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CONTENTS

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SCIENTIFIC AND INDUSTRIAL RESEARCH.—II

WE have already noted that one of the first problems in the development of an adequate strategy of research is the re-examination of our whole educational system with respect to the provision of adequately trained and broadly educated workers for scientific research, and the balancing of the immense needs for technical and scientific training by competent education in the liberal arts and humane studies. This involves not merely an adequate supply of competent investigators, but also of those capable of directing research effectively, as well as of the laboratory technicians necessary for the efficient use of the fully trained research worker. Again, since both the support of research in the first instance, and the utilization of its results afterwards, involve some understanding by the community generally of the value and significance of scientific research, we are concerned also with the general education of the community and not merely with education at the university level.

This point has not yet been as fully appreciated by scientific workers as is desirable, despite the attention which has been focused on education in general by the Government White Paper on Educational Reconstruction, the debates leading up to the new Education Act, and the recent series of reports such as the McNair Report on Teachers and Youth Leaders, the Norwood Report on Curriculum and Examinations in Secondary Schools and the still more recent Fleming Report on the Public Schools and the General Educational System. This neglect is the more important as the attention given to scientific and technical training in the Government's own White Paper and the Norwood Report, to say the least, can scarcely be regarded as adequate. To some extent this has been corrected in the Statements issued by Nuffield College on "Industry and Education" and on "Problems of Scientific and Industrial Research", the latter of which reiterates that the foundations for a sound and scientifically minded industry must be laid in the schools by good grounding in mathematics and in the principles and methods of science, coupled with a thorough mastery of the English language and a broad cultural approach to all subjects. "We live in a world in which science lies at the very roots of community, and a mastery of scientific thinking grows more and more indispensable for the successful practice of the arts of life. The culture of the modern age, if it is to have any meaning, must be deeply imbued with scientific ways of thought."

Strong support for this point of view can be found in the report of the Chemistry Education Advisory Board on the Education and Training of Chemists, and in the report of the Federation of British Industries Committee on Industry and Education, but it is one that will demand the sustained support of scientific workers if it is to be achieved in practice. None the less, it is to the universities that we may well direct our attention in the first instance. Their place in the strategy of research, as the main source

of supply, both direct and indirect, of the type of personnel required, is unique and unchallengeable. It is this position that must be considered before we consider the further question of their place in, or relation to, whatever organization of research may be desirable to implement our strategy.

Attention has been directed to the universities as a source of supply for the research workers required in industry and elsewhere in several reports. While in most of these papers and reports the short-range and long-range problems are clearly distinguished, the more fundamental problems involved have seldom been discussed. The universities are social institutions, just as research from one point of view is a social process, and any scheme of university expansion with its concomitant calls for larger endowment must make plain to the ordinary citizen what social purposes such expansion will serve. That presupposes a re-examination of the fundamental questions of the functions of the universities and their place in the society of to-day. As Rashdell has pointed out, new needs must be met by new machinery. University institutions must undergo perpetual modification in the future, as they have undergone perpetual modification in the past.

But Rashdell's further observation in this connexion is worth noting. "It is well," he adds, "in this as in wider fields of social, political and religious organisations, as far as possible to preserve historical continuity." That observation is worth remembering for the help that attention to such historical continuity may give in developing a social philosophy. A false philosophy, as Dr. Conant recently noted, was one of the reasons for the triumph of Nazism in Germany; and the University Grants Committee in its last quinquennial report recognized the special responsibilities of British universities in this field in view of the suppression in European universities of independent thought and critical discussion. The late Prof. J. L. Stocks was even more explicit. "What is wanted," he wrote in an essay "On the Need for a Social Philosophy", "is a philosophic discipline, encouraging and promoting the careful exposition and discussion of the pre-suppositions of social organisation on every side. No such discipline exists in this country at present. Our generation is not being given in these matters the tools necessary for coming to a sound critical judgment, and . . . philosophy alone has the power to give them those tools. When men do not know the faith by which they live, they will be apt inadvertently to betray it."

In the attempt to restate the functions of the universities in the modern world, too little regard has been paid to the experience of the past. That can afford a surer guide to our grand strategy than preoccupation with the minor tactics required to deal with some transient if embarrassingly urgent problem. There could in fact be no finer starting point for the reconsideration of the place of the universities in the society of to-day than Rashdell's study of the medieval universities from which we have already quoted. "The two most essential functions which a true university has to perform and which all universities have more or less discharged amid the widest possible variety of system and method and organisation . . . are to make possible the life of study, whether for a few years or during a whole career, and to bring together during that period, face to face in living intercourse, teacher and teacher, teacher and student, student and student." Thus Rashdell has crystallized three of the four principles which guided the Association of University Teachers in its approach to university problems as set forth in the report on university developments: the pursuit of knowledge, not controlled or dominated by any private or corporate interest; the dissemination of knowledge and culture; and the communal aspect—universities are schools of communal living, in which the development of students as individuals and their development as social beings are equally important.

Those three principles are more or less explicit in the great bulk of the reports and books or papers that have discussed the problems of university development, whether in regard to research or teaching, in recent years. The fourth principle, that universities are a part of society, both materially and intellectually, and bear a direct responsibility, and must therefore study the application of organized knowledge to practical problems, and train men and women for particular tasks finds almost equally general acceptance.

It is of special interest, to the scientific worker, to note how well these ideas are brought out by Dr. F. R. Leavis in his sketch for an "English School" in "Education and the University". This plea for a liberal or humane school at first appears to be remote from their own concern, but Dr. Leavis has crystallized his objective in words which show unmistakably its relevance. Strongly contesting subjective views, he visualizes a university as a focus of humane consciousness where intelligence, bringing to bear a mature sense of values, applies itself to the problems of civilization. That is the reason for his plea for a school of the humanities. He aims at producing minds that will approach the problems of modern civilization with an understanding of their origins, a maturity of outlook, and a sense of human possibilities, difficult of achievement, that traditional cultures bear witness to and that it would be disastrous to lose sight of for good.

Whatever view we may take of the functions of the universities or of their place in our strategy of research, we cannot ignore their inherent possibilities of leadership. Just as in the field of thought a university stands for adventure, so in regard to society the university plays its greatest part as a stabilizing factor. Sir Walter Raleigh pointed out that a university must be perpetually alert to discard superseded methods and to detect the importance and significance of new studies and new ways of approach, encouraging adventure and giving to each a place in the long line of pioneers who are pushing forward the boundaries and claiming new provinces. While serving as a repository of the reasoning of the ablest minds attracted to it, the university must continue its vital function of checking the dangerous extremes to which all institutions with power are subject, and above all at this time those extreme

tendencies of modern civilization shown in the modern State and in the tyranny of opinion.

But if it is not part of the duty of a university to inculcate any particular philosophy of life, it is, as the University Grants Committee recognized, most assuredly an essential part of its work to assist its students to formulate adequate philosophies of life for themselves. Only so can the universities make their great contribution to meet the danger to which Prof. Stocks directs attention; and there is here a very important practical point to be considered in relation to demands for increasing the range of technological studies at the universities. In a passage that deserves to be noted particularly in regard to the extra-mural activities of the universities and their part in adult education, Rashdell, after a warning not to lose or lower the ideal of the university as the place *par excellence* for professed and properly trained students, not for amateurs or dilettantes or even for the most serious of leisure hour students; for the highest intellectual cultivation, and not merely for elementary instruction or useful knowledge; for the advancement of science, and not merely for its conservation or diffusion; continues with the plea that it is the place "where different branches of knowledge are brought into contact and harmonious combination with one another, and where education and research advance side by side".

Prof. D. W. Bronk pointed out in his paper on the discovery and interpretation of biological phenomena in the symposium on the "Organisation, Direction and Support of Research" arranged by the American Philosophical Society last November that the departmentalism of science has tended to become more restrictive and the boundaries of teaching departments have insensibly created artificial barriers to the free range of inquiry. Questions as to the barriers we have erected around disciplines and departments must be frankly faced in considering the replanning and reorganization of the universities to meet post-war needs. Nowhere will more fundamental thinking be required than at this point and nowhere more than here will the universities need, as has been well said, "official window cleaners whose chief function is perpetually to open windows and let in air—the colder the better".

But there is more involved here than decisions as to how far to retain some of these compartments for administrative convenience or the clear thinking about the impediments they offer to effect research and the limitations they impose on the character of the training we give our future investigators. As already indicated, we have to define the relation of technology to university studies. Technological studies have significance not only in regard to the survival of the nation and the needs of individuals, but also to the advancement and the unity of knowledge itself. In fact, technological requirements are an important factor enforcing the consideration of a new synthesis of scientific effort. Nevertheless, we are, as Mr. P. R. Morris rightly said in a recent lecture to the Royal Society of Arts, "in danger of forgetting, and the present haphazard organization of courses and studies encourages us to continue to forget, that the differentiation of knowledge into faculties and subjects can easily be regarded as a division of knowledge itself. There is here a fundamental question of principle of the highest importance and also a practical problem of systematisation and organisation".

That fundamental question has to be considered both from the point of view of the universities themselves and from that of their relations with the technical colleges and the place of the latter in the educational system. It is not the only principle which should determine whether or not the technical colleges should be developed into institutions of university rank but independent of the universities, but it is an important factor bearing on our decision. Almost a generation ago, Prof. Arthur Smithells argued powerfully that the isolation of professional or technological studies and their cultivation in separate institutions was fraught with serious dangers and disadvantages, and advocated the embodiment of professional and technical studies in our universities, and for the reason that a wider outlook would be thereby promoted. The Committee on Post-War University Education of the British Association, in its recent report though without reasons given, supports this view and considers that the development of technical colleges into institutions of university rank, but independent of the universities, should not be encouraged. Rather, British colleges carrying out technological work of university standard should be associated with their regional university, as the Imperial College of Science and Technology in London, the Royal Technical College in Glasgow and the College of Technology in Manchester.

From this view Sir Alfred Egerton dissents. He considers it highly important that there should be in Great Britain an institution such as the Imperial College, somewhat similar to the Massachusetts Institute of Technology; there should be one in the south of England, one in the north and one in Scotland, closely associated with the universities, with strong post-graduate schools and providing undergraduate teaching. There have been other powerful pleas for such institutes from the research point of view. But it is important that there should be no confusion with other proposals to advance certain university colleges to full university rank, which is a possibility also contemplated by the British Association Committee. Such proposals obviously are related primarily to the quantitative aspects of university expansion—the size of our university population and the size and number of the universities to cater for it.

These questions have been raised already, notably by Sir Ernest Simon in his pamphlet on the development of British Universities, and by the Association of University Teachers in the report already mentioned, where tentatively it is suggested that a university in Great Britain should range in size from 2,000 to 5,000 students, with residential accommodation for a large number of students. On this basis a national policy would first aim at building up the smaller universities to the optimum size and sub-

sequently at transforming some at least of the university colleges into true independent universities to provide the balance of whatever accommodation may be required to meet the needs of the university population at which it is decided to aim. Some approximate figure must clearly be adopted as target if any real plans for university expansion are to be formulated. That estimate will depend in part only on the demands for research workers and for teachers, for it must be related to the general question of university finance and the distribution of what increased grants may be available, not merely for expansion but also for improving the conditions and standards in existing departments. In fact, until we have attempted to formulate some reasonable estimate as to the student population at which we should aim, whether the pre-war standard of about 50,000, with better selection and higher standards, a twenty per cent increase, the fifty per cent increase suggested by the Association of University Teachers, or a hundred per cent increase, we can scarcely decide on what increase in grants is desirable, and this is a notable omission in the report of the British Association Committee.

It will be recognized, of course, that closer co-operation between the universities, particularly in regard to the development of schools of research and teaching, the elimination of redundancy, and the planning to cover existing gaps may offer some possibilities of economy to offset some of the increase. But whatever the target number we select, we must have regard, first to the principles already adumbrated; second, to the danger of opening the doors too wide and not retaining first-class staff owing to competition; and third, to the capacity of society to utilize the students when qualified. On the second point it may be observed here that the question of status and standards among the university staffs is of first-class importance. Quality must come before quantity and there must at least be that much relation between the financial rewards in a university career, whether of teaching or research, and those elsewhere, to ensure that a due proportion of the ablest minds of each succeeding generation are attracted to such careers. Accordingly no policy of university expansion which neglects to bring such matters as staff salaries and grading, superannuation, and the like, more into keeping with conditions in industry will achieve its purpose. Beyond this, if a university is a free and graded association of free men and women united in a corporate organization to study apart and develop truth, no limits can be set to the institutional forms its activities may take or to the spheres of conduct in which it may fruitfully intervene, other than those which in practice mere prudence will dictate to avoid the unwise diffusion of resources.

The third point requires somewhat fuller consideration. Mannheim has directed attention to the dangers which arise when there are more persons on the intellectual labour market than society as it is requires for carrying out its intellectual work. It is, of course, true that one of the reasons for expanding the universities of Great Britain is that at present industry is making insufficient use of scientific knowledge because it does not employ in the right positions a sufficient number of those trained to use such knowledge. It is also true that the demand for such workers has increased and that progressive firms already anticipate a difficulty in finding sufficient recruits of the requisite calibre unless the university schools of research are expanded. None the less, the warning which Mannheim gives of the effect of over-supply on society in the lost social value of the intellectual professions and the belittling by public opinion of cultural and intellectual activity is not one to be disregarded if we hope to plan for a new society and to preserve the essential elements of freedom and culture; and that warning is powerfully enforced by experience in Germany.

What, then, in short should be our basic strategy with regard to the universities and research? First, we must look to them for the supply of the research workers required in all branches of science and for industry, for government institutions and departments, and for fundamental research at the universities themselves. Second, we must look to them ultimately for the supply of leaders in all walks of society competent to apply scientific knowledge to the service of industry or of the nation as a whole. Thirdly, we must look to them to play a vital part in that work of adult education through which alone we can hope for a society in which policies and plans based on scientifically ascertained facts can be assured of reasoned and general support. Finally, these teaching functions must be in balance with the equally vital function of research of extending the bounds of knowledge.

That last task must be considered more fully in connexion with the actual organization of research. It is sufficient to note here that teaching must be in vital touch with research, and that we may have to consider more carefully to what extent the two functions can be combined in the same staff. That there must be the vital contact is not denied, nor the value to the research worker himself of attempting to expound to others the significance of the field in which he is working. What we are concerned with is raising the standard of teaching and with giving to the really great teacher with a genuine talent for exposition and for inspiring others the full scope and encouragement that he deserves. Such teachers are not necessarily great investigators also, and one reason for the inadequate appreciation of science is certainly the failure of scientific workers themselves to accord fitting status and prestige to the great expositor in their ranks. We would do well, as Sir J. J. Thomson urged, to pay far greater regard in our appointments to teaching posts, whether of professors or lectureships, to the powers of the candidates to present a subject in a clear and attractive way.

These relations will demand especial consideration with regard to the social sciences, where university study has important contributions to offer in clarifying the issues involved in many social and economic problems to-day, both in regard to methods and assumptions, and the problem of values and moral issues. Never was it more important that the univer-

sities should be places where thought and disinterested inquiry are pursued on the highest level, and where the best minds of each generation are trained for intellectual achievement. Teaching and research alike in the universities must be pursued in a spirit entirely free from bias, prejudice or preconceived ideas.

The first two tasks, however, must be related quantitatively to some reasonable estimate of the needs of society for university graduates, first in the immediate post-war period, but finally to the long-term needs. That relation should be sufficiently flexible to minimize any over-training likely to hamper transfer or adjustment as the needs of society shift slightly from one field or branch of science. Clearly such flexibility must be had in mind in considering afresh the content of university curricula. Clearly also such quantitative relations involve a much fuller study of the structure of society and of the technique of social adjustment, for which provision also must be made in the organization set up to implement our strategy. Furthermore, limitation of the numbers of students entering the universities presupposes, as the British Association Committee emphasizes in its report, much more care in selection. When the number of places is limited, there can be no longer room except for those possessing the appropriate qualities of ability and character, though originality and creative needs should be our first concern here.

Qualitatively, all these four tasks alike involve loyalty to the conception of the university as a place where teaching and research are linked inseparably, set forth so consistently by Rashdell and by so many of those who have since touched this theme, but by none better than by Haldane: "A place of research, where the new and necessary knowledge is to be developed; a place of training where the exponents of that knowledge—the men who are to seek authority—are to be nurtured, and receive their spiritual baptism. Such a university cannot be dependent in its spirit. It cannot live and thrive under the domination either of the Government or the Church. Freedom and development are the breath of its nostrils, and it can recognize no authority, except that which rests on the right of Truth to command obedience".

Whatever the magnitude or directions which university expansion may take, those ideals must be served, and such service will assuredly demand all the inspiration and vision that the universities' greatest traditions of independent and fearless inquiry and faithful service can supply. In a memorable passage Rashdell described the service the University of Paris rendered in checking in France the dangerous tendencies of the Inquisition in Spain.

"The political position of Paris gave its university a place in the political and ecclesiastical world which no other university has ever occupied . . . a body of educated men, protected by the sanctity of their order against the hand of secular justice, possessing the right of public meeting, of free debate, and of access to the throne. The tendency of a body so situated to become a great organ of public opinion, a channel through which the Court might address itself to the nation, and the voice of the nation reach the Court, was strengthened by the deliberate policy of the House of Valois".

The point which Rashdell here makes that at a particular crisis in the history of Europe the universities performed the function which is discharged at the present time by the Press, the platform or even by the polling-booths is of wider significance than as illustrating that Rashdell was fully aware of the social functions of the universities. It is even more explicitly shown in his reference to the University of Oxford: "It was not as a great semi-ecclesiastical corporation but as a centre of speculative thought and of religious life, that Oxford contributed to the making of English history. It was through her influence upon the religious life of England that the University of Oxford did at one supreme moment open a new page in the history of England and of the civilized world."

No one can ponder such passages without glimpsing something of the possibilities if the universities recognize the opportunities which confront them and face the task of reconstruction and development in a like spirit. There is need for fundamental thinking, for close analysis and wise organization and marshalling of resources, which however much they are augmented are bound to be limited. But creative thought and wise administration alike will be most fruitful as in loyalty to these ideals and traditions of the past the universities seek to discover the new forms and opportunities of service which are opening before them, and to grasp them surely in ever more active and intimate co-operation with the whole community upon which in part their own spiritual and intellectual effectiveness in enriching the national life depends.

THE APPRECIATION OF SCENERY

The Beauties of Scenery

A Geographical Survey. By Dr. Vaughan Cornish. Pp. 128+16 plates. (London: Frederick Muller, Ltd., 1943.) 6s. net.

THE scientific study of scenery, which owed so much to Sir Archibald Geikie, Lord Avebury, and later to J. E. Marr, has benefited greatly in recent years from the writings of Dr. Vaughan Cornish. He has not only devoted himself to the problems of the preservation of scenery and to the related question of national parks, but has sought also for a new approach to the appreciation of scenery. He has endeavoured to develop an analytic study of beauty in scenery, and in this new book he has sought to provide a manual on this subject, which he hopes may be useful as a basis "for education in scenic amenity in preparation for the re-planning of town and country".

His approach to the scenery of an area is influenced by his geological and geographical interests. Indeed it is certain that any real understanding of scenery must have a geological basis (especially if geology is taken to include physical geography). It may readily be admitted that many have a warm appreciation of the beauties of scenery without such a geological basis; but it can be claimed that some knowledge

of the geological structure and the moulding of the foundations of a landscape clarifies the vision and enlarges the interest. It is regrettable that so little reference is made to these simple geological factors in school work. What is needed is not so much a formal study of the science with numerous technical terms, but rather an indication of some of the influences of the rocks on life and landscape.

