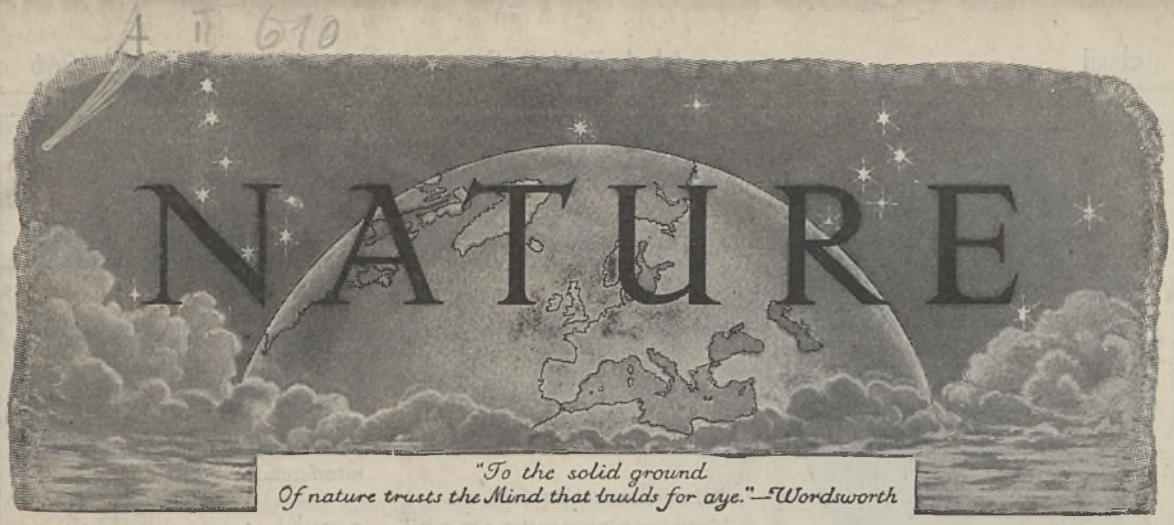


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# NATURE

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## MATHEMATICAL TECHNOLOGY OR QUANTITATIVE MATHEMATICS

WE publish in this issue an article by A. Erdélyi and John Todd, entitled "Advanced Instruction in Practical Mathematics", which follows an earlier article by D. H. Sadler and John Todd (*Nature* of May 4, p. 571), "Mathematics in Government Service and Industry : some Deductions from the War-time Experience of the Admiralty Computing Service". They claim that it has now been fully demonstrated that there is a need, in Government departments such as the Admiralty, the Ministry of Supply and Aircraft Production, and in industrial research associations or research departments of engineering or other firms, for a new type of mathematician, whom Dr. N. W. MacLachlan has called a 'mathematical technologist'. Such a man will have a good knowledge of academic mathematics, but in addition will know how to apply this knowledge to obtain a complete approximate solution, with full numerical calculations, of an engineering or other problem. Much of modern academic mathematics is of a qualitative nature. We prove that a solution of a problem exists, under certain conditions, and that this solution has certain properties, such as breaking down at specified exceptional points. The mathematical technologist will not be ignorant of this, but will supplement it with detailed quantitative knowledge, giving all the information required to any desired degree of approximation. So far the universities of Great Britain have done little or nothing to produce such men. What should be done about it ?

Before considering the proposals put forward by Mr. Todd and others, all of whom agree in their general objects, we must face the fact that many mathematicians of the greatest eminence will view such proposals with reluctance. For example, Prof. G. H. Hardy, the acknowledged leader of British pure mathematics, to whom most of the ablest young mathematicians have, for many years, looked for guidance and inspiration, divides mathematics into "real" and "trivial" ("A Mathematician's Apology", Cambridge, 1940). By real mathematics he means that which has permanent æsthetic value, for example, the best Greek mathematics. This mathematics "is eternal because the best of it may, like the best literature, continue to cause intense emotional satisfaction to thousands of people after thousands of years". Such mathematics includes not only Fermat's investigations into the theory of numbers and other work in pure mathematics, but also Einstein's theory of relativity, and Dirac's quantum mechanics. On the other hand, Prof. Hardy describes as "trivial" nearly everything that could be called laboratory mathematics, such as the work of gunnery experts and aeroplane designers. He admits that ballistics and aerodynamics demand a quite elaborate technique, so that it is perhaps hard to call them "trivial", but they are described as repulsively ugly and intolerably dull. It is not quite clear how far Prof. Hardy has been influenced by his appreciation of beauty, and how far by his dislike of war. Plato, on the other hand, advocated the study

of geometry not only for its permanent æsthetic value, but also for its usefulness in war. Both Plato and Prof. Hardy agree in disliking practical or mechanical applications. Plato would leave these to an inferior class without political rights, and Prof. Hardy to the garage mechanic. Really the Greeks were the more logical, for the philosopher cannot exist without the productive efforts of either slaves or of the machine. It is not contempt of human values, but a deep respect for them, that leads us to develop the machine as the only way of making possible a tolerable life for all. To develop the machine we need the technologist, and every branch of science must be called upon to make its contribution to human well-being.

But this contribution need not be a sacrifice without hope of reward, even from the point of view of abstract thought. Archimedes, the greatest mathematician of ancient times, who turned his attention to ballistics when it was necessary to defend his homeland against the invader, opened up many new and fruitful lines of development of mathematical theory. His genius was apparent in his disregard for the narrow limitations laid down by Plato. Gauss, "the prince of mathematicians", is revered for his researches in the theory of numbers and other branches of pure mathematics; but he was also greatly interested in calculating the orbit of the planet Ceres. His interest in practical surveying led to his beautiful theoretical researches on the differential geometry of surfaces. Why should any mathematician think it degrading to follow in the footsteps of Archimedes or Gauss?

We have thought it worth while to deal, at some length, with the possible *a priori* objections to the proposals of Mr. Todd and others, before examining in detail the proposals themselves, because once the desirability of the existence of mathematical technology is admitted, the case they make out can scarcely be denied. They point out that the need for training in computational mathematics was emphasized by the Assistant Director of Scientific Research in the Admiralty in 1942. Earlier in the War, great assistance had been given to the Admiralty and to other Government departments by the Nautical Almanac Office. When the work continued to expand, Mr. Sadler, superintendent of that Office, was called in to make an investigation, and made proposals which eventually led to the formation of a Mathematics Division of the National Physical Laboratory. This will be a permanent organisation, for peace as well as for war.

The question arises how the permanent senior staff of such an organisation are to be trained. To a certain extent, good mathematicians could pick up the technique by actual experience in the National Physical Laboratory itself. But this is not really satisfactory if new processes are to be devised, for the conditions of work in the Civil Service, especially for work which demands a high degree of accuracy, may not be the most suitable for innovations or research. Moreover, there are the somewhat similar needs of workers in any of the increasingly numerous industrial research associations. It would seem that systematic courses in the subject, such as could be offered by a university or institute of similar standing, would best meet requirements.

The greatest mathematical centre in Great Britain is the University of Cambridge; and it now has a Mathematical Laboratory, which is reasonably well equipped, and active workers who understand the importance of mathematical technology. It is not too much to hope that a flourishing post-graduate school may grow out of the work of this Laboratory. There is also the Imperial College of Science and Technology, London, which, as shown by Prof. S. Chapman's article "University Training of Mathematicians" (*Mathematical Gazette*, 30, 61; 1946), has a competent staff who have sympathy and experience with work of this sort. It is true that Prof. Chapman was describing a modification of the undergraduate course which has produced good results, whereas Mr. Todd and his associates prefer a post-graduate course in computation following an honours course in mathematics of the usual type; but the general point of view is so similar that it should be easy to devise concerted action.

Now that the University Grants Committee has new terms of reference, which empower it to advocate a positive policy, it might well consider the establishment of an institute devoted to mathematical technology or quantitative mathematics. The term "advanced practical mathematics", used by Mr. Todd, has an unfortunate association with instruction in the use of formulæ without proof, sometimes given in technical colleges, and so require careful consideration. In the beginning, at any rate, the organisation should be elastic. In addition to complete courses for those who are desirous of taking a full course of training, there should be short courses to attract mathematicians who, though suspicious, might be willing to investigate a new aspect of their subject. Whether such an institute should publish monographs, or a journal of its own, and how far it should install elaborate calculating machines of mechanical or electronic types, are matters for the future. What does seem clear now is that a start should be made as quickly as possible.

## APPEAL TO CLIO

### History is on Our Side

A Contribution to Political Religion and Scientific Faith. By Joseph Needham. Pp. 226. (London: George Allen and Unwin, Ltd., 1946.) 8*s*. 6*d*. net.

UNDER the title "History is on Our Side", Dr. Joseph Needham has brought together twelve essays and addresses written or delivered between 1931 and 1942, some of which were revised during his stay in China. Most of them display the omnivorous character of Dr. Needham's reading, and some of them have the charm and persuasiveness that marked his earlier book, "Time: the Refreshing River". But in spite of a certain spiritual quality, they are rarely so convincing as his earlier book. They lack unity, and the book as a whole is a rather confused mixture of science, politics, religion and philosophy in which the enthusiasm of a convert has warped the judgment and critical faculty that one would expect of a scientific man of Dr. Needham's standing. Dogmatism

and a tendency to *ex cathedra* judgments rob the book of any pretensions to form a serious contribution to either political or religious thought: one is left no wiser at the end as to what 'political religion' may be, or 'scientific faith'.

The happiest of these essays is that entitled "Cambridge Summer", where Dr. Needham not only displays his wide erudition but also an imaginative insight that gives his essay a real charm. Elsewhere, too, Dr. Needham shows a real power to interpret the past and give it new meaning, and more especially when his interest lights on some forgotten figure and brings it to life again. But the historian who would welcome Dr. Needham's talent as a historical interpreter would be appalled at the inaccuracy of his quotations, and the ease with which his enthusiasms or prejudices lead him to throw to the winds the old Cambridge tradition of exact learning and cautious statement. It was not Lord Stamp but the Bishop of Ripon who suggested a moratorium for scientific discovery, although abbreviated press reports of Lord Stamp's words have conveyed that impression. Similarly, Dr. Needham confuses Johnson's well-known refutation of Bishop Berkeley's "ingenious sophistry" with the dictum of David Hume that Berkeley's arguments "admit of no answer and carry no conviction". "A letter to an American Friend" entitled "University Democracy" also shows imagination, and its vigour and earnestness make it even after eight years a stimulating contribution to current debate on the future universities. The same cannot be said of the Schiff Lecture at Cornell University in 1940, "The Nazi Attack on International Science". Effective propaganda when written no doubt, in spite of a rather superficial and unconvincing analysis of the havoc in German science, this essay is dated and the connexion with the others is slight.

These three essays occupy almost half the book, and it is in the remaining essays such as those entitled "The Two Faces of Christianity", "History is on Our Side", "Religion and Politics", that Dr. Needham's bold incursions into religion and philosophy, or indeed into physics, are most provocative. Indeed, if it can be said of them that they frequently fail to convince, they certainly admit of an answer. Startlingly rapid argument, for example, in an essay "The Liquefaction of Form and Matter", leads Dr. Needham to conclude that "we can stop thinking of Form and Matter altogether if we begin thinking of Organisation and Energy". Dr. Needham passes far too lightly over the difficulties that yet remain, and his omissions no less than his assertions might provoke a devastating reply from a physicist. Nor where he should be more at home, as in his essay "The Gist of Evolution", is Dr. Needham altogether free from such faults. A fervent adherence to his creed of dialectic materialism betrays him into overstatement or over-simplification and a neglect of the arguments on the other side which rob this book of a claim to be a real contribution to serious thought.

When this has been said, it remains true that, without establishing his thesis convincingly, Dr. Needham gives something more than an interesting study of his enthusiasms and prejudices. Through the book there is woven a moving and human picture of communism and the ideal it represents. The picture may be overdrawn and not entirely accurate, and there is an absence of the hard thinking and unfailing accuracy that are necessary to carry conviction. Dr. Needham's profound admiration for Soviet Russia pervades the book, although the basis of that admiration is never very clear. He believes that in essentials Soviet Russia has shown the way to the moral regeneration required to establish a world community. He states the contrast between evolutionary progress and retrogression in terms of the Fascist–Communist antithesis, but there is no analysis of the difference between the two different conceptions of democracy that tend to divide the post-war world. Again, although he sees communism as the successor and heir of "Christian materialism", he fails to recognize the nature of the Christian attempt to reconcile individual consciousness and initiative with social responsibility, or that the essential problem before us to-day is whether the individual can preserve his integrity within a collectivist society. The recent literary purge at Leningrad betokens stirrings towards intellectual freedom which do not suggest that the creative instincts, whether in art or in science, have quite the play that Dr. Needham would have us believe. That physical order is everywhere decreasing and biological and social organisation increasing; that the whole enterprise of science is a manifestation of social organisation; that the world co-operative commonwealth is a certain resolution of our difficulties, are large assumptions which may possibly be true, though they can scarcely be described as having the full authority of evolution behind them, at least on the evidence Dr. Needham presents. We may agree with Dr. Needham that the achievement of some new and closer form of world order by man's conscious effort to modify his environment and his relations with his fellows is the condition of survival; but not all the charm of Dr. Needham's essays, his rich illusiveness, and deep human concern quite convince the reader that he has pointed the way to solve the problem.

R. Brightman

## ELECTRON OPTICS FOR STUDENTS

### Introduction to Electron Optics

The Production, Propagation and Focusing of Electron Beams. Dr. V. E. Cosslett. Pp. xii+272+8 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1946.) 25*s*. net.

IT was a surprise to read in Dr. Cosslett's preface that a course of lectures in electron optics has been given in the honours physics course at Oxford since 1942; yet the surprise was unwarranted because the War has forced electron optical devices out of the laboratory and into industry and the Services. Dr. Cosslett has aimed at providing a textbook "intermediate in length and level of treatment", and hopes that it will be of use to students and research workers; presumably those using electronic devices rather than their designers.

The first half of the book is devoted to the theory of electrostatic and magnetic lenses together with their aberrations. After a brief introductory chapter dealing with the elements of electron motion in electromagnetic fields, the author considers methods of determining electrostatic field distributions and ray paths. Besides the standard material on analytical methods, electrolytic troughs and rubber sheet models, a short account of the application of Southwell's relaxation method is included. This method has not been widely used, and one would like to know whether it is a better tool than, say,

the electrolytic trough. Separate chapters on electrostatic focusing and magnetic focusing follow. These chapters contain some new material by the author and his colleagues on the numerical computation of focal lengths. The matter is well balanced, and the methods of ray tracing described are well suited to the needs of the learner, although few specialists will find their pet techniques described. The section ends with a treatment of aberrations which is one of the best parts of the book, Dr. Cosslett having steered a straight course between the Scylla of obscurity and the Charybdis of superficiality.

