science.

Donations or Pensions may be granted to persons who comply with these conditions.

For particulars apply to MESSRS. SHEPHERD & WEDDERBURN, W.S., 16 Charlotte Square, Edinburgh, 2.

COUNTY BOROUGH OF DONCASTER EDUCATION COMMITTEE

GRAMMAR SCHOOL

Headmaster: F. C. Lay, M.A., B.Sc.

Applications are invited for the post of LABORATORY STEWARD in the Science Department of the School.

Candidates should be skilled in laboratory arts, and have had experience in the service work of laboratories.

Salary, £208 per annum by annual increments of £13 to £234 per annum, plus war bonus.

The post will be subject to the provisions of the Local Government Superannuation Act, 1937.

Applications (by letter) should be sent to the Chief Education Officer at the Education Offices, Doncaster, not later than Sept. 30, 1944.

Canvassing in any form will disqualify a candidate.

JESUS COLLEGE, OXFORD

FELLOWSHIP AND TUTORSHIP IN MATHEMATICS

The Governing Body of Jesus College proposes to elect an official Fellow and Tutor in Mathematics.

The Tutor's duties will be to share in the College teaching for Honour Moderations and for the Honour School of Mathematics (more especially on the side of Pure Mathematics).

The total initial stipend will be at least £500 per annum, together with dinner allowance and rooms in College rent free.

Applications made on behalf of candidates who are abroad will be considered. Inability to take up the appointment immediately owing to National Service will not disqualify any suitable candidate. The choice of the College will not be limited to those who apply.

Applications, with references and not more than three testimonials, should be submitted not later than December 1, 1944, to the Senior Tutor, Jesus College, Oxford, from whom further details may be obtained.

EDINBURGH AND EAST OF SCOTLAND COLLEGE OF AGRICULTURE

INVESTIGATION INTO BOVINE MASTITIS

Wanted, Temporary Assistant to the Advisory Bacteriologist. Applicants should possess a qualification in Bacteriology, preferably an Honours Degree, or have equivalent postgraduate experience. Maximum salary £800, plus war bonus.

Applications, stating qualification and experience and copies of testimonials, should be lodged with the undersigned not later than Oct. 7, 1944.

THOMAS BLACKBURN,
Secretary.

13 George Square,
Edinburgh, 8.

INTERNATIONAL STUDENT SERVICE

The British I.S.S. Committee invites applications for the post of Director, at a salary of approximately £700 per annum, for a minimum period of two years. Duties will include the organization of a National Appeal for world student relief, together with educational work in the Universities.—Applicants should forward five copies of their applications, accompanied by recent testimonials or references, by October 14, to the Secretary, International Student Service, 11D Regent Street, London, S.W.1.

HARPER ADAMS AGRICULTURAL COLLEGE

ASSISTANT LECTURER IN AGRICULTURAL ZOOLOGY

Applications are invited for the above appointment. Salary up to £800 p.a. (plus war bonus), according to qualifications and experience.

Applications and enquiries for information should be addressed without delay to the Principal, H.A.A.C., Newport, Shropshire.

UNIVERSITY OF DURHAM

Applications are invited for the PROFESSORSHIP OF NAVAL ARCHITECTURE, tenable at King's College, Newcastle upon Tyne. The candidate appointed, if now on National Service, will not be expected to take up appointment until his release. The salary will not be less than £1,500—Further particulars may be obtained from the Acting Registrar, University Offices, 46 North Bailey, Durham, by whom applications should be received not later than Nov. 30, 1944.

BRITISH CAST IRON RESEARCH ASSOCIATION

The Council invite applications for the post of CHIEF of the DEVELOPMENT DEPARTMENT. Salary, £1,000 to £1,200 per annum.—Applications should be sent to the Secretary of the Association, Alvechurch, Birmingham, from whom a memorandum relating to the appointment may be obtained.

A week-end course on "Medical and Administrative Problems connected with the Resettlement in Industry of the Disabled (Ex-Service and Civilian)," postponed from July, will be held at the London School of Hygiene and Tropical Medicine on Saturday and Sunday, Oct. 28 and 29, 1944. The course is designed for industrial medical officers and other medical practitioners interested in the subject, and the lecturers will include Dr. Harold Balme, Mr. R. E. Gomme, Dr. E. C. Warner, Mr. R. W. Watson-Jones, Dr. Aubrey J. Lewis, and Dr. J. B. McDougall.—Applications, together with the fee of one guinea (and 2s. 6d. if lunch is required on the Sunday), should be sent to the Secretary of the School, Keppel Street, Gower Street, London, W.C.1, before Monday, Oct. 23.

An old established Company with Works in the Manchester district, invites applications from qualified men between 25 and 30 years of age for: (1) ANALYTICAL CHEMIST, candidates must have a sound knowledge of analytical chemistry with preferably some experience in industry; (2) RESEARCH CHEMIST, candidates should hold a University Degree in Chemistry and have some experience in industrial research. These are progressive and permanent positions for men of ability and initiative.—Applications, in own handwriting, giving age and details of training and experience, should be addressed to Box 751, L.P.E., 110 St. Martin's Lane, London, W.C.2.

Chemist or Metallurgist with Works experience required to undertake development work as Assistant to Works' Manager in a North of England works Smelting and Manufacturing Non-Ferrous Metals and products. Applicants should be between 27 and 35 years of age and must have B.Sc. or equivalent degree. Permanent appointment with good prospects for the right man.—Applications, with full particulars of qualifications and experience, should be addressed to the Managing Director, Walkers Parker & Co., Ltd., Elswick Lead Works, Newcastle upon Tyne 1.

Applications are invited for Vacancies for Temporary Examining Officers in the Patent Office. Candidates should have a University Degree (or equivalent) in Science of Technology with Chemistry as a subject. Salaries will be fixed within the following ranges, according to age, qualifications, and experience: men, £280 to £600; women, £280 to £500; Civil Service war bonus (at present £49 11s. per annum for men and £40 9s. per annum for women) is payable in addition.—Applicants should write, quoting F.2982A, to the Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London W.C.2, for the necessary forms, which should be returned completed on or before October 9, 1944.

Industrial Research Chemist. A qualified Chemist, with some Research and Industrial experience, is required by a progressive concern in the Spen Valley district of Yorkshire, operating under Essential Work Order. Knowledge of plastics, textiles, or associated subjects is an advantage. Applicants preferred between 25 and 35. Salary £400 to £600 p.a., according to experience and qualifications. Post is permanent with good post war prospects.—Applicants should write, quoting F.1737XA, to Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2, for the necessary forms, which should be returned completed on or before October 27, 1944.

Dairy Bacteriologist required for enterprising firm (not a dairy) interested in sterilization, disinfection, and clean milk production. Applicants must be a graduate, preferably with research experience. Duties will entail "field" work over a wide area and research in well-equipped London laboratory. Permanency and good prospects.—Reply in confidence, giving full details of career and experience, to Box 248, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Large Company in London (Scheduled under Essential Work Order) requires services of Technically Qualified Lady to Search Patent and Technical Literature and Prepare Abstracts (ability to translate French or German scientific literature an advantage).—Applicants should state full particulars of qualifications, experience, age, and salary required to Box 247, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Biochemist, aged 25–35 years, required for Research Department of well-known Pharmaceutical Company in North London. Candidates should hold a University Degree in Chemistry. Previous experience in industrial research or manufacture desirable. Permanent and progressive position. Salary £350 to £450, according to experience.—Box 249, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Physicist, B.Sc., 27, over four years experience in Industrial Research and Development work, desires responsible position. Specially interested in mechanical and flow properties of industrial materials (plastics, rubber, bitumens, etc.)—Box 246, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Required for Medical Research Institute Doctor of Medicine, with special theoretical knowledge and good experience in biochemistry, with interest in clinical research work. Position offers good development.—Box 245, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Geologist, 1st Class Cambridge degrees and wide experience, available on fee or salaried basis for petroleum or mineral work.—Box 242, T. G. Scott & Son, Ltd, 9 Arundel Street, London, W.C.2.

Wanted: "Fire and Explosion Risks" by Schwartz. (Griffin.)—Offers to Indian Jute Mills Association, Imperial Institute, South Kensington, S.W.7.

Microscopes, of all descriptions, only a few available second-hand, perfect condition. Send details of your requirements enclosing 3d. stamp. — Telephone or correspondence only: Chards. 47 Beckenham Road, West Wickham, Kent (Spring Park 1628).

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

THE LABORATORY, PLYMOUTH

Limited supplies of marine biological material are still available, but orders should be placed well in advance.

For prices and detailed information apply to: The Director, The Marine Biological Laboratory, Plymouth.

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NEWS and VIEWS

University of Bristol : Chair of Chemistry

IT has been announced that Dr. Wilson Baker is to succeed Prof. E. L. Hirst as Alfred Capper Pass professor of chemistry in the University of Bristol. Dr. Baker studied in the University of Manchester and, after a period of service in France with the Friends' War Victims Relief Organisation, he obtained the degree of B.Sc. with first-class honours in chemistry in 1921. He then held successively the Mercer scholarship, the Baeyer fellowship and the Dalton scholarship for research in chemistry, and on taking the Ph.D. in 1924 he was appointed assistant lecturer in Manchester. In 1927 he joined the chemistry staff in the University of Oxford and has also held for some time the position of fellow and prælector in chemistry at the Queen's College. He received the degree of D.Sc. (Manchester) in 1933.

Dr. Baker is distinguished as an organic chemist whose work has developed markedly our knowledge of various groups of natural products. Special reference may be made to his contribution to the chemistry of flavones and *iso*-flavones and the polyhydroxybenzenes. In addition to work on natural products, Dr. Baker has made important contributions to the theory of chelated compounds of the aromatic series, and has given attention to the study of condensation products of phenols with ketones. Along with Mr. T. W. J. Taylor, he undertook a revision of Sidgwick's "Organic Chemistry of Nitrogen", the new edition of which was published in 1937. Dr. Baker hopes to commence his work in Bristol at the beginning of January 1945.

Chair of Civil Engineering

THE appointment of Dr. A. G. Pugsley to the chair of civil engineering at the University of Bristol has been announced. As an acknowledged authority on structures, he will be able to maintain a tradition established by his predecessors, J. F. Baker and A. J. Sutton Pippard. Dr. Pugsley was educated at Rutlish School, Merton, took his London degree in engineering at the Battersea Polytechnic, and followed this by an apprenticeship to civil engineering at the Royal Arsenal, Woolwich, under Colonel H. Mitchell. He then joined the staff of the Royal Airship Works, Cardington, and was engaged upon problems of structural design until the establishment was broken up by the Government's decision to discontinue airship development following the accidental loss of the *R*.101. He transferred to similar work on heavier-than-air craft at the Royal Aircraft Establishment, Farnborough, and later was appointed head of the Structural and Mechanical Engineering Department there. During part of this period he held the appointment, by arrangement with the Air Ministry, of part-time lecturer on aircraft structures in the post-graduate Aeronautics Department of the Imperial College of Science and Technology, South Kensington, London. He resigned this in 1941 owing to pressure of official duties at Farnborough.

Dr. Pugsley's researches have been mainly in the field of elasticity in aircraft structures, upon questions of interaction of aerodynamic loading with structural elasticities and inertias, and the development of air-worthiness design regulations putting these into practice. He was awarded the D.Sc. by the University of London for this work. His activities at Farnborough included a notable expansion of the experimental work on structures, including investigation of structural accidents. He was awarded the O.B.E. early in the present year.

Society for Visiting Scientists

THE Society for Visiting Scientists was founded on the initiative of the British Council, and in consultation with the Royal Society, to provide a meeting place and information centre for men of science from overseas visiting Great Britain. The premises at 5 Old Burlington Street, W.1, consist of a lounge and meeting rooms, a bar, refectory, and some dormitory accommodation. These are at the disposal of members. The information centre is open to all visiting men of science, so anyone arriving in Britain can, if he wishes, proceed at once to the House and be given advice and details of how he can apply for membership. Under the present conditions it was decided to postpone the official opening for the time being ; but the Society has been functioning unofficially for the last few months and has already been used by a number of British and foreign scientific workers, including members of the French Scientific Mission. It is hoped that an official opening will take place in the near future. In the meantime the Executive Committee has held an informal reception. On this occasion the president, Prof. F. G. Donnan, pointed out the importance of offering hospitality to young scientific workers, and deplored the lack of facilities for them in the past. He added, "I hope sincerely that this modest beginning will be but the nucleus of something much greater and more widely spread, something that in the happy days to come will contribute to the friendship, intercourse, and good fellowship of scientists throughout the world".