The author of this little book has set himself a considerable task in attempting to cover a very wide field in such a small compass. In his first chapter he has discussed the sky by day and night, clouds, rainbows, the Arctic summer, eclipses, stars, comets and the aurora, all in eighteen pages.

But still more compression has been required in the second chapter, in which Dr. Cornish deals with "Land and Water". The coast-line of southern England illustrates many of his early points, but after little more than two pages we are rushed away to the coasts of the Riviera and to Norway and New Zealand. The scope is so wide that the discussion is tantalizingly brief, and the change of topic is so sudden that there is a suggestion at times that one is reading a series of notes rather than a connected study. Yet from this chapter the reader will gather some indication of the geological factors affecting scenery, and it may be hoped that he will be stimulated to seek more elaborate accounts of the landscapes familiar to him. Some suggestion of suitable books for further reading on these topics would have been useful.

After a chapter on natural vegetation and wild life, in which mammals and birds are taken to be as essential a part of the scenery as man himself (especially the colours of his clothing), there are two chapters on the scenery of civilization. Here Dr. Cornish gives an account of many types of architecture, from Swiss chalets and Cotswold cottages to the buildings of Washington and Rome, from megaliths to skyscrapers.

In his last chapter the author has somewhat extended the meaning of scenery to include "indoor scenery". This naturally affords him an opportunity of writing about the architecture of interiors of houses and churches; but it is rather surprising to find the theme still further enlarged by the inclusion of screens and mural painting, and then of furniture, carpets, convex mirrors, and finally, the engraving of coins.

There is, however, one approach to scenery to which the author makes no reference, but which will surely be of increasing interest in the future, that is, the aspect of the country as seen from the air. While there are some who find air journeys intolerably dull, there is much of interest and of beauty to be seen from the air which is not apparent from the ground: the wide sweep of landscape features, the changes in crossing the broader climatic belts (for example, over Africa), and the amazing colours and patterns of shallow seas when flying along a coast-line, especially when the water is clear. Even aerial photographs, the use of which is certain to increase after the War, show many aspects of scenic design. With the increase of civilian flying there will be an opportunity to provide passengers with data to make journeys more fascinating and to widen their interest in the history of scenery.

It remains to add that Dr. Cornish's volume is illustrated by thirty-two photographs showing many of the features with which he deals.

A. E. TRUEMAN.

CHEMICAL EXAMINATION OF WATERS

The Chemical Analysis of Waters, Boiler- and Feed-Waters, Sewage, and Effluents

By Denis Dickinson. (Blackie's 'Technique' Series.) Pp. xii+140. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1944.) 6s. net.

THIS latest addition to Blackie's "Technique" series of handbooks maintains the high standard of earlier volumes. It is a very practical guide to the wide subject of water analysis, and has been written primarily to meet the needs of the industrial chemist.

A chemical analysis of water may be undertaken for a variety of purposes; for example, to test its suitability for drinking, washing, feeding boilers, or discharge to a stream. It will thus be realized that the tests to be applied will depend very largely upon the purpose for which the analysis is made; and the book under review deals with most of the tests which could come into consideration. The details given of the tests are sufficient to enable the industrial chemist to carry them out, but the book would have been enhanced in value if the author had indicated the interpretation to be placed upon the results of the analysis.

Perhaps in no branch of chemical analysis are there so many tests as there are in water analysis which depend for their result upon a strict observance of the various conditions under which the test is carried out. This is sufficiently indicated in the several chapters of the book dealing with oxygen tests for organic matter, the biological oxygen demand, and determination of albuminoid nitrogen. These facts cry out for a standardization in methods of carrying out tests, and it is most important that greater uniformity should prevail, so that the results obtained by one analyst may be comparable with those obtained by another. The author does touch upon this aspect of standardization, both in regard to the methods of carrying out the tests and the method of expressing results, but he does not take sides for or against.

The fourteen chapters of the book are very well written, and although it might be considered invidious to select any chapters for special mention, those dealing with hardness and boiler-feed and boiler-waters are specially worthy of praise. It may be that they indicate some special interest of the author.

It is important when reading a book of this kind to bear in mind that chemical analysis alone only affords an incomplete picture of a water, and that in considering, for example, its suitability for drinking purposes, the chemical analysis should be supplemented by a bacteriological examination. Such an examination is perhaps not always so important in connexion with trade effluents.

The book presents a very wide review of the subject with which it deals, and the reference to fluorine as being responsible for the condition known as dental fluorosis is specially to be welcomed. The latest information on this subject has been included. Reference might have been made to the radium content or radioactivity of waters, a subject which is deserving of more attention than it has received in the past.

In an appendix the author includes typical analyses of various kinds of water, including drinking water, sewage and sewage effluents and a variety of trade

effluents. Typical analyses of waters used for locomotive boiler-feed are also included.

In conclusion, the book is a useful compilation which should prove of value not only to the industrial chemist but also to all those who have to examine waters as to their suitability for the many purposes for which they find a use. As the author says, he has only attempted to include a fraction of the known methods of analysis, and for other methods it would be necessary to refer to the larger text-books; but as already stated, he has provided an excellent guide to the wide subject of chemical analysis of waters.

H. T. CALVERT.

NUTRITION AND HEALTH

Nutrition and National Health

Being the Cantor Lectures delivered before the Royal Society of Arts, 1936. By Major-General Sir Robert McCarrison. Pp. 75+3 plates. (London: Faber and Faber, Ltd., 1944.) 6*s*. net.

THIS attractively written book is a re-publication of the three Cantor Lectures delivered to the Royal Society of Arts in 1936. The author was formerly director of research in nutrition in India.

The first lecture is devoted to the physiology of nutrition; the second to the relation of oxygen, water, proteins, mineral salts and vitamins to health and illness; the third to the effects of nutrition on national health. The whole constitutes a useful introduction to the study of a subject much in the public mind at present, illustrated throughout by references to the author's work in India and to results obtained in Great Britain.

If criticism is to be made, it might suggest that the opportunity of reprinting could have been taken to include some account of the creation and work of the Nutrition Society, that more recent researches might have been included and that more space might have been given to nutrition of those animals on which we depend for our food supplies and to the effects of the national food policy during this War. The education of the public, the medical student, the medical practitioner, the school teacher and others for which Sir Robert appeals has surely been going on vigorously in recent years, and the public is already very conscious of food values. It has learned, too, the pleasure and advantage of growing its own greenstuffs and of producing its own eggs, thanks to the national policy of aiding both these enterprises. It may still be true that greenstuffs have already lost much of their food value before they reach the poor, but this can only be true of large cities and only of parts of these; for everywhere within and outside them allotments have been growing vast quantities of vegetables for some years, and it is a little late in the day to advocate, as Sir Robert does, the extension of these and of facilities for keeping poultry. There are parts of the country, indeed, in which people cannot eat all the greenstuffs that they grow.

The book is a beautiful example of what can be done within the limits of the authorized war-time standards of economy. Some readers will wonder why, if books like this can be produced within such limits, more of them do not appear. For the same reason some may even wonder whether any other standards will be really needed after the War.

G. LAPAGE.

PHILOSOPHY OF ORGANISM

A Contribution to the Theory of the Living Organism

By Prof. W. E. Agar. Pp. 207. (Melbourne: Melbourne University Press; London: Oxford University Press, 1943.) 12*s*. 6*d*.

THE keynote of Prof. Agar's book, in which he has drawn freely upon the materials both of philosophy and biology, is frankness, directness and lucidity. At least some preliminary contact with the biological philosophy of Whitehead is demanded of the reader. The main thesis is that all living organisms are subjects, that all, possibly including even the simplest, are organizations of subjects, and that the characteristic activity of a subject is the act of perception. In this perception he sees the establishment by the subject of its causal relation with the external world. Even in inanimate objects, process is conceived as one of experience or feeling. In developing this thesis, in which Whitehead's philosophy of organism is freely invoked, many aspects of the organism, especially those of which we have knowledge from experimental investigation, are discussed with refreshing lucidity.

In treating the component parts of living organisms, even at the level of cells or cell aggregates, as feeling, perceiving subjects, the author realizes that he is introducing an interpretation which is likely to be opposed or denied by many biologists. Thus, for example, he writes: "As perception always carries with it the anticipation of further relevant experience, and the meaning of the present experience includes action, or potential action, appropriate to the anticipation, the notion of final causation is involved . . . the anticipatory aspect of causation compels us to recognize the reality of final causation in all perceiving organisms". Thus, in this connexion the teleological nature of causation is recognized. The author is well aware that in adopting this point of view he is treading dangerous ground—that in which science and philosophy stand in danger of becoming confused—but he is prepared to maintain his position and to justify his views. The thesis which, in some respects, is the antithesis of a mechanistic theory, thus rejects the view that "biology is only a science so long as it is only biochemistry and biophysics".

Consideration is given to such topics as purposive action and its interpretation, the unity of the organism considered in the light of experimental studies, biological fields, *Gestalt* psychology, animal behaviour in terms of perception, and aspects of embryonic development and its interpretation as behaviour. In a final chapter the conclusions reached are considered in relation to the Darwinian and Lamarckian views of the process of evolution, a verdict in favour of the former being given. If his thesis is correct, says Prof. Agar, biologists must accept perception as one of their ultimate data; but he admits that even in imagination it is not easy to trace "the detailed course of the evolution of the higher out of the lower types of perception".

No adequate short review of this book is possible, for the book is itself commendably short, and while full of meat, yet does not give the impression of being crowded. If biologists admit that they should give heed to the trend of thought in Whitehead's philosophy of organism, as sooner or later it seems they must, then they would do well to read this book.

CURRENT PROBLEMS OF VISUAL RESEARCH

By DR. W. S. STILES
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Variations in the Visual Threshold

THE problems of visual research discussed in this lecture mainly concern the sensitivity of the retina. A very general test of retinal sensitivity is the determination of the threshold increment, or, briefly, the threshold. The eye views a given distribution of brightness—which may be varying with time in a prescribed way—and, at a given moment, a small additional light stimulus is applied at a particular point in the visual field. By repeated trials with different intensities of the additional stimulus, the critical intensity can be determined at which the observer sees the stimulus on fifty per cent of occasions. This threshold increment, or better, its reciprocal, provides a measure of the sensitivity of a given part of the retina at a given time. It can be determined under a wide range of conditions, and by varying the angular size, exposure time and colour of the test stimulus the response can be made to depend in different degrees on different mechanisms in the retina.

In a typical determination of the threshold increment by the method now commonly adopted, an S-shaped curve is obtained showing how the chance of seeing the test stimulus varies with its intensity. Frequently, there is a considerable range of stimulus intensities, of the order of 3 to 1, within which it is a matter of chance whether the stimulus will be seen. This range of indefiniteness is commonly attributed to uncontrollable variations in the sensitivity of the retinal or post-retinal processes in the observer. Some years ago, however, it was suggested in several quarters[1,2,3] that for an eye in its most sensitive state the threshold is so small that *quantum fluctuations in the stimulus* might be responsible for a part of the observed scatter.

The threshold, expressed as the number of quanta of radiation entering the eye from the test stimulus, has its smallest value when the eye is fully dark-adapted and when the test stimulus is a very brief flash (0·01 sec. or less) from a point source (10 min. diameter or less) of green light ($\lambda = 510$ mμ) which is viewed by slightly averted vision, so that the image is formed on the parafoveal retina. Under these conditions the threshold has a value of about 50 quanta. Because of the corpuscular nature of radiation, any physical apparatus designed to flash a fixed number, say, N, quanta into the eye can do so only on the average, the actual number varying about N with a standard deviation of $\sqrt{N}$. Thus, even if the subject invariably responded when 50 or more quanta entered the eye, a flash of nominally 40 quanta would sometimes contain 51 quanta and would be seen, whereas one of nominally 60 quanta would sometimes contain only 49 quanta and would be missed.

But quantum fluctuations on 50 quanta are too small to explain the whole of the scatter evidenced in the experimental S-shaped curves, and there seemed no satisfactory way of separating quantum from biological fluctuations. Recently a big step forward was made by Hecht, Shlaer and Pirenne[4], who advanced strong reasons for thinking that quantum fluctuations are the main factor. They made new determinations of the threshold under the optimum conditions indicated above and obtained values ranging from 54 to 148 quanta for seven observers. They estimate that, of the light incident on the cornea, only about half reaches the retina, the other half being lost by absorption, reflexion or scattering in the optic media of the eye. The crux of their argument is, now, that of the light reaching the retina, at most 20 per cent is actually absorbed by the visual purple, the light-sensitive substance in the retinal rods, which are certainly the end-organs by which the stimulus is seen under the conditions of the threshold measurements. They arrived at the figure of 20 per cent from estimates of the total quantity of visual purple in the retina and from a comparison of the spectral absorption curve of visual purple with the scotopic visibility curve. They conclude that the threshold increment of 54–148 quanta measured outside the eye corresponds to an absorption of at most 5–14 quanta in the retinal rods, and these latter numbers are the ones on which the quantum fluctuations must be assessed. Assuming that the absorption of n quanta (or more) will always produce a visual response, the S-shaped curve can be calculated from the Poisson probability formula for any value of n. Hecht, Shlaer and Pirenne found that their experimental S-shaped curves fitted the calculated curves for values of n ranging from 5 to 7 (see Fig. 1). The agreement with the upper limit of 5–14 quanta, derived from the absolute value of the threshold, is remarkably close, and these workers draw the conclusion that quantum fluctuations of the stimulus are the main cause of the indefiniteness of the absolute threshold of vision.

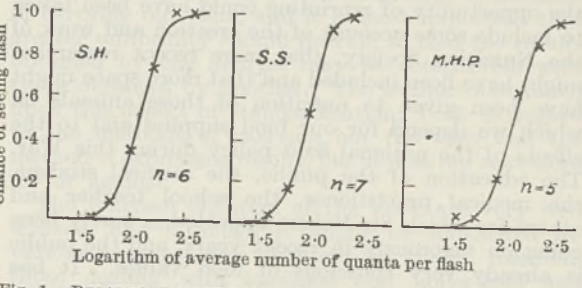

Fig. 1. RELATION BETWEEN THE CHANCE OF SEEING THE STIMULUS AND THE NOMINAL INTENSITY OF THE STIMULUS. THE PLOTTED POINTS ARE THE EXPERIMENTAL VALUES: THE CURVES ARE CALCULATED FROM THE POISSON DISTRIBUTION ASSUMING THE EFFECTIVE NUMBER OF QUANTA IN THE VISUAL ACT TO BE 6, 7 AND 5 FOR THE RESPECTIVE OBSERVERS. (FROM HECHT, SHLAER AND PIRENNE[4].)

The conclusion applies in the first instance to monochromatic green light (510 mμ), the radiation to which the dark-adapted eye is most sensitive, but it is probably equally valid for other wave-lengths. For these other colours, although the number of quanta in the threshold flash outside the eye may be many thousands, the number actually absorbed in the rods and thereby participating in the visual act is reduced to the same value as for green light by the smaller absorption of the visual purple. It is also possible that when the retina is adapted to brightness levels above zero, the scatter of measurements of the threshold increment is still mainly determined by quantum fluctuations.

The S-shaped curve has a bearing on another interesting visual question—the problem of summa-

* Abridged from a lecture before the Physical Society delivered on May 24.

tion. If two or more similar patches of light are sufficiently close together in a dark field of view, they are visible at a lower brightness than a single patch. If the patches are small, say, 0·1° in diameter, and contained in an area of about 1° diameter, the threshold brightness for ten patches is about one tenth that for one. This is an example of physiological summation. The patches assist each other by some retinal interaction which has a very limited radius of action. If the patches are widely separated, however, a kind of summation is to be expected merely as a result of the scatter of the threshold evidenced in the S-shaped curve. If for a given patch brightness the chance of seeing a single patch is p, the chance P of detecting a group of n patches is the chance of not missing every patch, or $1-(1-p)^n$. This is provided the chance of seeing a given patch is independent of the presence or absence of the other patches. From an experimental S-shaped curve for p, the corresponding curve for P can be calculated from the formula just given, for any value of n, and the relative thresholds for the single patch and the group can be determined. Meatham and Lambert[5] discuss this point in their work on the visibilities of groups of light patches seen against a starlight background, and from their S-shaped curve for p they calculate that four patches would reduce the threshold brightness by a factor of 0·85, and that for a very large number of patches the reduction factor would be about 0·6.

Summation of this kind may be called probability summation, to distinguish it from physiological summation, which occurs in the retina or other more peripheral parts of the response process. Its operation does not depend on the cause of the scatter evidenced in the S-shaped curve, which may be either quantum or biological fluctuations or some resultant of the two.

Pirenne[6] has independently applied a similar idea to binocular summation in the perception of a point flash by the dark-adapted eye.

Visibility Curves under Different Conditions

Recently visibility curves for both fovea and parafovea have been determined by the brightness matching method, using a sufficiently small matching field for the retinal properties within it to be fairly constant. In this work of Walters and Wright[7], measurements were made from near threshold up to quite high brightnesses of the matching field, and the gradual change in the form of the parafoveal visibility curve from a typical rod curve with maximum at about 510 mμ to a typical cone curve with maximum at about 560 mμ was established. At the lowest brightnesses used, the form of the visibility curve in the red end was still changing, indicating that the cones were still having some effect.

It is of interest to try to interpret the changes in the parafoveal visibility curve, using the picture of the rod-cone transition which is presented by measurements of the threshold. The change in the parafoveal threshold as the brightness level is raised follows a curve such as that shown in Fig. 2, which refers to a green adapting brightness and a yellow test stimulus. There is no reasonable doubt about the meaning of this curve. The lower part represents the threshold of the rod mechanism, the upper part the threshold of the cone mechanism.

Experiment shows that if the wave-length of the test stimulus is changed, say from 580 to 500 mμ,

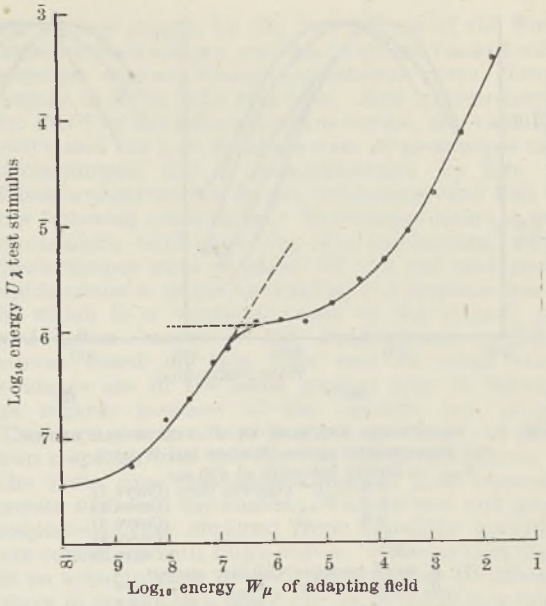

Fig. 2. 5° PARAFOVEAL THRESHOLD FOR A TEST STIMULUS OF WAVE-LENGTH 580 mμ AND AN ADAPTING FIELD OF WAVE-LENGTH 500 mμ. (FROM STILES[8].)

the rod component curve is moved bodily down to lower energy thresholds because the rods are more sensitive to light of wave-length 500 mμ. The cones, however, are less sensitive to this wave-length and the cone curve moves up. Change in the wave-length of the adapting field produces similar bodily shifts of the component curves, but parallel to the horizontal axis.