The second half of the book deals with the application of the theoretical principles already discussed to various electron optical devices commonly used in research and industry to-day. The different types of electron emission are first briefly discussed; next comes a chapter on cathode ray tubes and picture converters; electron diffraction and electron microscopes share another, then cylindrical field devices including the β-ray spectrograph, magnetron, cyclotron, betatron, beam testrodes and mass spectrographs are summarily described in eighteen pages. Velocity-modulated beams occupy the last chapter, and the book is rounded off by an appendix on the Hamiltonian optics. Clearly it is quite impossible to deal adequately with this mass of material in a hundred or so pages, and one must express a doubt as to whether the needs of the student are best served by such inclusiveness. The level of these discussions is very variable, and it is quite obvious where the interests and practical experience of the author lie. For example, the discussion of beam tetrodes and magnetrons is too brief to be convincing, and some distortions of fact have crept in; thus, a remark at the end of the section on beam tetrodes implies that in general they possess mutual conductances several times greater than pentodes, which is certainly not the case. The description of magnetron operation in the dynatron regime given on p. 220 is confused.

The short chapter on velocity modulation devices does not include any recent material, but allowances must be made for the fact that the book has been rather a long time in printing (the preface is dated April 1945); although other sections contain references to the Smyth Report on atomic energy.

It is unfair to criticize the book on specialist grounds. It is obvious that a text-book of this type must contain material on the practical application of the subject if it is to grasp the student's interest, and no individual could write authoritatively on all the subjects considered. One major criticism is unfortunately necessary. There are two main divisions in modern electron optics; the first, to which the book is confined, is light-current optics, in which the electrons travel along paths prescribed by fields external to the beam. In heavy-current electron optics, the electron motion is also a function of the space-charge fields set up inside the beam, and, in fact, space-charge conditions determine the maximum current which can be passed through any electronic device. The electron optical design of a klystron is far less a question of providing specified focal lengths than it is of providing specified currents, and it was only when designers forgot about cathode ray tube gun designs that much progress was made. Dr. Cosslett just mentions the pioneer work of J. R. Pierce on these lines, but he misinterprets it by saying that Pierce's treatment neglects space-charge effects, whereas Pierce actually investigates field conditions at a boundary between a region in which rectilinear space-charge flow occurs, that is, in which Poisson's equation is obeyed, and a region in which Laplace's equation is obeyed. Pierce then provides electrodes shaped so as to produce the desired fields. This omission is a major blemish on the book, because a good deal has been published on space-charge flow in various tube geometries, and the subject is just as important technically as light-current optics. It is to be regretted that the book does not use M.K.S. units, which save endless numerical mistakes, especially when high-frequency effects have to be considered.

In spite of these criticisms, Dr. Cosslett has written a useful book—more useful than some much more pretentious works on the subject—and a careful student could learn a great deal from it. Electron optical specialists will not find much of interest, but non-specialists who use electronic apparatus may find the sections on applications stimulating.

A. H. Beck

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# THE UNIVERSITY AND SOCIETY

## Mission of the University

By José Ortega y Gasset. Translated with an Introduction by Howard Lee Nostrand. (International Library of Sociology and Social Reconstruction.) Pp. v+81. (London: Kegan Paul and Co., Ltd., 1946.) 7*s*. 6*d*. net.

In an earlier work, "The Revolt of the Masses", Señor Ortega singles out as one of the most dangerous phenomena of our times the deliberate refusal on the part of the masses to shoulder the enormous burden imposed by the increasing specialization of knowledge. As a result, European man has become 'atomized', and the nineteenth century universities have added to the disintegration by producing "The new barbarian, the professional man". In the present essay, the university is called upon to undertake the work of re-integration. To do this, the university must be completely remodelled, and the most valuable part of the essay consists in a rather sketchy draft of how this is to be done. The new university will be an institute for higher education for the ordinary man. Its core will be a faculty of culture where every student will receive an education designed to put him "at the height of the times", that is, familiar with the vital system of ideas of the period. This education is to be a synthesis of physics (more widely conceived than is usual in Britain), biology, history, sociology and philosophy. In addition, he would be trained "by the most economical, direct and efficient methods" to be a good professional.

These ideas were first expounded in a series of lectures given in 1930 to students in Madrid, and in some respects are relevant only to conditions then prevailing in Spain. To some extent also they represent Ortega's reaction against the over-specialization he found in the German universities, especially in science. But there is enough of general interest to make this a valuable contribution to the continuing debate on the role of the university. Its value would have been greatly increased had the author developed it into the course on the idea of the university spoken of in his preface. For it is easier to agree with his diagnosis of the maladies of universities than with the cure proposed. So many questions are left unanswered. Who is to draw up the synthetic curriculum, and whence will its teachers come? How to ensure that the education which was "at the

height of the times" when the student received it is not an intellectual millstone when he is thirty years older ? Such names as Aristotle and Thomas Aquinas remind us that the best of syntheses have an awkward tendency towards fossilization rather than dynamic evolution. Moreover, with all its defects, the nineteenth century university, in Britain at least, had two great merits. In its humane studies, especially in the classics, it gave what has been called "the constant vision of greatness", while in the natural sciences the student was able to watch at first-hand the actual advance of knowledge. Indeed, at the best, both these high virtues might be combined in either discipline, but it is hard to see their place in Ortega's university.

The author has nothing to say on literary or linguistic studies, nor on fine arts, which would seem to be mere appendages of history, and so far as the sciences are concerned the student would be dangerously far from the fountain of knowledge. The English university teacher would not, on the whole, be inclined to welcome a university "centred on the student", and he will surely pray to be delivered from the science of university pedagogy for which Ortega calls. None the less, the plea that the university should show more care for general culture is one that we must not lightly neglect. In his final paragraph, where he calls upon the university to intervene in current affairs, treating the great themes of the day from its own point of view, cultural, professional and scientific, Ortega seems to point to the possibility of the university realizing much of its mission of general culture through its extramural work. The English universities—too narrowly preoccupied in the past with "Workers' Education"—have only begun to address themselves to this task. D. R. Dudley

## STATISTICS IN INDUSTRIAL RESEARCH

### Industrial Experimentation

By K. A. Brownlee. Pp. 116. (London: H.M. Stationery Office, 1946.) 2*s*.

NOT the least of R. A. Fisher's contributions to statistical science has been his insistence that the statistician is as necessary in the planning of experimentation as in the interpretation of its results. In experimental biology, the importance of giving due weight to statistical considerations is now widely recognized, and the intimate connexion between the design of an experiment and the appropriate method of statistical analysis is emphasized in many text-books. Important recent developments of statistical method have arisen in response to the needs of agricultural experimentation : published accounts have described their advantages and illustrated their working chiefly in relation to agricultural or other biological problems. The value of principles such as factorial design, or of techniques such as the analysis of variance, however, is by no means restricted to the elucidation of biological problems.

Mr. K. A. Brownlee presents examples of the application to industry of methods well known in biological research ; both statisticians and industrial research workers should be grateful to him for his attempt to increase their collaboration. He rightly emphasizes the importance of consultation with the statistician before an experiment is begun as well as during the analysis of the results, a policy which, if consistently followed, would lead to greater efficiency and economy of effort in the conduct of many experimental programmes.

After introductory remarks on fundamental statistical concepts of probability distributions and variability, Mr. Brownlee shows the use of elementary significance tests in comparing two sample means or variances. Two short chapters contain discussions of contingency tables and $\chi^2$ tests, and of the Poisson distribution (the binomial distribution is omitted). The remaining two-thirds of the book are concerned primarily with the analysis of variance, especially in relation to factorial experiments and, to a lesser extent, with regression and correlation. Methods of quality control are mentioned, but only briefly, since Mr. Brownlee's subject is experiment rather than routine production. Each type of analysis is illustrated, with considerable arithmetical detail, by examples of its application.

Unfortunately the book, so good in intention, is much less satisfactory in execution. The systems of computation for many of the simpler techniques may be learnt rapidly, but without some critical appreciation of their meaning they may easily be misapplied ; even a statistical 'cookery-book' needs to appeal to the reader's critical faculty as well as to his arithmetical facility. Mr. Brownlee gives very full instruction in calculation, but often seems to suggest that application of inflexible (and sometimes apparently arbitrary) rules is sufficient for the interpretation of experimental data. Furthermore, the description of the subject-matter of many examples is so condensed that the reader unfamiliar with this particular field of industrial experimentation (the manufacture of explosives) may not readily see the relevance of the methods to his own problems.

The section on the comparison of two samples revives unnecessarily the practice of making arbitrary distinction between 'small' and 'large' samples ; the trivial simplification in computation resulting from the 'large sample' rule is more than counterbalanced by its confusion of the reader who does not realize that one rule is an approximation to the other. The discussion of correlation and regression is useful so far as it goes, but it is marred by complicated notation, and the existence of further extensions of the methods is not mentioned ; the statement of the fiducial limits of a regression equation takes no account of errors in the estimated regression coefficient, and no distinction is drawn between the precision of prediction of a single value and that of the mean value of the dependent variate for a given value of the independent variate. In his main chapter on the analysis of variance, Mr. Brownlee first tests the significance of high-order interactions, and pools non-significant components with the error sum of squares ; he then tests interactions of lower order against the new error mean square, and continues the pooling process. Though pooling of components in this way may occasionally be excused, it will tend to produce under-estimation of error mean squares, and its general adoption might lead to serious biases in tests of significance. The whole of this chapter exemplifies the uncritical presentation of the subject, for the analysis of variance is shown as an entirely automatic method of interpreting data. In the account of factorial experiments, no mention is made of factors at more than two levels, and, in spite of their detailed description, the methods of computation shown are not always the most expeditious.

Apart from faults in theory such as have been noted in the previous paragraph, the chief reason why this book fails to satisfy is that its aims are too many. It appears to be intended as a general description of the potentialities of statistical science in industrial experimentation, as an elementary manual of instruction, and also as an introduction to the use of various more advanced analytical techniques. Whether the combination of these within a single book is desirable may be doubted; its successful accomplishment in 116 pages is impossible.

D. J. Finney

## MEDICAL ENTOMOLOGY

### Entomology (Medical and Veterinary)

By Prof. D. N. Roy. Pp. xii+358. (Calcutta: Saraswaty Library, 1946.) 30 rupees.

THE author of this book is professor of medical entomology in the Calcutta School of Tropical Medicine. His object in writing it, he informs us, is to ease the scarcity of works of a technical nature now available in India. It is intended for the use of medical and veterinary students as well as for public health officials, all of whom require up-to-date information on insects in relation to disease. It is a matter of interest that the book has been written, printed, illustrated and published in India by Indians.

As is usual in preparing works of this kind, the scope of entomology has been extended so as to include ticks and various other animals that are implicated, in some way or other, with disease transmission. The importance of *Anopheles* mosquitoes in the tropics needs no comment, and this feature accounts for these insects receiving fuller treatment than any of the other groups. Keys and tables for the identification of both the adults and the larvæ are given; methods of conducting malarial surveys and of the preparation of blood-films are explained, and there is an interesting account of the different means for malaria control in its various aspects—chemical, biological or otherwise. The account of Culicine mosquitoes, notwithstanding their great importance from the medical point of view, is much more condensed, and the chapter concludes with a bibliography of about 270 titles.

The Psychodidæ follow, and a short but useful account of the flies is given, with a good bibliography of the relevant literature. A good and, on the whole, adequate account of the Cyclorrhapha as exemplified by the house-fly is given. The habits of all more important species are referred to and the essential details of the most modern methods of prevention and control are provided. The next twenty-four pages deal with the fleas and their relations to bubonic plague, together with certain other diseases. The account of the Anoplura gives the chief facts regarding the medical importance of *Pediculus* and methods of disinfestation. It is interesting to note that the almost incredible number of 9,020 individual lice (adults and immature forms) is recorded from one female patient. Passing over several groups, we come to the ticks and other Arachnida, etc.; the book concludes with a chapter on entomological technique, including section-cutting and staining.

Viewed as a whole, it is a useful volume, well adapted for the purposes intended. The subject-matter is concisely expressed and well up to date. A good feature is the bibliographies at the end of each account. The main criticism is that the author plunges too suddenly into a specialized subject without an adequate preliminary account of insects as a whole. No references are given to general works on entomology, while a short list of the leading textbooks of medical entomology would be useful to the reader who desires to widen his point of view beyond the confines of this book. These omissions, however, are minor features in a good reliable volume, the author of which is to be congratulated on his efforts.

A. D. Imms

## PROTOZOOLOGY

### Protozoology

By Prof. Richard R. Kudo. Third edition. Pp. xiii + 778. (Springfield, Ill.: Charles C. Thomas, 1946.) 8 dollars.

IT is now fifteen years since Kudo, who occupies one of the very few university chairs of protozoology in the world, produced his "Handbook of Protozoology"; the second edition appeared in 1939, and now a third edition has been issued.

This third edition, much of which has been rewritten, contains two new chapters, one on the major groups and phylogeny of the Protozoa, and one on the collection, cultivation and observation of them. The author, rightly believing that adequate illustrations are important, has added sixty-nine figures, forty-seven of which are new, while twenty-two are taken from his "Manual of Human Protozoa", which was published in 1944. The result is a book which will be valuable to all biologists who wish to study the Protozoa. It is well printed and tastefully produced, but here and there the language is quaint, and there are misprints which could have been eliminated; and the definite article is sometimes omitted. Most of the illustrations are in line and stipple, and the majority are good or excellent. The coloured figures of the human malarial parasites are better than many that have been published. A few of the illustrations, however, are too small. The beauty and clarity of Bělař's figure of the pædogamy of *Actinophys sol* on p. 164 have suffered in this way; and students of parasitic Protozoa will feel that the figures of *Crithidia*, *Herpetomonas*, *Giardia*, *Trichomonas*, *Trypanosoma gambiense*, *T. rhodesiense* and of some other parasitic species compare unfavourably with those published in books of medical parasitology.

These are, however, relatively unimportant criticisms. More important is the fact that, in this book, one of the few volumes dealing with the Protozoa from the biologist's point of view, only 176 of the 710 pages are devoted to the general biology of the Protozoa, which raises so many problems of fundamental biological importance. The second part of the book, devoted to taxonomy and special biology, gives some further notes about the biology of some species, but these are notes only. On the other hand, the reader who desires further information about particular points can obtain it by following up the references given at the end of each chapter.

It is likely that this book, like other books of equally wide scope, will grow with the years and become more and more valuable to the biologist.

G. Lapage

## Honey Production in the British Isles

By R. O. B. Manley. Pp. 328 + 15 plates. (London : Faber and Faber, Ltd., 1946.) 18*s*. net.

WHEN a modern technical work sells second-hand for considerably more than its published price, there is a clear case for re-issue. The above is substantially a re-issue of the former edition, with errata corrected and some new illustrations.

It is the only book on bee-keeping in Great Britain written by one who depends upon honey production for his livelihood. If more amateur bee-keepers followed the professionals in choice of apparatus and methods of management, more of them could develop their hobby into a profitable side-line or even a means of livelihood.

Everything written by Mr. Manley makes good reading and is worthy of careful study. It is only on re-reading this work, now ten years old, that one realizes how far the first edition was in advance of the teaching of that time. Many bee-keepers have yet much leeway to make up. Some of them know it and will welcome this re-issue.