Rehabilitation of Liberated Countries

THE rapid advances of the Allies in both eastern and western Europe has brought into prominence the vitally important task of carrying relief to the suffering peoples and helping them to restart their agricultural and industrial activities. Several conferences have recently been held both in Great Britain and in North America dealing with the many important problems involved. The work falls into three stages. During the period of military operations it is in charge of the Civil Affairs Branch of the Army. Military necessities must obviously be of over-riding importance, and the closest liaison with the military authorities is essential. This organization will deal with the emergency period, but ceases to act when the military operations have ceased. At that stage a National Government will take charge, and it can look to the United Nations Relief and Rehabilitation Administration for advice and supplies for completing the relief measures and restarting the agricultural and industrial life of the country.

The work of U.N.R.R.A. falls into several sections : supplies of food, clothing, agricultural materials, machinery and spare parts for restarting damaged factories, especially those concerned with food ; and with the returning of the scattered populations to their homes. Expert committees have collected data and worked out bases of allocations and priorities. The combined boards in Washington will furnish the most important supplies, and although reserves of food are not yet available owing to military demands

and those of the Civil Affairs Branch, U.N.R.R.A. has already received substantial allocations of other principal items including clothes, seeds and medical stores. In addition, U.N.R.R.A. has established a claim on crops still to be harvested, on clothes to be made, etc. The agricultural and industrial requirements are closely linked: if, for example, the flour mills could be started, it would be possible to send wheat into the countries assisted; and this would provide not only bread for the people but also milling offals that would produce milk and also animal manure to enrich the soil. Fishing also is to be restarted.

The third stage is reached when the agricultural and industrial life of the country is beginning to function normally; at that stage U.N.R.R.A. ceases to operate as its purposes do not include reconstruction. Organizations have been designed for dealing with the new problems that will arise. A permanent world food and agricultural organization is to be established, and a draft constitution has already been agreed. Its functions will include the collection, analysis and dissemination of information about nutrition, food and agriculture. It will promote and recommend national and international action on research and education in these subjects; also on the conservation of resources, improved methods of production, marketing and distribution, and the provision of adequate agricultural credit; it will also furnish technical assistance to Governments when required. No term is set to the operations of this body.

A Medical Service in Ethiopia

AN opportunity for immediate medical service—and especially, it would seem, for service by trained nurses—is indicated by an article by Dr. Ruth Young, formerly principal of the Lady Hardinge Medical College for Women, New Delhi, on "Medicine and Nursing in Ethiopia" (*The Lancet*, 797; June 17, 1944). Although it is difficult to assess accurately the incidence of particular diseases in Ethiopia, because no vital statistics exist, Dr. Young has been able to gather valuable information about the physique, diet and general health of the people. The physique of the people living on the plateau is fairly good, and they are strong and hardy. The common diseases are typhus, relapsing fever, pneumonia, venereal diseases, dysenteries, trachoma and such parasitic diseases as scabies, tropical ulcer, infestations with intestinal worms and malaria. Leprosy is fairly widespread; but tuberculosis is apparently not so serious a problem as it is in other parts of Africa, nor do diseases due to deficiencies in diet seem to be common. From what Dr. Young says there would seem to be as much need of agricultural and veterinary assistance as of medical help. The cows are poor milkers and, although goats are numerous, they are kept chiefly for meat and skins and are not much milked. On the other hand, any increase in production of animal food products would, it seems, be largely neutralized by the numerous fasts imposed by the Coptic Church, which, apart from a longer Lent than ours and other fasts, forbids the use of foods of animal origin on two days of every week. Butter, milk and eggs are included in these forbidden foods.

Maternal mortality is apparently low, and complications at childbirth are not common. Dr. Young attributes this to the fact that most births are normal and to the very strong prejudice against any kind of interference at childbirth. There is no class of professional midwives similar to that which does "such untold damage in a country like India". Infant mortality is, on the other hand, probably very high. From questions addressed to women, Dr. Young learned that 176 out of 353 children born alive had died, and she concluded from the evidence available that something like 109 of these had died before the age of one year. There is also a high rate of sterility, probably due mainly to syphilis which, like gonorrhœa, is common. The chief needs at the moment are, Dr. Young thinks, intensive preventive work and the teaching of mothercraft and hygiene rather than the provision of hospital beds. There are at present no properly trained nurses. In an annotation on this interesting article, *The Lancet* (795; June 17, 1944) refers to the hospital to be built in Addis Ababa in memory of the late Princess Tsahai. Most of us will remember the tragic death of this young daughter of the Emperor at the age of twenty-two. In Great Britain, while she was in exile, she qualified as a State registered nurse after training at the Great Ormond Street Hospital for Sick Children, London, and later she took further training at Guy's Hospital. Returning home, she married the governor of a province in Ethiopia and began to organize the health service which she wished to see in her own country.

Simple Teaching Apparatus In Physics

IN his presidential address given to the Essex Science Teachers' Association, Lord Rayleigh asks, and discusses, the question "Are Expensive Appliances Necessary?" In the physical laboratory a great deal can be learnt about Wheatstone's bridge by means of a wire stretched along a rough board, graduated with ink or pencil marks, with a piece of metal held in the hand to make contact with it at any point. From a purely teaching point of view this is as good, if not better than, a post-office box costing as many pounds as the other does pence. It is much less likely to muddle the beginner and will in all probability give him more insight into the physics of what he is doing. If the student has rigged it up for himself he will further get a sense of independence and achievement which he never gets by handling the elaborate constructions of the instrument maker. It is not uncommon to find people who regard an optical instrument not as an arrangement of reflecting and refracting surfaces, but as a construction of lacquered brass. The schoolboy first regards a telescope as a thing which 'pulls out'. All the essentials of the instrument can be better appreciated by sticking lenses with 'Plasticene' on a strip of wood. Helmholtz told Lord Rayleigh that as a boy he made his own telescope out of spectacle lenses and a cardboard tube. In instruments made by the instrument maker many essential parts are rightly hidden from view by protective devices, and the young student is deterred from meddling with them for fear of damaging valuable property.

Simple Apparatus in Physics Research

IN the same address Lord Rayleigh claims that beginners in research also should be "graduates in the school of string and sealing wax". Faraday, and Maxwell in such constructions in the Cavendish Laboratory as his model of the thermodynamic surface, are each quoted as examples. Sir Charles Parsons, the greatest mechanical engineer of his generation, was able to deal with formidable problems

of large-scale construction, yet he found paper, sealing wax, wire and steel knitting needles very adequate materials for making a working model of his air turbine. When the late Lord Rayleigh had occasion to set up a pair of mirrors for Fresnel's interference experiment he mounted them in a few minutes on two lumps of soft wax. The amateur method is not only much cheaper but also often takes little more time than the dispatch of an order to the instrument maker. Progress, too, can be made while the mind is red-hot upon the project, before delay has cooled enthusiasm. Little sympathy is shown for the research worker who puts the responsibility for designing his apparatus upon a firm of instrument makers. Lord Rutherford is quoted as saying that, if necessary, he could carry out research at the North Pole. J. C. McConnel, who was compelled for health reasons to winter in Switzerland out of reach of laboratories or facilities of any kind, still made important observations on the crystallization of ice, noting in particular how large were the individual crystals and how they behaved under bending forces when single crystal rods were cut in various directions. Lord Rayleigh paid a tribute to the instrument making industry and its part in practical life and non-pioneering research.

The New Carnegie Cyclotron

A NEW giant cyclotron has recently been put into operation at the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. The new cyclotron, one of the two largest in operation in the world (the other being at Berkeley, California), generates particles of 15,000,000 electron volts energy, permitting the most precise measurements ever made of the forces released by atomic disintegration. The cyclotron itself weighs more than 225 tons, has an overall height of 12 ft.; it is 30 ft. long and 20 ft. wide. It took four years to build, at a total cost of 500,000 dollars for the cyclotron, its appurtenances, and the special three-story building housing the equipment and instrument shop. The magnet is made up of four iron castings, the largest weighing more than fifty tons. Surrounded by this heavy magnet is the accelerating chamber, about sixty inches in diameter, in which atomic particles are produced. The cyclotron is housed ten feet below ground.

A New Type of Still

THE *Bulletin and Laboratory Notes* of September 1943, issued by Messrs. Baird and Tatlock, Ltd., Esher, Surrey, contains a description of an interesting copper and glass still for the preparation of distilled water in the laboratory. The water is boiled by an electric immersion heater in a tinned copper boiler, with a water-sealed lid of the same material. The lid carries a central metal tube over which is a glass hood communicating by a backward-sloping glass tube to the special water-cooled spiral glass condenser. A horizontal baffle inside the lid under the central steam outlet minimizes the passage of spray into the hood, which also serves as a trap. More than 90 per cent heating efficiency is claimed. The standard model has a 1·8 kW. motor and produces 2·7 lit. of distilled water per hour, with a total water consumption of 36 lit. The water, in a particular experiment, had a *p*H of 6·0–6·2, and conductivity 1·5–2·0 gemmohs, although these figures will vary with the quality of the tap, water. Oil or gas heating may be used in emergency. The whole apparatus is conveniently mounted in one piece by suitable clamps and appears to be very robust, and an additional feature is that a supply of hot cooling water can be diverted to a tank near a sink and used for washing. Other interesting types of stills are also described in the *Bulletin*.

Institute of Industrial Administration: Awards

THE Institute of Industrial Administration has awarded the Institute travelling scholarship to Mr. A. G. Irvine for his thesis on "The Purposes and Techniques of Market Research". This scholarship, of the value of £250, enables the holder to spend three months in the United States studying American practice in his particular field of management, assisted by the New York office of the donors of the scholarship, Messrs. Stevenson, Jordan and Harrison, Ltd. The Wilson Medal of the Institute has been awarded to Mr. A. W. Goldstaub, for his paper on "Internal Audit in Industry". The Junior Executive Prize of books to the value of £5 has been won by Dr. W. L. Kent, for his paper on "The Application of Science to Industry", and Mr. G. Kinnaird Evens, for his paper on "The Future of Psychology in Industry".

"Books: The Warehouse of Knowledge"

WITH reference to the leading article "Books: the Warehouse of Knowledge", published in *Nature* of September 9, p. 319, Mr. Stanley Unwin writes: "If the established book publishers had as much as 5 per cent of 'the paper in the country available for printing' they would be in clover. The total of 420,000 which you give merely includes four categories of paper consumers and omits all others such as the printers. At the beginning of the War it was estimated that books called for about 1¼ per cent of the total. It is unlikely even to-day that the figure exceeds 2 per cent." We regret our error in stated percentage of paper available, and since it was a considerable over-estimate, Mr. Unwin's correction adds still further point to our argument. It may be possible, however, that even Mr. Unwin's figures need correction, so far as books are concerned, for, as *The Bookseller* of September 14 points out: "These usages, however, do not consume all the paper available for printing. There is, in addition, an unknown but obviously considerable quantity of printing paper employed outside the above categories; for instance, the paper used in company reports, trade catalogues, and for a large variety of other commercial purposes".

Announcements

THE title of reader in timber technology in the University of London has been conferred on Dr. F. Y. Henderson in respect of the post held by him at the Imperial College of Science and Technology.

MR. F. E. HUGHES (assistant conservator of forests, Gold Coast) has been appointed senior assistant conservator of forests, Gold Coast.

ACCORDING to the August issue of the *Anglo-Swedish Review*, the birth-rate figure in Sweden for the first quarter of 1944 of 33,261 was the highest recorded for this period since 1921; the figures for the corresponding period in 1943 and 1942 were 30,079 and 26,240 respectively. More children were born in the towns than in the country, the birth-rate figure for Stockholm being especially high.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Phytic Acid and Phytase in Cereals

THE interesting letter of Dr. R. A. McCance and Miss E. M. Widdowson in *Nature* of May 27[1], in which they point out the relatively large quantity of phytase in wheat as compared with oats, gives me the opportunity of recording some further facts on this important practical issue which supplement those given in the letter. This is no mere academic question, but concerns what in the past certainly has been, and in my view possibly still is, the most prominent problem of malnutrition affecting people in Great Britain.