By a reasonable generalization of these experimental results[8] the condition that the two halves of a photometric field, viewed parafoveally, shall be on the threshold of discrimination is obtained in the form:

$$1 = \left[\frac{\delta\sigma}{F_s(\sigma)}\right]^2 + \left[\frac{\delta\pi}{F_p(\pi)}\right]^2 \quad . \ . \ . \ (1)$$

where σ and $\sigma + \delta\sigma$ are the scotopic values, and π and $\pi + \delta\pi$ are the photopic values of the lights in the two halves of the field. The scotopic and photopic values of a light of energy distribution $W_\lambda d\lambda$ are defined as $\sigma = \int W_\lambda s_\lambda d\lambda$ and $\pi = \int W_\lambda p_\lambda d\lambda$, where s_λ and p_λ are respectively the spectral sensitivity curves of the rod and cone mechanisms. The fixed functions $F_s(x)$ and $F_p(x)$ are determined by the shapes of the rod and cone component curves of Fig. 2. By applying a method due originally to Helmholtz[9] the threshold condition (1) can be used to derive a step-by-step visibility curve for any intensity level of the matching field. Curves calculated in this way are compared with a selection of Walters and Wright's experimental curves in Fig. 3.

As the brightness level is raised, both the observed and theoretical curves[10] show initially a rise in the red and later a shift of the maximum towards the red, and the intensities at which these changes occur are in fair agreement. It should be observed, however, that the step-by-step method was not used by Walters and Wright; they used a fixed red comparison field. At high brightnesses, the step-by-step and the fixed comparison field visibility curves are substantially the same, but this may not be so in the transitional

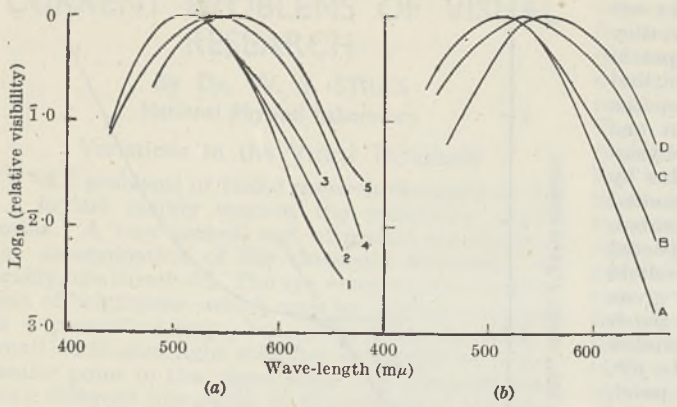

Fig. 3. BRIGHTNESS MATCHING IN 3° PARAFOVEAL REGION.
(*a*) Experimental curves (Walters and Wright)
W_{630} = Energy intensity at 630 mμ
= $3{\cdot}8 \times 10^{-6}$ ergs/deg.²/sec. (Curve 1)
= 6·2 ,, ,, ,, (Curve 2)
= 9·2 ,, ,, ,, (Curve 3)
= 37 ,, ,, ,, (Curve 4)
= 230 ,, ,, ,, (Curve 5)
(*b*) *A*, mean scotopic visibility curve[10]
B, computed curve, $W_{630} = 11 \times 10^{-6}$
C, ,, ,, $W_{630} = 29 \times 10^{-6}$
D, mean photopic visibility curve

region. Nevertheless, this tentative application of the Helmholtz method suggests that it may prove of use in interpreting on a common basis the threshold and brightness matching results.

The Helmholtz method of deriving a step-by-step visibility curve from threshold measurements can also be applied to foveal vision. Here, instead of two mechanisms, rods and cones, there are three mechanisms to consider, the three kinds of cone. The threshold condition takes the form:

$$1 = \left[\frac{\delta x}{F_r(x)}\right]^2 + \left[\frac{\delta y}{F_g(y)}\right]^2 + \left[\frac{\delta z}{F_b(z)}\right]^2, \quad \ldots \quad (2)$$

where $x = \int W_\lambda r_\lambda d\lambda$, $y = \int W_\lambda g_\lambda d\lambda$, $z = \int W_\lambda b_\lambda d\lambda$ and r_λ, g_λ, b_λ are the spectral sensitivity curves of the three cone mechanisms. These curves and the fixed functions $F_r(x)$, $F_g(x)$, $F_b(x)$ have all been determined to a first approximation from measurements of foveal thresholds. The derived visibility curves, (*a*) for very high field brightness, (*b*) for a brightness at the level normally used in photometry, are shown as the plotted points in Fig. 4. The agreement with the C.I.E. visibility curve is promising.

The colour perceptions in the parafoveal retina are not radically different from those in the fovea, and it must be assumed that there, too, three cone mechanisms are operative. The discussion of the parafoveal visibility curve should therefore have been based on a four-dimensional threshold condition:

$$1 = \left[\frac{\delta\sigma}{F_s(\sigma)}\right]^2 + \left[\frac{\delta x}{F_r(x)}\right]^2 + \left[\frac{\delta y}{F_y(y)}\right]^2 + \left[\frac{\delta z}{F_z(z)}\right]^2 \quad \ldots \quad (3)$$

It is not difficult to see, however, that the resulting visibility curves would not be materially different from those obtained on the simpler view. But the form of the result raises a difficult question in our ideas of the visual mechanism. At the fovea, the two halves of the field will match in all respects if δx, δy and δz are small, that is, if three relations of the form $\int r_\lambda W_\lambda d\lambda = \int r_\lambda W_\lambda' d\lambda$ approx. are satisfied. In the parafovea it appears that four such relations would have to be satisfied, which apparently contradicts the main tenet of the trichromatic theory.

Psychologists, in particular Katz[11], have emphasized that hue, saturation and brightness are not the only modes of appearance of colours. It is conceivable that another modality, for example, a 'filminess-solidity' differentiation, might be manifest in parafoveal vision, and that to equate parafoveal fields in this respect, as well as in hue, saturation and brightness, a fourth variable would be required. However this may be, the immediate requirement for an attack on this interesting visual problem is a thorough investigation of colour-matching in the parafovea.

The Retina in a State of Change

Wright[12] has shown that information about the relative rates of recovery of the different cone mechanisms can be obtained by the method of binocular colour matching. The test light seen by the recovering eye is colour-matched by a mixture of three spectral primaries forming the comparison light seen by the control eye. As recovery proceeds, the varying amounts of the primaries required determine three recovery curves. One of the first problems attacked by Wright was the determination of the visibility curves of the three cone mechanisms, or the fundamental response curves. The underlying assumption was the so-called law of coefficients. This says that if x, y, z are the quantities of the fundamental primaries (that is, hypothetical primaries each of which stimulates only one of the cone mechanisms) which match the test light before the application of the adapting light, then at a given time t after removing the adapting light the quantities required will be ax, by, cz, where the coefficients a, b, c are independent of the intensity and colour of the test light. They will, of course, depend on the characteristics of the adapting light and the time t. By experimenting with various test lights and adapting lights, Wright was able to derive a set of fundamental response curves which were consistent with the results and with the coefficient law. These seemed satisfactory except for the fact that the green response curve dropped to negative values in the blue end of the spectrum. Although negative values are quite acceptable in colorimetry, they cannot easily be interpreted as a property of a cone mechanism. Recently Walters[13] has shown that the coefficient law is not true in general, and has suggested that it becomes true only in the limiting case of a test stimulus of very low intensity. On this view, he has made a re-determination of the red and green response curves.

The coefficient law may fail because the test light itself is sufficiently bright to modify the recovery process, and this modification may occur to different extents for the three mechanisms. This would not necessarily entail any interaction between the three mechanisms. However, there is evidence of true interaction between the mechanisms. A specially noteworthy effect is the phenomenon of the positive blue[13,14]. If the retina is adapted with a strong red light and a red test light is applied, then within the first few seconds of recovery the test stimulus appears desaturated or possibly purplish, and positive blue has to be introduced into the comparison patch. It might be expected that the red adapting light would

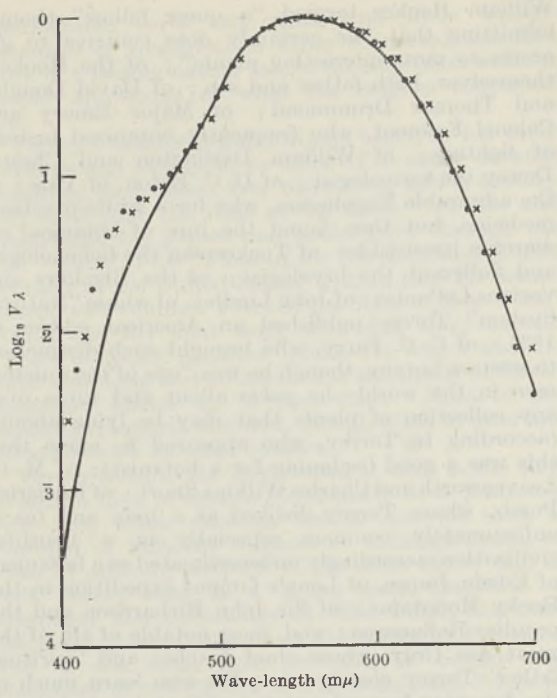

Fig. 4. FOVEAL VISIBILITY CURVE.
⊙, derived by threshold method: very high brightness;
×, derived by threshold method: photometric brightness level (80 photons);
Continuous curve: C.I.E. visibility curve.

fatigue the blue mechanism less than the red or green, but then the red test stimulus would also stimulate the blue mechanism less. The evidence now accumulated seems to rule out any explanation of the positive blue on the basis of three independent mechanisms with constant spectral response curves. It should be noted that the effect cannot be attributed to a blue after-image superposed on, but otherwise independent of, the test light, for it can occur under conditions where no blue after-image is visible in the absence of the test light.

Another type of interaction occurs if the rate of recovery of, say, the green mechanism depends on the instantaneous conditions or on the rates of recovery of the other two mechanisms. Such interaction might not of itself entail a breakdown in the coefficient law. That interaction of the kind in question does occur has been shown by Wright[14], who found that the red and green recovery curves followed different courses depending on whether, in the initial adaptation, the blue mechanism was, or was not, highly stimulated. It is not difficult to conceive how interaction of this type could be brought about if the recovery of the three mechanisms depended on some common and limited reservoir of photochemical material or on some common recuperative substance, such as oxygen carried by the blood.

On the whole, it seems that the notion of three independent cone mechanisms with fixed response curves works fairly well provided the retina has become adapted to the radiation falling on it. It is in the process of changing from one state of adaptation to another that the effects of interaction are chiefly exhibited.

Fundamental Response Curves

König believed that the principal colour blinds—protanopes, deuteranopes, tritanopes—differed from the normal simply by the lack of one of the three response mechanisms, and his proposed fundamental response curves—*Grundempfindungen*—were chosen largely to fit in with this idea. New measurements by Pitt[15] of the colour-mixture curves, the visibility curve and the hue discrimination of protanopes and deuteranopes, and a reconsideration by him of König's observations on five tritanopes, lead him to the following conclusions. Protanopes lack the red mechanism, tritanopes the blue mechanism, while deuteranopes have in place, of the red and green mechanisms a single mechanism the response curve of which is a weighted mean of the normal red and green curves. His fundamental response curves based on this view and on some other evidence are of the same general type as König's as regards position of the maxima and shape. They are also in tolerably good agreement, in these two respects, with the spectral sensitivity curves of the three cone mechanisms derived from measurements of foveal thresholds. Walters' red and green response curves obtained from binocular matching are consistent with Pitt's curves. It seems that there is an accumulation of evidence obtained in different ways in favour of a set of curves of the König type.

Of recent years a great many measurements have been made, both in Great Britain by Wright[16,17] and his co-workers and in the United States by MacAdam[18], on the hue limen and the more general colour limen throughout the colour triangle. The results have been expressed in terms of the C.I.E. trichromatic system and the so-called uniform chromaticity system. Presumably, if expressed in terms of the fundamental primaries, they would assume a particularly significant form. This does not mean that when so expressed they would exhibit any very obvious or simple property. In particular, they will not show that, in the triangle or in the rectangular system, just distinguishable colours are always separated by a fixed distance. It now seems certain that no linear transformation of the C.I.E. co-ordinates would present the limen measurements in this simple form. The analysis of the data is complicated by the existence of considerable differences between the results of different observers. By the use of *non-linear* transformations of the C.I.E. co-ordinates, Moon and Spencer[19] have succeeded in expressing the complete liminal data of one observer in the much desired form in which a fixed distance in the diagram separates all pairs of just distinguishable colours. The physical implications of this result are not yet clear.

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JOHN TORREY: AMERICAN BOTANIST

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TO those familiar with the vast and productive western and middle-western regions of the United States, the realization may come as something of a shock that these spacious lands were not only little developed but also very little known a century ago. A recent book* embraces that very important phase of American history—the detailed exploration and development of the West. In it we learn much of the coming and going of expeditions, of the trials of explorers and administrators, and of the discovery of all manner of new features. The West was still a country where exploration in the full geographical sense could be carried out—in contrast to the world to-day which, to be honest, we must admit contains few if any major areas remaining to be discovered or even primarily surveyed—and it was still very much a land of wild Indians and all manner of dangers both known and unforeseen. Much the same was true, in lesser degree, of the Rocky Mountains and many tracts lying nearer to the eastern and southern fringes of civilization.

But the very period of these explorations (well on in the nineteenth century) was one of great scientific awakening and development; and so, fortunately, they saw a telescoping of geographical exposition with the scientific investigation which is the real and none the less fascinating work of the explorer of to-day.

Accordingly to the subject of this biography, the expeditions brought in plant collections in considerable number and variety, which led to his being the first to describe the flora of many areas that had previously remained unknown botanically. At first the recognition of the calls of botany needed activating by the instruction and dispatch of collectors; but in time it seemed to proceed almost automatically. Indeed, the reader might be excused if, in a fit of enthusiasm, he were to conclude that this account of the botanical investigation which proceeded in the United States in the days of John Torrey gave a very fair picture also of the history of American exploration in those momentous times.

Torrey the botanist was born in 1796 in New York, of a New England father of British ancestry, and died early in 1873 in his seventy-seventh year. Though a physician by training and to a considerable extent a chemist by profession, he was practically always a botanist by choice. Botany it was that brought him fame, and, through him, made great the name. His long and active life encompassed those of many famous botanists, whom he helped and encouraged in his own country and corresponded with in other parts of the world—so that the story of his work and times is punctuated with their names and contains long extracts from their correspondence.

We learn much of Amos Eaton, "the first great teacher of natural history in America"; of the scholarly mycologist Schweinitz (a prominent clergyman like the pioneering G. H. E. Muhlenberg, "the father of American botany"); of Nuttall, whom Sir William Hooker termed "a queer fellow" though admitting that "he certainly does contrive to get access to most interesting plants"; of the Hookers themselves, both father and son; of David Douglas and Thomas Drummond; of Major Emory and Colonel Frémont, who frequently botanized instead of fighting; of William Darlington and Chester Dewey the caricologist; of D. C. Eaton, of Yale; of the admirable Engelmann, who for a while practised medicine, but then found the lure of botanical researches irresistible; of Tuckerman the lichenologist and Sullivant the bryologist; of the Bigelows and various LeContes; of John Lindley, of whose "Natural System" Torrey published an American edition in 1831; of C. C. Parry, who brought such distinction to western botany, though he was "one of the quietest men in the world—he *pokes* about and turns over any collection of plants that may be lying about" (according to Torrey, who appeared to agree that this was a good beginning for a botanist); of M. C. Leavenworth and Charles Wilkins Short; of Frederick Pursh, whom Torrey disliked as a man and (as is unfortunately common especially in a youthful civilization) accordingly underestimated as a botanist; of Edwin James, of Long's famous expedition in the Rocky Mountains; of Sir John Richardson and the peculiar Rafinesque; and, most notable of all, of the great Asa Gray, whose chief teacher and 'spiritual father' Torrey clearly was. We also learn much of the American learned societies of that day and this—including the Smithsonian Institution, the American Philosophical Society, the National Academy of Sciences at Washington, D.C., and the Lyceum of Natural History of New York with its successor the New York Academy of Sciences.

The author of Torrey's biography has obviously been at great pains to rout out all manner of data and evidence, both published and unpublished. Nevertheless the resulting publication is not without blemishes—as, for example, a fair quota of misprints and ambiguities, the rather loose literary style and apparent lack of expert editing, and the inclusion of such a welter of fact and seemingly minor detail that the result is at times confusing. Moreover, where so much space is given to the description of expeditions and the routes they took, it is surprising not to find more maps. The characters are also very numerous, coming and going so that the central one is apt to be swamped, and no very clear picture of John Torrey, the man, emerges. However, we are given here and there tantalizing glimpses of the real and rather lovable human being—as, for example, in extracts from his personal letters and in the anecdote about the child John who "considered it a great hardship to be sent after dark into the country . . ." although by day he loved the wild tracts beyond the small heart of contemporary New York.

In short, the book is not easy reading; but the theme is intensely interesting. For Torrey lived in one of the most vigorous phases of American history, a history which is seen in this biography from a new or at least unhackneyed angle—that of a pioneer in taxonomic and phytogeographical research whose experiences should prove valuable to students, botanical or otherwise, of the period or of that noble and fundamental science. For fundamental it is, in that taxonomy (most profitably with the background of its geographical offshoot) deals with the delimitation and identification, and where necessary the description and classification, of biological entities of

* John Torrey: a Story of North American Botany. By Andrew Denny Rodgers, III. Pp. x+352. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1942.) 3.75 dollars or 25s. net.

innumerable sorts and sizes, and little enough botanical or zoological or other connected scientific work of a lasting nature can be accomplished without proper knowledge of what the entities concerned are.

Torrey's botanical publications began in his early twenties and extended, as those of so many devoted botanists have done, over more than half a century and until past the time of his death. In size and importance his papers and books grew through the first volume of his "Flora of the Northern and Middle Sections of the United States" (1824), then his monumental two-volume "Flora of the State of New York" (1843) and his joint work with Asa Gray on the "Flora of North America" (1838–43), which was the most searching and authoritative treatment of North American plants up to that time. Most of the expedition reports followed, though often in intervals between work at other subjects.

Torrey lived in the days when, at least in the New World, a man of science could easily be a 'professor' (the title often meaning less in America than in Europe) of different subjects at different times, or even of different subjects at the same time; and in fact Torrey was, as a young man, professor of chemistry and mineralogy at West Point, and later for many years professor of chemistry at Princeton and at the same time professor of botany and chemistry at the College of Physicians and Surgeons of New York (part of what is now Columbia University), where he had graduated. As a chemist he appears to have discovered pectin, which he called "sclerotin", while his chemical knowledge and ability received high recognition later in life when he was made United States assayer; but always he was in touch with, and usually he had a hand in, anything of importance, botanically speaking, which was going on in that rapidly developing country.

As a man Torrey was predominantly straightforward and hard-working, clearly owing his deserved and lasting fame to the consistent expression of these qualities through a life-long devotion to his favourite subject. He appears during his life-time to have been highly respected and widely loved. In the words of one of the most eminent of his successors in the modern practice of taxonomy, Prof. M. L. Fernald, of Harvard, "Torrey was exact, scholarly, a kindly and devoutly religious man, and in the goodness of his heart ready to help everyone". I have heard Prof. Fernald refer to Torrey's descriptions of plants as "wonderfully vivid and accurate, models to this day" —high praise indeed from the director of the Gray Herbarium, whose great founder was Torrey's pupil, assistant and then associate over a total span of more than forty years.