One could wish that the author could have found time to re-write some few parts of the work, for he surely has something to teach us on hive ventilation ; treatment of disease also would be brought up to date.

Mr. Manley is perhaps the only writer who gives really reliable and detailed information on the costs and profits of commercial bee-keeping. This information is all on a pre-war basis, but as figures were then at least stable the reader can make his own corrections, whereas comparison at a later date with 1946 figures would be by no means simple.

E. B. WEDMORE

## History of Air Navigation

By Arthur J. Hughes. Pp. 154. (London : George Allen and Unwin, Ltd., 1946.) 10*s*. 6*d*. net.

ALTHOUGH published in 1946, it appears from the preface that this book was completed in 1944. It was not possible, therefore, to give any information about war-time developments to aid air navigation, of which particulars at that time had not been released. The book was thus out of date before it was published. It is disappointing in other ways ; illustrations of a great variety of instruments are given, but in many cases without sufficient description for those who are not familiar with them to understand how they are used. The reader will look in vain for any account of special methods of navigation adopted for polar flights. The chapter on ancient navigation has nothing to do with air navigation. Although aviation has a short history, developments—stimulated as they have been by two great wars—have been rapid. A fascinating story of the history of air navigation might have been written. This book seems to fall between two stools : it is not sufficiently technical and specialized for the expert, but it is too technical and assumes too much basic knowledge for the general reader.

## Digestion

Edited by H. J. Vonk, J. J. Mansour-Bek and E. J. Slijper. Part 1. (Tabulæ Biologicæ, Vol. 21.) Pp. xvi+284. (Amsterdam : Dr. W. Junk, 1946.)

THE editors explain in the preface that the manuscripts of this volume were ready in 1939, but the difficulties caused by the War and the German occupation of the Netherlands delayed printing until this year. The whole volume is now to be published in three parts, the first two dealing with vertebrates and the third with invertebrates, of which this is the first. An appendix, containing the accumulated data of the last seven years, is planned and will be included in the third part.

The present part contains articles on the physiological anatomy of the digestive organs and on the food of vertebrates, on the rhythmic action of the glands of secretion and their composition, and on the digestive enzymes. With one exception (an article by Linderström-Lang and Holter on the distribution of enzymes in the mucous membrane of the gastro-intestinal canal) the authors are all Dutch. We may notice particularly the article on the digestive enzymes by Chr. Engel, which is a valuable summary of the knowledge up to 1939. However, in view of the great progress made in recent years on the pancreatic enzymes, there is no doubt that much of the older work on the peptidases, etc., of the intestinal canal will need re-evaluation. J. A. V. BUTLER

## Experimental Plastics and Synthetic Resins

By Dr. G. F. D'Alelio. Pp. ix+185. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1946.) 3 dollars.

THIS publication should prove of considerable value to graduate students starting upon a career in the plastics industry. We have nothing quite like it in Great Britain. Ninety-seven experiments are described and twenty-seven test methods. A distinctive character of the book is the way in which these exercises are put together ; they all need thought rather than mere routine attention. Among the tests are such interesting topics as the determination of *p*H, acid number, and degree of unsaturation (akin to the iodine number). In the arts and crafts there should be a future for this compilation, since the use of methacrylate esters and the various polyvinyls is increasing in these fields. It would be advantageous if museum and gallery workshops could be provided with this book, for their skilled technicians to see what can be done with polymers and condensation products in general.

The attractive format and neat arrangement of the text are commendable. F. IAN G. RAWLINS

## The Gas-filled Triode

By G. Windred. Pp. 72. (London : Hulton Press, Ltd., 1946.) 2*s*. 6*d*. net.

THIS monograph outlines both the historical and practical aspects of the gas-filled triode ; these devices find many applications in industrial control and trigger circuits. The author gives a complete list of those models available at the present time, together with their operating conditions and possible circuits.

## Systematic Inorganic Chemistry of the Fifth-and-Sixth-Group Non-metallic Elements

By Prof. Don M. Yost and Horace Russell, Jr. (Prentice-Hall Chemistry Series.) Pp. xx+423. (London : Oxford University Press, 1946.) 21*s*. net.

THIS book was published in the United States in 1944, and was reviewed in *Nature* (**154**, 723 ; 1944). The present issue has a new title-page, but is otherwise the same. The book is one which can be recommended to students, and the fact that it has been made available in Britain is to be welcomed.

# ADVANCED INSTRUCTION IN PRACTICAL MATHEMATICS*

By A. ERDÉLYI and JOHN TODD

ALL who watched the development of industrial research in recent decades and those who, during the War, had an opportunity of observing work in Government research departments, must realize that the usual academic syllabus in mathematics does not provide an adequate preparation for a future research worker in Government service or industry. Students, for example, of engineering (with which we include, for the sake of brevity in this article, physics, chemistry, etc.), biology or economics, do not get, as a rule, a mathematical training sufficiently advanced to enable them to follow up, and participate in, recent research in their subjects; and the training of students of mathematics is not very suitable for the type of work we have in mind. The truth is that in recent decades there has grown up a new type of research worker—Dr. N. W. McLachlan has called him the mathematical technologist—and so far British universities have not provided very much for him. An urgent need thus arises for an institution where students are instructed in advanced mathematical techniques not usually included in university curricula, yet needed in 'mathematical technology' (and mathematical biology or economics for that matter) and where they are introduced to research. The need for such an institution, which we may call an 'Institute for Practical Mathematics', was pointed out in a recent article[1] which, evaluating the war-time experience of the Admiralty Computing Service, came to the conclusion that such an institution is necessary both to teach potential 'customers' of the industrial mathematician to state their problems in a suitable way, and also to ensure that the mathematician will be able to tackle these problems in a practical manner.

Since it is impracticable to add to the present syllabus without dangerously lowering the standard of instruction, and since there is scarcely anything in that syllabus that could profitably be discarded in order to make place for more practical mathematics, it is inevitable that the main activity of the suggested institute should consist of post-graduate courses. This theoretical conclusion is borne out by practice in the United States, where such post-graduate courses have been given, for example, at Brown and New York† Universities, for several years and have proved a great success. There is much to be learned from the American courses, notably the beneficial effects of a close collaboration between the academic institutions on one side, and Government agencies and industry on the other side. It is perhaps not too much to say that the usefulness of such courses depends in the first place on the success with which this collaboration is maintained. The role of industry and Government departments is a threefold one; they suggest suitable subjects of instruction, send students, and also provide some of the instructors. In this way a very fruitful and mutually beneficial contact is established between the academic and the industrial mathematician.

Among the principal functions of the suggested Institute for Practical Mathematics we may mention short courses for engineers and others; advanced courses for mathematicians; research; and the preparation of monographs.

Engineers, biologists, economists, and other potential 'customers' of the practical mathematician should be given instruction in routine techniques. In addition, they ought to attend courses of a broader character in which they would get a general idea of methods of modern practical mathematics without learning any details, see what types of problems are accessible to mathematical treatment, and learn to formulate their problems in a suitable way. Engineers lacking such training have been known to give up a problem as a 'bad job' because it did not seem to be amenable to the mathematical methods with which they were familiar: yet, had they only known it, there was an efficient method of dealing with the problem, a method, though, which requires a specialist and is outside the reach of a general practitioner of applied mathematics. Still worse, in some cases the engineer 'over-simplifies' his problem in order to make it accessible to what he considers the appropriate technique and thereby makes the work more cumbersome, if more elementary, and the result of less practical value. The purpose of the mathematical training of an engineer (and on a higher level that of a practical mathematician) should not be to provide him with the detailed working knowledge of as much of mathematical technique as possible within a given limit of time; the aim should be to give him a detailed working knowledge of the most frequently used routine techniques, together with a comprehensive survey of what a mathematician can do for him, and also to teach him how to collaborate with the mathematician when occasion demands it.

The reader may feel that we labour this point unduly, but it is in fact an important one: to explain what we mean an example given in the earlier article may be mentioned. Every engineer should be able to perform elementary numerical work, interpolation in tables, numerical solution of equations, numerical integration, etc.; but to attempt to teach much more in a short course is not worth while: numerical work involving advanced techniques or large-scale computations (systematic tabulation) should be left to the professional computer. Yet, the engineer should have a sound idea of what the modern computer can do for him. Instead of teaching the engineer yet a few more numerical methods which in any event he would not have to use often, and not be able to use efficiently, he should be given a comprehensive survey of modern numerical methods, including machine computations and specialized computing equipment such as differential analysers and punched-card equipment.

Post-graduate courses for mathematicians should be the backbone of an Institute for Practical Mathematics. A general mathematical background of about the standard of B.A. or B.Sc. honours degree would be assumed and students should be offered degree courses for M.A. and M.Sc. degrees and also facilities for research leading to a Ph.D. degree. Here again detailed instruction should be given in a number of subjects, and the student allowed selection in a wide range of courses offered (a biological mathematician would naturally make a selection different from that of a research worker in electromagnetic theory): and the specialized courses should be supplemented by a general survey of as nearly as

* This article is published with the permission of the Director of Physical Research, Royal Naval Scientific Service.

† It is regretted that, in the article in *Nature* of May 4, New York University was confused with another place. Notes of lecture courses at both Brown University and New York University were made available in mimeographed form; some have now been published as books. These give some idea of the level of instruction necessary.

possible the whole of practical mathematics. Besides full courses, there should be single lectures or short courses on selected topics. The courses, on the whole, should be much more concerned with the mathematical techniques than with technicalities in the domains of their applications; but some instruction in the latter fields must be contemplated, for in many cases it is neither possible nor desirable to teach the techniques completely independently of their background. To make this point clear, we can imagine a student, becoming interested, say, in elasticity, in his undergraduate days, and coming to the Institute to learn some of the newer mathematical tricks and to see them applied to *old* problems, and then returning to his teacher to apply them to *new* problems.

We mention here some of the subjects which in our opinion should be taught, it being understood that the list is neither exhaustive nor definitive, nor are the subjects arranged in order of importance: it merely serves to indicate the general trend as we have observed it.

Interpolation, numerical differentiation and integration, least squares, curve fitting, difference equations;

Advanced numerical and graphical methods (including relaxation technique and machine methods of computation);

Slowly convergent series (transformations by means of contour integrals, convergence factors, Euler and other transformations);

Matrices and tensors (with applications to engineering problems);

Conformal mappings and two-dimensional potentials;

Contour integration (with practical applications);

Asymptotic series;

Laplace and Fourier transforms (Heaviside operational calculus);

Special functions (Bessel, Legendre and other functions, orthogonal polynomials);

Boundary value problems (separation of variables, general solutions, solution by means of functional transformations);

Non-linear differential equations (oscillations);

Integral equations (including the non-linear integral equations of oscillation theory and biology);

Calculus of variations (including the Rayleigh–Ritz method and other approximations);

Electromagnetic and acoustic waves;

Mathematical theory of elasticity (plates and shells);

Stability problems (buckling);

Hydro- and aero-dynamics (including shock waves, supersonic motion and turbulent flow);

Mathematical theory of servo-mechanisms;

Thermodynamics;

Theory of games (for economical applications);

Algebra (for biologists);

Elements of mathematical statistics (errors, various standard distributions, etc.);

Probability theory and its applications to the testing of statistical hypotheses and statistical estimating (for example, design of experiments and production control);

Random processes and time series.

At a later stage such an institution, with a nucleus of permanent staff, a fluctuating body of temporary and part-time instructors, and research students, could develop into a natural centre of research in practical mathematics. Fundamental research in this branch of mathematics would prosper in an atmosphere in which an intimate contact with the needs of industrial research associations is combined with academic mentality. Industrial research institutions on encountering a problem which needs a new mathematical technique would not unnaturally send some of their staff to the Institute of Practical Mathematics to learn that technique, and in many cases also to carry out some of the research under expert supervision there.

To facilitate research, and to make its results available to wider circles, it is desirable to publish monographs on subjects on which the current literature does not provide adequate, or adequately arranged, information. The Admiralty Computing Service in Great Britain, and similar organisations abroad*, have done great service in issuing such monographs as a "Catalogue of Conformal Representations", a "Manual of Non-linear Oscillations". In these monographs, results scattered in periodicals and text-books are collected and arranged so as to be of the greatest possible practical value. A body in which teaching and industrial research experience join hands would clearly be the most suitable centre for the publication of such monographs: it would be able to ensure a high scientific level and at the same time the greatest possible practical usefulness both in the selection of the material and in its presentation. As a large project of this character which deserves attention, we mention a manual of the solutions of the partial differential equation of wave motion. The efficient carrying out of such a project would depend on team-work in which academic and industrial research workers would collaborate, and the Institute for Practical Mathematics would be the natural place for this collaboration.

As to the location of the Institute, the strong concentration of industrial and Government research establishments makes it natural for it to be situated in or near London, where these research establishments and the University of London with its many colleges provide a considerable reservoir of potential part-time students and part-time teachers. There has been for some time at the Imperial College of Science and Technology[2] a strong tendency towards instruction in practical mathematics, and more recently the University of London has realized the need for courses in "Ancillary Mathematics" for students of various sciences, and such courses are now being given at some colleges. This instruction has, however, been mainly at undergraduate level, and, most desirable as it is, cannot in general lead directly to productive research. However, the experience of those concerned with these courses will be invaluable in any planning of post-graduate courses. For reasons such as these the Institute for Practical Mathematics might most conveniently be organised as a School or Institute of the University of London.

We hold that the Institute for Practical Mathematics should have a comparatively small permanent full-time staff, augmented by part-time staff and temporary full-time staff. The part-time staff could be drawn mainly from the London colleges and from research establishments in or near London; the temporary full-time staff would consist of visiting lecturers from abroad, from provincial universities and technical colleges, and industrial research workers spending their sabbatical year (or other kind of long leave) at the Institute. Thus a steady general trend could be combined with great flexibility and variety.

The majority of the students would be full-time students taking a post-graduate course immediately after taking their first degree. These students would be those who have shown a definite interest in research involving practical mathematics, or those who have been advised to consider a career in directed research rather than one in fundamental research.

* It is hoped that arrangements will shortly be made for the full publication of those monographs which have so far been available only to Government departments and similar agencies. Among the books of this character published outside Great Britain which have come to our notice are:

Kamke, E., "Differentialgleichungen: Lösungsmethoden und Lösungen", 1 and 2. (Leipzig, 1943, 1944.)

Magnus, W., and Oberhettinger, F., "Formeln und Sätze für die speziellen Funktionen der mathematischen Physik" (Berlin, 1943).

Ryzhik, I. M., "Tables of Integrals, Series, Sums and Products". (In Russian.) (Leningrad, 1943.)

After completing their courses these students would be ready for posts in Government or industrial research or for teaching posts, especially in the new technical colleges. Among the other students would be found some part-time ones specializing in their last (undergraduate) year. In addition, there would be research workers from Government or industrial establishments who would be attending courses or carrying out research, some full-time, some part-time.