Cereals form such a large part of the national dietary, namely, about 50 per cent, that, if they have a nutritional defect, it is certain to be of great consequence to health and development. What we must aim at is to get all the advantages of these valuable foods and at the same time to eliminate or prevent any baneful action they may have. Now, cereals have such a defect in that they are not only poor in calcium content but also they can, under some conditions, interfere with the availability to the body of calcium of other foods[2]. This is of special importance to the child and adolescent, whose needs for calcium to incorporate in the growing bones, the developing teeth and other organs are great. In the adult animal also cereals can denude the bones of their calcium salts under some conditions. Contrary to all expectation, cereals such as oatmeal and maize, which contain most calcium, are just those which can interfere most with calcium deposition during growth.

In 1939 it was found that one substance in cereals which plays a large part in this harmful action is phytic acid[3]. Any form of treatment which reduces the phytic acid in cereals either by eliminating it or by hydrolysing it will reduce the rickets-producing or anticalcifying effect. It was found that malting of cereals, and, more especially, germination followed by autolysis of the crushed grain, reduce this action; and now McCance and Widdowson have emphasized the importance of the hydrolysis of phytic acid that accompanies the change from flour to bread as the result of the action of the abundant phytase in the flour. They point out that oats and oatmeal, on the other hand, contain but little phytase to break down the phytic acid. They suggest that the difference in phytase content of wheat and oats explains the results described many years ago of the smaller rachitogenic action of bread as compared with oatmeal[2].

That this explanation is true is undoubted, but it is only part of the truth. Oats and wheat are both rich in phytic acid. In my experience oats are the richer source, but the variation in different samples of both grains is large and for the purpose of the argument we will assume that the amount is the same in each cereal and of the order of 200 mgm. phytic acid phosphorus in 100 gm. of the grain. Now the husk which is removed in the preparation of the oatmeal forms about 30 per cent by weight of the grain, and since this husk contains no phytic acid (it does contain a little phytase) the percentage of phytic acid in the dehusked grain rises correspondingly, namely, up to 270 mgm. or more of phytic acid phosphorus per 100 gm. oatmeal. On the other hand, in processing wheat to flour, assuming that the wheat-meal flour is of 85 per cent extraction, the 15 per cent removed in the milling is largely made up of the coarser bran, which is very rich both in phytic acid and phytase. Thus 85 per cent extraction wheat-meal flour would contain about 120 mgm. or even less phytic acid phosphorus per 100 gm. flour. Starting, therefore, with oats and wheat grain both containing 200 mgm. phytic acid phosphorus per 100 gm. of grain, by the time each preparation reaches the cook, there is a great difference between their contents: 270–300 mgm. phytic acid phosphorus in oatmeal and 120 mgm. in national wheat-meal flour; and this is not the end of the story.

In preparing these products for the consumer, the cook again alters their relative phytic acid content. The oatmeal is boiled as porridge, its small phytase content is destroyed and the phytic acid remains at the same high figure. In the case of wheaten flour, the matter is different. The high phytase content gets a chance of destroying phytic acid in the flour during the period when the dough is standing. In this process, however, the flour phytase is not the only phytase present. The added yeast is also rich in this enzyme, and it may, under some conditions, assist the hydrolytic breakdown of phytic acid. Whether it does so assist seems to depend on the method of bread-making adopted. If the amount of yeast added is relatively large (2·1 per cent of flour) and the time of standing of the dough short (2 hours), the yeast may add largely to the phytic acid destruction. If, however, the yeast added is small (0·6 per cent of flour) and the dough rising-time long (6 hours), the yeast phytase may be ineffective. The phytase action of both flour and yeast is greatly increased as the *p*H is lowered towards 4·5, and it is possible that the additive effect of the larger amount of yeast may be partially or wholly explained by this change in *p*H. The accompanying results obtained on baking bread with flour at two levels of phytic acid content illustrate this effect of yeast.

HYDROLYSIS OF PHYTIC ACID IN BREAD-MAKING

	Mgm. phytic acid phosphorus			
	Wheat-meal flour per 100 gm.	In bread per 100 gm. flour	Hydrolysed by phytase in 100 gm. flour	Probably hydrolysed by yeast per 100 gm. flour
SPECIMEN 1				
(*a*) High yeast; short rising time:				
(*x*) living yeast	75	29	25	21
(*y*) dead yeast	75	50	25	0
(*b*) Low yeast; long rising time:				
(*x*) living yeast	75	26	46	3
(*y*) dead yeast	75	29	46	0
SPECIMEN 2				
(*a*) High yeast; short rising time:				
(*x*) living yeast	174	77	76	21
(*y*) dead yeast	174	98	76	0
(*b*) Low yeast; long rising time:				
(*x*) living yeast	174	60	114	0
(*y*) dead yeast	174	57	117	0

High and low yeast = 2·1 per cent and 0·6 per cent respectively.
Short and long rising time = 2 hours and 6 hours respectively.

Finally, it may be asked, what are the nutritional implications of this phytic acid–phytase problem of cereals? In the normal high cereal diet, three situations are presented: (1) when it contains much phytic acid, as when oatmeal or maize meal is largely eaten; (2) when it contains much inositol and phosphoric acid produced by hydrolysis of phytic acid by phytase, together with some unhydrolysed phytic acid, for example, when bread made from high extraction flour is eaten; (3) when it contains but little phytic acid or hydrolysed phytic acid, as when bread from low extraction flour or when a cereal such as rice is eaten. Since both inositol and phosphate are essential constituents of the diet, it is clearly desirable to have good supplies of these in the food, that is, conditions (1) and (2) above, but only so long as (*a*) these substances are available to the body and (*b*) neither phytic acid nor its product phosphoric acid is allowed to exert its calcium-stealing influence. Both these necessary conditions can be obtained by increasing the calcium in the diet and by maintaining a sufficiently high vitamin D intake. Man, especially the Scot, instinctively found the answer to this problem in the case of oatmeal by taking milk freely with his porridge. That is also the *raison d'être* for the present practice of adding calcium carbonate to the modern loaf and vitamin D to the margarine, although it is probable that, in both cases, the present supplements are too small for the optimum calcium–phosphorus nutrition of many people.

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Catelectrotonic Potentials in the Dorsal Roots of the Spinal Cord

THE preparation has been the isolated oxygenated spinal cord of the frog. It is well known[1,2] that a dorsal root volley gives rise to a prolonged negative potential which is propagated electrotonically from the spinal cord along that root and also along other dorsal roots both ipselateral and contralateral. In adjacent ipselateral roots this dorsal root potential may be as large (10 mV.) as in the root of entry.

With submaximal volleys the dorsal root potential rises to a rounded summit in about 20 msec. and then decays approximately exponentially with successive half-times of about 30–60 msec. With larger volleys there is usually a prolonged negative 'tail' which is attributable to long-continued activity of the internuncial neurones of the spinal cord, and is paralleled by prolonged after-discharge from the motoneurones. In conformity with this explanation, the tail is increased in size and duration by rapid repetitive stimulation and after soaking the cord in strychnine (1 in 200,000).

An antidromic volley in the ventral root fibres also sets up in adjacent dorsal roots a prolonged negative potential which has a longer latent period and a slower rise to a more flattened summit, but which decays at least as rapidly as the dorsal root potential set up by a dorsal root volley (half-times 25–45 msec.). This decay is always exponential, and never shows any prolonged tail.

If the spinal cord is anæsthetized by soaking in nembutal solutions, the rising phases of both types of dorsal root potential are not appreciably altered, but the decaying phases of both are greatly prolonged. Moreover, the abolition of activity in the internuncial neurones is associated with a removal of the tail of the dorsal root potential set up by dorsal root volleys (single or repetitive), which consequently now decays in a strictly exponential fashion, closely resembling the decay of the dorsal root potential set up by the ventral root volleys. The 'half-times' are lengthened 10–20 times by 1 in 7,000 nembutal, ranging with this latter dose between 0·4 and 0·7 sec. Further increase in dosage abolishes the dorsal root potential set up by ventral root volleys.

The exponential time course of the decay suggests that, as with the synaptic potential produced in the motoneurones[3], the 'dorsal root potential is produced by the relatively brief action of an actively depolarizing agent, the decaying phase of the dorsal root potential being relatively passive (except for the internuncial activity) and governed by the electric time constant of the membrane being depolarized. This analysis of the dorsal root potential into active and passive phases is supported by the effect of nembutal, which (apart from the removal of any internuncial activity) can be simply explained as due to a lengthening of the time constant of the membrane. This time constant is a product of impedance and capacity, and since the capacity of living membranes is but little altered even during extreme changes in the time constant[4], it seems likely that nembutal produces a large (10–20-fold) increase in the electric impedance of the membrane. It has long been suspected that anæsthetics act in this way[5,6]. However, in the spinal cord this effect appears to be largely restricted to certain membranes; for the electric time constant of the motoneurones remains short even under deep nembutal anæsthesia, the half-time for the synaptic potential being about 25 msec. in the frog[3].

The location of the membranes responsible for the dorsal root potential has been investigated by setting up a maximum volley in a dorsal root at all phases of a dorsal root potential produced in that root by a previous volley in that or another dorsal root, or a ventral root. There is an immediate destruction of a large fraction of the dorsal root potential in that root (usually 50–90 per cent, but with some roots as small as 20 per cent), but no effect on the dorsal root potentials in other roots.

On the basis of these experiments, it is suggested that the dorsal root potential is a catelectrotonic potential set up in the central terminals of the dorsal root fibres by the actively depolarizing action of potentials produced in nerve cells in close proximity, particularly in synaptic contact. With the dorsal root potentials set up by dorsal root volleys, the time course of the actively depolarizing action (determined by analysis) is such that it could be produced by the synaptic potentials set up in those nerve cells by the dorsal root volley. This suggestion would explain the extensive distribution up and down the cord of the dorsal root potential produced by a volley in one dorsal root. The decay of the dorsal

root potential would be governed by the time constant of the membrane of the terminal nerve fibres of that dorsal root, and it would be these terminals that are specifically affected by nembutal. The partial destruction of the dorsal root potential by a maximum volley in that root suggests that the impulses do not penetrate to all the central terminal nerve fibres of that root. This suggestion recalls the findings of Renshaw[6] and Lloyd[7] that an antidromic impulse in a ventral root fibre may fail to spread over the surface of the motoneurone of that fibre, block apparently occurring at the axon hillock.

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Mechanism of Burrowing in *Arenicola marina* L.

IF a living lugworm is put on the surface of wet sand or mud, it curves its head downwards and burrows in. During the burrowing act (which was described in detail by Just[1]), the proboscis is extruded and withdrawn, wave-movements of a characteristic kind travel forwards along the body, and the notopodia are directed backwards.

According to many authorities, the lugworm swallows sand as it burrows. Thus Stannius[2] wrote: "Legt man eine ausgegrabene Arenicola auf eine von Seewasser etwas bedeckte sandige Stelle des Ufers, so fängt sie alsbald an, eine Röhre im Sande sich zu bohren. . . . Die Röhren entstehen aber nicht ausschliesslich dadurch, dass die Würmer den Sand oder den Schlamm an die Seite drücken, sie verschlingen vielmehr beim Bohren beständig Sand; der ganze Darmkanal wird davon angefüllt, und ehe der hinterste Theil des Thieres die Oberfläche des Bodens ganz verlässt, wird der verschluckte Sand durch den After wieder entleert." Ashworth[3] concludes a description of burrowing with the words "By these means, a passage is eaten and forced through the mud".

When those passages were written, the mode of life of the lugworm was not well understood. In particular, burrowing and feeding were supposed to be one and the same process. More recent work, however, indicates that the two are quite distinct[4]. The worm is now believed to excavate an *L*-shaped gallery, and to lie with its head at the blind end, eating the surrounding mud. I therefore made the following experiments, to find out whether significant amounts of sand or mud are in fact swallowed during burrowing.