Gray himself styled Torrey "an investigator . . . characterized by a scrupulous accuracy, a remarkable fertility of mind, especially as shown in devising ways and means of research, and perhaps by some excess of caution", who had a "thorough love of truth for its own sake" and "took a prominent part down almost to the last days of his life" in putting into order and describing the materials coming in almost interminably from the exploring expeditions of the time. All this appeared to result from the circumstance that, as a boy, Torrey had been taught by Amos Eaton "the structure of flowers and the rudiments of botany" when Eaton was serving a term in the New York State prison, of which Torrey's father, Alderman William Torrey, was then fiscal agent. Eaton seems to have taught in such a way as to 'awaken a taste and kindle a zeal that could be extinguished only with the pupil's life'. How much greater in our scientifically enlightened days are the data and chances of the educator, and how vitally important his task!

The effect which Torrey has had on botanical knowledge and institutions in America can scarcely be over-emphasized. His name is commemorated in a 'unique' genus of the Coniferæ, in numerous species of vascular plants, in a noble peak in the Rocky Mountains, and in the splendid Torrey Botanical Club; his herbarium exertions "representing a deal of back-ache" went far towards starting two of the greatest herbaria of the world, namely, the United States National Herbarium and the Herbarium of the New York Botanical Garden. Essentially an *American* botanist, finding more than enough to do within the confines of his own sub-continent, Torrey was content to describe rather than to classify, to investigate rather than to theorize—wisely leaving to others, whom he knew would come, the generalization for which he realized the time to be unripe.

Although essentially a practical man, Torrey was to a considerable extent a 'cabinet' botanist, though living in the days when such were needed. He did not experience the thrills and adventures of the actual explorers whose results he worked out so tirelessly and meticulously. His were rather the thrills and adventures of research—the excitement of the microscope and of testing the validity of speculations—the joys which strict compliance with the requisites of minute analysis may bring: for his was the imagination which can see a verdant treasure in a dried specimen. He had the all-important taxonomist's flair; and had he lived in these days of cytogenetics and physecology there can be little doubt that he would have backed or underlain this flair with far more field observation. As things were, however, he was hard put to it, in the midst of other and often more lucrative duties, to arrange and assort, then diagnose, name and describe, the new things which came to him almost daily. There is something of greatness in the man who can sit and wait and have all that he wants come to him; and in the aggregate Torrey must have named and described some thousands of new species and varieties of plants.

In most modern countries, as in the United States of America, botany is a great subject with a vast following both professional and lay—especially among the enlightened who realize that it is by plants that man is largely surrounded, and on them that he lives—consequently its study is imbued with sentiment and historical flavour. In deference to this we may appropriately conclude the present account by quoting Asa Gray, who thus closed his obituary notice of Torrey's life: "Thirty or forty years ago, a new and remarkable evergreen tree was discovered in our own Southern States, which it was at once determined should bear Dr. Torrey's name. More recently a congener was found in the noble forests of California. Another species had already been recognized in Japan, and lately a fourth in the mountains of Northern China. All four of them have been introduced and are greatly prized as ornamental trees in Europe. So that, all round the world, *Torreya taxifolia*, *Torreya Californica*, *Torreya nucifera*, and *Torreya grandis*—as well as his own important contributions to botany, of which they are a memorial—should keep our associate's memory as green as their own perpetual verdure".

OBITUARIES

Brevet-Colonel F. Percival Mackie, C.S.I., O.B.E.

BREVET-COLONEL MACKIE, who had a distinguished career in the Indian Medical Service, died at Oransay, Birnam, on July 15. At the time of his death he was chief medical officer to the British Overseas Airways Corporation in London. He leaves a widow and three sons.

Born on February 19, 1875, son of the Rev. John Mackie, rector of Fylton, Glos, he was educated at Dean Close School, Cheltenham, the University of Bristol, and St. Bartholomew's Hospital. After graduating in medicine and surgery at the University of London he entered the Indian Medical Service in 1902, taking first place in the competitive examination of that year and winning the Gold Medal in medicine and the scholarship in surgery. Later in his career he added the F.R.C.P. and the F.R.C.S. as well as the D.P.H. to his professional qualifications.

In India, after a short period of military duty which included a tour as medical officer to the Younghusband Mission to Tibet, he elected for the civil side of the Service with the object of devoting himself to bacteriology and medical research, for which, at that time, organized arrangements in India were in an early stage of development. It was the time when the terrible drama that was being played by malaria, cholera and plague had confirmed the Government of India in its intention to establish an effective organization of bacteriological workers and laboratories, and when several outstanding discoveries in tropical medicine had inspired and stimulated qualified members of the Service to engage in one or other of the young sciences (particularly bacteriology, protozoology and medical entomology) which offered a prospect of finding effective means of control and prevention. Plague, which had appeared in Bombay in 1896, was still spreading eastwards and northwards throughout the country, and Mackie's first appointment in the newly created Bacteriological Department of the Government of India (which was afterwards known as the Medical Research Department) was to the Plague Research Laboratory, Parel, Bombay. This was in 1905, the year in which the British Plague Commission under Dr. C. F. Martin, director of the Lister Institute, arrived in India and selected the Parel laboratory as its headquarters. In this appointment Mackie shared in the brilliant work of the Commission which, as is well known, settled the question of rat-flea transmission and gave to India, and the world in general, fundamental knowledge of the epidemiology of plague to which little was added in later years.

From September 1908 until November 1909 Mackie was on deputation to Uganda as a member of the Royal Society's third Sleeping Sickness Commission under Sir David Bruce. On his return to India he again took up his post at Bombay.

In 1911 the Government of India deputed him for special research again, this time to study kala azar in Assam. The causal organism of this fatal disease (the Leishman-Donovan parasite) had been discovered a decade earlier; but the mode of transmission was still unknown. It was suspected generally that the transmitting agent must be an insect, but prolonged research with bed-bugs, mosquitoes, fleas, lice and ticks had yielded no convincing result. Mackie and others had observed a significant correspondence between the topographical distribution of cases of kala azar and of a particular species of sandfly, and he made an important contribution when he said in his report: "The only insect which has given any return for the work put into it is the sandfly, and I am of opinion that the relation of this insect to the disease would repay further investigation". Fourteen years later the correctness of this opinion was confirmed when intensive team-work by the staff of the Calcutta School of Tropical Medicine, supplemented by that of the Government of India's special Kala Azar Commission, convincingly incriminated the sandfly as the true vector.

Among much other outstanding work there is space to mention only the speedy and efficient manner in which Mackie, working under great difficulties of supply, established a central bacteriological laboratory in Mesopotamia in 1916 and thus ensured the prompt bacteriological diagnosis of cholera and other epidemic diseases which broke out among British troops on their way up the Tigris River to relieve Kut. The strain of the cholera vibrio which he isolated from a colleague who fell a victim to the disease was afterwards maintained as the type of the organism endemic in that part of the world. For his services in that War he was twice mentioned in dispatches and the honour of O.B.E. was conferred upon him.

After the War Mackie held in succession the posts of professor of pathology in the University of Calcutta, director of the Pasteur Institute, Assam, and director of the Haffkine Institute, Bombay. Later he officiated for a year as public health commissioner with the Government of India and for another year as surgeon general with the Government of Bombay. While holding these administrative offices he was honorary surgeon to the King and to the Viceroy. The C.S.I. was conferred upon him in 1932.

S. P. JAMES.

Mrs. E. J. Hatfield

MANY will have learned with regret of the death of Mrs. Hatfield in early June. Those who knew her will realize that she never spared herself; after retirement she took up part-time work for the British Social Hygiene Council.

During her earlier years she studied in the University of London and at Cambridge. Some of her student years were also spent in Germany. Possessed of an open mind, she later evinced much interest in biology and psychology and followed carefully the trend of modern biological research. At the North London Collegiate School, a great many pupils passed through her classes, and all will testify to the thoroughness of her training and to the inspiration for sound work which she inculcated. While teaching, she published the well-known text-book "An Introduction to Biology".

After her retirement from teaching Mrs. Hatfield lectured for a time at one of the training colleges. At the summer schools and conferences of the British Social Hygiene Council she will be remembered for her clearly delivered lectures and wise counsel. She played a most active part in the Association of Women Science Teachers and was always in demand as a speaker at the meetings of the Association. Her position on committees, consultative or otherwise, was recognition of the opinion in which she was held by her contemporaries.

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.

The Royal Institute of Chemistry of Great Britain & Ireland

(Founded 1877)
(Incorporated by Royal Charter, 1885)

APPOINTMENTS REGISTER

A Register of Chemists (Fellows, Associates and Senior Registered Students), who are available for appointments or who are seeking to improve their positions, is kept at the office of the Institute. The facilities afforded by this Register are available (free) to Companies and Firms requiring the services of chemists, and to Universities, Colleges and Technical Schools requiring Teachers of Chemistry and Technology.

Particulars of the Regulations and Examinations of the Institute can be obtained (free), on application to The Registrar, the Royal Institute of Chemistry, 30 Russell Square, London, W.C.1.

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Professor of Mechanical Engineering and Dean of the Faculty: S. J. Davies, D.Sc., Ph.D., Wh.Ex., M.I.Mech.E.

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J. F. S. ROSS, M.C., B.Sc. Ph.D.(Lond.),
Principal.

THE POLYTECHNIC

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A course of 24 Lectures on ELEMENTARY STATISTICS will be given by Miss H. V. ALLEN, Ph.D., on Wednesday Evenings from 7.30 to 9.0. Beginning on Oct. 4, 1944. Fee: One Guinea.

Applications should be made to the Head of the Department of Mathematics and Physics as soon as possible.

UNIVERSITY OF MANCHESTER

PHYSICS DEPARTMENT

Full particulars of the LECTURES and LABORATORY COURSES IN PHYSICS, preparing for both the Ordinary and Honours Degrees, will be forwarded on application to the Registrar.

The SESSION COMMENCES on THURSDAY, OCTOBER 5.

CITY OF LEICESTER EDUCATION COMMITTEE

LEICESTER COLLEGE OF TECHNOLOGY AND COMMERCE

Principal: L. W. Kershaw, O.B.E., B.Sc., A.M.Inst.C.E.

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A full-time Lecturer in Biology is required to take up duties as soon as possible.

Applicants should possess a good Honours Degree in Zoology, with some other biological subject as subsidiary. Qualifications and experience in Bacteriology, Microtechnique, or some branch of Applied Biology will be added recommendation.

Details of the work of the Department and that required from the Lecturer may be obtained from the Principal of the College.

Salary in accordance with the Burnham Technical Scale.

DEPARTMENT OF CHEMISTRY

Applications are invited from Honours Graduates for the post of Head of the School of Chemistry. Candidates should have Analytical Testing and Research experience. The successful candidate will be required to organize a Chemical Testing Service for local industries. Further particulars may be obtained from the Principal.

Salary £450 rising by annual increments of £20 to a maximum of £600, plus temporary cost-of-living bonus—at present £52 per annum. Qualifications and previous industrial as well as teaching experience will be taken into account in determining commencing salary.

Applications for these posts should be made by letter to the Principal of the College not later than Sept. 9, and should be accompanied by copies of not more than three recent testimonials, together with the names of two persons to whom reference may be made.

H. S. MAGNAY,
Education Department, Director of Education.
Newarke Street, Leicester.

SUNDERLAND EDUCATION COMMITTEE

THE TECHNICAL COLLEGE

Principal:
F. H. REID, B.Sc., Wh.Ex., M.I.Mech.E.

Applications are invited for the post of LECTURER IN CHEMISTRY to commence in Oct., 1944, or as early as possible after that date.

Salary: Burnham Technical Scale £284—£15—£480, plus £52 war bonus. The commencing salary will include an allowance for approved professional or industrial experience. After three years' service an additional £20 per annum will be made to the scale of salary in respect of "special work of an advanced character."

The standard of the full-time day course is that required for the B.Sc. (special chemistry) London.

Applicants should possess a good Honours Degree in Chemistry, with particular experience in Organic Chemistry. Previous teaching and/or research experience is desirable.

Forms of application and full particulars may be obtained from the Registrar, Technical College, Sunderland, upon the receipt of a stamped addressed envelope. Applications should be returned to the undersigned not later than Sept. 9, 1944.

W. THOMPSON,
Education Offices, Director of Education.
15 John Street,
Sunderland, Co. Durham.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

DIRECTOR OF FOREST PRODUCTS RESEARCH

Applications are invited for the post of DIRECTOR OF RESEARCH, Forest Products Research Laboratory, Princes Risborough, which will shortly become vacant on the retirement of the present Director. Candidates, who must be natural-born British subjects, should have high scientific qualifications with experience of, and ability to organize, direct, and develop, research aimed at industrial objectives. Knowledge and experience of wood and its present and potential uses would be advantageous but are not essential. Age should preferably not exceed 50. The salary will be of the order of £1,400 per annum, with superannuation provision under the Federated Superannuation System for Universities.

Applications, giving particulars of age, qualifications, experience, etc., and not less than two personal references, should be sent to the Secretary, Department of Scientific and Industrial Research, Teddington, Middlesex, not later than October 9, 1944. Further particulars of the post may be obtained by application to that address.

CHELSEA POLYTECHNIC

LONDON, S.W.3

RESPONSIBLE LECTURER IN PHYSIOLOGY

Applications are invited from University Graduates for the full-time post of Responsible Lecturer in Physiology. The successful candidate will be required to have qualifications and experience which will secure recognition as a teacher by the University of London. Salary will be in accordance with the London Burnham (Technical) Scale, with war bonus plus an allowance in respect of special responsibility.

Further particulars and form of application may be obtained by sending a stamped addressed foolscap envelope to the undersigned, to whom applications should be returned by Sept. 20, 1944.

F. J. HARLOW, M.B.E., Ph.D., B.Sc.
Principal.

THE UNIVERSITY OF MANCHESTER

BEYER CHAIR OF ENGINEERING

Applications are invited for appointment to the above post in Faculty of Science. Stipend £1,300 to £1,600 per annum, according to qualifications. It is hoped that the successful candidate would enter upon his duties on Sept. 29, 1945, but arrangements might be made to commence at a later date. Candidate should possess qualifications in Civil or Mechanical Engineering or both.

Applications, which must be received on or before Nov. 18, 1944, should be sent to the Registrar, The University, Manchester, 13, from whom further information may be obtained.

UNIVERSITY OF SYDNEY

BOARD OF SOCIAL STUDIES

Applications are invited for the position of DIRECTOR, Department of Social Studies.

Qualifications: University Degree and Degree or Diploma in Social Work; practical experience in some field of social work; teaching experience. Duties: to teach professional courses in social work; to direct practical work of students; to act as executive officer of Board of Social Studies. Terms: salary £700—£50—£900. Duties to commence March, 1945. Allowance for travelling expenses. Position will be held open if appointee engaged on national service. Applications should be made by airgraph or quickest available method, supporting documents being sent by surface mail, to the Registrar, University of Sydney, to reach him by Dec. 1, 1944. Further particulars from the Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1.

UNIVERSITY OF EDINBURGH

DEPARTMENT OF ZOOLOGY

An appointment is about to be made to a LECTURESHIP IN VERTEBRATE ZOOLOGY. Experience in teaching Vertebrate Zoology and in Research, and a knowledge of Embryology are essential. The salary will be between £450 and £600, according to qualifications.

Particulars of duties and conditions may be had from the undersigned, by whom applications, with three recent testimonials, must be received not later than Sept. 25, 1944.

W. A. FLEMING,
Secretary to the University, Edinburgh.

UNIVERSITY OF LEEDS

Applications are invited for the following posts: (1) ASSISTANT LECTURER IN ZOOLOGY, commencing salary £300 to £350 per annum, according to qualifications and experience. (2) DEMONSTRATOR IN ZOOLOGY, commencing salary £250 per annum. Duties to commence on October 1, 1944. Copies of application, together with names of persons to whom reference may be made, should be sent to the Acting Registrar, The University, Leeds, 2, not later than September 8, 1944. Further particulars on application to the Acting Registrar.

UNIVERSITY OF LEEDS

DEPARTMENT OF ELECTRICAL ENGINEERING

The University Council will proceed in the near future to an election to the Chair of Electrical Engineering. The date of appointment will be a matter of arrangement. Those desiring to have their names considered in connexion with the vacancy are asked to communicate, not later than September 30, with the Acting Registrar, The University, Leeds, 2, from whom further particulars may be obtained.

UNIVERSITY OF LONDON

The Senate invite applications for the UNIVERSITY READERSHIP IN CHEMISTRY tenable at the Royal Cancer Hospital (Free). Salary not less than £650.—Applications must be received not later than first post on Sept. 18, 1944, by the Academic Registrar, University of London, S.W.7, from whom further particulars should be obtained.

Physicist required for a Company in Birmingham. Must have first-class experience on problems relating to lighting and aircraft and automobile lamps. Approximate salary £450 to £550 per annum. Applicants should write, quoting A.630XA, 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 Sept. 26, 1944.

Applications are invited for the post of SECOND VETERINARY OFFICER, Imperial Bureau of Animal Health, Weybridge. Salary, £600—£25—£850, plus cost of living bonus, also F.S.S.U. on confirmation. Commencing salary dependent upon qualifications and experience. Particulars of the conditions of service may be obtained on application to the Secretary, Imperial Agricultural Bureaux, 2 Queen Anne's Gate Buildings, London, S.W.1.

Personal Technical and Secretarial Assistant (under 35) required by Director of Research Establishment; shorthand, typing, some technical knowledge, and good personality essential, preferably with Science Degree and secretarial experience. Commencing salary from £200 to £300 per annum, (including bonus), according to qualifications and experience.—Applicants should write, quoting A552A, 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—with copies of three testimonials—on or before Sept. 12, 1944.

University of Leeds, Department of Agriculture. Applications are invited for the appointment of a temporary ASSISTANT DAIRY BACTERIOLOGIST. Salary scale £300 to £400, plus bonus—Further particulars from the Registrar, who will receive applications up to Sept. 15, 1944.

The Nyasaland Research and Development Company Limited in considering their post-war programme will shortly be appointing a BOTANIST AND ORGANIC CHEMIST, and invite applications. Salary according to qualifications and experience.—Applications to be addressed to Dr. M. Nierenstein, 2 Rylestone Grove, Bristol, 9. Further appointments will be made later on, and all such appointments to commence immediately after cessation of European hostilities.

Technicians required for Radon Centre in the country; scientific qualifications not essential.—Apply, Barnato Joel Laboratories, Middlesex Hospital. London.

Research Fellow (Biochemist) required. —Applications, with full particulars, to Secretary, Research Institute, 117 Grove Street, Liverpool, 7.

Chemist, 25, requires permanent, progressive, post-war position. Experience: routine and research laboratory work, plant control, development, etc. Interested chemotherapy, but any posts considered.—Box 234, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Chemical Laboratory Assistant with experience as Lecture Assistant and Storekeeper, required in a University College. Wages according to age and experience.—Box 237, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

For Sale: as new, unbound. What offers for any or all? "Chemistry and Industry," 1929, 1942-3; J.C.S., 1931-40; B. Chem. Abstracts A 1931-7; A11 1942-3; B11, B111, 1942; Chem. and Engineering News (U.S.A.), 1942, Nos. 14-24. American Chem. Abstracts, 1942; 28 issues "American Perfumer" and "Soap, Perfumery and Cosmetics," 1937-8; Journal Royal Aeronautical Society, 1942; J.S.C.I., 1942-3.—Box 236, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Chemical Laboratory equipment, complete or in part, urgently wanted by Manufacturing Chemists whose premises were destroyed by enemy action.—Write, Box 230, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Wanted Urgently for research work: eyepiece camera with focusing ocular for photomicrography.—Box 231, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Zeiss Large Photomicrographic Camera for disposal. Complete Koehler illuminating system, remote control, fine adjustment, etc.—Box 235, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Zeiss, 1/12th Oil objective £9 10s. Beck Research Microscope, £20; and Ross "Stepruva" Prism Glasses, £25.—Details: Mackett, 51 Millers Road, Brighton.