It is believed that an institute planned on these lines would soon justify its existence by its usefulness: it would satisfy an urgent recognized need and therefore no very great difficulties are anticipated in financing it. It is difficult to estimate the size of such an institute at the time when higher education in Great Britain will have settled down to a steady state. It is, however, clear that there is a fairly definite size below which it would not be efficient, in so far as that it could not provide satisfactorily comprehensive courses. There is no doubt that there would be enough work, in each of the suggested directions, to occupy fully an organisation of the minimum size from the very beginning, and staff could be added and its scope extended in various directions in the light of experience. For example, there is a need for a British journal on the lines of the German *Zeitschrift für angewandte Mathematik und Mechanik* or the new American *Quarterly of Applied Mathematics*, and this institute would be the natural editorial centre.

[1] Sadler, D. H., and Todd, John, *Nature*, **157**, 571 (May 4, 1946).
[2] See, for example, Chapman, S., "University Training of Mathematicians", *Math. Gaz.*, **30**, 61 (1946).

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# PRINCETON UNIVERSITY, 1746–1946

By Prof. HUGH S. TAYLOR, F.R.S.

PRINCETON UNIVERSITY in Princeton, New Jersey, one of the five older institutions for higher learning in the United States, is celebrating the two hundredth anniversary of the granting of the original charter from King George II of England to the College of New Jersey on October 22, 1746. In deciding, in spite of many difficulties now confronting all institutions of higher learning in America, to organise a celebration of the event, the University based its decision on the belief that, in the present critical condition of the world, a re-dedication to the ideals of freedom and of obligation to the nation and to the world which have for two centuries animated the life of the University could not be ignored. Princeton, therefore, proposed "to direct its Bicentennial Celebration to the end of applying, in consultation with scholars throughout the world, our common skills, knowledge, and wisdom to the reconsideration of the fundamental obligations of higher learning to human society, hoping thus to contribute to the advancement of the comity of all nations and to the building of a free and peaceful world".

The primary means of implementing this purpose was the organisation of a series of fifteen scholars' conferences extending throughout the academic year 1946–47. These conferences are restricted in size and limited to distinguished scholars from many nations. They reduce to a minimum the presenting of formal papers, and develop to a maximum a free interchange of ideas among the members who meet as equals. Taken in their ensemble, they represent the first world congress of scholars of the post-war era.

The first six of these conferences have been completed. They form a progression from "The Future of Physical Science" through "The Chemistry and Physiology of Growth", "Engineering and Human Affairs", "The Evolution of Social Institutions in America", "The Development of International Society" to "The Humanistic Tradition in the Century Ahead", a progression from the physical and natural sciences through the social sciences to the values of humanism in the critical years ahead. Thirty-five foreign scholars representing fifteen other nations have joined with American scholars in three-day conferences on each of these six topics. In one conference eleven Nobel prize winners participated. The members of another conference were authors of more than a thousand books.

The remaining nine conferences of the second series, which will take place between the middle of November and May 1947, include two on the university—one on its relation to the public service, and one other relating to its world responsibilities. There will be one conference on the problems of mathematics, one on genetics, palæontology and evolution, one on the Near East and one on the Far East. There will be two on the fine arts, one restricted to the field of research and scholarship in the arts, and the other pertaining rather to the social implications of the fine arts in relation to the planning of man's physical environment. The final conference of this series in May will deal with secondary school education in the United States. The presence of so many noted world scholars in Princeton to attend the conferences in the course of the year has permitted the securing of an unusually distinguished list of bicentennial lecturers. The series of lectures already begun will be continued throughout the year. Bicentennial concerts and exhibitions in the realm of art form a part of the programme, especially with reference to the conference on "Research and Scholarship in the Arts" to be held late in April 1947.

Two convocations have already been held in September and October, and two more are to be held in February and June. At the first, the Archbishop of Canterbury, who preached the inaugural Bicentennial Sermon, the first of a series of ten, received an honorary degree. At the second convocation, concluding the first series of conferences, twenty-three honorary degrees were conferred. Eight scholars from Britain, including Lord Lindsay of Berker, Sir Hector Hetherington, Sir Harold Hartley, Sir John Boyd Orr, Sir Henry Hallett Dale, Salvador de Madariaga, Michael Polanyi and Ernest Woodward, were among the recipients of these degrees. For the final ceremonies and the convocation on June 16, 1947, delegates from colleges, universities and learned societies of the world will be invited to attend.

The bicentennial publication programme contemplates the issuing of twelve or fifteen books on various subjects, largely those dealing with the history of the university. In addition to this there will be published for each of the fifteen conferences a thirty-six page pamphlet summarizing the conference and giving its programme and list of members. The further question of what books may emerge from these

conferences is one which is being studied conference by conference as the programme proceeds.

A series of events has been arranged for February 22, 1947, which is Washington's birthday and, normally, Alumni Day in Princeton. The University on this occasion will honour especially distinguished scholars from among its own alumni at the convocation then planned. The June ceremonies will cover a period of about five days, beginning with the 'commencement' on June 13 and ending with the final convocation on June 17. The first three days of this period will be devoted to events of particular interest to the alumni. Plans are being made for a historical spectacle to be enacted in the Princeton stadium on June 15. The events of the programmes of June 16 and 17 will be of particular interest to the delegates, of whom it is expected there will be approximately eight hundred. During this June period there will take place the dedication of the new gymnasium, the laying of the corner-stone o the great new library, a formal dinner for distinguished guests and delegates at which the President of the United States and others will speak, and the awarding of honorary degrees at the final convocation.

What really distinguishes this particular programme from similar celebrations in the past is, in the first place, the fact that it is taking place in the period of an entire academic year. This permits the manifold activities to take place at a more leisurely tempo, in which each has its own place and right to existence without the competition of other concurrent events. In the second place, and far more important, it differs in that although at times of anniversaries such as this there is much justification for a historical point of view and for dwelling upon past achievements, the entire orientation of this programme is forward-looking. To be sure, we are not forgetting Princeton's long and honourable history, which will receive adequate attention in the course of the programme. We are, however, far more interested in the idea that, given proper orientation at this time, the efforts of the world of learning may prove as potent an instrument for good in a peaceful post-war world as they were potent for destruction during the period of the War.

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# JUBILEE OF THE BRITISH MYCOLOGICAL SOCIETY

By G. C. AINSWORTH

THIS year, the British Mycological Society, which was founded at a meeting of the Yorkshire Naturalists' Union at Selby in 1896 for "the study of mycology in all its branches", has been celebrating its jubilee. At an ordinary meeting on April 12 a comprehensive series of exhibits was arranged in the British Museum (Natural History) to illustrate the development of mycology in Great Britain and the history of the Society. In September, a well-attended five-day foray, held at Whitby in conjunction with the Mycological Committee of the Yorkshire Naturalists' Union, marked the resumption of a series of annual autumn forays begun in 1897 which, though uninterrupted by the First World War, had to be discontinued in 1939. The climax of the celebrations was the fiftieth annual general meeting, followed by the presidential address and five paper-reading sessions in the rooms of the Royal Institution, London, during October 23–25. This meeting, by the generous help of the British Council, was attended by mycologists from Austria, Belgium, Czechoslovakia, Denmark, France, Greece, Palestine, Switzerland, Sweden, and the United States.

In reply to an expression of loyal greetings from the annual meeting, a message of appreciation was received from H.M. the King. Greetings were received from foreign mycological societies (including an illuminated address from the Society for the Advancement of Mycology in Denmark) and from British natural history societies, while numerous members unable to be present sent messages of good will. In addition, the president received a letter of good wishes from Mr. Herbert Morrison, Lord President of the Council.

After the officers of 1947 had been elected as follows: *president*, Prof. C. G. C. Chesters; *vice-president*, Dr. J. T. Duncan; *secretary*, Dr. G. C. Ainsworth; *foray secretary*, Mr. G. Smith; *treasurer*, Mr. W. Buddin; *editors*, Dr. B. Barnes and Mr. W. C. Moore; the following honorary members were elected: Dr. B. O. Dodge (New York Botanical Garden), Prof. R. Falk (Palestine), Prof. Ernst Gäumann (Zurich), Prof. Roger Heim (Paris Natural History Museum), and Mr. A. A. Pearson, who has been treasurer of the Society for twenty-eight years.

Thirty-seven new applications for membership were approved. The membership now stands at 430—the highest in the Society's history.

The president, Dr. J. Ramsbottom, in an address entitled "Mycology then and now", traced the beginnings of the Society and outlined the course of mycology, and particularly the study of the subject in Great Britain, during the past hundred and fifty years. With characteristic flashes of humour he surveyed the successive fashions in mycological research, suggested directions for future efforts, and welcomed the increasing recognition that was being accorded to the one-time 'Cinderella of botany'.

The papers read at the subsequent sessions were designed to illustrate the relation of mycology to allied subjects, and they are to be published in full, together with the presidential address, in a special volume of the Society's *Transactions*. At the first session, which was devoted to mycology and medicine, Dr. C. W. Emmons (U.S. Public Health Service) reviewed fungi as a cause of disease in man, and Dr. J. H. Birkinshaw (London School of Hygiene and Tropical Medicine) gave an account of fungal metabolism with particular reference to the production of antibiotics active against organisms pathogenic to man. Dr. Emmons attributed the relative neglect of medical mycology in part to the great impetus given to bacteriology by Pasteur, Lister, and Koch, and to the fact that bacterial diseases of man are more common than those caused by fungi. He directed attention to the fact that although in the United States fungi were only held responsible for 0·03 per cent of the total deaths in 1942, this percentage was nearly twice that of the deaths attributed to paratyphoid fever, smallpox, cholera, and half a dozen other well-known diseases taken together. He pointed out that effective prophylactic or control measures are available to reduce the number of fatalities due to these better-known diseases, but to set against this, mycoses such as ringworm and other skin infections are not fatal diseases, although common and annoying. It is also possible that there are not

infrequently mild forms of the generalized fungus infections which are not always correctly diagnosed. Coccidioidal granuloma, for example, was first recognized in California in 1894, where it was considered to be invariably fatal; but it was not until 1937 that 'valley fever' or 'desert rheumatism' was recognized as being a mild, very frequent form of the same disease; perhaps only once in 5,000 cases does the mild form develop into the fatal disease. Against such a background an illustrated account was given of the mycological peculiarities of fungi of medical importance, and attention was directed to a number of unsolved problems involving the natural habitats and transmission of these fungi and the treatment of the diseases they cause.

After indicating earlier milestones in studies in the metabolism of moulds, Dr. Birkinshaw briefly described the method of approach to this subject developed by Prof. H. Raistrick and his school, and indicated the type of result obtained. In the course of a survey of selected groups of chemically related fungal products he traced the history of penicillin—the discoverer of which, Sir Alexander Fleming, was in the chair—noted the promising nature of streptomycin and indicated the chemical structure of these and other antibiotics, and discussed the prospects of the discovery of new and better antibiotics in the future.

Introducing the Thursday morning session, Mr. W. C. Moore (Ministry of Agriculture's Plant Pathology Laboratory) claimed that until recently the study of plant diseases in Britain had been dominated by investigations on plant pathogenic fungi. He directed attention to the misuse of the term 'mycologist' in the sense 'plant pathologist', and noted that the erstwhile advisory mycologists have become the advisory plant pathologists of the new National Agricultural Advisory Service. Mycologists and plant pathologists have a common interest in so far as they are concerned with plant pathogenic fungi, and such a common interest is well illustrated by the topic of seed-borne fungous diseases which was introduced by Dr. Lucie C. Doyer (Seed Testing Station, Wageningen), who gave a comprehensive account, illustrated by lantern slides, of different types of seed-borne fungi and the methods for their detection. Dr. Doyer particularly emphasized the wider aspects of the subject and indicated the urgent need for international co-operation in matters of seed testing, to facilitate the movement of seed from one part of the world to another. Attention was directed to the International Seed Testing Association, at the next congress of which (to be held in the United States) international rules for the determination of seed-borne diseases will be discussed, and on the committee for the determination of plant diseases of which fourteen countries are represented. Prof. A. E. Muskett (Queen's University, Belfast) then described the techniques developed in Northern Ireland for examining seed for seed-borne diseases with special reference to *Helminthosporium* disease of oats, the seed-borne diseases of flax, and blind seed disease (*Phialea temulenta*) of rye-grass. Prof. Muskett indicated certain results of a survey of flax seed produced in the United Kingdom during the past three years. Contamination by *Colletotrichum lini*, *Polyspora lini*, and *Phoma* sp. was much heavier north and west of the Pennines than south and east. The purity and germination of contaminated samples were of a very high order, and such samples would be legally acceptable as seed of first quality. It is, however, the build-up of parasites by repeated sowings of seed from the same stocks that is responsible for the failure to produce flax seed under the climatic conditions which prevail in the north and west. Dr. Mary Noble (Seed-testing Station, Edinburgh) communicated a paper on a seed-borne disease of clover, particularly of New Zealand seed, caused by previously undescribed species of *Sclerotinia* the *Botrytis* state of which bears a superficial resemblance to *B. anthophila*.

The afternoon topic illustrated the relation of soil fungi to forestry and soil fertility. Prof. Elias Melin (University of Uppsala) read a paper on recent advances in the study of tree mycorrhiza, summarizing researches made by himself and his pupils and by other workers in this field. He emphasized the importance of Basidiomycetes among mycorrhiza-forming fungi, and showed lantern slides of a representative series, directing attention to the fact that many species of fungi, not always nearly related to one another, may form mycorrhiza with one and the same species of tree. For example, about thirty species have so far been proved able to form mycorrhizal associations with the Scots pine (*Pinus sylvestris*). He then described certain physiological requirements of mycorrhizal fungi and touched on the water-soluble, thermo-labile substances demonstrated in leaf litter, and able to exercise a strong antibiotic action against tree mycorrhiza fungi[1]. Prof. C. G. C. Chesters described ingenious methods for sampling the fungi of the soil, by which fungi ramifying through the soil can be distinguished from those confined within different types of plant debris, and he indicated the preliminary results of surveys using such techniques. The session ended with a showing of the beautiful, if somewhat sinister, film of high technical merit made by Dr. J. Comandon and Mr. P. de Fonbrune (Pasteur Institute) of various nematode-catching fungi belonging to the Zoopagaceæ. The details of the mechanisms by which these fungi secure their prey was clearly demonstrated by skilful micromanipulation.

On Friday morning, with Prof. W. Brown in the chair, Dr. Nils Fries (University of Uppsala) gave a lucid summary of the nutrition of fungi from the aspect of growth-factor requirements. After dealing with the growth-factors so far recognized, he gave an account of our present knowledge of the part they play in fungal metabolism, and in conclusion indicated the results he was obtaining by a new technique for isolating physiological mutants. Using this method the author had obtained more than five hundred mutants of *Ophiostoma multiannulatum* during the last three months, and four hundred of these had already been roughly classified in respect of their growth-factor requirements. Dr. Lilian Hawker (University of Bristol) then illustrated the subject by a particular example, summarizing the results of researches carried out over a period of years on the effect of growth substances on the mycelial growth and fruiting of *Melanospora destruens*.