(1) *Weighing experiments.* Lugworms were first weighed, then allowed to burrow until only the tip of the tail could still be seen, then dug out and weighed again. The anus was watched, and, if the worm defæcated during burrowing, that particular experiment was discarded. Usually, however, defæcation did not occur. Of the successful experiments, two were done on the beach at Bangor, the worms being allowed to burrow as soon as they were dug up, and the rest in the Department of Zoology of the University of North Wales, using muddy sand from the beach. Generally there was a very slight loss of weight during burrowing (see table). The density of the wet, muddy sand was about 1·9, so it seems that significant amounts cannot have been swallowed.

Situation	Worm No.	Weights (gm.)		
		Before burrowing	After burrowing	Difference
Beach	1	4·0	3·8	—0·2
	2	7·5	7·3	—0·2
Laboratory	3	3·8	3·8	0·0
	4	7·0	6·9	—0·1
	5	8·2	8·1	—0·1
	6	12·3	12·3	0·0

(2) *Dissection experiments.* Five worms were kept in clean sea water in the laboratory for from three to four weeks. Three of them were then allowed to burrow into sand from the beach, as described above, then dissected under 8 per cent magnesium chloride, which acts as a narcotic[5]. The other two were dissected without preliminary burrowing. In the two controls, there was no trace of sand in any part of the gut. In the worms which had burrowed, small amounts of sand were found in the œsophagus, but there was none in any other part of the gut. One of the three had a single, minute mass of sand, comprising only some half-dozen sand-grains; the second had a single, compact mass, 2–3 c.mm. in volume; and the third had most of its œsophagus incompletely filled with a cylinder of sand. In all cases, the amounts ingested were negligibly small, compared with the volume of a whole worm.

Clearly, the idea that Arenicola passes through the sand like an animated cork borer is fallacious. Burrowing is achieved by thrusting the sand, or mud, aside; very little, if any, is taken in through the mouth. The proboscis is used in burrowing, and also, presumably, in feeding[6], so it appears to be capable of widely different types of action.

In conclusion, a note may be added about the remark of Stannius[2], quoted above, that defæcation accompanies burrowing. I saw defæcation during burrowing in two of four worms on the beach, and never in the laboratory. The worms used in the laboratory had been kept in clean water for a couple of days at least, and had partly or completely emptied their intestines. I think it likely that the defæcation occurs only in replete worms, as a pressure effect of some kind incidental to burrowing. Perhaps those which defæcated would shortly have done so in any case, even if they had not been disturbed.

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Sewage Bacteria Bed Fauna in its Natural Setting

IT has been observed that the bacteria beds of sewage works form an environment for insects unlike anything in Nature[1]. The depth of the habitable zone is great, so that compared with most insect habitats it is almost like the cube against the square. It is well aerated and constantly supplied with a basic food supply both in solution and in finely divided form evenly spread over the bed. The temperature is protected from extremes, on one hand by the heat generated by vital processes and on the other hand by the effects of evaporation. The daily temperature swing is restricted. Larvæ and pupæ are not accessible to birds except at the surface. This insect fauna is characterized by the small number of successful species and the great prevalence of those few which do succeed. In eight years of trapping on the Knostrop beds at Leeds, more than half a million insects were caught and scrutinized; and, though in all about a hundred species were taken, 99·7 per cent of the total belonged to six species of nematocerous flies, namely, *Metriocnemus longitarsus*, *M. hirticollis*, *Spaniotoma minima*, *S. perennis*, *Psychoda alternata* and *P. severini*. The enchytraeid worm, *Lumbricillus lineatus*, has an abundance equal to, or perhaps surpassing, that of any of these larvæ in the Knostrop beds. At some works, though not at Leeds, *Psychoda cinerea* and *Anisopus cinctus* show a similar prevalence. The collembolan *Achorutes viaticus* and the cordylurid fly *Spathiophora hydromyzina* are the only other insects so far recorded as prevalent in the beds.

I have recently located this fauna almost intact, though mingled with a number of other successful forms, in the natural setting of a mud flat about four miles from the nearest sewage works. A small, slightly contaminated stream passes under a bridge and, as an effect of an eddy, forms a mud flat about thirty yards long and fifteen yards wide with a surface usually an inch or two above water level. It is constantly water-logged through seepage, but is rarely flooded and then only for brief periods after heavy rainstorms, for there is a sill a short distance downstream giving a rapid recovery to normal level. It is overhung by trees and receives in autumn a thick carpet of leaves which is absorbed into the mud in winter and largely disintegrated by summer. Samples of the surface mud taken to the laboratory have yielded 1,500 insects, of which 44 per cent belong to eight of the ten species enumerated above as forming the insect fauna of the bacteria beds, Achorutes and Spathiophora only having not appeared in the cultures. Of the others emerging, 31 per cent is shared equally between the blood-sucking genus Culicoides and the short-palped crane-flies, Limoniinæ, both of which have very rarely appeared in collections from the bacteria beds. The characteristic enchytraeid worm of the sewage bed, *L. lineatus*, also occurs in the mud flat, but in numbers is almost masked by a swarming tubificid worm densely clustered just below the surface.

Thus it appears that the macrofauna of the bacteria bed is derived from that of the organic mud flat, but the two types of environment are not much alike. The mud flat, however, does rather resemble the sand sewage filter. In this a bed of porous sand some four feet deep is flooded at frequent intervals with settled sewage which seeps through and is purified in passage. A mat of cellulose and other débris forms on the surface, and when this has thickened and dried it can be rolled off like a carpet, leaving the filter again porous and receptive to further dosing.

This discovery of the bacteria bed fauna in its natural setting should help in the study of its theoretical aspects which hold much of interest, especially in regard to animal competition[2,3,4]. It is also of practical interest since the invasion of dwellings by sewage flies is often a matter of concern to sanitary authorities and it is important to know from what other sources they may come.

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The University,
Leeds, 2. Aug. 16.

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IN commenting in *Nature* of July 15, p. 94 on the 1942–43 report of the Imperial Forestry Institute, it is stated that there is difficulty in distinguishing between the respective parts played by the Imperial Forestry Institute and the University Department or School of Forestry. This is simply explained by the fact, set out at length in the 1937–38 report, that in 1938 they became a single organization supported jointly by the Colonies, the Forestry Commission, the University of Oxford and a few smaller contributors. At the same time, the information branch of the Institute was taken over by the Imperial Agricultural Bureaux to constitute a new Imperial Forestry Bureau which still works in close collaboration with the Institute. This latter change resulted in a transfer to the Bureaux of nearly all the original Dominion support for the Institute, leaving the Colonial Empire in a still more predominant position among the supporters of the Institute.

The amalgamation of School and Institute was made primarily for administrative reasons and to fit in with the new arrangements for the training of officers for the Colonial Forest Service; it did not affect the research work being done by the staff. This latter work continues to be directed towards Empire needs and interests so far as is possible in Great Britain. In several fields, however, for example sylviculture, there is not a great deal having a direct bearing on Empire forestry that can be done in Britain. Research in these subjects is accordingly directed more towards fundamental problems and problems representative of types likely to occur anywhere, and it has to be carried out in the woods and forests accessible from Oxford. Such studies are clearly likely to be more productive and useful if undertaken in co-operation with the related research activities of the Forestry Commission.

From the educational point of view, it is essential, for keeping the teaching live and practical, that the staff should be in the closest possible touch with current practice and developments where the teaching is done. Moreover, the Forestry Commission looks to Oxford, as having the only University Forestry School in England, to play its part and undertake its share in forestry education for service at home as well as abroad, and in forestry research of a fundamental nature. It was for these reasons that

it was felt desirable to await the publication of the Forestry Commission's plans before deciding on some aspects of the future teaching and research organization at the Institute. If the stress in the report appears to be on the importance of closer co-operation in research with the Forestry Commission, this was only because there appeared to be room for it, whereas decisions affecting Colonial forestry had already been agreed. The expected White Paper has since been published; it was considered by the University Committee for Forestry, which found that no further changes in its own plans were necessitated.

This opportunity may be taken to add that forestry has recently been made an Honour School in this University, as from the next academic year; two years study of biological and physical science will normally be required before the two years forestry courses are undertaken, as was already the position under the statute of 1938.

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Structure of Cellulose

IN their criticism of my suggested structure of cellulose[1], Astbury and Davies[2] appealed to evidence not then available to me in a thesis by Dr. C. J. Brown[3]. My thanks are due to Dr. Astbury for bringing this interesting work to notice and to Dr. Brown for the opportunity to read it. I do not think that it settles the issue between the angles 110° and 90° at the oxygen of the pyranose ring. The difference amounts to ± 0·15 A. in the *b* co-ordinate of C1 and C5 respectively, whereas the author, rather modestly, claims only an accuracy of ± 0·4 A. The features referred to by Astbury and Davies describe a regular six-sided figure—I presume they would not suggest that this is a precise description.

In "the most detailed saccharide crystal analysis so far reported", Cox and Jeffery[4] conclude in favour of a slightly flattened form of the Sachse *trans* form. This is the form I adopt and, moreover, the strainless arm-chair form, though Dr. Astbury does not appear to recognize it nor appreciate its comfort. In these, as in other studies, reasonable agreement is found with forms based on the 110° assumption, but it remains to be proved that the error in a trial of 90° must be significantly greater.

Meyer and Misch[5] also assume 110°, but I cannot reproduce their parameters from their geometrical assumptions. A unit of length to fit into the 10·3 A. identity period can be obtained by assuming a regular ring of bonds of length 1·50 A. (mean of 4 C–C and 2 C–O bonds) but this is too crude an approximation. My calculations of the rigorous form, with the screw axis as shown by Meyer and Misch, give a length of 11·12 A. (Curiously enough this is longer than it would be if the ring were a regular figure of 1·54 A. bonds.) With another choice of axis, the chain might be buckled into the cell, but I have been unable to find a probable form in conformity with the geometry and with the clearest features of the X-ray diffraction, from the (*h* 0 *l*) zone.

Cox[6] recognizes that the form of the molecule may be modified by intermolecular forces. This consideration should modify any dogmatism about the unknown form of the cellulose ring, but it does not seriously affect the power of his elegant argument for a nearly co-planar arrangement of the sugar ring carbons[7].

It must be admitted that direct evidence to decide between 90° and 110° for the oxygen angle in the cellulose ring is lacking. If Astbury and Davies, Cox and Brown, Meyer and Misch, Haworth and others assume an unstrained angle of 110°, they may do so in good company—but Pauling[8] as well as Peirce must be excluded from the company.

The variation of the oxygen angle shows it to be deformable. If one sees an elastic thread under an evident load, it is no speculation to assume that its unstrained length is less than the observed length. In H_2O, the oxygen angle is 105° and it is distended by the ionic character of the H fields. This ionic character is less in F_2O and the angle is less, 100°. In H_2S, the greater separation of the H fields means less repulsive stress and the angle is 92°. (These are the values quoted by Pauling[8].) When large groups are attached to the two bonds, the angle is correspondingly large, attaining 130° and more in the diphenyl ethers[9,10]. All this is in perfect accord with Pauling's theory, that the oxygen bonds arise from *p* electrons and are unstrained at 90°.

It is true that atoms of the appropriate size to enforce an angle of some 110°, Cl (in Cl_2O) and C, are not infrequently involved, but this obviously strained angle of a soft atom is not to be confused with the tetrahedral angle of the hard and symmetrical carbon atom. The latest figures on the aliphatic ethers give values of 110° or less[11], and these are clearly strained by an otherwise unbalanced repulsion between the closely held carbon atoms. Dioxane (110°)[12] looks more like a pyranose ring but, by symmetry, the field round each oxygen atom must be closely similar to that in dimethyl ether. When the two carbon neighbours of the oxygen are held also by a line of three carbon atoms, these can take some of the stress from the oxygen bonds and even impose an opposite strain, if there be a minimum of free energy when a line of carbon atoms is co-planar.

The position seems to be, therefore, that the unstrained angle is 90° and the strain is unknown—so the simplest assumption is the strainless form, as given in my note. The fact that it fits so neatly into the cellulose lattice commends it, but I would be the last to claim for the resultant structure any status beyond that of a tentative, approximate speculation, possibly useful as a working hypothesis to correlate the general body of data: and this is all that I would allow to any detailed crystal structure ascribed to a macromolecular fibre.