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).

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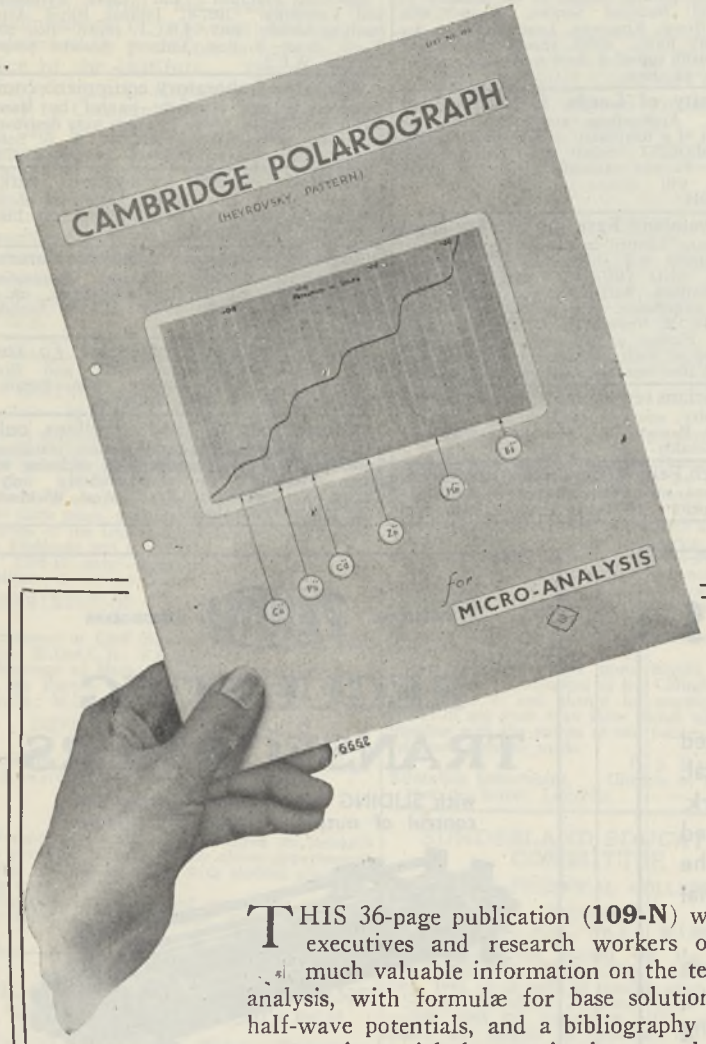

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(*v.* J. E. Page, NATURE, 1944, **154**, 199–12th August.)

THIS 36-page publication (**109-N**) will be sent to responsible executives and research workers on request. It contains much valuable information on the technique of polarographic analysis, with formulæ for base solutions, tables and charts of half-wave potentials, and a bibliography of 168 important references. A special feature is the reproduction of actual records obtained in original experiments in our own laboratory. A supplement describes the new Cambridge Voltamoscope, for routine determinations, which performs the same functions, but is non-recording.

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Those of us who knew Mrs. Hatfield as a friend learned to value her pleasant personality and ready smile. One could not be in her company for long without realizing her capabilities and wide cultural interests. Her outstanding characteristic was courage —the keynote of her life. Her friends and colleagues will miss very much one who possessed a fund of knowledge and a balanced outlook on life.

P. M. TAYLOR.

WE regret to announce the following deaths:

Sir Arthur Hurst, president during 1927–29 of the Section of Medicine of the Royal Society of Medicine, on August 17, aged sixty-five.

Prof. S. P. Mercer, professor of agricultural botany in the Queen's University, Belfast, and senior technical research officer of the Ministry of Agriculture, Northern Ireland, aged fifty-three.

NEWS and VIEWS

Agriculture at Edinburgh

THE endowment of the chair of agriculture in the University of Edinburgh was presented in 1790 by Sir William Pulteney, Bt., M.P., as a mark of his appreciation of his old University. Agriculture thus became the first chair in Edinburgh to be founded by a private benefactor, for its twenty-three predecessors had all been instituted either by the Crown or by the Town Council of Edinburgh, and it is probably the earliest foundation of its kind in any university in Britain. The present occupant of the chair, Prof. Ernest Shearer, who is also principal of the Edinburgh and East of Scotland College of Agriculture, retires after eighteen years of service at the end of this session, and the electors have selected as his successor in both posts Dr. S. J. Watson, director-in-charge of the Jealott's Hill Agricultural Research Station of Imperial Chemical Industries, Ltd.

Dr. Watson was educated at Armstrong College, Newcastle-upon-Tyne, and his agricultural interests have covered a wide field. He has been associated with Imperial Chemical Industries at first as officer-in-charge of the Animal Nutrition and Biochemistry Section, and latterly as director of the Agricultural Research Station. At Jealott's Hill his experimental work is well known to agriculturists and to scientific workers, and he has made a recognized contribution to the knowledge and practice of farm methods. His books include "The Feeding of Cattle", "The Science and Practice of Conservation of Crops" and "Silage and Crop Preservation", and his published papers cover many subjects associated with the feeding values of different kinds of crops, processes of preserving crops by drying and silage methods, and the planning of cropping.

Geophysics at Columbia University: Appointment of Prof. Maurice Ewing

PROF. MAURICE EWING, associate professor of physics at Lehigh University, has been appointed associate professor of geophysics in the Department of Geology of Columbia University. Prof. Ewing is at present engaged in research for the U.S. Navy with the civilian rank of chief scientist, and will take up his new post at the end of the War. At Columbia, Prof. Ewing will direct graduate instruction in geophysics as part of a post-war programme of geological training and research, and will continue his investigations of the continental shelf and the ocean basins. In recent years, through the development of special equipment of his own invention, Prof. Ewing has made geophysical measurements, both from ships on the surface and from submarines, of the continental margin beneath the ocean along the Atlantic coast of North America. Through these studies it was found in 1935–38 that the slope of the outwashed sediments off the Atlantic Coast did not conform to the slope of the underlying rock floor. In war-time the experience gained from these studies has been of special value to the U.S. Navy Department, and through the co-operation of the Government Prof. Ewing has been enabled to devote all his time to geophysical research, working from the Woods Hole Oceanographic Institute, at Woods Hole, Mass.

Employment Policy and Technical Efficiency

SOME further points in regard to the White Paper on Employment Policy were elucidated in the debate in the House of Lords on July 5 and 6. Welcoming an inquiry from Lord Barnby, Lord Woolton stated that the Government proposed to take statutory powers in order to get the statistics required. On the question of cartels and international agreements raised both by Lord Trent and Lord McGowan, Lord Woolton indicated Government concurrence in the proposal that there should be a Government inquiry on restrictive practices, and urged that the question should be considered on a factual and not an emotional basis, and from the point of view of the public interest. As was independently pointed out by Lord Wardington, such agreements embody principles identical with those enunciated in the Atlantic Charter, which advocates international agreements and co-operation and the creation of spheres of interest. On the point of technical efficiency stressed by Viscount Samuel as the most important point in the White Paper, Lord Barnby, who also raised the question of the Government's views with regard to trade associations, urged that if industry is to have efficient equipment, it requires a revision of the Factory Acts to permit the two-day shift operation of female labour. Expensive new equipment must, to carry overheads, run more than eight hours in the twenty-four. Lord McGowan referred to the growing emergence in British industry of a new social outlook, and also asked for more guidance as to the basis on which future international commercial relations are to be built. The question of controls was repeatedly mentioned, and Lord Woolton's statement that the Government is already considering the steps by which we could have an orderly unwinding of the controls reflected the practical temper of this debate, which showed a deep sense of the fundamental importance of a high standard of efficiency in British industry and that the realization of the White Paper proposals would come, as Lord Woolton said, by steady evolution and the application of modern scientific methods.

Science in the Universities

THE report "Science in the Universities" submitted by the Association of Scientific Workers to the University Grants Committee, March 1944, which has now been published, covers very little ground that has not already been dealt with by the reports from the Parliamentary and Scientific Committee, the Association of University Teachers, or the Nuffield College statements. It is limited to consideration of the physical and biological sciences and the applied sciences immediately related to them such as are normally taught in universities, with some attention to the social sciences; within these limits, it is one of the best guides that has appeared to the ways in which the rapid expansion of scientific knowledge and its application are affecting the universities, and to the measures required to deal with the immediate problems. Among the recommendations may be mentioned those stressing practical work in the vacations as part of the training of all scientific workers, not merely those training for industry; the emphasis on the education and training of laboratory technicians, and also on the technique of teaching.

The report supports the proposal for a universities academic council to co-ordinate the development of research, and also advocates research committees in each university to watch over the development of research, and administer the Government grant for research. Stress is also laid on the extension of maintenance grants, especially in post-graduate work, and the improvement of salaries and conditions of service. The report visualizes a doubling of the 1939 undergraduate population within four years after the War. The capital cost of the accommodation required, including a possible trebling of science departments, is estimated at not less than £30 millions over ten to twenty years, with an increase in annual expenditure to £15 millions within five years and to £20 millions after ten years. Doubling the Government grant in the first full academic post-war year, with an increase to £9 millions in the fifth year, is recommended.

Standard Frequency Broadcasts

SOME slight modifications have recently been made in the radio transmissions of standard frequencies broadcast by the U.S. National Bureau of Standards from station WWV. A new radio frequency at 2·5 Mc./sec. now operates from 23.00 until 13.00 U.T.; and the time signals have been modified by the omission of the pulse on the 59th second of every minute. The service now comprises standard radio frequencies of 2·5, 5, 10 and 15 Mc./sec., at least three of which are available at any time; standard audio frequencies of 440 and 4,000 c./sec. broadcast on these carriers; and interruptions of these broadcasts which constitute accurate time signals synchronized with the basic time service of the U.S. Naval Observatory. The time signals, which are available throughout the 24 hours, consist of pulses of 0·005 sec. duration at intervals of 1 sec. on all the carrier frequencies, and of 1-min. interruptions of the modulating frequencies every 5 min. The seconds pulses are heard as faint ticks which provide useful standards of short time intervals for physical measurements as well as serving their main function as accurate time signals. On the 59th second of every minute the pulse is omitted.

The 1-min. interval in the audio-frequency transmission is used to give the station announcement, either in Morse or (at the hour and half-hour) orally, and it also permits use of the radio frequencies uncomplicated by the presence of the low frequencies. The accuracy of all the frequencies, radio and audio, as transmitted, is higher than 1 part in 10^7. The intervals given by the seconds pulses are correct to 10^{-5} sec. The 1-min., 4-min. and 5-min. intervals marked by the interruption and resumption of the modulating frequencies are accurate to 1 part in 10^7. The Astronomer Royal's annual report remarks of these broadcasts: "A remarkable degree of agreement has been noted in comparisons of both frequency and time; as a time signal, this form of transmission appears to be capable of a very high standard of precision and to be well adapted for accurate comparisons".

International Trade

A BROADSHEET, "Facts about International Trade" (No. 219), issued by P E P (Political and Economic Planning), describes developments since the P E P report on international trade was published in 1937, and is intended to form the starting point for a later examination of some of the main problems of post-war international trade. The main conclusions emerging from the report itself and the present broadsheet are, first, that exports are essentially a means of obtaining necessary or desirable imports: neither Britain, the United States nor any other country should export primarily to create home employment; export and import policy should be deliberately related to a nation's balance of payments and to its long-term foreign lending and borrowing. Secondly, trade restrictions and bilateralism were a symptom more than a cause of the decline in world trade after 1929; post-war policy should aim at a continuing expansion of effective world demand, making full use of the world's man-power and resources. Multilateral trade, while creating the necessary conditions for obtaining the greatest possible advantages from international trade, also heightens the economic interdependence of nations. A restoration of mul'ilateral trade requires: (*a*) an efficient international monetary exchange clearing system in which all nations have complete confidence; (*b*) the maintenance of full employment within national economies; (*c*) the maximum attainable measure of political security. These three requirements are essential to a universal 'economy of peace'. Failing the establishment of a universal multilateral system of trade, the 'low-tariff club' represents a means by which nations most dependent on international trade can secure the benefits of multilateralism on a limited scale. 'Lend-lease' is essentially a war-time method of international exchange and is unlikely to continue after the immediate post-war period of securities; but world prosperity, like peace, is indivisible. Finally, Great Britain's major problem in foreign trade after the War is to increase her visible exports very considerably, to repair the inroads of war here and in overseas investment income, and to maintain the volume of imports vital to her standard of living.

Soviet Academy of Sciences in Western Siberia

IT is announced in the *Soviet War News* that a new branch of the Soviet Academy of Sciences has been opened in western Siberia to direct scientific activities in the territory stretching from the Ural Mountains to the banks of the Yenisei, and from the Arctic coast to China and Central Asia. It is believed that

a promising future exists there for agriculture, forestry, fishing and coal mining; and there are large deposits of metals and raw materials for the chemical industry. Long before the outbreak of war, the Soviet Government had made detailed plans for the development of Western Siberia; the War has given a great impetus to the process of industrialization. Many of the factories, colleges and scientific research institutions evacuated to the territory from the danger zones have already returned to their homes, but not without leaving behind important traces of their activities, as well as a proportion of their staffs to continue the work begun in Siberia.

The West Siberian branch of the Academy incorporates the Mining, Engineering and Geology Institute, the Chemico-Metallurgical Institute, the Power and Transport Institute and the Medical and Biological Institute; Novosibirsk has been chosen as its seat; and it will also have offices in Tomsk and Omsk, as well as in the new industrial towns which have sprung up during the last twenty-five years. Typical of these are Kemerovo (chemical and coal industry), Prokopievsk (coal), Stalinsk (metallurgical industry and mining) and Barnaul (centre of the Altai region). Prof. A. Skochinsky, a specialist in mining engineering, is head of the newly formed branch.

British Film Institute Summer School

A COURSE on visual education was organized by the British Film Institute at Bangor during August 19–26. Among a wide range of topics discussed, very useful contributions were made by Mr. Geoffrey Bell of the Shell Film Unit who discussed "The Scientific Film" and Mr. Neilson Baxter, of the same Unit, who dealt with "The Documentary Film". Both argued that the scientific, realist approach to a subject so characteristic of the documentary group of film-makers is in essence also the proper characteristic of an educational classroom film, as well as being useful for enlarging the child's general knowledge of his environment. Other speakers were Mr. G. P. Meredith, lecturer in visual education at the University College of the South-West, Dr. Winifred Cullis, who made a plea for an increase in the number of films for teaching physiology, and Lieut. M. G. Bowden of the U.S. Army, who gave the conference an account of the extent to which visual aids were used in America. The conference was attended by Polish, Dutch and Canadian representatives, as well as by English teachers and film-makers.

Crop-cutting Survey of Wheat in the Punjab

PRELIMINARY results have just reached Great Britain of an interesting example of random stratified sampling on the grand scale, devised by Dr. P. V. Sukhatme, statistician to the Imperial Council of Agricultural Research, New Delhi, and carried out by the Department of Agriculture of the Punjab. By sampling a hundred out of the total of nine million acres under wheat, the net out-turn of that crop for twenty-seven of the twenty-nine districts of the Province is estimated at 3,448,700 tons, with a standard error only just over 1 per cent. The cost of the survey scarcely exceeded Rs. 1,000 per district.

Uniformity of practice was obtained by central training of the senior staff concerned in all the details of the experiment, and also by central selection of the 748 villages (about 2 per cent of the total number available) used for the scheme. These were, for each district of the Province, proportionate in number to the area under wheat, but equally distributed among the tehsils of the district, and randomly within each tehsil. Within each village three fields were selected (since previous experimentation had shown little difference between the variation between villages and that between the fields of a village, and practical considerations of time, labour and cost counselled concentration of fields within a village), and within each field one plot of 1/20 acre (the variation between plots in a field being less than that attributable to either source just mentioned). Selection of the fields in villages and of the plot in each field was by use of random numbers supplied by the centre, which was able to check the process. Harvesting, threshing, winnowing and weighing were normally completed in one day. The final estimate includes adjustments for 'driage' owing to the divergence of this procedure, necessary for accuracy and speed, from the general practice (which allows a week or two for drying between harvest and threshing), and also for the different yields of wheat sown pure or mixed with other crops.

Improved Use of Daylight

Two useful recent publications deal with the more effective use of natural daylight. "The Natural Lighting of Houses and Flats with Graded Daylight Factor Tables", by T. Smith and Miss E. D. Brown of the National Physical Laboratory (London: H.M. Stationery Office, 4*d.* net), gives guidance in the choice of window dimensions for houses and flats. The penetration of daylight through a window is discussed, and tables are given from which the penetration of daylight for different window dimensions may be assessed. These tables are for daylight factors of 2, 1 and 0·5 per cent respectively. "Natural Lighting", Lighting Reconstruction Pamphlet No. 4 issued by the Illuminating Engineering Society (1*s.*), deals with the subject in a descriptive manner, and shows particularly the benefit derived from high windows and the suitable planning of buildings. In the most favourable circumstances, a daylight factor of 5 per cent may be attained at the working table, and in no case should the daylight factor be less than 0·2 per cent.

Announcements

MR. R. H. HILL, secretary of the Bodleian Library, has been appointed librarian and secretary to the Trustees of the National Central Library, in succession to Dr. Luxmoore Newcombe, who retires at the end of the year.

BOOKS and prints relating to various States of Central and South America, the West Indies and the Antarctic, as well as some rare old maps are the subject of Catalogue 671, issued by Messrs. Francis Edwards, Ltd., Marylebone High Street, London, W.1. The catalogue includes several rare items: a complete set of the *Challenger* results in forty-one volumes; J. Colnett's "Voyage of Whaling and Discovery" (1793–94), with his manuscript journal of the same date; the manuscripts of several of Cunninghame Graham's books; Grynaeus' "Novus Orbis", with the rare map of 1532; the first Latin edition of Munster, "Cosmographiae Universalis" (1550); "Purchas his Pilgrimes" (1624–26); Apian's map of America (1520); and Arrowsmith's chart of the Pacific (1798).

LETTERS TO THE EDITORS

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

Marine Biological Research in Great Britain

THE letter published in *Nature* of July 29 from Prof. F. E. Fritsch opens an important subject which has been in the minds of a number of zoologists during the past few years, and it is one in connexion with which some of us would be extremely glad to see action taken on the lines which Prof. Fritsch indicates. Whatever this action may be, it is essential to realize from the outset (as Prof. Fritsch does) that nothing short of one or more teams of full-time workers will meet the case adequately; the problems involved are too numerous and too complex to make a part-time attack on them any longer profitable. One can envisage valuable part-time assistance for the team, but a nucleus of full-time workers is indispensable.

It is not clear whether Prof. Fritsch has more in mind the benthic communities which exist between tidemarks, or those below tidemarks—presumably both. In fact, the need for new advances is very great in both fields, but the methods required for offshore work are very different from those appropriate between tidemarks, and undoubtedly different groups of workers should tackle the two aspects. As my own particular interest is in the intertidal zone, I should like to offer a comment referring to this belt, leaving the development of the offshore theme to others more competent to deal with it.