At the final session taxonomic problems were discussed. Dr. M. A. Brett described recent observations on *Cladosporium herbarum*, Miss E. M. Wakefield (Royal Botanic Gardens, Kew) discussed the criteria for the delimitation of species and larger groups in the Hymenomycetes, and Prof. Roger Heim dealt with problems of taxonomy and phylogeny in macrofungi with special reference to a number of forms showing gill-like pores or pore-like gills, recently described by him from tropical Africa.

In addition to the London meeting there was an excursion for foreign guests and members on the previous Sunday to Kew Gardens and Hampton Court, a foray to Windsor Forest on the Tuesday, and a series of informal evening meetings at which Dr. P. H. Gregory introduced a slow-motion film made by Mr. E. D. Eyles showing the part played by raindrops in effecting spore dispersal in *Lycoperdon perlatum*. Dr. E. J. H. Corner exhibited a very beautiful series of drawings for a monograph on *Clavaria* (executed by the author while interned by the Japanese in Singapore), and Dr. W. A. R. Dillon Weston arranged a series of his glass models of fungi.

The one shadow over the celebrations was the death in July at the age of eighty-five of Carleton Rea. Mr. Rea, a barrister by profession, was the author of "British Basidiomyceteæ" (1922), and had an international reputation as a student of the larger fungi. He was one of the founders of the Society, of which he was secretary from its inception until 1918, treasurer during 1897–1918, an editor of the *Transactions* for thirty-four years, twice president, and a vice-president for 1946.

[1] Melin and Wiken, *Nature*, **158**, 200 (1946).

# THE KING'S PICTURES

By Dr. A. T. HOPWOOD
British Museum (Natural History)

DURING the interval between the two World Wars, the Royal Academy added to its fame by a series of winter exhibitions unsurpassed in the history of art. The Italian, Dutch, and other Exhibitions are still fresh in the minds of those who visited them. Now that fighting has again ceased, the president and members are able, through the gracious kindness of His Majesty the King, to celebrate the return of more peaceful conditions with an exhibition in every way worthy of its great predecessors.

Some of the five hundred pictures are always accessible to the public at Hampton Court, and others at Windsor. Still others have been exhibited from time to time, or else are known from reproductions; but this is the first time that the cream of the Royal Collections has been gathered together in a series of rooms designed for the sole purpose of showing pictures. The result is a display which for richness and variety could scarcely be equalled anywhere else in the world. Eight Rembrandts, five Holbeins, a Vermeer, a Duccio, three Titians, seven Tintorettos, a whole room full of Primitives, three rooms devoted to Italian pictures, with another for Canaletto, two rooms for the Dutch School and one for the Flemish, add to these five rooms of portraits and one of English subject pictures, and there in brief is what the Exhibition contains.

With so much to see, one is bound to be influenced by personal taste; I found greatest pleasure in the early portraits (Gallery I), the Primitives (Gallery IV) and the Flemish and Dutch Schools (Galleries VIII, IX, X); but apart from purely artistic matters, there are other aspects of the Exhibition worthy of consideration.

In portraiture, for example, it is interesting to compare the changes in fashion and taste both in artists and sitters; to compare the subtle flattery of Van Dyck with the frankness of the portrait of the Emperor Charles V (No. 142), attributed to the studio of Bernaert van Orley, and the almost equally frank pastels by J. E. Liotard (No. 74); or the grand manner of previous reigns, with the domestic felicity of the early years of Queen Victoria.

Another point arises from the consideration of three works by Lucas Cranach the Elder (Nos. 139, 140, 153) and one by his younger son, Lucas Cranach the Younger (No. 148); all four pictures are, to quote the catalogue, "signed with the snake". The father ran a successful workshop, or factory, in which his sons Hans and Lucas were employed; the snake was the trademark. Greater men than Cranach had their workshops, whence they issued as many pictures as they could sell. Most of the task of painting was left to apprentices and pupils who followed a given design. The master usually, but by no means always, painted the flesh. Holbein may have had such a workshop (*cf.* note to No. 6), but his studio and records perished in the fire which destroyed the Palace of Whitehall. Rubens certainly did; his most brilliant pupil and assistant was Van Dyck. A *modello*, or pattern, from Rubens' studio is in the present Exhibition (No. 279). Tintoretto (No. 206) also employed assistants. Indeed, the practice was widespread, and, however shocking it may appear to a later generation, it was sound common-sense to those who followed it. Not only did those who lived by the brush give their patrons what they wanted, but also they saw to it that their wares were available in sufficient quantity.

A study of Charles I on horseback by Van Dyck (No. 32) is of interest in connexion with a picture by Vrancx (No. 278) and an equestrian portrait by Rubens (No. 287). Van Dyck has given his horse a head which appears small in proportion to the body. This is a feature generally seen in pictures of the seventeenth and early eighteenth centuries. It is usually considered to be a convention without foundation in fact, but this view does not commend itself for a variety of reasons. First, it was during the seventeenth century that the influence of the Arab cross was beginning to be felt, and although the man at arms continued to be mounted on the Great Horse, as in Vrancx's picture, nobles and princes were riding more mettlesome steeds possessing a mixture of the hot blood and the cold. The proportion of the length of head to the body is approximately the same in the Great Horse and the Arab, but when the breeds are crossed the Arab head appears on the larger body. Secondly, horses of these proportions were fashionable during the Baroque period, and were described in the works of such contemporary masters of horsemanship as the Duke of Newcastle ("A New Method . . .", London, 1667), La Guerinière ("École de Cavallerie", Paris, 1729) and Winter ("Stuterey", Nuremberg, 1687). La Guerinière's illustrations are by various engravers after drawings by C. Parrocel, some of whose preliminary sketches are in the Royal Library at Windsor. It is significant that in these studies, too, the horses have the same small head.

Such parade horses, trained in the *Haute Ecole*, were valued on the Continent for their length of mane and tail, but the horse shown in Rubens' picture is only a moderate example. It in no wise compares with the animal presented to the Landgrave of Hesse-Cassel by the Count of Oldenburg. Winter says that the mane and tail were protected by bags of red velvet, otherwise one groom was needed to carry part of the mane, and two others to carry the tail.

There are many other side-lines which might be discussed, but, when all is said and done, they remain side-lines subsidiary to the over-riding interest of the pictures as pictures ; although some knowledge of them is often a help in coming to a proper understanding of the pictures themselves.

Lastly, a word of praise must be given to the Catalogue. In it are a brief history of the Royal Collections, biographical notes on the artists, and references to literature on which the student may draw for additional information. It will retain its value as a handy work of reference long after the Exhibition has ended.

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# THE SOCIAL SURVEY

By Prof. P. SARGANT FLORENCE
University of Birmingham

THE phrase 'social survey' now covers a multitude of activities, which differ in aim and method. The aim of the earliest English surveys, such as Booth's "Life and Labour of the People of London" and Rowntree's "Poverty", were to discover in specific areas the extent and degrees of poverty in the sense of family income low in relation to the expenditure on food and other necessities. The aims of more recent social surveys, such as the Worcester Civic Survey[1] or the Herefordshire Survey[2], have been to lay a foundation for physical planning, and the location of industry ; or, like the work of the War-time Social Survey, to obtain information for solving immediate *ad hoc* problems of fact and opinion confronting Government departments.

There can be little doubt of the usefulness of surveys to achieve many of these aims. In a paper to the Institute of Public Administration, Mr. Louis Moss mentions war-time surveys carried out to determine fair clothes rationing where work entailed extra wear and tear, and fair fat and sugar distribution between bakers and cake-making housewives. He adumbrates future surveys into the kinds of houses that will satisfy both human needs and technical possibilities, and into the obstacles in the way of full utilization of man-power. The planning surveys include among their aims the greater accessibility of work-places, schools and shops, and therefore map the existing sites of all these places in any given area in relation to homes of the population. Their recommendations for industrial location help to solve problems of unstable and maldistributed employment.

The differing aims of surveys past and present have been achieved by methods that differ quite as widely, though a common factor is the standardized schedule of questions that are usually put. Controversy about the scientific validity of these methods has tended to fasten on the sampling technique employed, if any. But something more fundamental must first be discussed, and that is the nature of the original data. If the source of the data is liable to distort the facts, no amount of juggling with sampling formulæ will make results reliable.

Data are usually distinguished as documentary or as observed—observation being of environment, of behaviour, or of written or verbal responses. But documentary evidence must itself have been observed at one time. Figures of output, for example, enumerated in the Census of Production, are now documentary ; but originally they were observed by foremen, inspectors and managers in some factory, who duly recorded what they observed. A more fundamental distinction thus seems to lie between data observed by competent persons and checked and counterchecked (the usual process in official statistics), and data less certainly observed. It is a matter of degree how certain the observation is. On the whole, observation will be more certain under three types of proviso.

(1) Where observations of facts are direct by the surveyor and not gathered from other people's verbal or written statements. The statements of other people may distort facts owing to bias, emotion or failure to be observant ; or (if there is a time-lapse between fact and statement) by sheer failure of memory. This uncertainty does not apply where opinions and feelings are sought, or, at least, the *present* opinions and feelings of the persons making the statement.

(2) Where the observation of the surveyor can be checked by various tests, or several surveyors can be found to agree. Thus, in house-to-house visits there are a number of counter-checking tests of income and poverty ; and, more obviously, the sites or locations of homes, shops, factories, schools, etc., are there for all to see.

(3) This second proviso leads on to the further proviso that when people are asked for statements about facts they will be more accurate about recurrent and continuing facts than about passing events. Thus, a housewife can probably be trusted to be more correct about the number of rooms in her house, or the shops she frequents or the habitual place of work of her husband, than about past illnesses in her family or the precise nature of past purchases.

Social surveys of the type described by Mr. Moss have largely relied on verbal responses, and it is important to ask how far such data are likely to be sufficiently accurate for the type of knowledge required. They are probably not accurate enough for discovering past events ; though accurate enough for opinions, provided the questions are not so worded (and intoned) as to be leading questions. Mr. Moss is right to stress the importance to democratic processes of a continuous knowledge of public opinion.

Yet we hope that opinion surveys will not dictate policy. In the listener survey conducted by the B.B.C., classical music came very low indeed on the priority list of the majority of listeners. Similarly, simply designed furniture would probably come very low, compared to the ornate, in the scale of popularity. The B.B.C. wisely neglected to attune its programmes to debased popular taste ; let us hope a similar course will follow the surveys foreshadowed by Mr. Moss into the wishes and needs of consumers. English social surveys, if they are really to set the pattern of cultural life, will have to take a wider sweep and to integrate all phases of community and individual activity (whether reducible to statistics or not) as the anthropologist does when studying primitive societies. This application of anthropology has taken firm root in America, but we have yet to set about an English "Middletown"[3] or an equivalent to "Yankee City"[4].

[1] "County Town." By Glaisyer, Brennan, Ritchie and Florence. Department of Commerce, University of Birmingham. (John Murray.)

[2] "English County." By the West Midland Group on Post-War Reconstruction and Planning. (Faber and Faber.)

[3] "Middletown" and "Middletown in Transition". By R. S. and H. M. Lynd. (Harcourt, Bruce and Co.)

[4] "Yankee City." By W. L. Warner and P. S. Lunt. (Oxford University Press.)

# OBITUARIES

## Prof. H. C. Plummer, F.R.S.

Henry Crozier Plummer, formerly professor of mathematics at the Military College of Science, Woolwich, and sometime Royal Astronomer of Ireland, died at Oxford on September 30, within a few weeks of his seventy-first birthday.

Born at Oxford on October 24, 1875, Plummer was brought up in a scientific atmosphere. His father, W. E. Plummer, was a first assistant at the University Observatory, Liverpool, then under the directorship of Pritchard, and afterwards director of the Observatory of the Mersey Docks and Harbour Board and reader in astronomy in the University of Liverpool. Plummer was educated at St. Edward's School, Oxford, and at Hertford College, where he distinguished himself by obtaining firsts in Mathematical Moderations and in Final Schools, and gaining the open mathematical scholarship; the study of physics claimed his attention for a further year. After a year as lecturer in mathematics at Manchester and another year as demonstrator at the Clarendon Laboratory, Plummer was appointed in 1901 assistant in the University Observatory, Oxford, then directed by H. H. Turner. A year's leave of absence at Lick Observatory in 1907 introduced him to spectroscopic work, which was then being rapidly developed at Lick and elsewhere in America. In 1912, Plummer left Oxford for Dunsink Observatory to succeed E. T. Whittaker as Royal Astronomer of Ireland and Andrews professor of astronomy in the University of Dublin. There his "Dynamical Astronomy" (1918) was written, a treatise that reveals Plummer's thorough grasp of the principles of celestial mechanics and a freshness and elegance of mathematical presentation that stamped the book as a notable contribution to the subject. His election to the Royal Society followed in 1920. Next year Plummer left Dunsink on his appointment to the professorship of mathematics at Woolwich, which he retained until his retirement in 1940.

Plummer's astronomical papers covered a very wide variety of subjects. Throughout his life he retained a lively interest in the theory of instruments; his last address to the Royal Astronomical Society in 1941 from the presidential chair was on the development of the vertical telescope—to which he had made contributions more than a third of a century before—and a critical sense of the degree of accuracy with which instruments must be credited. His clear geometrical insight enabled him to devise new theoretical methods—as in his application of projective geometry to the determination of binary star orbits—and to illuminate methods introduced by others; in this last connexion his paper on the mathematical principles underlying Schlesinger's method of 'dependences' may be mentioned as a fundamental contribution to this important method of photographic astronometry. Plummer was an expert on the 'theory of errors', and he wrote many papers on this subject, culminating in his "Probability and Frequency", published in 1939.

Plummer's interest in various problems of celestial mechanics was aroused in his early years and maintained throughout his life. The well-worn subjects of refraction and aberration found him with something fresh to say—he was one of the first to discuss the latter subject in the light of the principles of 'special relativity'. At Dunsink he had embarked on an ambitious programme on the photometry of variable stars, and he was the first, with Shapley, to throw out the suggestion that cepheid stars owed their variability to rhythmic pulsations. His work on the distribution of stars in globular clusters was remarkable for the analytical elegance which it displayed. These are but a few of his many activities in astronomical research. His acute historical sense must, however, not be forgotten, and especially his deep interest in Newton's manuscripts.

Plummer was president of the Royal Astronomical Society during 1939–41, an honour which he deeply appreciated. Quiet, modest and self-effacing, he was a staunch friend to those who had gained his confidence and esteem. In 1924 he married Beatrice Howard, daughter of the late H. H. Howard, who pre-deceased him by a few months.

W. M. Smart

## Dr. J. J. Drbohlav

Protozoologists generally, and other friends in Britain, the United States, and elsewhere, will learn with regret of the unexpected death on August 11 of Dr. J. J. Drbohlav at Prague, where he was head of the Department of Microbiological Diagnosis at the State Institute of Hygiene before the War.