The parameters are given to 0·01 A. because they express the geometrical consequences of assumptions reasonably defined to that degree of accuracy. This basic, strainless form may later be strained to accord with direct evidence still to be found, but it seems worthy of inclusion in 'trial and error' studies. To that end, it was offered through the speedy channel of the correspondence to *Nature*.

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Cloud Chamber Photographs of Penetrating Showers

IN a long series of counter experiments, Wataghin, de Souze and Pompia[1], and Jánossy[2] and his co-workers have established the existence of showers of penetrating particles different from electron cascade showers and knock-on showers. It now seems probable that the theory of cosmic-ray mesons put forward recently by Hamilton, Heitler and Peng[3] can account satisfactorily for these showers in terms of mesons (and neutrettos). These particles are assumed to be created by protons (or neutrons), of energies greater than 2×10^9 eV. by cascade or multiple processes.

More direct confirmation of this interpretation of the experimental results is desirable, and for this reason we have recently set up a cloud chamber controlled by a set of counters which selects penetrating showers. The counter sets are arranged in three trays and are connected in sevenfold coincidence such that 95 per cent of all coincidences are caused by penetrating showers. The middle and bottom trays are surrounded by lead 15 cm. in thickness, and the total vertical thickness of lead is 53 cm. Electron cascade showers are thus effectively cut out. The top tray is covered with lead 5 cm. in thickness, and the cloud chamber is placed between the middle and bottom trays.

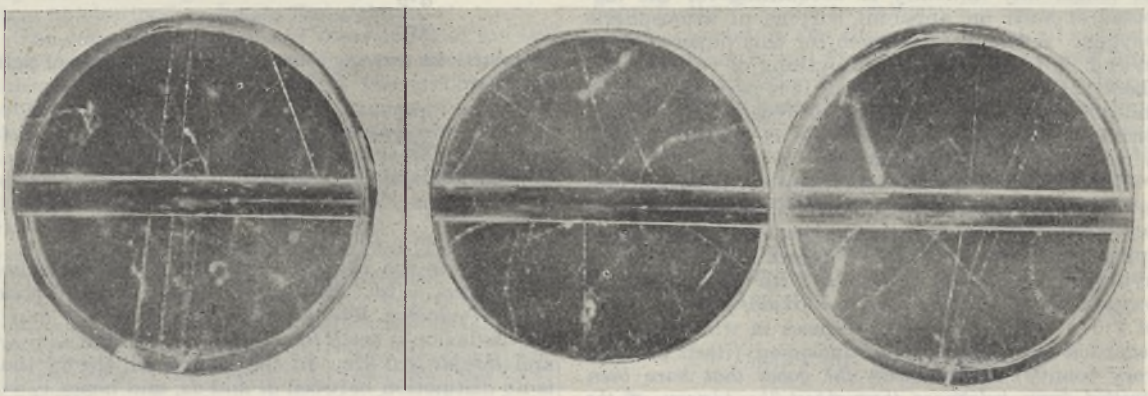
Some thirty photographs have been obtained so far, and of these, eighteen photographs show penetrating particles which pass through a lead block, 2·3 cm. in thickness, without multiplication. Nine of the eighteen photographs show showers consisting of two or more penetrating particles.

The results are consistent with the assumption that almost all penetrating showers contain ionizing penetrating particles. Further, they show that the ionizing particles themselves are penetrating, and are not soft ionizing secondaries to a non-ionizing penetrating radiation. The ionizing penetrating particles may, however, be accompanied by non-ionizing particles (for example, neutrettos).

Showers of two main types occur among the nine photographs. The first type, typical of almost all the published photographs of showers of penetrating particles, consists of penetrating particles originating at one point, that is, particles produced by a multiple process. Jánossy[2] has shown that these showers are to be expected from the theory of Hamilton, Heitler and Peng if the incident proton (or neutron) has an energy between 2×10^9 eV. and 2×10^{10} eV. An example of this type of shower is reproduced in Fig. 1.

The second type of shower, two examples of which are reproduced in Fig. 2, consists of penetrating particles coming from different directions. It seems probable that this type of shower is an example of the production of penetrating particles by a cascade process[3,4].

Bose, Choudhuri and Sinha[5] have recently published a photograph which they claim shows the production of mesons by a cascade process. To establish such a claim it is first necessary to prove that the shower is not an electron cascade, for electron cascade showers are very frequent while penetrating showers are rare; and it is insufficient to state that the shower contains mesons. Moreover, the one group of particles on Sinha's photograph which clearly passes through the lead plate in the cloud chamber emerges accompanied by several electrons. It is assumed that these are knock-on electrons produced by mesons, but this is very unlikely as the chance of a number of mesons producing several knock-on electrons is negligibly small. The multiplication of the particles in passing through the lead plate is, in fact, a clear indication that they are electrons and not mesons.



1 2a 2b

FIG. 1. AN EXAMPLE OF A SHOWER OF PENETRATING PARTICLES PRODUCED BY A MULTIPLE PROCESS. THREE PARTICLES CAN BE SEEN PASSING THROUGH THE LEAD PLATE.

Fig. 2. TWO EXAMPLES OF SHOWERS OF PENETRATING PARTICLES PRODUCED BY A CASCADE. IN (*a*), TWO PARTICLES CAN BE SEEN TO PASS THROUGH THE LEAD PLATE, WHEREAS IN (*b*) THREE (AND POSSIBLY FOUR) PARTICLES PASS THROUGH THE PLATE.

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[1] Wataghin, G., de Souze, M., and Pompia, P. A., *Phys. Rev.*, **57**, 61, 339 (1940).
[2] Jánossy, L., *Phys. Rev.*, **64**, 345 (1943).
[3] Hamilton, J., Heitler, W., and Peng, H. W., *Phys. Rev.*, **64**, 78 (1943).
[4] Peng, H. W., *Proc. Roy. Irish Acad.*, **49** A, 245 (1944).
[5] Bose, D. M., Choudhuri, B., and Sinha, M., *Phys. Rev.*, **65**, 341 (1944).

Volcanic Contributions to the Atmosphere and Ocean

IF it be assumed, as is now again the fashion, that the nascent earth passed through a liquid stage, it is obvious that "the molten spheroid . . . retained, occluded within itself, some large part of the water in the present hydrosphere, as well as much of the carbon dioxide represented by the present carbonates and carbonaceous deposits"[1]. Most of the carbon dioxide that has become available as a source of

carbon is undoubtedly of volcanic origin, being derived from magma.

A useful estimate of the amount of carbon that has been extracted from the atmosphere by various means has been made by Poole[2], who, however, has unnecessarily revived the theory that this has been all present at one time in gaseous combination in a 'primitive' atmosphere. Poole assumes that some of the fixed carbon has been derived from methane so present instead of from carbon dioxide—an assumption he has considered necessary because of an apparent over-supply of the by-product oxygen if carbon dioxide were the sole (or greatly predominant) source of carbon. When, however, oxidation of juvenile hydrogen throughout the long history of volcanic activity is taken into account, there is no longer any difficulty in accounting for the disposal of such an apparent surplus of atmospheric oxygen. A supply of oxygen for this purpose must indeed be found if there is anything of value in the theory of the volcanic furnace. It is permissible, and indeed necessary, therefore, to recalculate Poole's estimate of atmospheric methane as carbon dioxide, a more likely atmospheric gas.

When this is done, the total mass of carbon dioxide is $7{\cdot}02 \times 10^{16}$ metric tons; and to this must be added $0{\cdot}4 \times 10^{16}$ metric tons of nitrogen now in the atmosphere, and also $0{\cdot}18 \times 10^{16}$ metric tons of juvenile hydrogen which has combined with the surplus of oxygen liberated from carbon dioxide, giving a total of $7{\cdot}6 \times 10^{16}$ metric tons of gases in what must be regarded as the primitive atmosphere (itself perhaps very scanty) *together with the gases that have been emitted from volcanoes throughout the history of the earth*. This excludes juvenile water vapour, which it is impossible to estimate by this method; it has undoubtedly made a substantial contribution to the ocean, however. For comparison, the mass of the atmosphere at present, as given by Poole, is $0{\cdot}52 \times 10^{16}$ metric tons.

One great advantage of recognition of the juvenile (magmatic) origin of carbon, as compared with the 'primitive atmosphere' theory, is that it is in agreement with the geological doctrine of uniformitarianism. If one is to understand that doctrine in a forward-looking sense, a continuance of the supply of carbon from volcanoes will make possible the accumulation of further deposits of coal and limestone in the thousands of millions of years of future geological time; whereas in accordance with the 'primitive atmosphere' theory the supply of carbon for this purpose is exhausted, geological processes have worked themselves to a standstill, and we have arrived at the end of the world.

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[1] Chamberlin, T. C., and Salisbury, R. D., *Geology*, 2, 90 (1906).
[2] Poole, J. H. J., *Sci. Proc. Roy. Dublin Soc.*, 22, 345 (1941).

The Deflexion of Light and Relativity

IN a recent paper, E. F. Freundlich and W. Ledermann[1] have pointed out that "the question remains unsettled whether the light deflection at the sun's limb amounts to 1·75″ as predicted by the Theory of Relativity or whether it is substantially larger, namely, equal to 2·2″ as indicated by the findings of the Potsdam Expedition of 1929 and confirmed by a renewed discussion of previous observational material". The authors then proceed to discuss how an experiment can be planned to settle the question so that the standard deviation of the final result does not exceed 0·1″.

If m is the solar mass and R the radius in natural units, $4m/R$ is the predicted deflexion[2]. But 2·2″ means $5m/R$. As the deflexion provides a crucial test of the theory, the question that is often asked is whether relativity must be modified to give the result $5m/R$ instead of $4m/R$. It is well known that the Newtonian result, $2m/R$, is obtained from the usual equation,

$$\frac{d^2u}{d\varphi^2} + u = \frac{m}{h^2}; \qquad (1)$$

and the relativistic result from

$$\frac{d^2u}{d\varphi^2} + u = 3mu^2. \qquad (2)$$

For particles moving *almost* with the velocity of light, we have

$$\frac{d^2u}{d\varphi^2} + u = \frac{m}{h^2} + 3mu^2, \qquad (3)$$

and the deflexion, small as it is, is

$$\frac{2m}{Rv_0^2} + \frac{4m}{R}, \qquad (4)$$

where v_0 is the velocity, $Rd\varphi/ds$, at the perihelion. For light $v_0 = \infty$. The range $1 \leqslant v_0 \leqslant \infty$ corresponds to the velocity $Rd\varphi/dt$ lying between 0·70c and c. The deflexion is $5m/R$ for a particle for which $v_0 = \sqrt{2}$ and $Rd\varphi/dt$ is 0·82c. In the Newtonian theory there is no distinction between dt and ds, and hence $v_0 = 1$ for light, but the second term of (4), which is of relativistic origin, is absent.

If the deflexion is really 2·2″, one wonders if fast moving atomic particles, with velocities of the order of 0·8c, participate in the process leading to the observed result.

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Benares Hindu University.
Aug. 13.

[1] Freundlich, E. F., and Ledermann, W., *Mon. Not. Roy. Ast. Soc.*, 104, 40 (1944).
[2] Eddington, Sir A. S., "The Mathematical Theory of Relativity", 90 (1924).

The Commutation of Annual Subscriptions

MOST learned societies allow future annual subscriptions to be commuted by single payments which range from five to twenty-five times the annual subscription with, in many cases, a reduction to members of long standing. Although this is usually advantageous to the younger members, it is too expensive at later ages when there is most interest in commutation. There has thus arisen a growing demand for commutation scales on an actuarial basis.

Some examples of such scales may be given. The Institute of Actuaries, with an annual subscription of 3 guineas ceasing at the age of seventy, requires a payment of 30 guineas at age forty-five, with 1 guinea less for each additional year of age up to sixty and then by steps of 1½ guineas to a minimum of 7½ guineas at sixty-five and over. The actuarial basis of this scale is not stated, but the amounts appear to be two thirds of those derived from a 3½ per cent annuity table.