My own approach to British shore ecology has been through foreign waters, beginning with the Great Barrier Reef Expedition in 1928–29, extending to other tropical coasts, and including ten years in South Africa, where one sees a complete transition from sub-tropical to almost sub-antarctic conditions. During the years 1931–40 I was able, with the assistance of a dozen collaborators, to carry out a preliminary general survey of the South African coast, covering a distance of more than 1,800 miles, which was visited at about a hundred localities altogether[1]. Having done this, we naturally wished to compare our results with those arrived at in other countries, but it is very striking how little there is with which *direct* comparison is possible, despite the existence of a considerable literature. We reach, therefore, the rather astonishing conclusion that the intertidal region of South Africa (almost unknown, ecologically, in 1930) is probably, at the moment, better known, in its broad outlines, than any stretch of coast of comparable length in the world. The work from another area most nearly comparable with it is that of Fischer-Piette from the French and Channel coasts; one can piece together a rather imperfect picture for the coasts of North America (especially the Pacific coast); there are the accounts of coral reefs; but many regions of the world are unknown altogether, or known from one or two isolated papers only. A *general* picture of the tidal belt round the British coasts does not exist, in spite of our detailed knowledge of particular localities. This will be partly remedied so far as Algæ are concerned when surveys carried out during the present War are published; for animals there is an immense amount of work still to be done.

It is important to emphasize, in this connexion, that we shall never get a satisfying picture of the British coasts until we can fit them, in their due relation, into the larger picture of the world as a whole. Advances in the ecology of large areas have affected the land, fresh water, and the oceans much more than the tidal region; and a preliminary general statement covering intertidal biology in the world as a whole is very much needed. The need for relating Britain to this general picture can best be illustrated by a specific example. The South African survey mentioned above began as an attempt to solve the problem presented by the action of ocean currents on the coasts of the thirty-mile-long Cape Peninsula, a region of special zoo-geographical interest. It was immediately discovered, however, that this problem was literally insoluble until some sort of picture of the South African coast as a whole had been obtained; once the latter was available, the Peninsula became intelligible. Similarly, Britain will probably never become fully intelligible until its relation to the rest of the world is better understood than at present.

I do not wish to imply that future developments in Britain need necessarily repeat the particular type of work already done in South Africa. It has been pointed out that geographically Britain is a much more difficult and confused region than South Africa, unlikely to give clear-cut results, and that the amount of work needed to obtain the results would be out of proportion to their value. However this may be, it will be agreed by most people that a great deal of further work of *some* types is needed on the British coasts.

I should like, therefore, to develop Prof. Fritsch's thesis to this extent, that we need three things, involving three different modes of attack, and each of them demanding a team of full-time workers. These are (*a*) further work on the British coasts between tidemarks; (*b*) further work on the continental shelf of the British region, below tidemarks; and (*c*) an attempt to make a preliminary world-statement, based on a carefully selected series of samples, all seen by the same workers. As a matter of fact, there exist fairly detailed plans covering certain parts of the programme just outlined, and it would seem desirable that those most immediately concerned should consult together as to the best means of giving effect to such plans.

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Aberystwyth.

[1] A general account of this survey is in the press and due to appear in the next issue of the *Annals of the Natal Museum*; earlier parts of the work are described in a series of papers in that journal, and also in *J. Linn. Soc. (Zool.)*, *Trans Roy. Soc. S. Africa* and other periodicals.

WE have read with interest Prof. F. E. Fritsch's letter on marine biological research in Great Britain[1], in which he stresses the need for the co-operation of botanists and zoologists in the investigation especially of marine benthos and refers to the difficulties and limitations experienced by investigators in universities at a distance from the sea.

We should welcome the new developments which Prof. Fritsch envisages as desirable at Plymouth. It seems to us that, whether or not these materialize,

there is ample room also for similar developments elsewhere. In particular, centres for 'academic' research, complementary to, and co-operating with, Plymouth, would find adequate opportunity for useful work. We have had such a centre in view in planning our development policy here and in preparatory work that has been in progress for a number of years.

In Bangor we are exceptionally favoured, in close proximity to a littoral fauna and flora which, both in variety of habitats and in wealth of interesting species, must be judged to be among the richest in the kingdom. Certainly no other university institution in Great Britain is better provided in this respect at its very doors. Consequently marine biology has always taken a prominent place in our university courses. A vacation course in marine zoology, which draws students from many other universities, has been held annually for the last thirteen years. We have regarded marine biology, moreover, as a subject which should have high priority in the promotion of research in this College.

Much is already known about the fauna of this area, as can be seen from a glance at the pages of almost any standard systematic work on British marine animals—for example, Alder and Hancock's "British Nudibranchiate Mollusca"; moreover, the pioneer work of Sir William Herdman and his collaborators provides a preliminary survey of the fauna. The staff of the Zoology Department has been for a number of years compiling a fauna list from these records and, with the help of a number of visiting workers, has extensively added to it. Though much remains to be done before this list can be regarded as sufficiently complete for publication, we already have a good working knowledge of the principal species and their distribution.

Parallel information on the marine flora has been accumulated by members of staff of the Botany Department, supplementing the earlier records of Prof. R. W. Phillips, whose algological library is housed in the Department. The work done by Phillips and Lloyd Williams created a local tradition which we feel should be maintained.

Prof. Fritsch has stressed the importance of the benthic diatoms. Other components of the microflora may also prove of great importance. The study of the marine microflora is a natural extension of a study of the freshwater microflora of this district which is already being carried on intensively.

Aware of the opportunities our situation offers and conscious of the need for providing special facilities for the study of marine biology in at least one of the constituent colleges of the University of Wales, the Council of this College has included among its principal post-war aims the founding of a marine biological station at Bangor, to serve the needs of academic research and teaching within the Principality. We hope that this might also serve in part the wider need to which Prof. Fritsch has directed attention.

To be reasonably useful and efficient, such a station as we plan would require a team of workers covering the various aspects of marine biology, both floral and faunal. The advantage of founding such a station in close conjunction with our existing departments is obvious, since the staffs of these departments would go some way towards providing the nucleus of a team. We hope, too, that we shall have the co-operation of our colleagues who are interested in marine biology from the other Colleges of this University.

F. W. ROGERS BRAMBELL.
D. THODAY.
University College of North Wales,
Bangor. Aug. 1.

[1] *Nature*, **154**, 144 (1944).

I WOULD like to endorse Prof. F. E. Fritsch's letter in *Nature* of July 29 on this subject. It is regrettable that a country such as ours with many suitable habitats for marine algæ should lag behind Continental countries in the study of this particular group of plants. Both the last and the present Wars revived an interest in the marine algæ, and the present War has certainly shown how ignorant we still are about many fundamental facts of the life-history of seaweeds. Some of these problems are now being solved and the gaps in our knowledge closed, but it is important that the work should not cease when the War ends. The establishment of a centre for this work is long overdue. At the recent annual meeting of the Marine Biological Association, it was hoped that at least one if not more whole-time workers on marine algæ might be appointed at the end of the War. This may well be a start in the direction indicated by Prof. Fritsch.

As regards the establishment of centres outside Great Britain, some time ago I advocated in *Nature*[1] the establishment of a research station in the West Indies with an algologist on the permanent staff. This station I suggested should be administered by British universities. Since then, the Commission on Higher Education has visited the West Indies and it is going to propose the establishment of a university college in the islands. A research station such as I envisaged may well form part of such a college. It remains to be seen what the Commission suggests in its report.

V. J. CHAPMAN.
Botany School, Cambridge.

[1] *Nature*, **152**, 47 (1943).

Action of Pepsin on Acylated and Non-acylated Cysteine- (Cystine-) Tyrosine Peptides

IN connexion with some projected immunochemical work, we have recently had occasion to synthesize cysteyl- and cystyl-tyrosine and tyrosyl-cysteine and -cystine. Since these peptides represent a type which has not hitherto been available, it was considered worth while to study the action on them and their N-carbobenzyloxy derivatives of crystalline pepsin.

So far the only synthetic substrates known to be attacked by pepsin are certain derivatives of peptides containing tyrosine or phenylalanine and glutamic acid, in which the amino group of the aromatic amino-acid is combined with the α-carboxyl group of an acylated glutamic acid[1]. The peptic hydrolysis of these substrates occurs most rapidly at *p*H 4·0 and scarcely at all below *p*H 2·0; no hydrolysis of the free peptides takes place and the reaction is further inhibited if the free carboxyl group of the glutamic acid residue is blocked. On the basis of these observations, Bergmann[2] has drawn the general conclusion that hydrolysis by pepsin is conditional on the absence of a free amino group from the immediate

neighbourhood of the linkage attacked, and that a substrate for peptic action must contain more than one free carboxyl group.

Some of our own observations on the cysteine-(cystine-) tyrosine peptides are given in the accompanying table, from which the following conclusions may be drawn: (1) This group of compounds includes some which offer good examples of simple synthetic substrates for peptic action. (2) The action of pepsin on these substrates is much more marked at *p*H 4·0 than at *p*H 1·8, although in two cases at least it is still significant at the latter reaction. (3) While the N-acylated peptides are more rapidly hydrolysed, the action of pepsin extends in this series to the free peptides, which thus represent the first true peptides shown to be attacked by this enzyme.

PERCENTAGE SPLITTING OF ACYLATED AND NON-ACYLATED CYSTEINE-(CYSTINE-)TYROSINE PEPTIDES BY CRYSTALLINE PEPSIN IN 48 HR. AT 37°.

	*p*H 4·0	*p*H 1·8
A. ACYLATED PEPTIDES		
N-Carbobenzyloxytyrosylcysteine	39	10
N-Carbobenzyloxytyrosylcystine	7	0
N-Carbobenzyloxycysteyltyrosine	53	32
N-Carbobenzyloxycystyltyrosine	21	6
N-Carbobenzyloxy-S-benzylcysteyltyrosine	26	—
B. NON-ACYLATED PEPTIDES		
Tyrosylcysteine	22	8
Tyrosylcystine	5	8
Cysteyltyrosine	31	21
Cystyltyrosine	5	0

In view of these results, it seems that the generalization of Bergmann regarding the necessary conditions for peptic action requires modification. In none of our cysteine derivatives (which are the more readily hydrolysed) is there more than one free carboxyl group, and the hydrolysis of the free peptides is unmistakable; it is especially noteworthy that one of the free peptides (cysteyltyrosine) is significantly hydrolysed at *p*H 1·8, a reaction at which the amino group will be charged.

A further point which seems to us to be of interest emerges from our experiments. It will be noted that the rate of hydrolysis is conspicuously greater, both with the acylated and non-acylated peptides, when these are in the reduced form; that this increased susceptibility to peptic action is due to the presence of free –SH groups is further shown by the fact that blockage of the –SH group of N-carbobenzyloxycysteyltyrosine with a benzyl residue reduces its rate of hydrolysis to that of the corresponding cystine derivative. This greater susceptibility of the cysteine derivatives to peptic hydrolysis may be related with the facts that: (*a*) pepsin attacks proteins more vigorously when they are in the denatured than in the native state; and (*b*) denaturation of proteins is accompanied by the appearance of –SH groups. Taking into account our own observations and the known fact that free tyrosine can be liberated from proteins by pepsin, it seems not unlikely that at least one point of attack of a denatured protein by this enzyme may be a cysteyltyrosine or tyrosylcysteine linkage.

A complete account of the synthesis of the peptides described above and of the enzymic experiments is being submitted for publication elsewhere.

C. R. HARINGTON.
ROSALIND V. PITT RIVERS.
National Institute for Medical Research,
London, N.W.3.
Aug. 8.

[1] Fruton, J. S., and Bergmann, M., *J. Biol. Chem.*, **127**, 627 (1939).
[2] Bergmann, M., and Fruton, J. S., "Advances in Enzymology", **1**, 63 (1941).

Effect of Adrenalectomy and Anterior Pituitary Injections on Mammary Development

THOUGH mammary growth has been stimulated experimentally with desoxycorticosterone[1,2], the possible significance of the adrenal cortex in normal and experimental mammary development has scarcely been investigated from other aspects. Elucidation of the role of the adrenal cortex in mammary development assumes added importance in view of the claim that the agents directly responsible for the growth of the mammary gland are two mammogenic hormones, secreted by the anterior pituitary, which cause growth of the mammary ducts[3] and alveoli[4] respectively. The possibility must be considered that the mammogenic action of anterior pituitary extracts may be mediated, wholly or in part, by the adrenals. We have accordingly begun a study of the effect of adrenalectomy on the mammary gland in relation to the mammogenic action of the anterior pituitary. A preliminary account of the results so far obtained may be of interest.

In this study we have used a fresh saline extract of ox anterior pituitary[5], for the gift of which we are indebted to Prof. F. G. Young. Using immature gonadectomized rats, it was found that this extract evoked a striking increase in the degree of arborization of the mammary duct system. To use a rough analogy, whole mounts of the mammary glands of control and injected rats were reminiscent of the appearance of a deciduous tree in winter and late spring respectively.

Having established that this pituitary extract possessed marked mammogenic activity, an experiment involving adrenalectomy was set up. This involved four groups, each of 5 male rats, and four of 6 female rats, all gonadectomized at 27 days. Two groups of either sex were adrenalectomized at 74–85 days, and one group of adrenalectomized and one of non-adrenalectomized rats of either sex received ten daily subcutaneous injections of 0·4 ml. anterior pituitary extract (equals 100 mgm. fresh tissue). At the end of the injection period, whole mounts (hæmatoxylin) of all the mammary glands, normally 10 in the male and 12 in the female, were prepared and the glandular areas measured.

The glands were examined under the low power (× 15) binocular and each assigned a score on a subjective scale on the basis of the degree of the arborization of the duct system, the number of lateral buds and the presence of the deeply staining club-shaped end buds characteristic of actively growing ducts. The results indicated once again that in both sexes the pituitary extract increased the complexity of the duct system; only in males, however, was there any evidence of a decreased effect in adrenalectomized rats. In uninjected animals, in contrast to previously reported experiments[6,7], adrenalectomy had no discernible effect on mammary structure. In a majority of the non-adrenalectomized males injected with anterior pituitary, the mammary ducts, though not very complicated, were dilated and lined with deeply staining and distended structures which appeared to be alveoli; in contrast, the comparable group of adrenalectomized males showed thin, branching duct systems. The appearance of the former glands was reminiscent of that of glands described by Astwood *et al.*[8] in normal adult male rats or in gonadectomized immature rats of both

Mean total areas (mm.²) of the mammary glands of groups of rats.

	Uninjected, non-adrenalect. rats	Non-adrenalect. rats injected with ant. pit. ext.	Uninjected, adrenalect. rats	Adrenalect. rats injected with ant. pit. ext.	Stand. Error of single mean*	Stand. Error of comparison of four means*	Stand. Error of comparison of two means*
Males	609·2	559·3	458·2	457·5	54·1	108·3	76·5
Females	919·4	1376·8	863·6	842·8	121·8	243·6	172·2

* Obtained from an analysis of variance.

sexes treated with androgens. It seems possible that in males, at least, the pituitary injections evoked the secretion of adrenal cortex steroids with androgenic activity.

The mammary area data were summed for each rat and the results for each sex subjected to an analysis of variance. For help with the statistical analysis we are indebted to Dr. K. L. Blaxter and Dr. K. Mather. The mean values for each group and the standard errors are given in the accompanying table. In both sexes the total mammary gland area (which was greater in females than in males) was significantly decreased by adrenalectomy ($P = 0{\cdot}02$ for males and 0·03 for females), a result not in agreement with the only two previous reports[6,7] we have been able to find on this subject. The results also suggest that, in females, anterior pituitary treatment increased the mammary gland area in the presence of the adrenals but not in their absence; the probability ($P = 0{\cdot}06$) was, however, not very great, and this conclusion cannot be taken as established unless the results are confirmed by those of other experiments, at present in progress, in which, it is hoped, conditions will be more favourable for the demonstration of the expected effects. In males, there was no evidence that the anterior pituitary extract had any effect on mammary gland area, either in the presence or absence of the adrenals.

The implication of the foregoing results is that the intervention of hormones of the adrenal cortex must be taken into consideration in relation both to normal and experimental mammary development.

We are indebted to the Agricultural Research Council for a research grant to one of us (A. T. C.) and to Dr. S. K. Kon for facilities for working with rats.

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Effects of Administration of Trinitrotoluene

SEVERAL workers have shown that the administration of aromatic nitro- and amino-bodies to the human being results in cyanosis and porphyrinuria, indicating a disturbance of pigment metabolism. Trinitrotoluene (T.N.T.), for example, may damage the liver and cause anæmia, jaundice and porphyrinuria, and serious effects on the health of munition workers can result. A short while ago, we were investigating the action of T.N.T. upon the hæmopoietic system in healthy rats and, as its metabolism in the body has now been studied extensively[1], we think it is of interest to record some of our results here.

Groups of three male albino rats (150–200 gm. each) were maintained in metabolism cages on a daily fixed weight of porphyrin-free diet in a paste form as used in earlier experiments[2]. The animals were allowed free access to water and their urines were collected in flasks containing toluol. Every two days the urines were collected and transferred to volumetric flasks and made up 100 ml. with the cage washings. The improved Webster test for T.N.T. derivatives[3] was performed on each, and the porphyrin content in the remainder estimated using Rimington and Hemmings' technique[4]. After three control periods each of two days during which excretion values per 100 gm. body weight became fairly constant, three groups of rats were injected subcutaneously with varying doses of a suspension of T.N.T. in 2 per cent acacia mucilage in tap water. Each dose was given per body weight. Injections of the same dose were given every two days in alternate flanks of the back. Each animal received nine injections. One control group of rats received a corresponding dose of mucilage of acacia only. All the conditions were standardized so far as possible.

After one injection, the urines from the rats receiving T.N.T. were red, now shown to be probably a derivative of 2 : 4 : 6-trinitrobenzyl alcohol[1], and later the acid shakings of the ether extracts became light brown. Unidentified brown pigments often accompany increases in porphyrin excretion. Throughout the experiments, coproporphyrin only was identified in the urine by measuring the absorption graph in 25 per cent hydrochloric acid. It was probably the Series III isomer, though this was not confirmed. Group I receiving 200 mgm. T.N.T. per kgm. showed no significant change in urinary porphyrin in the time studied; mean total urinary porphyrin per 100 gm. body weight before injection was 4·6 μ gm. per 2 days, and after dosage was 5·5 μ gm. Group 2 receiving 400 mgm. T.N.T. per kgm. showed an increase after six injections (5·8 μ gm. to 11·3 μ gm.), while Group 3 receiving 600 mgm. T.N.T. per kgm. showed porphyrinuria after four injections (4·0 μ gm. to 11·8 μ gm.). Liver damage was noted in this latter group by taking sections and also staining for iron. The stomachs of these rats were very brown and blown up. The modified Webster's test was completely negative throughout, confirming previous views that porphyrinuria is not related to the presence of T.N.T. in the urine[5]. Values of urinary porphyrin for the control group were 6·1 μ gm. before injection and a mean of 6·9 μ gm. following acacia dosage.

Four further groups of adult male albino rats (150–200 gm. each) were similarly treated but received the dosage of T.N.T. by stomach tube. The

onset of porphyrinuria was expected to be quicker. Group 1 showed no change in urinary porphyrin, but Groups 2 and 3 showed extensive porphyrinuria following two injections of 400 and 600 mgm. T.N.T. per kgm. respectively (1·9 μ gm. to 6·3 μ gm., and 5·4 μ gm. to 15·5 μ gm.). The acid shakings of the urines of these two groups were dark brown. The modified Webster's test was again negative throughout, and the control group showed no change in porphyrin output.