Jaroslav Drbohlav was born at Úlibice, near Jičín (Bohemia), where his father was schoolmaster, on March 14, 1893. He matriculated at the University of Prague in 1912, and took his medical degree in 1917—during the First World War. While still a student he published several original papers (on respiration), and during the War acted as assistant in the Bacteriological Institute. Soon after the War he was made director of the pathological laboratory at Moravská Ostrava, where he successfully coped with an outbreak of smallpox. In 1921 he obtained a Rockefeller Foundation scholarship, and went to the United States to study in various bacteriological laboratories—especially at Harvard, where he took the doctorate in public health with a thesis on the relation of insect flagellates to leishmaniasis.

On his return to Prague, Drbohlav continued his studies at the State Institute of Hygiene, which he helped to found and where he was appointed chief of his department in 1929. Here he devoted himself to various problems of public health and microbiology, and published papers on many different subjects—the streptococci of puerperal fever, spirochætosis, tularæmia, malaria in Subcarpathian Russia, the extermination of rats, blood donors and blood preservation, etc. But after the German occupation of Czechoslovakia in 1938 he was forced to leave the State Institute and transferred to a minor administrative post, and finally retired prematurely in 1944. A patriotic Czech, he was lucky to escape with his life, as several of his colleagues were murdered.

Drbohlav published some hundred papers on his researches, mostly in the Czech language, but his international reputation rests chiefly on his joint publications with William C. Boeck (an American) during 1924–25 on the cultivation of *Entamœba histolytica*. This work—now a classic of protozoology—was done during his sojourn at Harvard. These two young men then succeeded for the first time in cultivating the parasite which causes amœbic dysentery in man, and introduced new methods which continue to bear ample fruit. Drbohlav himself, indeed, considerably extended the first findings during a stay at Paris in

1925. It is safe to say that Boeck and Drbohlav, and their culture-media, will be remembered as long as the study of intestinal protozoa continues; and for this reason, if for no other, the name of Jaroslav Drbohlav will ever occupy an honourable place not only in his own country but also in the history of microbiology.

I am indebted to Dr. F. M. Berger, a mutual friend and former colleague of Dr. Drbohlav, for some of the data in this note—obtained from Czech sources not generally available. CLIFFORD DOBELL

## Prof. T. W. Griffith, C.M.G.

THOMAS WARDROP GRIFFITH, emeritus professor of medicine in the University of Leeds and honorary consulting physician in the General Infirmary in Leeds, died in his eighty-sixth year on October 21.

After graduation with highest honours and demonstrating in anatomy under Sir John Struthers for a short period, Griffith chose a clinical career and was successively resident medical officer, honorary assistant physician and honorary physician in the General Infirmary, Leeds. Concurrently, from 1887 until 1910, he filled the chair of anatomy in the University of Leeds, until on promotion to the post of full physician he was transferred to the chair of medicine, which he held until 1925. He served in the 2nd Northern General Hospital during 1914–19, having charge of the special cardiac centre. From 1918 until 1927 he sat on the General Medical Council.

The chair of anatomy at Leeds carried a trifling honorarium, but Griffith spent a large amount of time in its service. The department in the new building (1893) was planned with skill and foresight and was about the best in Great Britain. With his own hands he made a large number of preparations for the museum and for illustration in lectures. In the course of time he amassed a remarkable collection of specimens of abnormalities of the heart, many of which are described in the medical journals. His best known work (with Oliver) was on the distribution of the cutaneous fibres of the thoracic nerves, which demonstrated that the segmental zones were lower and more horizontal than the line of the nerve trunks.

Griffith's daily morning lecture was given with zest, clear, convincing, often dramatic; enlivened by the use of his own strong and supple frame in demonstrating the movements of joints and actions of muscles and by many apt references to the use of anatomical knowledge in clinical work: his anatomy was indeed 'living anatomy', and the attention of his audience was never allowed to flag. His visits to the dissecting room were a stimulating breeze.

In the Leeds Infirmary, Griffith exercised the same skill as was shown in planning the Anatomy School by taking the chief part in the conversion of a part of the hospital into a teaching block to accommodate classes and clinics for the trebled post-war entry of students in 1919–20. Punctuality and complete discharge of all honorary public duties were unfailing. The generations of students whom he encouraged, stimulated and disciplined remember him with regard, and have been grieved to know that this most active and productive life has been clouded by progressive blindness. He was the last of the Victorian clinicians who professed a fundamental subject, the men who begat, and weaned, all the provincial medical schools. J. KAY JAMIESON

## Prof. George Baborovský

DR. GEORGE BABOROVSKÝ, professor of physical chemistry at the Technical College, Brno, died on October 10 at the age of seventy-one. Born at the west Bohemian mining town of Příbram, he graduated at Prague in 1902 and then spent three years under Ostwald at Leipzig. He returned to Prague to become assistant professor of physical chemistry, but in 1911 he went to the Brno Technical College as full professor. The College was given university rank in 1919, and from his laboratory Baborovský published a series of researches dealing with electrochemical subjects, especially the hydration of ions. In 1917 he introduced a new method for finding the absolute hydration by determinations of the true transport numbers of the electrolytes concerned.

Several of Baborovský's later papers are available in English as they appeared in the *Collection of Czechoslovak Chemical Communications*, 1929–38. Baborovský also wrote the standard Czech text-book on physical chemistry, and during his enforced idleness after 1939 he compiled a comprehensive treatise on colloids which was published in 1944 under the title "Colloids Everywhere". G. DRUCE

## Dr. A. H. Belinfante

AMONG the Continental men of science to perish in the Terezin concentration camp was the promising young Dutch physical chemist, Dr. Adriaan Hendrik Belinfante. He was deported to Terezin from Holland, together with his wife, mother and children, in February 1944. The mother, who was seventy-six, died in April, but Belinfante and his wife survived until October of that year. He was forty-four years of age. His scientific work, most of which was published in the *Recueil de travaux chimiques des Pays-bas*, dealt with the mechanism of certain oxidation processes, autoxidation, 'induced oxidation' and similar phenomena; it covered such widely different reactions as the thermit process with aluminium, molybdenum oxide and calcium fluoride, explosions with benzene – air mixtures and the role of induced oxidation of lactic acid in relation to the cancer problem.

## Mr. A. W. Lupton

THE death occurred on October 1 of Mr. A. W. Lupton, senior lecturer in pharmacy and pharmaceutical chemistry in the University of Leeds. Mr. Lupton was appointed a full-time lecturer in 1933 when the work of the Leeds College of Pharmacy, of which he had for some time been head, was taken over by the University. He was responsible for the training of students for the professional qualifications in pharmacy, as well as for the instruction of medical and dental students, and he did much to raise the status of pharmacy in the University.

WE regret to announce the following deaths:

Prof. R. M. Ferrier, emeritus professor of civil engineering, University of Bristol, on October 28.

Prof. Percy F. Frankland, F.R.S., emeritus professor of chemistry in the University of Birmingham, on October 28, aged eighty-eight.

Dr. A. Liebert, sometime director of the Kant-Gesellschaft and extra-ordinary professor of philosophy in the University of Berlin, aged sixty-eight.

# NEWS and VIEWS

## University of Bristol : Plans for Extension

On October 29, at a meeting of representative men and women of the region, an appeal was launched for funds for the extension of the University of Bristol. The University has for some years been engaged in making plans for its future expansion and development. Although it possesses several fine buildings, certain departments are already cramped. In the Medical Faculty, teaching has been dispersed and accommodation was severely restricted even before the Department of Anatomy was destroyed in an air raid. With the expansion which must take place to meet the demands for both undergraduate teaching and graduate training and research, new buildings are a necessity. The scope of the Faculty of Engineering has recently been enlarged by the foundation of the Sir George White chair of aeronautical engineering. The Faculty is housed at some distance from the University in a building on which it has no permanent hold, and new quarters are necessary here, too. Both in the Faculties of Arts and Science certain departments require more room, especially in view of the growing numbers of staff and scholars engaged on research.

Apart from such natural expansion, several new departments are in preparation. It has long been felt that the University of a great agricultural region should make a direct contribution to the interests of the countryside, but it has also been felt that work already done elsewhere in the south of England should not be duplicated. The proposal that a School of Veterinary Science should be established at Bristol has now provided an opportunity which will be taken. A Field Station is already available, and the pre-clinical teaching will be provided for in the new Medical School. It is further proposed to institute a graduate diploma in horticulture for students already possessing an honours degree in one of the sciences bearing on that subject. The purpose is to provide men with a training in fundamental science capable of carrying out research on applied lines. This will be done in association with the Research Station at Long Ashton. The University also proposes to set up an Institute of Education on the lines of Scheme A of the McNair Report, and will thus assume responsibility for the training of teachers in a group of associated colleges.

The demand for a general increase in the numbers of men and women taking university courses lays a special obligation on a University formerly small in numbers and therefore capable of economic expansion, and it is proposed to plan for an ultimate student population of some 3,000. It has been urged on the University that its situation, and the amenities it enjoys, make it specially suitable for development on residential lines. The suggestion is welcome, and fits in with past policy. There are already three fine Halls which formerly allowed all students not living in the city to spend one or two years in residence : further, the University had been successful in evolving a system of student life intermediate between the collegiate and the institutional. It has just acquired four mansions which give a material increase in living room. As a most important item in its plans, it puts the provision of several new Halls. The site for these, in fine and open surroundings, within reasonable distance of the University, is already available, and an immediate objective is the building of two new Halls to be called after Mr. Winston Churchill, chancellor of the University, with whose name the appeal has been associated.

## Universities Quarterly

The need for a journal wholly devoted to university education and the vital problems affecting university development has grown more urgent in recent years. *Universities Quarterly*, the first number of which has just been published, is an attempt to meet this need. Its primary purpose is to discuss—"with complete freedom and from all angles"—what can best be done by the universities themselves, industry and the Government, to enable the universities to adapt their teaching, research, and, if need be, guiding philosophy, to meet the demands of a rapidly changing society. The journal is not, in consequence, intended solely—or even primarily—for members of university staffs. Rather is it the intention of the editorial board, of which Sir Ernest Simon is chairman, that many of the articles will be of interest also to those engaged in public life, the Civil Service, local government, and teaching work in secondary schools and technical colleges. Catholicity of appeal is, perhaps, the most notable feature of the first number. Bertrand Russell urges that most students should learn something of the fundamentals of philosophic thinking. Bonamy Dobrée discusses knowledge for its own sake. Sir William Larke writes on industry and the universities. Sir Ernest Simon deals with the problems of expansion and development facing the universities as a result of the growing national demand for higher education. Other features include an article by Dr. O. C. Carmichael on "Higher Education in the United States", a series of short contributions on "Why Compulsory Philology ?", and book reviews. The last, which ought undoubtedly to have a major place in a journal of this type, is unfortunately the weakest feature in the first number. *Universities Quarterly* is published by Turnstile Press, Ltd., 10 Great Turnstile, London, W.C.1, and the price is 5*s*. per issue.

## Scientific Instrument Manufacturers' Association of Great Britain

The annual report, for 1945–46, of the president and council of the Scientific Instrument Manufacturers' Association of Great Britain Ltd. (from the Association, River Plate House, 12–13 South Place, London, E.C.2) remarks on the growing appreciation of the part that scientific instruments and laboratory apparatus play in science, industry and education, and how this has, to a large extent, contributed to the continued expansion and progress of the Association. The report records that, during the year under review, twelve new firms joined the Association, bringing its total membership up to eighty-six, and that the formation of a new section, dealing with electronics, is under consideration. At the last annual general meeting, the council was empowered to appoint a permanent director of the Association, and although seventy replies were received to advertisements in the Press, it was decided, after full consideration, that an approach be made to the British Scientific Instruments Research Association, with which the Scientific Instrument Manufacturers Association actively collaborates, for the appointment of Mr. A. J. Philpot as director of both bodies.

Many new problems have faced the Association during the year, and the council has expressed,

through individuals or appropriate committees, the Association's views on such matters as the de-requisition of business premises, the call-up of young technicians, the control and future of German industry, the disposal of surplus scientific instruments, and the post-war protection of the British scientific instrument industry. During the year, valuable contacts were made with the Scientific Apparatus Manufacturers Association of America and with the French Syndicat Général de l'Optique et des Instrument de Précision. Previous personal contacts made in Sweden led to the successful exhibition of British scientific instruments held in Stockholm during May–June last, in which forty members of the Association took part (see *Nature*, 158, 66; 1946). The Association is taking part in the "Britain Can Make It" Exhibition, and participation in an exhibition to be held in Brussels, as well as in the 1947 British Industries Fair, is stated to be under active consideration.

## Royal Observatory, Greenwich: Annual Report

THE report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, covers the period May 1, 1945, to April 30, 1946, and deals with the usual matters presented at the annual visitation. The Astronomer Royal was able to resume occupation on October 1, 1945, when a portion of the damaged Flamsteed House was repaired, and a small amount of work has been carried out at the Observatory, but no structural repairs have been attempted up to the present. The covering of the dome of the 28-in. equatorial, which suffered on several occasions from the effects of blast, is beyond repair, and it will not be renewed in view of the pending removal of the Observatory to Herstmonceux. The telescope will be dismantled as soon as storage accommodation is available, and will be re-erected on the new site. It is impossible to provide even an outline of the lengthy report, which should be read by all who are interested in the work and in particular in the future of the Royal Observatory.

One matter in connexion with this latter point is of supreme importance and is dealt with very clearly at the end of the report. It is most essential, if the Royal Observatory is to continue its work in contributing to the development of astronomical science, that the basic grades should be recruited at a higher level. Post-graduate research for students from the universities should be provided for by the Royal Observatory, and it is hoped that some such scheme will materialize in the near future. While proposals have been submitted for regrading its staff (including that of the Nautical Almanac Office) on the basis of the reorganised Scientific Civil Service, no decision has yet been made. At present both the salaries and prospects of promotion of the Observatory staff are very inferior to those in other scientific establishments, and unless improvements are made the recruitment of staff to fill vacancies must present serious difficulties. This is a matter of the utmost importance, and it is time that the British public was aware of the dangers to the development of astronomical science in Great Britain if overdue reforms are not forthcoming.

## Research Council of Alberta

THE twenty-sixth annual report of the Research Council of Alberta (Edmonton, Alberta: King's Printer), covering the year 1945, includes lists of members of the Council and the Technical Advisory Committee, the technical staff and of the publications of the Council. Most of the investigations in progress in the previous year were continued, new investigations including a soils survey in co-operation with the Dominion Government and studies of the possibilities for the commercial utilization of cereal straws and of Alberta poplar. Difficulties in obtaining technical staff, services and supplies continued to handicap the work. Much of the work on bituminous sands was concerned with the critical problem of freeing the crude oil, recovered by the separation unit, from water, sand and silt, and preparation of it in suitable form for the refinery. Study of the hot-water separation method continued, and the most significant advance in the year was the discovery that the silt and clay present in bituminous sand powerfully assist displacement of the oil from the sand by hot water. Three papers on this work were published during the year. A detailed report on the use of Alberta coals in automatic domestic stokers was issued as Report No. 46. Other fuel investigations related to briquetting, while the major geological project was a field investigation of part of the Highwood coal area. A report on the "Geology of the Red Deer and Rosebud Sheets" was published during the year, and a study of the Fischer – Tropsch synthesis of petrol and other liquid fuels from natural gas has been concerned with the reduction and conditioning of catalysts. A co-operative soils survey programme was planned with the soil survey department of the Dominion Government, but was not completed owing to shortage of qualified staff, and it will be some time before the detailed reports are available. A study is also in progress of the periodic rise and fall in the number of rabbits, fur-bearing and other animals and birds at intervals of about ten years.