The Royal Society now permits commutation on payment of the amount which the fellow would have to pay for a Government annuity on his own life

of the amount of the annual subscription. This varies with the price of 2½ per cent Consols and the basis is a very stringent one, since the amounts payable are those required if fellows had entered into agreements to continue their annual subscriptions for the remainder of their lives.

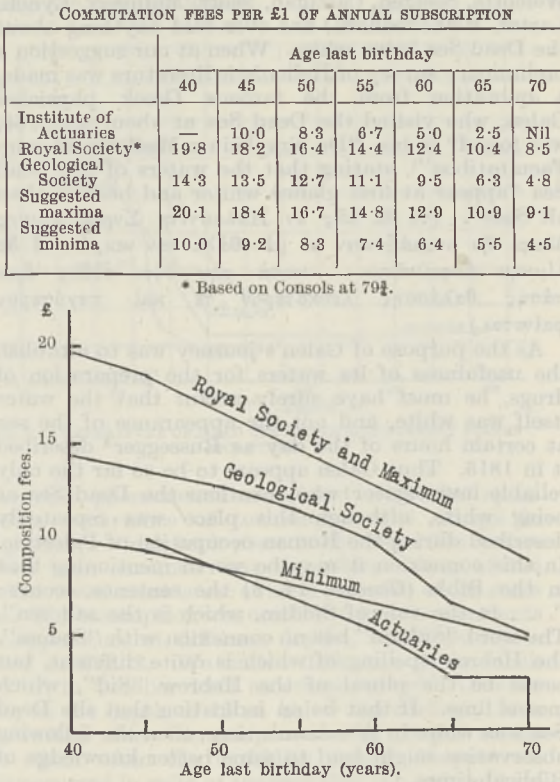
The most elaborate scale is that of the Geological Society of London. The full table contains some thousands of entries; it quotes the commutation fee for each age *at election* from twenty to eighty, combined with each number of annual contributions already paid, from nought to fifty. It does not seem to have been noticed that, in general, age at election plus number of annual contributions already paid equals present age. Apart from a few unnecessary irregularities, the vast table could be replaced by its top line with "age last birthday" substituted for "age at election" or by its first column.

The commutation scales of these societies for ages forty to seventy, all expressed as per £1 of annual subscription, are summarized in the accompanying table and graph, which also give suggested maximum and minimum scales. The maximum scale, which on the graph can scarcely be shown separately from that of the Royal Society, is based on the Mortality of Annuitants, 1900–1920, $a(m)$ 3% Ultimate.

COMMUTATION FEES PER £1 OF ANNUAL SUBSCRIPTION £

	Age last birthday						
	40	45	50	55	60	65	70
Institute of Actuaries	—	10·0	8·3	6·7	5·0	2·5	Nil
Royal Society*	19·8	18·2	16·4	14·4	12·4	10·4	8·5
Geological Society	14·3	13·5	12·7	11·1	9·5	6·3	4·8
Suggested maxima	20·1	18·4	16·7	14·8	12·9	10·9	9·1
Suggested minima	10·0	9·2	8·3	7·4	6·4	5·5	4·5

* Based on Consols at 79¼.



Any society which wishes to institute a scale of commutation fees should, I think, take into account the normal rate of withdrawal from its ranks. The suggested maximum scale, which assumes that withdrawals are impossible, will rarely, if ever, be applicable, and in general some percentage of the maximum should be used. Where withdrawals are rare, the percentage should be nearly 100 per cent, but where withdrawals are more frequent, as in societies the members of which are loosely held together only by a common interest in some field of activity, a lower percentage should be used. It is suggested 50 per cent of the maximum should be regarded as the minimum. Women should pay slightly higher commutation fees, but most societies will ignore this. In selecting a scale, simplicity is more important than adherence to exact actuarial values; in most cases either a single arithmetical progression or possibly two, as used by the Institute of Actuaries, will suffice. Thus the minimum commutation scale for a society with an annual subscription of 5 guineas might be 70 guineas at age twenty-five and decrease by one guinea for each additional year of age to a minimum of 20 guineas at age seventy-five.

What should be done with such commutation fees? Most societies invest the whole of them and transfer to ordinary income only the interest earned; they thus build up useful hidden reserves in their accounts. Some further transfer to ordinary income is, however, reasonable and, in the absence of periodical actuarial investigation, it will in the long run be found satisfactory to transfer to ordinary income, in addition to the interest earned on the commutation fee fund, some small portion of each commutation fee received. This may be, say, one sixth, or alternatively the amount of one annual subscription. Only the balance of each commutation fee would then be invested.

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Mr. W. L. Sclater

MANY years after his friends—Dr. A. C. Stark, the brothers H. F. and W. Francis and F. C. Selous—had lost their lives by enemy action, W. L. Sclater also fell a victim to enemy action[1]. Sclater was director of the South African Museum from 1896 to 1906. He was appointed director when the new building (the present one) had just been completed, and his was the task of planning the arrangement of the exhibits. In the main his original plan persists, though with the logical alterations and extensions made possible by the addition of a new wing in recent years.

The late Dr. Peringuey was already on the Museum staff as entomologist. Sclater proceeded to assemble, as members of the staff or as honorary curators, a body of scientific workers to undertake research on the Museum collections: the late Dr. W. F. Purcell for invertebrates, the late Dr. Gilchrist for marine biology, the late Dr. Corstorphine for geology, and afterwards Dr. Rogers (happily still with us), and the late Dr. Pearson for botany; he himself took charge of the vertebrates. The acquisition of specimens was extended and accelerated by regular museum correspondents in all parts of the country, and the collections grew at a pace which has scarcely been exceeded in recent years, except in the various groups of invertebrates, even with the Museum's increased staff and facilities for field work.

To him was due the appointment of a promising young taxidermist, Mr. J. Drury of Perth, whose talents reached full fruition only after Sclater had resigned the directorship, and resulted in the unique series of casts of living Bushmen.

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South African Museum,
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[1] *Nature*, **154**, 204 (1944).

OCCASIONAL WHITENESS OF THE DEAD SEA

By DR. R. BLOCH and H. Z. LITTMAN
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and DR. B. ELAZARI-VOLCANI
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ON the morning of August 25, 1943, it was observed that the whole Dead Sea, which at this season is always perfectly clear, had become milky white. The same observation was made on the same morning at the northern and southern ends, which are seventy kilometres apart, and it was further ascertained that during that night the whole Dead Sea had turned white. During winter storms a seam of some 100 metres occurs frequently along the shores, turbid and yellowish, but it was never observed that the whole Dead Sea surface had turned white. The turbidity gradually disappeared and in December 1943 the water became almost clear again.

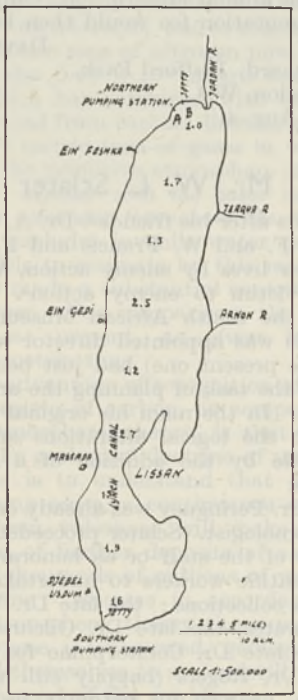

Fig. 1. MAP OF THE DEAD SEA, SHOWING THE RELATIVE TURBIDITY OF THE SURFACE LAYER.

The nephelometric analysis of several water samples taken on October 10, 1943, revealed the distribution of the turbidity as shown in the map (Fig. 1). The numbers represent the relative turbidity, the lowest value taken as unity. Samples at different depths taken at point *A* in the map showed the following relative turbidity:

Depth in metres ..	0	2	3	5	10	15	20	50
Relative turbidity ..	1·3	1·2	1·1	1·5	1·9	1·1	⩽1	clear

A sample of 30 litres was taken at place *B* and filtered. It contained 0·018 gm./litre of a white solid of which 15 per cent was insoluble in diluted hydrochloric acid, 5 per cent was insoluble in concentrated hydrochloric acid, and 80 per cent was calcium carbonate. Moreover, the turbidity of other samples dissolved readily on adding hydrochloric acid, developing carbon dioxide.

On a rough calculation, one million tons of calcium carbonate seem to have spread over the whole Dead Sea during the night. There is no obvious explanation for this phenomenon. There was only the usual slight wind blowing from both the northern and southern shores towards the centre of the Sea. No earthquake was registered before or after the night in question, and the occurrence of a slight tremor 12 and 16 days later (September 6 and 10) offers no explanation. Dr. M. R. Madwar, director of the Helwan Observatory, Egypt, informs us that no other nearby earthquakes were recorded.

We inquired, therefore, whether the phenomenon which we had witnessed had ever been observed before. The Dead Sea has been under close observation since 1921, when Mr. M. Novomejsky, the founder and managing director of the Palestine Potash Ltd., started his experimental installations and observation posts. During this period no such phenomenon is known to have occurred. In the nineteenth and the early twentieth centuries several scientific men visited the Dead Sea but none of them (Schubert, Russegger, Robinson, Wilson, Welcotts, Seetzen, Castigan, Scott, Molineux, Lynch, Larter, Blanckenhorn) has ever said anything about the Dead Sea being white. When at our suggestion a preliminary survey of Hellenistic literature was made, a quotation from the famous Greek physician Galen, who visited the Dead Sea at about A.D. 158, was found* in his "De Simplicium Medicamentorum Facultatibus"[1], stating that the waters of the Dead Sea "appear at first glance whiter and heavier than all Seas". (το δὲ τῆς ἐν Παλαστίνῃ Σνρία λίμνης ὕδωρ, ἣν ονομάξονσιν οἱ μὲν θάλασσαν νεκράν, οἱ δε λίμνην ἀσφαλτῖτιν . . . κατὰ τὴν ὄψιν εὐθυς ἅμα πάσης θαλάσσης λευκότερον τὲ καὶ παχύτερον φαίνεται.)

As the purpose of Galen's journey was to establish the usefulness of its waters for the preparation of drugs, he must have surely meant that the water itself was white, and not the appearance of the sea at certain hours of the day as Russegger[2] described it in 1815. Thus Galen appears to be so far the only reliable investigator who mentions the Dead Sea as being white, although this place was repeatedly described during the Roman occupation of Palestine. In this connexion it may be worth mentioning that in the Bible (*Genesis*, 14, 3) the sentence occurs: ". . . in the vale of Siddim, which is the salt sea". The word "Siddim" has no connexion with "Sodom", the Hebrew spelling of which is quite different, but could be the plural of the Hebrew "Sid", which means lime. If that be an indication that the Dead Sea was white in Abraham's time, then the following observation might lead to some better knowledge of Biblical times.

We have seen that human records have very little to tell about this outstanding event in the history of the Dead Sea. But we have found much more in the books of Nature.

One of us[3] obtained during December 1941 from the bed of the Dead Sea a number of profiles 10–170 cm. long, from depths varying from 70–330 metres and taken at different places. On dissecting the longest profile a 'spectrum' of layers of different colours—black, dark-blue, grey, brown and white—was revealed.

* Flusser, Hebrew University, Jerusalem, private communication.

The thickness of the distinct white layers is 0·3–6 mm. It is interesting to note that the white zones of sediment form no seasonal repeat pattern. The following table shows the result of analyses of the dry substance of two white layers (Nos. 1 and 2) and of some dark material (No. 3); these were made two years after taking the profile.

No.	1	2	3
Distance from top of profile (cm.) ..	38	52	53–58
Calcium carbonate (per cent)	70	81	38
Insoluble in hydrochloric acid (per cent)	7	3	35

The identity of colour and chemical composition of the white layers with the material causing the turbidity is striking. We therefore assume that each white layer of the Dead Sea bed is caused by an outbreak of turbidity, and that similar outbreaks occurred earlier and are distinctly recorded on the profile. The dark layers, containing much more silicates, are formed by the mineral materials brought annually into the Dead Sea during the normal periods between outbreaks of turbidity. Hence, an exceptional opportunity is thereby offered to investigate the history of the Dead Sea chronologically, and to detect the time of similar 'blanchings' in history by fixing the thickness of the annual dark sedimentation which settles on the 'white lawn' that has formed during the last outbreak.