The results show that the absorption of T.N.T. in the rat takes place more rapidly in the stomach than by subcutaneous injection; the toxic effects such as porphyrinuria and liver damage follow more quickly. A red urine was not produced by administering doses of 2 : 4-dinitrotoluene or of *p*-nitrotoluene, and it is suggested that three nitro-groups are necessary for the formation of the red colour.

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Birds and Butterflies

CAPT. C. R. STONOR, under this heading in *Nature* of July 15, p. 80, says that he "did not see a single bird, of any species, catch or chase a butterfly" during a month in rain-forest in South India. One can only comment that abundant evidence was provided from tropical Africa by the late C. F. M. Swynnerton. This outstanding field naturalist, well known for his work on tsetse control, could not find time, while engaged in this work, to sort out the massed observations for publication. After his lamented death in an aeroplane crash, it fell to my lot to edit some of his material[1].

It is interesting to note that some of the subjects of these records were the same families—or even genera—of birds as were seen by Capt. Stonor not catching butterflies; for example, rollers, bee-eaters, drongos. Capt Stonor especially mentions the "large racquet-tailed drongo" in his negative evidence, and I would refer him, and readers, to my note[2] in which I showed photographs of two butterflies from different parts of the range of this bird, each bearing a clearly imprinted mark on a wing closely corresponding with the imprint of the bill of a specimen.

Not only does the study of such beak-marks provide evidence that butterflies are attacked but also, as I showed in 1941[3], it has provided significant evidence that the attacks are less destructive of the aposematic ('warningly coloured') species which serve as models for mimicry than those mimicking them. Regarding Capt. Stonor's statement that he saw no beak marks, I may perhaps be excused for saying that they are not always so obvious as those I have mentioned above, and particularly in "tattered specimens" which have been mauled and rubbed so that the density of the scaly covering is reduced; experience in close study of 'set' specimens is needed.

The statement that "the butterflies seldom flew higher than four or five yards from the ground; while most of the insectivorous birds . . . feed twenty feet up at the least", presumably means that it is considered that at high levels there are no butterflies to be attacked. This, however, is far from being the case. It is recorded by Beebe[4], Hingston[5] and Chapin[6] that the fauna of the tree-tops is distinct from that at lower levels, and Hingston particularly notes "Butterflies are commonly seen fluttering over the canopy. Some species probably never come to earth." Most butterfly collectors in the forests must have had my exasperating experience of seeing desirable specimens flying around and settling on the tops of trees in flower. The oriental butterfly *Eriboea schreiberi* Godt. is particularly interesting in this connexion. It is stated by Fruhstorfer[7] to be 'extremely rare' (that is, in *collections*) and he also says "It is also frequently stated that single wings are found from which we may conclude that *schreiberi* is very much pursued by birds". The same curious fact is the subject of comment by Poulton in his notes attached to G. A. K. Marshall's records of attacks on butterflies[8].

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A New Species of Amœba: *A. kerrii*

SINCE the publication of full details with relevant plates and drawings will necessarily be long delayed, the following account of a new species of amœba belonging to Schaeffer's genus Metachaos, isolated from some water-weeds collected on the shore in front of the Marine Biological Station of Keppel by Miss Maureen McAlister in 1939, and now under cultivation in Notre Dame Laboratory, will serve as a preliminary notice to other workers.

Species of the genera Chaos and Metachaos are distinguished by their cytoplasmic characteristics or by details of their life-history. This amœba, named in honour of Sir John Graham Kerr, who first emphasized the urgent necessity of research on an organism so universally used for education in biology, is easily identified in its fully adult and senile stages by its dusky appearance when viewed over a black background by reflected light, this dark colour being due to the extraordinary abundance of crystals which distend the cytoplasm and completely mask the presence of the nutritive spheres. The nucleus by contrast looks almost like a vacuole as it is rolled about in the cytoplasm.

Young adults and adolescents are much clearer and more like the typical appearance of most of the free-living, large amœbæ. Pure-line cultures of *Amœba kerrii* are easily established, the creature feeding on rotifers, ciliates and flagellates. Wheat grains form a suitable pabulum.

Fission divisions occur in adolescent and in young adults, but not in old or senile adults, once in three

days, at a suitable temperature. The line of demarcation between two daughter amœbæ travels down from north to south of the fission sphere (= the form assumed by the dividing amœba), which remains firmly in contact with the substratum during the whole process of division. In this it resembles *A. proteus* γ and *A. discoides*, and differs from *A. lescheræ*. Division of the nucleus is mitotic and takes place within the nuclear membrane; the chromosomes are small and numerous. The telophasic stages are semi-elliptical in outline, in contradistinction to those of *A. lescheræ*, which are more or less triangular. The ectoplasm, which has no longitudinal folds, is tougher than that of the other amœbæ we have investigated. This is an especially useful characteristic for the study of the developing young, permanent preparations of which are, in consequence, more readily made.

The resting nuclei of both adult and developing amœbæ are of the typical form. In the former, a central karyosome suspended in an achromatic network is separated by a clear area from the region of the regularly disposed chromatin blocks lying just under the nuclear membrane. A variety of form consequent upon the fact that the nucleus is rolled about into all sorts of positions by the surrounding cytoplasm may be seen when large numbers of *A. kerrii* are fixed and stained.

The reproductive cycle commences with the emission of chromidia from the nucleus of an adult amœba into the surrounding cytoplasm. Each chromidial mass becomes the rudiment of the nucleus of the new amœba, which is differentiated in the agamont and becomes an encysted agamete. Hundreds of these are shed into the surrounding medium, where they remain for a varying period of time. Hatching out of the young amœba, which is only just visible under a $\frac{1}{6}$-in. objective, is more easily observed in winter. A limax form is that most often assumed by the growing young amœba, the nucleus of which is easily visible. In about eight months the whole life-cycle of *A. kerrii* is completed.

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July 2.

Boundaries of Space and Time

IT is with some diffidence that I venture to comment on the very abstruse issues raised by Prof. Dingle in his Halley Lecture (*Nature*, **153**, 731, 758; 1944) but there is an aspect of the matter to which it seems worth while to direct attention.

The theory of relativity tells us that observable space has a boundary, the extent of which can be approximately estimated, and that any events which may take place, or which may have taken place, at or beyond this boundary are unknown and unknowable. It would also appear that the interpretation of events which may appear to occur near the boundary must be indeterminate, because it is impossible to say to what extent they may be influenced by events or conditions beyond the boundary, of which, it is agreed, we can have no knowledge. Moreover, it may be suggested that this doctrine of a boundary to the observable universe is reasonable whether we accept the other implications of the theory or not.

The boundaries of comprehensible time, past and future, are not known with the same precision as the boundaries of observable space, but it is reasonable to postulate that such boundaries must exist, and that any discussion of events which lie beyond these boundaries is meaningless.

The purpose of the present letter is to point out an important consequence which follows from these postulates: when we are discussing events lying within these boundaries of space and time, we are not entitled to introduce into our argument any assumptions as to conditions at the boundaries or beyond them. Thus we are not entitled to favour theories which enable us to extend the boundaries of time to infinity any more than we are entitled to favour theories which postulate an infinite extension of space. Provided that the boundaries of time permitted by a theory are sufficiently extensive to be consistent with observed facts, no more can be demanded of it.

There is also a further point. We live in a world of change, but there are certain properties of the universe as we know it which appear to be constant in time. It must be remembered, however, that our observations extend over an interval of time which is infinitesimal compared with the periods of time which we are wont to discuss, and we do not therefore appear to have any reliable means of determining whether these apparently constant quantities are in fact constant, or whether they are slowly variable over long periods, and if so in what sense. Where two or more theories are consistent with the observed facts and differ only in respect of the conditions which they involve at the boundaries of space and time, the selection of one theory or another would appear to be entirely a matter of convenience.

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THE theory of relativity tells us that observable space may not be infinite in extent, but it does not postulate a boundary; "finite but unbounded" is the usual phrase. The theory gives no support to the idea that observable events can be influenced by conditions outside the region of possible observation, nor does it set any limits to time. In this respect time differs from space. The last paragraph of Colonel Edgeworth's letter is perfectly correct in principle, but the range of our present knowledge can scarcely be called infinitesimal. A quantity may change so slowly as to appear constant, but the progress of science consists partly in extending the range of observation so as to detect such changes; the slowing down of the earth's rotation, and the reddening of nebular light, however it be interpreted, are examples. It is always possible, of course (unless constancy is postulated by definition), to say that an apparently constant phenomenon is changing too slowly for detection; but any theory which included this assumption would probably give some indication of the rate of change, and further knowledge would enable us to determine whether the assumption was valid. The question of retaining the theory would then be decided on grounds other than convenience.

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ROYAL SOCIETY OF CANADA

ANNUAL MEETING

THE 1944 meeting of the Royal Society of Canada was held at the University of Montreal during May 29–31 under the presidency of Mgr. Olivier Maraault, rector of the University.

New fellows presented at the first general meeting included the following in the scientific sections: Section III (Chemical, Mathematical and Physical Sciences): R. C. Dearle, G. S. Field, John T. Henderson, G. de B. Robinson, W. Ure; Section IV (Geological Sciences): J. W. Ambrose, G. V. Douglas, H. B. Yates; Section V (Biological Sciences): J. A. Anderson, W. V. Cone, G. E. Hall, W. F. Hanna, Georges Maheux, D. S. Rawson. Lieut.-General A. G. L. McNaughton, who had been elected an honorary fellow in 1941, while he was absent from the Dominion as Commander-in-Chief of Canada's Army Overseas, was also presented.

The Society's medals were presented at the evening meeting on May 29 as follows: Flavelle Medal to Prof. Velyien E. Henderson, professor of pharmacy and pharmacology in the University of Toronto, in recognition of contributions to knowledge in the fields of pharmacology, physiology and therapeutics, including the discovery of the anæsthetic properties of cyclopropane; Henry Marshall Tory Medal to Prof. Frank Allen, professor of physics in the University of Manitoba, for his contributions to the subjects of optics and acoustics and especially to a border region of physics and physiology; Tyrell Medal to Prof. Harold A. Innis, professor of political economy in the University of Toronto.

Following the presentation of the medals, the presidential address "Montréal: une Synthèse" was delivered by Mgr. Marault. A popular lecture on "War, Peace and Commerce" was given on the evening of May 30 by Dr. B. K. Sandwell.

In Section III, the presidential address by Prof. T. Thorvaldson, professor of chemistry in the University of Saskatchewan, dealt with "The Solid State". It reviewed the various theories of chemical reactions in the solid state and the experimental evidence in support of them. This was followed by a symposium on the same subject, in which Prof. M. A. Peacock described the methods of identification of solid phases by crystallographic means and Prof. E. F. Burton showed some recent photographs taken with the Toronto electron microscope of the forms of solid particles of ultramicroscopic dimensions. The final paper of this symposium, by Dr. G. S. Whitby, was on rubber, and described the chemical constitution and related physical properties of several of the new artificial rubbers now being produced.

Among the thirty-two other papers presented to the Section, mention may be made of one by Prof. Frank Allen, in which results of experiments on the sensitivity of the colour sensations were described. He finds that when the right eye, for example, is adapted to red light, the red sensation is reduced, but in the left eye all three sensations (red, green and violet) are enhanced. If the eye is rested after adaptation for three minutes, a reversal in sensitivity occurs. There is thus an oscillation of sensitivity. A paper on further simplification in thermodynamical calculations along lines previously developed was read by Prof. A. N. Shaw. Dr. J. A. Pearce and E. C. Walker reported the orbital elements of λ Andromedæ based on a series of measurements made on high-dispersion spectrograms taken at Victoria, B.C. Dr. E. C. Beale discussed results which indicate that some new molecular absorption lines recently discovered show characteristics closely similar to atomic lines. It is suggested that their probable origin is to be found in the solid particles responsible for general absorption in interstellar space, and that laboratory investigations of the absorption spectra of such particles as are likely to be present in interstellar space might be fruitful in their identification. A new mechanical height computer for *radio sonde* observations was described and shown by Dr. W. E. Knowles Middleton. Dr. J. A. Pearce, of the Dominion Observatory, was elected president of the Section, and Prof. C. T. Sullivan, Repath professor of pure mathematics at McGill University, vice-president.

In Section IV, the presidential address by Dr. W. A. Bell, palæobotanist of the Geological Survey of Canada, dealt with the use of some floras in Canadian stratigraphy. Fossil floras have proved very useful in subdividing the very thick carboniferous sediments of the Maritime Provinces into six groups, of which three are Mississippian and three Pennsylvanian. The use of the terms Mississippian and Pennsylvanian is more appropriate as regards major floral and tectonic events of the Acadian province than Lower and Upper Carboniferous. The former terms are not synonymous with the latter, for the Mississippian terminated in an early part of Upper Carboniferous time, as in the Mississippian valley region. The group subdivision established mainly on floral evidence is apparently the most natural one, for it is corroborated by tectonic events. Coal formation was not confined to one age as formerly assumed, but took place locally in the Pennsylvanian in each of the three ages represented by the groups of strata.

Nineteen other papers on geological and mineralogical researches were presented. Dr. Madeleine Fritz, Royal Ontario Museum of Palæontology, reported the recent discovery of the bryozoan species *Trachytoechus moniliformia* Fritz, n.sp. in the Gaspe sandstone of Lemieux Township, Gaspe County, in the interior of the Gaspe peninsula. This has provided evidence to substantiate the belief that the rocks in which the specimen was found are of Middle Devonian age. Dr. F. J. Alcock, of the Geological Survey of Canada, presented evidence based on the findings of several striated surfaces and many erratics in central Gaspe which support his already published conclusions that the Labrador ice sheet crossed the Shickshock Mountains. Dr. J. S. DeLury, professor of geology and mineralogy in the University of Manitoba, was elected president of the Section, and Dr. B. R. MacKay, of Ottawa, vice-president.

Dr. H. S. Jackson, University of Toronto, President of Section V, spoke on "Life Cycles and Phylogeny in the Higher Fungi". The discussion centred in a comparison of life-cycles in the rusts with those in the red algæ. It was shown that not only do the normal cycles correspond very closely, but that the same sort of simplified cycles occur in both groups. A life-cycle comparable to that of the ascomycetes also occurs among the simplified red algæ.

Prof. Velyien Henderson, the Flavelle Medal winner, presented a paper by invitation entitled "Studies in Anaesthesia with the Cyclopropane Group". Prof. A. T. Cameron, professor of biochemistry in the University of Manitoba, outlined the results of his researches on the relative sweetness of certain sugars and mixtures of sugar. If a solution

contains known concentrations of two or more sugars, a means has been found for calculating the sweetness of this mixture in terms of that of a specific concentration of sucrose or of glucose. It has been demonstrated that the sweetness of 25 per cent sucrose is not more than (and is probably less than) 3·3 times that of 5 per cent sucrose. Forty-three other papers on various phases of biological and medical sciences made up the programme of Section V. Dr. Robert Newton, president and formerly professor of plant biochemistry in the University of Alberta, is the new president of the Section and Prof. B. P. Babkin, research professor of physiology in McGill University, vice-president.

Prof. J. K. Robertson, professor of physics in the Queen's University, Kingston, Ontario, is the new president of the Society, and Prof. E. S. Moore, professor of geology in the University of Toronto, vice-president. J. R. DYMOND.

THE ROYAL OBSERVATORY, GREENWICH

ANNUAL REPORT

THE annual report of the Astronomer Royal to the Board of Visitors covers the period May 1, 1943–April 30, 1944, and describes the work done during the year at Greenwich and the various out-stations which together constitute the war-time Royal Observatory. Until the last-named date, no further damage by enemy action had been sustained at Greenwich. On the observational side, a restricted astronomical programme on the Airy transit circle has been maintained, solar work has been continued on the photoheliograph and spectrohelioscope, and the routine meteorological observations have been made as in normal times. Work at the out-stations includes the maintenance and improvement of the time service, which still operates from two undisclosed locations, the rating and supply of chronometers and watches for use in H.M. Forces, the production of the *Nautical Almanac* and various ancillary publications, and the regular magnetic observations made, as in previous years, at Abinger.

Fundamental observations of position made on the Airy transit circle include about a thousand transits of stars, the sun, and the planets. Collimation observations, which have hitherto been possible only in daylight and then only with difficulty, are now facilitated by artificial illumination. A surprising feature revealed by the level observations of the last twenty-one years is that in that time the east pier of the instrument has steadily sunk by about $\frac{1}{12}$ in. relative to the west pier, though no such subsidence had occurred before in the seventy-two years of its previous history.

A discussion of the preliminary tests on the new reversible transit circle, based on observations made between its installation in 1936 and 1940, shows that the annual variations in level and azimuth are satisfactorily small. The diurnal changes in azimuth are small; those in level are of more consequence but can be reduced by better lagging of the piers; but those in collimation are disconcertingly large when the ambient temperature is unsteady. At present there seems no escape from the conclusion that a large amount of observing time must be used on observations of collimation in order to provide a satisfactory control of the variations. Latitude results on the Cookson floating zenith telescope relating to the period 1936–40 have also been derived, and the observations are examined with the view of tracing to their source the occasional large residuals shown, especially by recent observations. No certain conclusion is reached, though anomalous surface tension effects and wind effects are suspected.

The solar work calls for little comment. Sunspot frequency has slowly fallen, no spots being recorded at all during February, and only one very small spot during April. The epoch of minimum activity has apparently been reached, and the first high-latitude spots of the new cycle appeared in May 1943. Geomagnetic activity was considerable, however: one great storm and twenty smaller ones occurred, some of these latter falling in a 27-day cycle characteristic of storms at solar minimum. It is surprising that one of the five short-wave radio fade-outs which occurred during the year did so when no spot was visible on the disk. Fade-outs of this type have hitherto been attributed to solar flares ('chromospheric eruptions'), which are associated almost exclusively with sunspots. It will be interesting if positive spectroscopic evidence can be obtained that this is an instance of a flare occurring unassociated with a spot.

The Nautical Almanac Office continues its routine computational work involved in the production of the *Nautical Almanac*, the *Abridged Nautical Almanac*, the *Air Almanac* and the *Astronomical Navigation Tables*. A large increase in the work of the Office has occurred, and still more is forecast, as a result of the formation of the Admiralty Computing Service early in 1943. The Nautical Almanac Office forms the nucleus of this body, performing all the centralized computing and advising on tables, methods and machines. Some forty pieces of computation have been undertaken, none of them of an astronomical character, and about half of them have already been completed.