A paper by E. Stansfield, chief research engineer of the Research Council of Alberta, on recent work of the Council, presented to the Annual Western Institute of the Canadian Institute of Mining and Metallurgy in October 1945, has now been issued as Contribution 10 of the Research Council, and the picture it gives of the work of Council is supplemented by a list of the more important items in the programme for 1946–47 and a summary of the appropriations granted by the legislature. Mr. Stansfield, in his paper, refers briefly to the studies initiated on the biological cycle, to earlier work on the wetting of coal, current work on coal for automatic domestic stokers, and on low-temperature carbonization, portable gas producers, briquetting, etc.

## Forestry in China

IN *Acta Brevia Sinensia* (No. 11; 1945) some interesting information is given on Chinese forests and forest resources, a subject upon which all too little is known in Europe. Abstracts are given from papers or forthcoming books on half a dozen aspects of forestry procedure, analyses of the forest, extraction, etc., with a note on the Forest Products Laboratory. The report on a survey of the forest resources of China for railway sleepers proposed in south-west China records investigations in the five provinces of west Sikong, south Szechuan, south-east Kweichow, north Kwangsi and south Hunan. Several forests hitherto unknown were explored for the first time. Among the more important of these are the evergreen forests of Loochen in the region between the provinces of Kweichow and Kwangsi, and the mixed forest at the upper part of Nien Shao Ho, south-east Kweichow. The lumber markets at Yaan,

Hokiang, Kweiling and Hengyang were also investigated with reference to their possible supplies to the railways. In a preliminary study of Chinese forests and timbers (to be published shortly in English) the forests are discussed under the five divisions: (1) the Manchurian Forest, (2) the north-west, (3) the south-west, (4) the Nanling, and (5) the southern hardwoods forest. In Part 2 an enumeration of the most important and commonest Chinese timbers is given, a most interesting item; among others are Chinese fir, pine, spruce, larch, Chinese cedar, hemlock, oaks, birch, maple, poplar, schima, red gum, walnut, Chinese mahogany, beech, elm, ash, basswood, red alder, "other common softwoods and hardwoods", whatever that means; and others with native names only. A map shows Chinese forest regions, and a table of estimated forest resources and lumber markets is included.

There is also a brief account of the Forest Products Laboratory, which was organised in 1939 at Peipei, Chungking, and forms a unit of the National Bureau of Industrial Research at the Ministry of Economic Affairs. Its main purpose is to investigate the properties of Chinese timbers to promote their better utilization. The inquiry in connexion with the chief of the timbers will be carried out as follows: their proper names, supplies, structure, physico-chemical, seasoning, preserving and wood-working properties. Owing to the destruction of the original building in an air raid, the laboratory is now at Kaiting. During the past five years considerable assistance has been received from the Fan Memorial Institute of Biology, the Rockefeller Foundation, the Agricultural Promotion Association, the National Wu Han University and the British Council Cultural Scientific Mission in China.

## Royal Scottish Museum, Edinburgh

THE progressive activity of the Royal Scottish Museum is shown by the Director's report for the year 1945. Having been closed during 1939–43, no time has been lost in carrying out vigorous schemes to "recapture its lost public and to attract the younger generation who knew it not". The organisation of numerous temporary exhibitions relevant to a variety of topical and educational subjects; lectures of strong Scottish interest; the practical support of the activities of outside educational and cultural institutions; the resumption of services for visiting classes of school children and various adult educational groups, and the regular showing of instructive motion films, have all contributed to the winning of the firm public appreciation which the Royal Scottish Museum merits. A very popular feature connected with some of the special exhibitions was the introduction of demonstrations which "livened the exhibits and encouraged closer study of both processes and products".

This report and those from other museums exploring similar fields of interest indicate plainly enough that activity of this kind will be, in future, a necessity if there is to be a general public appreciation and use of museum services as a whole. The opportunity afforded by the war-time evacuation of collections for the reorganisation of the 'old' in the interests of the 'new' has not been missed in Edinburgh, for it is reported that plans for a revised lay-out of the collections were put into operation during the year. Among the several important acquisitions reported, mention may be made of the gift by Mr. J. R. Lockie of a collection of more than 4,400 Communion tokens (previously on loan to the Museum); the Museum's collection of these now becomes one of the largest and finest in existence.

## A New Synthetic Insecticide

THE discovery of the insecticidal properties of D.D.T. (the *para*, *para*-isomer of dichlorodiphenyltrichloroethane) closely followed by the isolation of the γ-isomer of benzene-hexachloride, which is even more toxic to some insects, has provided a great stimulus to the search for new and still more potent substances—especially for substances in which it may be possible to secure proprietary rights. The two insecticides above are both highly chlorinated ring compounds, and it is in this group of materials that the search seems to be most actively prosecuted at the present time. The latest product is a chemical of unrevealed composition with the empirical formula $C_{10}H_6Cl_8$. It has been produced by the Velsicol Corporation in Chicago under the name of "Velsicol 1068", and is to be marketed in Great Britain by the Hygienic Chemical Co., Ltd. It is a viscous, colourless, odourless liquid, less volatile than benzene hexachloride ('Gammexane'), more volatile than D.D.T. In solubility it resembles these substances, and in toxicity to insects it comes somewhere between them. The same applies apparently to its toxicity to mammals. More extensive trials will be needed before the relative merits of these materials can be established and the best uses of "Velsicol 1068" defined. It is to be hoped that the structural formula of the compound will soon be published.

## Early Metallurgy

THE Royal Anthropological Institute has appointed a Mining and Metallurgical Committee to investigate problems of early metallurgy, as part of its scheme for group studies of the evolution of man. Among the first matters to be studied by the Committee is man's early use of copper. When found in its metallic form, the element is known as 'native' copper, and metal of this kind undoubtedly formed the earliest sources of copper supply. Samples from various parts of the world are being collected by the Committee and analysed with the object, if possible, of relating their particular composition to that of ancient specimens of copper work. The Committee includes the following: Mr. C. E. N. Bromehead (Geological Survey and Museum); Prof. V. Gordon Childe (Institute of Archæology, London); Mr. H. H. Coghlan (chairman); Prof. C. H. Desch; Dr. Oliver Davies (Queen's University of Belfast); Mr. A. Digby (British Museum); Prof. C. F. C. Hawkes (University of Oxford); Dr. W. Lamb (secretary); Mr. T. K. Penniman (Pitt Rivers Museum, Oxford); Prof. Stuart Piggott (University of Edinburgh); Dr. H. J. Plenderleith (British Museum); Dr. J. Raftery (National Museum, Dublin); Mr. B. Webster Smith (Copper Development Association).

## List of Awards for Scientific Research

A FOURTH edition (June 1946) of the "List of Whole-Time Awards for Scientific Research, other than Professorships, offered by Public and Private Bodies in Great Britain and Northern Ireland", prepared primarily for the use of the Commissioners for the Exhibition of 1851, follows the same lines as its predecessors, of which the last was issued in November 1937 (London: Roy. Comm. Exhib. 1851. 1*s*.). It does not include awards of less than £150 a year, or

scholarships for special branches of medicine or veterinary science. It also omits awards offered by universities and scientific societies exclusively for the benefits of their own members, and awards for which British subjects are not eligible. An endeavour has been made to bring the information fully up to date, but the post-war policy of some of the bodies responsible for the administration of awards has not been finally settled. Some new awards, founded by recent benefactions, may also have been omitted through lack of information. The awards are arranged in three classes according to whether they are open awards offered (1) by private and public bodies other than universities or colleges, (2) by universities and colleges, and (3) awards restricted to candidates from particular localities or institutions. There is a subject index and a general index.

## Sintered Glass

A NEW technique for the production of complex glass-metal structures, such as the bases of thermionic valves, is described by E. G. Dorgelo in the January 1946 issue of the *Philips Technical Review*, vol. 8. The process consists in pressing finely powdered glass into a graphite mould in which the metal parts are supported, and in sintering it in a mixed nitrogen – hydrogen atmosphere by high-frequency induction heating. The finished product is opalescent because of the large number of gas bubbles, the average diameter of which is about 50 microns, which are trapped in the fused glass; but these are said not to affect the mechanical properties detrimentally, while in respect of electrical breakdown it is suggested that the powdered-glass product is likely to be superior to that of ordinary glass in which, by mischance, air bubbles of larger size have become enclosed.

## Observing Ultra-violet Radiation at a Height of 100 Miles

*Sky and Telescope* of August has a short note which refers to the films developed by the Eastman Kodak Company with special fluorescent coatings for recording ultra-violet radiation. They are to be used in spectrographs mounted in the noses of V2 rockets, and the ultra-violet radiation of sunlight will be recorded when the rockets reach altitudes of about 100 miles. The glow on the fluorescent coating produced by the ultra-violet light is recorded on the film.

## University of Sheffield: Appointments

RECENT appointments by the Council of the University of Sheffield include the following: Dr. W. S. Bullough (Sorby Fellow), to be honorary lecturer in zoology; Dr. May H. Beattie, to be honorary demonstrator in bacteriology; Derek R. Wood, to be lecturer in pharmacology; D. K. Hill and H. E. Taylor, to be lecturers in the Department of Glass Technology.

## Colonial Service Appointments

THE following appointments in the Colonial Service have been announced: M. A. Barrett, to be agricultural officer, Kenya; J. Bowden, to be entomologist, Gold Coast; A. Simpson, to be geologist, Nigeria; R. C. Clarke, to be land surveyor, Hong Kong; R. S. A. Beauchamp, to be director of freshwater fisheries, Research Station, Jinja, Uganda; G. A. W. Dove, to be geologist, Lands and Mines Department, British Guiana; J. B. Pollock, to be metallurgist chemist, Uganda; B. W. Thompson, to be professional assistant at the Royal Observatory, Hong Kong; R. P. Davidson, agricultural officer, Malaya, to be agricultural officer, Uganda; T. R. Hayes, senior agricultural officer, Uganda, to be principal agricultural officer, Uganda; M. G. de Courcy-Ireland, agricultural officer, Uganda, to be senior agricultural officer, Uganda; W. J. M. Irving, agricultural officer, Uganda, to be senior agricultural officer, Uganda; C. L. Skidmore, senior agricultural officer, Gold Coast, to be assistant director of agriculture, Gold Coast; J. M. Wingate, senior agricultural officer, Gold Coast, to be assistant director of agriculture, Gold Coast; G. R. G. Kerr, conservator of forests, Nigeria, to be regional assistant chief conservator of forests, Nigeria; D. R. Rosevear, conservator of forests, Nigeria, to be regional assistant chief conservator of forests, Nigeria; N. S. Stevenson, conservator of forests, Nigeria, to be regional assistant chief conservator of forests, Nigeria; M. Perks, surveyor, Nigeria, to be surveyor, Northern Rhodesia.

## Announcements

PROF. M. STACEY, of the University of Birmingham, will deliver the Tilden Lecture of the Chemical Society on December 5 at 7.30 p.m.; his subject will be "Macromolecules Synthesized by Micro-organisms".

THE Institution of Naval Architects is offering the following scholarships, tenable for three or four years, according to the length of the course at the university selected, for competition in 1947: *Naval Architecture:* Vickers-Armstrongs, £200 a year; Denny, £130 a year, at the University of Glasgow only; *Marine Engineering:* Yarrow, £170 a year. Entries close on May 31, 1947. Full particulars can be obtained from the secretary of the Institution of Naval Architects, 10 Upper Belgrave Street, London, S.W.1.

DR. A. BOERGER, of the University of Montevideo, director of the Agricultural Research and Plant Breeding Station of La Estanzuela, Uruguay, since 1912, president of the Uruguayan National Commission on the Forage Crop Problem, and author of several books of major importance on agricultural and grassland research in the La Plata region, has received the degrees of doctor *honoris causa* of the University of Montevideo, and of doctor *honoris causa* in agrarian sciences of the University of Buenos Aires. In conferring these distinctions, the authorities of the Universities acknowledged in warm terms the indebtedness of the two great stock-raising countries of the La Plata basin to Dr. Boerger's life-time of devotion to agricultural and grassland research, a devotion which has redounded greatly to the economic advantage of both countries.

IN the article "The Multiplicity of Foramina Mentalia in a Human Mandible from the Copper Age of Anatolia" (*Nature*, June 15, p. 792), the author is described as "professor". Dr. Muzaffer Senyürek points out that he holds the post of assistant professor only.

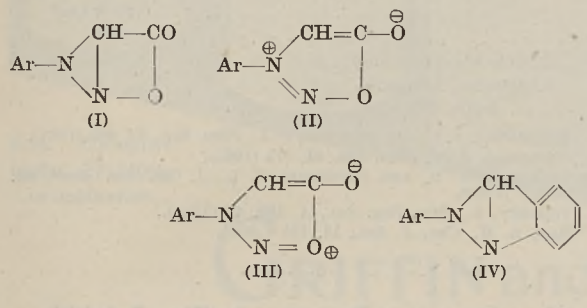
ERRATUM. In the article "Recent Additions to the London Zoo" (*Nature*, Nov. 2, p. 637), the Mau escarpment was described as in "western" Uganda; this should read "eastern" Uganda.

# LETTERS TO THE EDITORS

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

## Structure of the 'Sydnones'

It has been shown by J. C. Earl[1] that the N-nitroso-N-arylglycines, for example, $Ph.N(NO).CH_2.CO_2H$, on treatment with acetic anhydride lose a molecule of water, giving monomolecular anhydro derivatives which have been termed 'sydnones'. The structure tentatively suggested for these compounds contains the fused three- and four-membered ring system (I), and is unacceptable for a number of reasons which need not be enumerated.




As shown by Earl, the 'sydnones' are converted into the original N-nitroso-N-arylglycines by hydrolysis with alkali, and it is therefore most improbable that any molecular rearrangement, such as migration of the aryl group, occurs during their formation. The five-membered ring system shown in (I) is, therefore, almost certainly present in the 'sydnones'. A modification of the structure proposed by Earl, however, avoids the obvious difficulties inherent in the formulation (I); it also allows a ready explanation of the stability of the compounds and accounts equally satisfactorily for their properties. The modification now advanced omits the bridge bond in (I), and substitutes a hybrid structure derived from a number of ionic states of which there are, for example, eight zwitterionic forms (not all of equal probability), two of which are shown in formulæ (II) and (III). On this view the 'sydnones' are partially aromatic in character, and might be expected to possess the degree of stability which they, in fact, show.