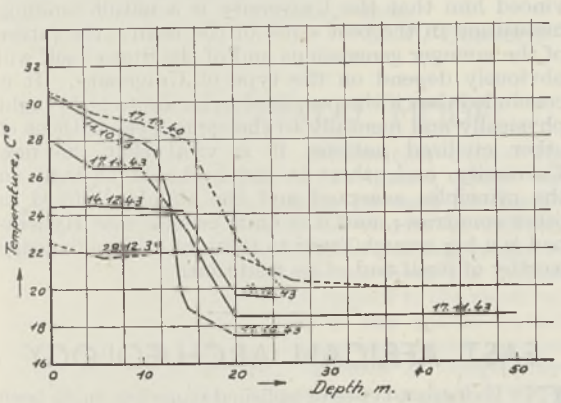

Fig. 2. TEMPERATURE OF DEAD SEA WATER AT DIFFERENT DEPTHS AND TIMES.

Another phenomenon connected with the spontaneous occurrence of turbidity is the change in temperature which took place in the Dead Sea water. It has been assumed that the white colour of the surface water must cause a rise in reflexion of the sun's rays. The assumption was confirmed by measurements of temperature at different depths, which are represented in Fig. 2. We find a difference of as much as 8° C. in October 1943 as compared with October 1940, at the depth of 15 m. below the surface. It is noteworthy that the temperature of deeper strata rose again when the turbidity slowly disappeared. This occurred in spite of the fact that the temperature nearer the surface was then lower owing to the progressing winter season. It is therefore most probable that the lower temperature in 1943 was not caused by fluctuation of atmospheric temperature but by the stronger reflexion of the sun's rays.

It may also be assumed that the lower temperature has caused a corresponding reduction of evaporation, but measurements of the sea-level gave no clear picture, because the quantity of rainfall during the preceding winter season was exceptionally large and evaporation during the first month of 1943 was low. It may, however, be possible to find later on the correlation between the rise of sea-level and the 'blanching' of the Dead Sea and thereby to determine the sea-levels which existed in the past.

We have, of course, tried many explanations for the phenomenon described, but none of them is as yet well enough founded to be of sufficient general interest. Owing to war time conditions, it was unfortunately not possible to make more exhaustive observations and measurements, but it is hoped to clarify some time later the various questions by systematic borings of the Dead Sea bed, and by a careful study of the ancient literature on Palestine and the Dead Sea. We hope that the results will not only be important from geological or even technical aspects, in affording an exact knowledge of sea-levels at different times, but also for students of history and of the Bible, since there is a close link between the Dead Sea and the development of religion.

We wish to extend our thanks to the managing director of the Palestine Potash Ltd., Mr. M. Novomejsky, and to those of the Company's staff, who were helpful with suggestions and measurements, especially to Messrs. Campbell, Cahaner, Shirisly and Schnerb.

[1] Galen, "De Simplicium Medicamentorum Facultatibus", IV, 20; editio Kühn, XI, 690.
[2] Ritter, C., "Die Erdkunde von Asien", 764 V/II, par. 9 (Berlin, 1850).
[3] Elazari-Volcani, B., *Nature*, 152, 274 (1943).

INDIAN UNIVERSITY ARCHITECTURE

IN a paper read before the Indian Institute of Architects early this year, Nawab Zain Yar Jung Bahadur, chief architect, Hyderabad State, dealt with the design of a residential university, as exemplified in the new Osmania University in Hyderabad. This has been planned on the American campus principle on a site of 1,600 acres, giving ample space for future expansion and the inclusion of well laid-out grounds of impressive dimensions. The author had previously made a fairly thorough study of university architecture both in Europe and the United States, in which connexion he expressed pleasure at the evidence of a master plan in the design of the English universities of Birmingham and Nottingham, but regrets that it is less evident in the case of Edinburgh and Leeds and in most of the Indian universities.

The Osmania University is located in somewhat hilly and picturesque country at Adigmet, a village between Hyderabad and Secunderabad to the north-east of the city, nearly 200 ft. above the level of the city, of which it commands beautiful views. Among the ridges on which the University is being built the highest has been set apart for the senate hall, which is to be a monumental building and the keystone of the whole project. On one side of it is the arts college, already completed, and on the other the library and law college will be built. These will form the central group of the main axis. There are two ridges stretching from the senate hall hill: on the left ridge all the science colleges are or will be located, three of which—physics, chemistry, and biology—are already under construction. The ridge to the right has been reserved for the museum and the training college, the training school, the school of arts and the art gallery. The hostels and dining halls are situated in the loop behind the science

colleges, and the residential area for the teaching staff is beyond the hostels.

In addition to these, sites have been selected for the medical college and hospital, the colleges of agriculture and forestry, the college for women, a students union, a faculty club, a market, a post and telegraph office, botanical garden, stadium, gymnasium, swimming pool, and a colony for subordinates and servants. It is interesting to note, in regard to acoustics, that only large lecture theatres have been given acoustical treatment, and only those rooms where quiet is absolutely essential, owing to the heavy cost of acoustic materials.

One of the main causes of disease in India is said to be the impurity of drinking water; and the question of having separate drinking water for caste Hindus is also a problem for schools and colleges which cannot be ignored. To meet fully the special needs in this respect and minimize risk of infectious disease, modern drinking fountains are being installed throughout.

In regard to style, the author said that in other important countries of the world the science of architecture has made rapid progress, but in India he thinks they are sadly behind the times; and in spite of the money that has been and is being spent on educational institutions, he has seen nothing yet of real architectural value. "In fact some of the buildings are so poorly designed and so badly constructed that they are a blot on the landscape and invoke in the heart an unholy desire to pray for an earthquake or fire." The reigning Nizam, who has taken a keen interest in the new University, expressed the wish that, while possessing all modern facilities, it should have no Western elements in its architecture. Speaking of the arts college at the time of his Jubilee, His Exalted Highness said that "the architecture of this building represents a blending of the Hindu and Muslim styles, and the art and culture of both these races are reflected in the pillars and traceries and carvings on the doors and walls. Thus the building symbolises the close contacts and friendly relations subsisting for centuries between the various classes of my subjects. . . . The Osmania University should not only be a repository of Hyderabad's best traditions, a model of its high culture; it should also aim at broadmindedness and mutual toleration and unity among the students, for in that ideal lies the well-being and the prosperity of this State".

The author has accordingly embodied the Hindu and Muslim cultural elements of all periods in the State, such as the Buddhist, Jain, Brahmanic, Bahmani, Kutub Shahi and Moghal. These have all been blended to form a composite whole, signifying the evolution of a new style which should distinguish His Exalted Highness's reign from all the other rulers in the history of the Asafjahi dynasty.

The arts college which, at the beginning of this year, was the only completed building in the scheme, covers an area of 250,000 sq. ft. and is designed to accommodate two thousand students. It is a two-storied structure, with basement, built entirely of local granite of pink and grey shades, with the inner walls plastered and the outer surface in ashlar masonry. All the rooms are finished in plain white lime plaster, except the entrance hall, where stucco is used. The dome surmounting the entrance hall is about 50 ft. in diameter, resting on corbel slabs. The entrance hall is built in reinforced cement concrete, and is 66 ft. from floor to ceiling. The main roof and intermediate floors and staircases are constructed in reinforced cement concrete. All the floors are paved with polished Shahabad stones from the regions of Tandur and Nawandgi in Hyderabad State, with the exception of the entrance hall, where the floor is red terrazzo. The most difficult and slow part of the work was the process of stone-dressing, as the local granite is of the hardest variety. The stone lintels over the massive columns of the ground floor verandah of the arts college weigh about seven tons each and are 18 in. in span. The stones used for the decorative cornices weigh $2\frac{1}{2}$–$3\frac{3}{4}$ tons each. The complete woodwork (including furniture) of the entire buildings is being carried out in the best Rangoon teak. 4,000–5,000 workmen were engaged during the first year or two of the construction work. In addition to local labour many stone-dressers and artisans were imported from southern towns such as Tanjore, Turkapalam and the Conjivaram, to assist directly with the work and also to train the local workers.

The whole scheme is expected to cost a little over two crores, and the author replies to some criticism on the ground that far too much money is being expended on the new University. Before he had seen some of the world's greatest educational centres he was inclined to agree that the cost should be kept low; but examples in other parts of the world convinced him that the University is a nation-building institution in the best sense of the term; the future of the younger generations and of the State itself will obviously depend on the type of University. It is concluded that if the people of India are to be brought physically and mentally to the same level as those of other civilized nations, it is vital that the new University, and others in India, should be built on the principles accepted and the standards fixed in other countries; and it is quite certain that Hyderabad is a big enough State to think of a big university worthy of itself and of its traditions.

EAST AFRICAN ARCHÆOLOGY

FIVE distinct types of polished stone axe have been recognized in East Africa. Most of the specimens found were pecked and not ground into shape before being finally polished. No geographical significance can be attached to any of the five types; their distribution will probably be found to be very wide, though for the moment for obvious reasons they have mostly turned up where European settlement involving farming has taken place. A description of the various types, together with a list of some of the localities where they have been found, has been made available in a collection of reprints recently received*. A general sketch map, too, is appended. Finally, a short note on the occurrence of the different types outside East Africa concludes the article.

Gorgora, on Lake Tana, was a former Italian military station. The rock-shelter is situated some 150 ft. up in the side of a conical hill of volcanic rock which rises abruptly from the plain some three miles from the Lake. The shelter is most inaccessible and can only be approached from one direction. It is some 15 ft. long by 8 ft. at the widest. Black soil rich in humus was found from the surface to a depth

* "Notes on the Ground and Polished Stone Axes of East Africa", by Mary D. Leakey; "Excavations of a Rock-Shelter at Gorgora, Lake Tana, Ethiopia", by Colonel F. Moysey; "The Industries of the Gorgora Rock-Shelter, Lake Tana", by L. S. B. Leakey. Reprints of the *Journal of the East Africa and Uganda Natural History Society*, 17, Nos. 3 and 4 (77 and 78), 182–203.

of 4 ft.; then to the 9-ft. level there was a grey volcanic ash. At this level, concretions appeared, and these formations increased down to the 12-ft. level. Implements occurred throughout the deposits, and pottery was found to a depth of 3 ft. from the surface. There were no sterile layers.

Dr. Leakey's analysis shows that the industries of the 12-, 11- and 10-ft. levels can be classified as Early Stillbay; those from the 9-, 8- and 7-ft. levels as Middle Stillbay; those from the 6-, 5- and 4-ft. levels as Upper Stillbay; those from the 3-ft. level as Magosian; those from the top 2 ft. of deposit as late Mesolithic or Neolithic. This industry includes some crude microliths, and appears to be derived from the earlier Magosian. A few simply decorated sherds were also discovered in this level. The industries from the older levels are fairly typical, but the 4-ft. level gives us a transition stage between the latest Stillbay and the Magosian. An analysis of the different types of artefact found is given, and the article is well illustrated.

The rock-shelter at Gorgora is obviously of some importance. Such transition industries as those of the top 2 ft. and the 4-ft. level are very interesting. The excavations are not yet completely concluded, and it is to be hoped that further investigations at this site and elsewhere in the neighbourhood will be undertaken at a not too distant date.

M. C. BURKITT.

QUARTZ CRYSTAL MODEL

DIFFERENT types of deformation extend the range of frequencies that quartz plates can cover and a single plate may be used for totally different ranges when made to vibrate in different modes. To obtain most of these various modes of vibration the plates must be cut from the mother quartz at different angles with respect to the electrical, mechanical and optical axes of the quartz crystal. There are also special orientations which provide better frequency stability in cases of temperature changes, and these orientations are used where stringent temperature requirements apply.

A recent interesting article by F. Caroselli (*Bell Lab. Rec.*, **22**, No. 9; May 1944) describes and illustrates a large fabricated model of a quartz crystal, employed for showing more clearly the angular relations of the various cuts of plates to the original mother crystal. The model has an outer shell about two feet high that shows the typical shape of quartz as it grows in Nature, and an inner display of crystal plates. The shell and display tiers are made of sheet lucite and the plates are lucite, roughened to appear like etched quartz. The plates include those used for oscillators and filters.