A major section of the Astronomer Royal's report is devoted to the work of the Time Department, which is evidently still expanding rapidly. The time service has been operated, as in previous years, from duplicate stations, each a self-contained unit itself capable of providing the whole service. The change-over from pendulum clocks to quartz crystal clocks, forecast in the last report, is now under way. Three quartz clocks have been installed during the year, one at each station being equipped with a phonic motor having a 60 : 61 gearing to provide the vernier time signals. These signals are now operated solely from phonic motors, and the accuracy of spacing of the signal pulses has greatly improved. Errors of as much as five milliseconds due to the unfortunate habit of pendulum clocks of 'wandering' between final correction and signal transmission have also been eliminated by this substitution. The new clocks are not yet used as primary standards, since the quartz crystals are not sufficiently 'aged', so the long-term performance of the time service has not yet been materially improved by their installation. But in short-term performance a marked improvement has already occurred: the uncertainty of individual 24-hour intervals defined by successive 10^h GBR signals has decreased from ± 5 to $\pm 1{\cdot}2$ parts in 10^8. Improvements in long-term performance are predicted for the near future as a result, first, of the transference to floating-battery operation of the primary standards maintained outside the Observatory (their performance has hitherto suffered from

mains failures); and, secondly, of the eventual incorporation among the primaries of the quartz clocks newly installed, and others to be installed, at the Observatory. After that, improvements in the time service will depend not so much on horological developments as on improvement of the astronomical observations. Although minor improvements are possible in the standard small transit instruments at present in use (an optical autocollimation method of level determination is mentioned), their supersession by a photographic reflex zenith tube is forecast by the Astronomer Royal, and preparations for the new telescope are already at the design stage. The Admiralty has sanctioned construction of an instrument of aperture 10 in. and focal length 11 ft. 3 in., giving a scale of 1 minute of arc to 1 mm., and the main details have already been settled. This instrument should improve materially the accuracy of the time determinations. Together with the purely horological developments reported and forecast in this report, it should make possible the provision in the future of a time service equal to all the exacting demands made upon it, and second to none in the world.

CARNEGIE INSTITUTION OF WASHINGTON

ANNUAL REPORT

THE Year Book No. 42 of the Carnegie Institution of Washington, covering the year July 1, 1942–June 30, 1943, includes the reports of the Executive Committee, the auditors, and of the president, together with reports of departmental activities and co-operative studies. The president's report points out that although the total research effort of the Institution is more than twice as great as in the year just prior to the War, the efforts of the research staff are now so largely devoted to war research that the regular programmes have been severely curtailed. The services of seventy members of the Institution staff have been loaned for war work in other organizations. The Geophysical Laboratory is now completely devoted to a war programme for which its facilities and staff are specially fitted, and the Department of Terrestrial Magnetism is similarly occupied. The Mount Wilson Observatory has several important programmes under way utilizing the special knowledge of astronomers and physicists, and the war effort continues to demand more outstanding talent in the physical sciences than is available and to utilize to a lesser extent men from the biological sciences.

Investigations of the Division of Plant Biology referred to in the report are those on the biochemistry of algæ, including the selection and isolation of algæ, their pigments, effects of environment on their pigment content, and the production of organic matter by *Chlorella pyrenoidosa*. Investigations on the nature of substances produced directly by photosynthesis in sunflower leaves have continued, and improved methods of pigment analysis have been developed which show promise of application to other fields of chemical and biochemical investigation. In addition to investigations on the breeding of new forage grasses of importance for food production, excellent progress is reported in the normal programmes of biochemical investigation and experimental taxonomy. In the Department of Genetics, research in endocrinology, especially in regard to the action of the parathyroid gland, is being completed, and an interesting mutation in mice which aids in interpreting certain processes of normal development is being studied. Other investigations concern broken chromosomes in maize, the genetics of the mouse, hormone action in carbohydrate and fat metabolism, the effects of ultra-violet radiation on mitosis, radiation theory and breeding studies on the Russian dandelion.

At the Mount Wilson Observatory the remarkable reversal of sign of magnetic polarity characteristic of a new solar cycle has been fully confirmed. Advances in the efficiency of the stellar spectrographs have led to notable discoveries regarding the structure of the expanding shells surrounding the novæ of our galactic system and have aided in the interpretation of these objects. The discovery of a shell round the novæ in Auriga of 1891 is of exceptional interest. The powerful spectrographs in use with the 100-in. telescope have opened new fields in the analysis of stellar spectra, and in the study of differential motions in the stellar atmospheres, and of the distribution and composition of the gaseous clouds of interstellar space. The cyclotron at the Department of Terrestrial Magnetism has been completed, and cosmic data were assembled and analysed to increase the understanding of solar geomagnetic and ionospheric relations and to improve the technique of short-term forecasting of ionospheric disturbances. The value of the ionospheric programme undertaken by the Department has been emphasized by the urgent need of particulars regarding the relations of ionospheric variations and disturbances and the many confidential studies for operational application which have been made. Tables of changes in the annual mean value of the geomagnetic field with sunspot cycle, the average annual variations, daily post-perturbations and average solar daily variations for the period 1905–42 were nearly completed.

The final section of the president's report considers the broad problem of the status of scientific reesarch in the United States after the War and the unique position of the Institution. The importance of independent scientific bodies such as the Carnegie Institution in the pattern of scientific research likely to develop after the War is emphasized, and in a frank discussion of the probable endowment position of research generally as between the universities, the Government, and independent scientific institutions, the necessity of studying the trends carefully is stressed.

DROSOPHILA MELANOGASTER

THE American fruit fly holds a unique position in biology; this animal has probably been more intensively studied from all angles of biology than any other. The immense literature and specialized language illustrates the intensity of attention it has received. Yet some geneticists, and a much smaller proportion of botanists and zoologists, know very little of the results of this intense experimentation. It was understandable that during its early years of captivity it should be of particular interest for the development of the chromosome theory of heredity. As a consequence the excuse that it was a laboratory plaything might be considered to be reasonable.

Since that time, however, this Drosophila has provided most important data in subjects which are considered to be the province of the taxonomist, ecologist and morphologist.

Its intrinsic value as an organism about which we know more of its heritable characters than of any other living thing gives Drosophila a position which cannot be ignored when discussing the evolutionary problems and behaviour of organisms in the wild. The 'drosophilists' have realized the importance of wild population studies and are providing and accumulating many data in the United States.

It is fortunate that two monographs have just been issued[1,2] under the names of the late Dr. C. Bridges and Dr. K. S. Brehme, and Prof. J. T. Patterson, respectively. The first is a valuable and possibly classical work on the known characters of Drosophila. After listing the symbolization used in Drosophila literature in a form comprehensible to an ordinary geneticist, the inherited characters are described, together with the positions of the related genes on the chromosomes, their origins and authorities. These data, included in two hundred pages, are followed by chromosome maps of the genes which leave all other published maps far behind. A fitting conclusion to the publication is the inclusion of the salivary chromosome maps originally published in the *Journal of Heredity*. The conception of this work was designed by Dr. M. Demerec, director of the Carnegie Institution, and with the co-operation of many geneticists the compilation by Dr. Brehme is a fitting memorial to Dr. Bridges. This publication gives the biologist an accurate description of the genetic characters of *Drosophila melanogaster*.

The publication by Patterson and his co-workers carries, as it were, the attack into the enemy's camp. Here the species of Drosophila which have been found in the south-west of the United States and Mexico are described with the meticulous care of the systematist, and each is illustrated with coloured plates. Twenty-four new forms are described for the first time, while numerous data from collecting work provides an insight into geographical distribution and reasons for the fluctuations in numbers in wild populations. J. T. Patterson and R. P. Wagner consider the distribution of the species of Drosophila throughout the United States and give data on the reactions of different species to ecological factors. L. J. Wharton describes the metaphase complements and the salivary gland chromosomes of eighty Drosophila species.

As a result of these investigations on an animal the genetical constitution of which is better known than that of any other, it is possible to raise doubts and to call for reconsideration of important current and established theories, some of which are keystones in branches of biology. For example, it is clearly seen that homology between parts of chromosomes in related species cannot be assumed without hybridization experiments and linkage studies. Similar characters in different species may depend on different genic origins. This being so, to what extent can homology of characters in different organisms be utilized as has been done in the past by morphologists as a criterion in evolution ? Does the different origin and development of a character affect the validity of the evidence derived from analysing such characters in different phyla ?

Again, there is strong evidence in Drosophila that phylogenetic relationships based on metaphase chromosome idiograms may be invalid unless supported by salivary gland chromosome analysis or cross-over configurations and other genetical criteria.

On the problem of speciation, the distribution of the species of Drosophila in the United States is interesting. A very few species are widespread while a larger number of species, many of which are local, are found in areas where there is great environmental diversity.

The reviewer is impressed by the painstaking work, the absence of contentious or other theories and the manner in which the solid results become related into a coherent whole. The evidence touches on many fields of biology and it is salutary, and we believe necessary, to consider it in relation to current theories in different branches of botany and zoology.

F. W. SANSOME.

[1] Bridges, C. B., and Brehme, K. S., "The Mutants of *Drosophila melanogaster*", Carnegie Institution of Washington Pub. 552 (1944).

[2] Patterson, J. T., "Studies in the Genetics of Drosophila III", University of Texas Pub. 4313 (1944), 2.50 dollars.

SUMERIAN MYTHOLOGY*

TO-DAY everyone in the least interested in archæology has heard of the Sumerian culture of Mesopotamia and the cuneiform system of writing that was developed there. Not everyone realizes that only so recently as 1850 was the existence of this all-important non-Indo-European and non-Semitic people so much as suspected. Nowadays, of course, the Sumerians take pride of place as the dominant cultural element in Mesopotamia from the fourth to nearly the beginning of the second millennium B.C., and the influence of their culture is known to have spread far and wide and to have lasted long after the folk themselves had been swamped by their Semitic neighbours. Why are there to-day sixty seconds in a minute, sixty minutes in an hour, and 6×60 degrees in a circle ? Because the Sumerians used a unit of sixty. Their unit of weight, the mina, seems to have been just about equal to the Imperial pound.

The Sumerians used tablets of clay to write on, and many thousands of these have turned up in the course of excavations. More particularly is this true of the American excavations at Nippur, which were carried on at intervals between 1889 and 1900. But the writing is difficult to interpret and much of the material is broken ; and in consequence a great deal still remains to be deciphered. Most of the quarter of a million or so tablets that have been unearthed are concerned with matters of business, but a small proportion, dating mostly to about 2000 B.C., can be classed as 'literary' tablets, and these are inscribed with Sumerian epics, myths, hymns, lamentations, proverbs and words of wisdom. There are also a number inscribed with mathematical texts and incantations Mr. S. N. Kramer is concerned to publish much of this hitherto undeciphered material in a number of volumes, of which this one on Sumerian mythology is the first. He has had the opportunity of working for nearly two years at the Nippur collections now in Turkey, as well as at those from the same site now housed in the United States. This first volume is extremely well put together and illustrated. It does not assume a greater knowledge of Mesopotamian

* Memoirs of the American Philosophical Society. Vol. 21 : Sumerian Mythology, a Study of Spiritual and Literary Achievement in the Third Millenium B.C. Pp. xiv+125+21 plates. By S. N. Kramer. (Philadelphia, 1944.)

archæology than can be obtained from any one of the well-known manuals.

After an explanatory preface and an introduction there is a chapter on the scope and significance of Sumerian mythology. This is followed by an account of the myths of origins, of Kur and the slaying of the dragon, of the deluge—antedating, of course, the well-known Neo-Babylonian epic—of the marriage of the god Martu, and of the preference of Inanna, sister of the sun-god Utu, for the farmer-god Enkimdu over the shepherd-god Dumuzi: a pretty story which ends with the seeming victory of Dumuzi over Enkimdu.

These Sumerian 'literary' tablets are some centuries older than the Neo-Babylonian epics, and borrowing by these can be detected. They are also about six hundred years older than the somewhat similar material which is turning up at Ras Shamra in northern Syria. Contact in Mesopotamia between the intrusive, matter-of-fact Sumerian folk of unknown racial affinity and their Semitic neighbours seems to have resulted in the development of epics, myths and proverbs which have proved a veritable mine into which later cultures have delved when they in turn set themselves to answer such problems as the origin of the world and man. It is to be hoped the subsequent volumes will appear without undue delay.

M. C. BURKITT.

FORTHCOMING EVENTS

Tuesday, September 5

WOMEN'S ENGINEERING SOCIETY (MANCHESTER BRANCH) (at the Engineers' Club, Albert Square, Manchester), at 6.30 p.m.—Mr. E. T. Norris: "The Moving Coil Voltage Regulator".

Friday, September 8

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Sir Harold Spencer Jones, F.R.S., and Mr. R. T. Cullen: "The Division Errors of the Reversible Transit Circle of the Royal Observatory, Greenwich"; Mr. C. S. Beals: "Some Results of a Spectrophotometric Study of the Wolf Rayet Binary HD 193576"; Mr. D. L. Edwards: "Periodic Changes in γ Cassiopeiae during the past 100 Years".

APPOINTMENTS VACANT

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

UNIVERSITY READERSHIP IN PHYSICS tenable at King's College—The Academic Registrar, University of London, South Kensington, London, S.W.7 (September 6).

HEAD OF THE DEPARTMENT OF PRODUCTION ENGINEERING—The Principal, Leicester College of Technology and Commerce, Leicester (September 9).

LECTURER IN CHEMISTRY—The Registrar, Technical College, Sunderland (September 9).

CHIEF ENGINEER by large firm of Locomotive Manufacturers—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.2243.XA) (September 11).

SPEECH THERAPIST—The Director of Education, Education Offices, 15 John Street, Sunderland (September 15).

TECHNICAL EDITOR of the *Electrical Power Engineer* and DIRECTOR OF STUDIES of the Correspondence Tuition Scheme of the Association—The General Secretary, Electrical Power Engineers' Association, 102 St. George's Square, London, S.W.1 (endorsed 'Technical Editor') (September 15).

UNIVERSITY READERSHIP IN CHEMISTRY tenable at the Royal Cancer Hospital (Free)—The Academic Registrar, University of London, South Kensington, London, S.W.7 (September 18).

RESPONSIBLE LECTURER IN PHYSIOLOGY—The Principal, Chelsea Polytechnic, Manresa Road, London, S.W.3 (September 20).

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

DIRECTOR OF RESEARCH, Forest Products Research Laboratory, Princes Risborough—The Secretary, Department of Scientific and Industrial Research, Teddington, Middx. (October 9).

LECTURER IN PHILOSOPHY—The Very Rev. the Dean, Christ Church, Oxford (October 15).

DIRECTOR OF THE DEPARTMENT OF SOCIAL STUDIES, University of Sydney—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (Sydney, December 1).

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

ASSISTANT MASTER (temporary) qualified to teach ENGINEERING SUBJECTS and MATHEMATICS up to Ordinary National Certificate standard—The Principal, Technical Institute, Beckenham Road, Beckenham, Kent.

BOTANIST AND ORGANIC CHEMIST to the Nyasaland Research and Development Co., Ltd.—Dr. M. Nierenstein, 2 Rylestone Grove, Bristol 9.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Pitt Rivers Museum: University of Oxford. Occasional Papers on Technology, 1: The Manufacture of a Flint Arrow-head by Quartzite Hammer-stone. By Sir Francis H. S. Knowles. Pp. 38 (6 plates). 5*s*. Report of the Curator of the Pitt Rivers Museum (Department of Ethnology) for the Year ending 31 July 1943. Pp. 6. (Oxford: Pitt Rivers Museum.) [88

Tory Reform Committee. Bulletin No. 5: What Shall We Use for Money? Pp. 16. (London: Tory Reform Committee.) [88

A Scientific Policy for British Agriculture (particularly in relation to Nutrition). Pp. 16. (London: Parliamentary and Scientific Committee.) 9*d*. [108

Ministry of Fuel and Power: Committee on the Efficient Use of Fuel. Fuel Efficiency Bulletin No. 32: Fuel Economy at Collieries, with particular reference to Compressed Air. Pp. 17. (London: Ministry of Fuel and Power.) [108

Institution of Gas Engineers. Communication No. 269: The Gas Industry; some factors affecting Future Development. Pp. 56. (London: Institution of Gas Engineers.) [148

Royal College of Physicians of Edinburgh. Annual Report by the Curator of the Laboratory for the Year 1943. Pp. 12. (Edinburgh: Royal College of Physicians of Edinburgh.) [218

The AScW and other Bodies. Pp. 8. (London: Association of Scientific Workers.) 3*d*. [218

British Rubber Producers' Research Association. Publication No. 49: Rubber, Polyisoprenes and Allied Compounds, Part 7: Action of Nitric Oxide Thereon. By G. F. Bloomfield and (in part) G. A. Jeffrey. Pp. 6. (London: British Rubber Producers' Research Association.) [218

Other Countries

Smithsonian Institution: United States National Museum. Bulletin 185: Checklist of the Coleopterous Insects of Mexico, Central America, the West Indies and South America. Part 1. Compiled by Richard E. Blackwelder. Pp. xii+188. (Washington, D.C.: Government Printing Office.) 35 cents. [257

Department of Transport, Air Services Branch: Meteorological Division. Meteorology of the Canadian Arctic. Pp. iv+85. (Ottawa: Department of Transport.) [257

U.S. Department of Agriculture. Technical Bulletin No. 866: Nature and Extent of Mormon Cricket Damage to Crop and Range Plants. By Ralph B. Swain. Pp. 44. (Washington, D.C.: Government Printing Office.) [267

Annals of the Carnegie Museum. Vol. 30, Art. 5: A New Terrestrial Vulture from the Upper Eocene Deposits of Wyoming. By Alexander Wetmore. Pp. 57–70. Vol. 30, Art. 6: Another New Boa of the Genus Epicrates from the Bahamas. By M. Graham Netting and Coleman J. Goin. Pp. 71–76. (Pittsburgh, Pa.: Carnegie Museum.) [267

Smithsonian Institution: Bureau of American Ethnology. Bulletin 138: Stone Monuments of Southern Mexico. By Matthew W. Stirling. Pp. vii+84+62 plates. 35 cents. Bulletin 141: Ceramic Stratigraphy at Cerro de las Mesas, Veracruz, Mexico. By Philip Drucker. Pp. viii+95+58 plates. 50 cents. (Washington, D.C.: Government Printing Office.) [277

Transactions of the American Philosophical Society. New Series, Vol. 33, Part 3: Infectious Anemias due to Bartonella and related Red Cell Parasites. By David Weinman. Pp. 241–350. (Philadelphia: American Philosophical Society.) 1.25 dollars. [277

Uganda Protectorate: Forest Department. Annual Report for the Year ending 31st December 1943. Pp. 8. (Entebbe: Government Printer.) 1*s*. [317

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 25, No. 2: Relations of the Temperate Floras of North and South America. By Doughton Houghton Campbell. Pp. 139–146. Vol. 25, No. 3: *Pugillus astragalorum* Alter. By R. C. Barneby. Pp. 147–170+plate 17. Vol. 25, No. 4: Sublittoral Marine Algae of the Monterey Peninsula. By Prof. Gilbert M. Smith. Pp. 171–176. Vol. 25, No. 5: The Gander Oak, a New Hybrid Oak from San Diego County, California. By Carl B. Wolf. Pp. 177–188+plates 18–19. Vol. 25, No. 6: The Genus Drymaria in, and adjacent to, the Sonoran Desert. By Prof. Ira L. Wiggins. Pp. 189–214+plates 20–22. Vol. 25, No. 7: Water and Plant Anatomy. By Prof. George J. Peirce. Pp. 215–220. Vol. 25, No. 8: A Pleistocene Flora from the McKittrick Asphalt Deposits of California. By Prof. Herbert L. Mason. Pp. 221–234+plates 23–44. (San Francisco, Calif.: California Academy of Sciences.) [317

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st March 1943. Pp. 20. (Kingston: Government Printer.) [317

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium, Vol. 29, Part 1: Taxonomic Studies of Tropical American Plants. By C. V. Morton. Pp. xi+86. (Washington, D.C.: Government Printing Office.) 25 cents. [317

U.S. Department of Agriculture. Circular No. 675: Control of the Mexican Bean Beetle in Irrigated Districts in the West. By R. L. Wallis. Pp. 12. (Washington, D.C.: Government Printing Office.) [317