About the vertical axis the outer shell shows an array of faces that repeat three times in exact symmetry. This is the optical axis, and it is the only direction through quartz along which a light ray will travel without dividing into two rays of different velocities which are refracted by different amounts. The shell can be rotated with respect to the inner display so that its faces can assume three identical orientations with respect to the crystal plates. Three pairs of X and Y axes are marked on the apron of the model to demonstrate the trigonal symmetry of quartz.

Before constructing the outer shell of the model, formulæ were developed from published crystallographic data to compute the angles between adjacent faces. All identical faces were made the same size by having the major apex faces meet in the vertical axis of the model. Minor apex faces were located at an arbitrary distance from this central axis.

The model illustrates cuts used in ranges varying from less than 1 kc. to 24,000 kc., and each one is particularly suited for a definite range of frequency. In addition, there are several different cuts operating over the same range but having some specific characteristic. On the top tier of the display there is a plate the coating of which is divided so that it will vibrate by flexing the major surfaces; and on the bottom tier are a number of plates of the same cut but with the coating divided to excite the third, the fifth or seventh harmonics of a longitudinal mode of vibration.

COLOUR TELEVISION

A DEMONSTRATION was given a short time ago by Mr. J. L. Baird of his recent achievements of the reception of television in colour by a method which avoids the need for revolving disks and lenses; the apparatus is thus silent in operation and is claimed to be as efficient as the pre-war black-and-white receivers. The pictures in colour are also utilized to produce stereoscopic effects by the use of coloured viewing glasses, the left and right eye pictures corresponding to the left and right eye images.

For the reproduction of the received pictures a special cathode ray tube, termed a 'Telechrome', is used; this differs from the ordinary tube in having two cathode ray beams and a transparent double-sided screen. These two cathode ray beams are modulated by the incoming signals corresponding to the two primary colour pictures; and they impinge obliquely on opposite sides of the screen, these sides being coated with fluorescent powders of the appropriate colours. Thus the screen has formed upon its front face an image containing the orange-red colour components, and on its back face an image containing the blue-green components. When the screen is viewed normally from the front, these images are superimposed and thus give a picture in natural colour.

Such a two-sided tube has been developed with a screen, 10 in. in diameter, and was shown receiving a picture from a 600-line triple interlaced moving spot transmitter using a cathode ray tube in combination with a revolving disk with orange-red and blue-green filters. The tube gives a very bright picture due to the absence of colour filters and the fact that special powders are used giving only the desired colours, which are seen additively.

A method of using three colours has also been described in a patent specification. In this case, the back of the screen is ridged: the two sets of faces of the ridges are coated with blue and green powders respectively; and they are scanned by two cathode ray beams, modulated by the blue and green components respectively, of the incoming signals. The third beam, carrying the red picture components, impinges on the front of the screen as before. A new form of scanning is also being explored, using successive lines of different colour, with the object of reducing the colour flicker which is obtained when, as at present, the colour changes are by frame to frame only.

FORTHCOMING EVENTS

Saturday, September 23

BRITISH PSYCHOLOGICAL SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 2.30 p.m.—Prof. J. C. Flugel: "Psychological Aspects of Moral and Social Progress" (Papers in comment by Dr. Karl Mannheim and Dr. R. H. Thouless).

Tuesday, September 26

BRITISH SOCIETY FOR INTERNATIONAL BIBLIOGRAPHY (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 2.30 p.m.—Dr. S. C. Bradford: "Some General Principles of Bibliographical Classification, with application to the Universal Decimal Classification": Mr. C. L. Gilbert and Mr. C. G. Gray: "The Classification of Literature in the Technical Department of an Oil Company".

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP) (at 16 Princes Gate, South Kensington, London, S.W.7), at 6 p.m.—Mr. T. Thorne Baker: "Some Uses of Dried Emulsions in Photographic Industries", with a Demonstration of Silk Screen Printing.

Wednesday, September 27

INSTITUTE OF FUEL (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 2.30 p.m.—Mr. L. C. Southcott and Mr. D. W. Rudorff: "Superheaters for Water Tube Boilers".

Friday, September 29

BIOCHEMICAL SOCIETY (in the Department of Biochemistry, The University, Western Bank, Sheffield), at 11 a.m.—The 236th Meeting.

ROYAL INSTITUTE OF CHEMISTRY (joint meeting of the BIRMINGHAM AND MIDLANDS SECTION with the INSTITUTE OF PHYSICS) (in the Connaught Room, Imperial Hotel, Birmingham), at 6.30 p.m.—Dr. G. W. Scott-Blair: "Rheology of Plastics; Stress-strain-time Relations for High Polymers and Similar Materials".

APPOINTMENTS VACANT

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

DEPUTY CHIEF ENGINEER—The Borough Electrical Engineer and Manager, Guildhall, Swansea (September 28).

LECTURER (full-time) IN PHYSICS—The Principal, Royal Technical College, Salford (September 29).

CHEMIST to the Tees Valley Water Board—The Engineer and General Manager, Water Board Offices, Corporation Road, Middlesbrough (endorsed 'Chemist') (September 29).

SPEECH THERAPIST—The Director of Education, Shire Hall, Nottingham (September 30).

GRADUATE ASSISTANT MASTER IN ENGINEERING—The Principal, South Dorset Technical College, Newstead Road, Weymouth (September 30).

SPEECH THERAPIST—The Director of Education, Stanley Buildings, Caunce Street, Blackpool (September 30).

CHAIR OF PHYSIOLOGY in the University of Ceylon—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (September 30).

CHAIR OF ELECTRICAL ENGINEERING—The Acting Registrar, The University, Leeds 2 (September 30).

CHAIR OF BIOLOGY in Victoria University College, Wellington, New Zealand—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (September 30).

PRINCIPAL OF THE HACKNEY TECHNICAL INSTITUTE, and PRINCIPAL OF THE SOUTH-EAST LONDON TECHNICAL INSTITUTE—The Education Officer (T.1), County Hall, Westminster Bridge, London, S.E.1 (September 30).

PRINCIPAL OF THE WALKER TECHNICAL COLLEGE, Oakengates—The Secretary for Education, County Buildings, Shrewsbury, Shropshire (September 30).

TECHNICAL ASSISTANT FOR LABORATORY attached to Engineering Firm (N.W. London district)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.2278.XA) (October 2).

PHYSICIST OR ENGINEER, B.Sc. Grade, for scientific instrument development work (Oxford area)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. A.584.XA) (October 2).

ENGINEER AND GENERAL MANAGER to the New Zealand Hutt Valley Electric Power Board—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. D.931.A) (October 7).

EXAMINING OFFICERS (temporary) IN THE PATENTS OFFICE (candidates should have a University Degree (or equivalent) in Science or Technology with Chemistry as a subject)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. F.2982.A) (October 9).

PROFESSOR OF PHYSICS—The Registrar, University College, Singleton Park, Swansea (October 18).

HONOURS GRADUATE IN CHEMISTRY (London, Reference No. F.2719.XA), HONOURS GRADUATES (2) IN METALLURGY (Neath, Reference No. F.2720.XA; Shipley, Reference No. F.2721.XA), and HONOURS GRADUATE IN CHEMISTRY or Member of the Royal Institute of Chemistry, Branch E (London, Reference No. F.2722.XA), on the research staff of a progressive National Organization with home and overseas interests—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting the appropriate Reference No.) (October 21).

QUALIFIED CHEMIST with some research and industrial experience, by a progressive concern in the Spen Valley district of Yorkshire—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. F.1737.XA) (October 27).

LIBRARIAN—The Librarian, Queen's University, Belfast (October 31).

CHAIR OF PSYCHOLOGY in the University of Sydney—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (October 31).

BEYER CHAIR OF ENGINEERING—The Registrar, The University, Manchester 13 (November 18).

PROFESSORSHIP OF NAVAL ARCHITECTURE, tenable at King's College, Newcastle-upon-Tyne—The Acting Registrar, University Offices, 46 North Bailey, Durham (November 30).

FELLOWSHIP AND TUTORSHIP IN MATHEMATICS—The Senior Tutor, Jesus College, Oxford (December 1).

SPEECH THERAPIST—The Director of Education, Education Office, Rotherham.

LECTURER (woman, temporary) IN PSYCHOLOGY AND PRINCIPLES OF EDUCATION in the Glamorgan Training College, Barry—The Director of Education, Glamorgan County Hall, Cardiff.

LECTURER (full-time, temporary, man or woman) IN BIOLOGY in the Leeds College of Technology—The Director of Education, Education Offices, Leeds 1.

ASSISTANT HEAD OF THE DEPARTMENT OF ELECTRICAL ENGINEERING—The Principal, Birmingham Central Technical College, Suffolk Street, Birmingham 1.

AGRICULTURAL ENGINEER (for London), with practical knowledge of Drainage and Irrigation—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. R.S.70).

CHAIR OF OBSTETRICS AND GYNAECOLOGY in the Royal Faculty of Medicine, Baghdad, Iraq—Appointments Department, British Council, 3 Hanover Street, London, W.1.

SPECIALIST (for London), with general all-round knowledge of Food Processing of Milk, Dairy Products, Meat, Vegetable Fats and Oils, Fish, etc.—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. R.S.66).

LECTURER (full-time, temporary) IN THE DEPARTMENT OF ELECTRICAL ENGINEERING—The Principal, Borough Polytechnic, Borough Road, London, S.E.1.

PAPER MILL ENGINEER for Bengal, with practical Paper Mill experience, capable ultimately of taking charge of all Papermaking Plant Maintenance—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. O.S.228).

ASSISTANT LECTURER IN AGRICULTURAL ZOOLOGY—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

SECOND VETERINARY OFFICER, Imperial Bureau of Animal Health, Weybridge—The Secretary, Imperial Agricultural Bureaux, 2 Queen Anne's Gate Buildings, London, S.W.1.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scottish Society for Research in Plant-Breeding. Report (abridged) by the Directors and Report by the Director of Research to the Annual General Meeting, 20th July 1944. Pp. 34. (Edinburgh: Scottish Society for Research in Plant-Breeding.) [49

Tory Reform Committee. Bulletin No. 4: Government Policy for the Rebuilding of Urban Areas. Pp. 20. (London: Tory Reform Committee.) [49

Medical Research Council: Industrial Health Research Board. Report No. 85: The Recording of Sickness Absence in Industry. (A Preliminary Report.) By a Sub-Committee of the Industrial Health Research Board. Pp. 18. (London: H.M. Stationery Office.) 4*d*. net. [59

Transactions of the Royal Society of Edinburgh. Vol. 61, Part 1, No. 7: Cytological and Genetical Studies in the Genus Solanum, 2, Wild and Native Cultivated 'Diploid' Potatoes. By Dr. H. C. Choudhuri. Pp. 199–219+1 plate. (Edinburgh and London: Oliver and Boyd.) 5*s*. 9*d*. [79

British Standard Conversion Factors and Tables. (B.S. 350: 1944.) Pp. 96. (London: British Standards Institution.) 3*s*. 6*d*. net. [129

Other Countries

Trinidad and Tobago: Forest Department. Administration Report of the Conservator of Forests for the Year 1943. (Council Paper No. 26 of 1944.) Pp. 6. (Trinidad: Government Printer.) 6 cents. [88

Bulletin of the American Museum of Natural History. Vol. 83, Art. 1: The Haplolepidae, a New Family of Late Carboniferous Bony Fishes; a Study in Taxonomy and Evolution. By T. Stanley Westoll. Pp. 122+10 plates. Vol. 83, Art. 2: The Birds of Timor and Sumba. By Ernst Mayr. Pp. 123–194. (New York: American Museum of Natural History.) [88

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 25, No. 9: The Perennial Southwestern Datura and the Validity of Matthew's Hypothesis in Plant Geography. By Joseph Ewan. Pp. 235–244. (San Francisco, Calif.: California Academy of Sciences.) [88

Imperial College of Tropical Agriculture. Eleventh Report on Cacao Research, 1941–43. Pp. 38+12 plates. (Port-of-Spain: Government Printer.) 5*s*. [88

Catalogue

A Catalogue of Important Books on Natural History (Zoology and Botany). (No. 622.) Pp. 64. (London: Bernard Quaritch, Ltd.) 6*d*.