The problem of the structure of the 'sydnones' is closely related to that of the 2-substituted indazoles (IV; shown with a bridge bond to compare with I) and related compounds such as anthranil, 2-substituted benztriazoles, etc., for which a hybrid, largely zwitterionic structure has already been advanced by one of us[2]. Work on the structure of this type of molecule and on the 'sydnones' is in progress, and a full report will be published elsewhere.

Wilson Baker
W. D. Ollis

Department of Organic Chemistry,
University, Bristol.
Oct. 9.

[1] Earl, J. C., and Mackney, A. W., *J. Chem. Soc.*, 899 (1935). Earl, J. C., and Eade, R. A., *J. Chem. Soc.*, 591 (1946).
[2] Baker, W., Tilden Lecture, *J. Chem. Soc.*, 267 (1945).

## Catalytic Oxidation of Ascorbic Acid

Barron *et al.*[1] showed that ascorbic acid is not autoxidizable in acid solutions up to *p*H 7. They investigated the catalytic effect of salts of manganese, nickel, iron, cobalt, calcium and copper at *p*H 4–6 and found that copper alone had a marked catalytic effect. Mack and Kertesz[2] found that iron had no catalytic effect alone but increased the catalytic effect of copper.

Investigations in this Laboratory have shown that catalysis by ferrous iron is negligible above *p*H 2 but considerable at *p*H 1 and below. In contrast, copper catalysis decreases with decreasing *p*H and becomes negligible below *p*H 1. The accompanying table shows results of studies in solutions of 0·1 *M* sodium acetate adjusted to various *p*H levels with sulphuric acid. The solutions contained initially 20 mgm. of ascorbic acid per 100 ml. and were aerated rapidly at 40° C.

| Catalyst added | Per cent oxidation in 5 min. at *p*H | | | |
|---|---|---|---|---|
| | 0·4 | 1·0 | 2·0 | 3·0 |
| Nil | 0 | 0 | 0 | 0 |
| Cu″ (10 p.p.m.) | 0 | 0·3 | 7·0 | 54·3 |
| Fe″ (10 p.p.m.) | 43·0 | 20·8 | 0·9 | 0·9 |

At *p*H 0·4, copper has practically no catalytic effect but actually reduces the catalytic effect of iron. These results, in addition to their theoretical interest, are of importance in relation to the determination of ascorbic acid in canned foods. Further details will be published later.

F. E. Huelin
I. M. Stephens

Food Preservation Research Laboratory,
Homebush, New South Wales.
Oct. 15.

[1] Barron, E. S. G., *et al.*, *J. Biol. Chem.*, 112, 625 (1936).
[2] Mack, G. L., and Kertesz, Z. I., *Food Res.*, 1, 377 (1936).

## A Direct Method for Determining the Index of Refraction of Thin Films

In working with high-frequency discharges obtained in air, at a pressure of about 1 mm., by the use of external electrodes surrounding a glass tube, an interference pattern was observed after a run of twenty hours or more. The pattern was visible both inside the tube at the edges of the electrodes and on glass strips placed under the electrodes within the tube. Patterns were obtained on clear strips of glass and on strips previously coated with thin metallic layers. Fig. 1, an enlarged photograph taken by sodium light reflected from the surface of a strip, shows a characteristic pattern which was formed on that portion of the strip immediately under one of the electrodes. The pattern appears to be similar in nature to those observed by Bochstahler and Overbeck[1], Nathanson[2], Nathanson and Bartberger[3] and others, in sputtering discharges, and is due apparently either to the deposition of a thin layer

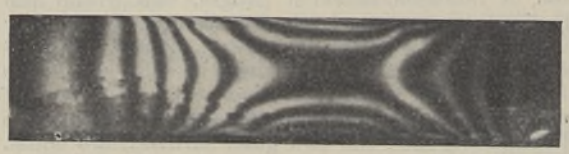


Fig. 1

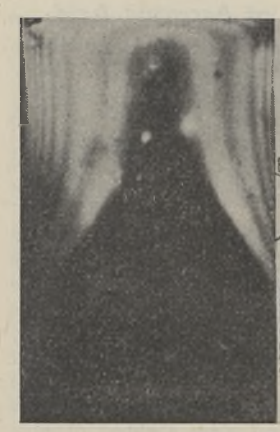


Fig. 2

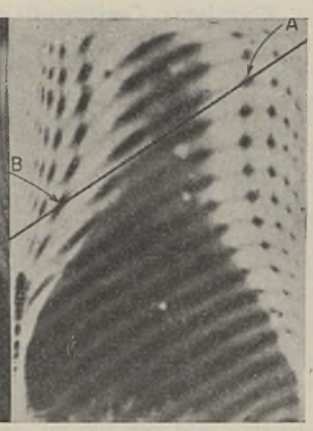



Fig. 3

of some transparent material, or to some action of the discharge on the surface of the glass. If we assume the first hypothesis, the maximum thickness of the deposit can be shown to be of the order of 5 wave-lengths (in the medium). Since this thickness is attained only very near the edge of the deposit, where it is a maximum, the total amount of material in a deposit must be very small and analysis by ordinary methods extremely difficult. It was thus thought advisable to obtain some clue as to the nature of the deposit by determining its index of refraction by means of what seems to be a new method.

The method was suggested by the recent work of Tolansky[4] on the determination of the contours of nearly plane surfaces by means of multiple reflexion fringes. A layer of silver with reflexion coefficient of the order of 0·9 was deposited by evaporation *in vacuo* on one surface of a compensating plate taken from an old Michelson's interferometer. The plate, about 15 mm. × 20 mm. × 5 mm., was placed with its silvered side up in a high-frequency discharge tube of 3 cm. diameter, containing air, in such a way that one end protruded about 3 mm. beyond the region surrounded by one of the external sleeve electrodes. A discharge was maintained in the tube for several hours, after which the plate was removed. The result (reproduced as Fig. 2) shows that the silver was removed from the centre of the plate and also from the end outside the electrode, a phenomenon related to the removal action of high-frequency discharges discussed by Hay[5]. On the remainder of the area, however, a deposit showing the interference pattern appears to have protected the silver coat, which is intact.

A second layer of silver was then evaporated *on top of the deposit*, and at the same time on one of the surfaces of another similar plate from the interferometer. The two silvered surfaces were then placed in close proximity in a device which allowed adjustment to be made until approximate parallelism could be attained.

Viewed in transmitted monochromatic light, the result, as shown in Fig. 3, showed two superimposed sets of multiple reflexion fringes, one within the medium showing the original pattern, and the other in the air gap between the plates. Points $A$ and $B$ (Fig. 3) are on the same fringe in each set, hence they represent regions at which the thicknesses of both the air gap and the deposit, as well as the distance between the two glass surfaces, are equal. Since the glass surfaces are optically plane, the distance between them must be constant everywhere on the line $AB$. The distance along any line parallel to $AB$ must also be constant.

Thus, if the number of fringes due to reflexion in the air gap that are cut by a segment of a line parallel to $AB$ is $a$, and the number of fringes of the set in the medium cut by the same segment is $b$, the index of refraction of the medium with respect to air is evidently $b/a$, since the change in the thickness of the air gap is entirely due to the change in the thickness of the medium along the line segment.

Using this method, the index of the medium was found by one of us (R. W. S.) to be $1{\cdot}49 \pm 0{\cdot}012$, for $\lambda = 5460$.

Further work is in progress to determine the origin and nature of these deposits, as well as their indices of refraction and dispersion.

J. K. Robertson
R. W. Stewart
J. I. Lodge

Queen's University,
Kingston, Canada.
Sept. 25.

[1] Bochstahler, L. I., and Overbeck, C. J., *Phys. Rev.*, **37**, 465 (1931).
[2] Nathanson, J. B., *Phys. Rev.*, **41**, 373 (1932).
[3] Nathanson, J. B., and Bartberger, C. L., *J. Opt. Soc. Amer.*, **29**, 417 (1939).
[4] Tolansky, S., *Proc. Roy. Soc.*, A, **184**, 41 (1945).
[5] Hay, R. H., *Can. J. Res.*, **16**, 191 (1938).

## Luminescence Processes in Zinc Sulphide Phosphors

In a recent communication in *Nature*[1], derivations of phosphorescence decay equations have been made, based on the electron trapping mechanism, which assume retrapping of electrons to be an important part of the process. The writers direct attention to two statements from papers by Randall and Wilkins[2] which, when thus isolated from their context, appear to contradict each other. Klasens and Wise assume in their letter that electron traps and luminescence impurity centres are independent of each other. Their subsequent theoretical treatment of the decay process is based on the above assumptions.

We have recently completed extensive studies of the phosphorescence and thermoluminescence characteristics of zinc sulphides and other phosphors governed by electron-trapping mechanisms, and papers are in preparation on this work. There is no doubt that retrapping of electrons can give rise to considerable modification of the theory of phosphorescence and thermoluminescence for phosphors having a single depth of trap. The basic equations for the emission given by Randall and Wilkins[2] are thereby altered and become:

$$I = -\frac{dn}{dt} = \frac{c.n^2 s}{N} \exp -E/kT, \quad . \quad . \quad (1)$$

where $I$ is the luminescence intensity, $n$ the number of trapped electrons in the $N$ available traps, $c$ and $s$ are constants, and $E$ is the trap depth. Equations 1 lead to new expressions for the decay of phosphorescence and the thermal glow-temperature variation.

Experimental evidence from our studies, which include investigation of the origin of dielectric changes in phosphors, the behaviour of phosphors with more than one activating impurity and the effects of 'killer' impurity, flux and preparation conditions, indicates two important facts: (*a*) Electron traps

## GOVERNMENT OF THE PUNJAB

Applications are invited from British subjects for the following appointments in the Punjab Agricultural Service Class I:

(a) Deputy Director
(b) Agricultural Chemist
(c) Plant Pathologist
(d) Agricultural Engineer
(e) Associate Professor of Entomology.

Candidates must possess for (a) a Degree in Science or Diploma in Agriculture or equivalent practical experience in Agriculture, experience in conducting experiments, administrative ability: for (b) a good Masters Degree in Chemistry or equivalent with special emphasis on Organic Chemistry, and extensive experience of research on animal nutrition, plant and food chemistry and connected chemical and physiological problems; for (c) A Degree in Agriculture (Botany principal subject) or Botany (Honour School) with special training in Plant Pathology including pure and applied Mycology; research experience in diseases of farm crops and fruit plants, ability to lecture to B.Sc. and M.Sc. classes and guide post-graduate research; for (d) A Degree in Engineering (Mechanical) or A.M.I.Mech.E. with five years experience in irrigation problems including water supply from wells, tube wells, etc., soil erosion conservation and drainage, power machinery, tractors, pumps, etc., a Degree also in Agriculture would be preferred; and for (e) a Degree in Science or Agriculture with Zoology (including Entomology) as one of the subjects, with post-graduate training in Entomology, pure and applied, leading to research degree, teaching experience in agricultural Zoology and Entomology including guidance of research.

Age limits 22–35 years but this may be relaxed in special circumstances, and candidates with war service may deduct the period of such service in computing their age. The posts are permanent and pensionable subject to two years probation.

Pay scale ranging from Rs. 350 to Rs. 1,200 a month (£315 to £1,080 a year) according to age, qualifications and experience with prospect of further advance. Additional payments are dearness allowance and for officers of non-Asiatic domicile Overseas Pay ranging from £135 to £360 a year. Provident Fund Free passage on appointment and further passages for leave purposes and for his family if the Officer is retained after probation. Further particulars and forms of application may be obtained on request by postcard to the High Commissioner for India, General Department, India House, Aldwych, London, W.C.2, quoting Ref. No. 258/284. Latest date for receipt of completed applications is November 30, 1946.

## THE ROYAL COMMISSION ON ANCIENT MONUMENTS (SCOTLAND)

Vacancies for (a) Architectural Editor and (b) Investigating Officer.

(a) Applications for the post of Architectural Editor are invited from candidates who (a) are Fellows or Associates of the Royal Institute of British Architects or (b) hold the degree of B.A. (Architecture) and who have, in addition, had some training in historical or archæological research.

The salary, including consolidation addition, is £790 per annum for a man or £662 for a woman. Applicants should be over 30 and under 48 years of age on January 2, 1947.

(b) Applications for the post of Investigating Officer are also invited from candidates who have University degrees or diplomas given for courses of study which have included some archæological subject. The salary scale, including consolidation addition, is £318 × 18–£490 × 25–£650 per annum for a man. For a woman the salary scale may be somewhat lower. In the case of entry above the age of 24 the initial salary may be increased by one increment for each year of age over 24 subject to a maximum of six such increments. Applicants should not be less than 24 nor more than 35 years on January 2, 1947.

Both posts are pensionable under the Superannuation Acts. Statements of the duties and of the qualifications required for each post and forms of application may be obtained from the Secretary, Royal Commission on Ancient Monuments (Scotland), 14 Queen Street, Edinburgh, 2, with whom applications must be lodged before January 2, 1947.

## MASSEY AGRICULTURAL COLLEGE

(University of New Zealand), Palmerston North, New Zealand

Lecturer in Dairy Farming

Applications closing December 5 are invited for the position of Lecturer in Dairy Farming. Commencing salary £675 per annum (New Zealand currency) rising to a maximum of £825 per annum.

Conditions of appointment may be obtained from the High Commissioner for New Zealand, 415, Strand, London, W.C.2.

## GOVERNMENT OF SOUTHERN RHODESIA

VACANCY FOR ANALYTICAL CHEMIST

Required by the Government of Southern Rhodesia a male Assistant Analytical Chemist for appointment in the Government Analyst's Laboratory in Salisbury, Southern Rhodesia. Professional qualification must be of specialized honours degree or A.R.I.C. standard. A young and recently qualified man is required, preferably unmarried. The successful applicant will be required to pass a medical examination by a Government or other duly appointed Medical Officer.

The salary will be £450 × £25 to £600 × £70 to £670 × £30 to £850 per annum with efficiency barriers at the £500 and £600 per annum steps.

The successful applicant will be provided with travelling fare from place of appointment to Southern Rhodesia.

Applications, stating age, nationality, marital condition, school and university career, professional training and attainment, the earliest date on which duty could be assumed, together with copies of testimonials should reach the Secretary, Office of the High Commissioner for Southern Rhodesia, Rhodesia House, 429 Strand, London, W.C.2, not later than December 31, 1946. Application forms will be despatched on request.

Canvassing will disqualify applicants.

## NATAL UNIVERSITY COLLEGE

(UNIVERSITY OF SOUTH AFRICA)

Applications are invited for the post of Senior Lecturer in Mathematics (Statistics) in Durban.

The lecturer will be required to give instruction mainly to students of Commerce and Social Science in elementary statistical methods, as well as in mathematical statistics to a more advanced stage, in the mathematics of finance, and in general mathematics. The successful candidate will be expected to assist in the statistical research conducted by the Departments of Economics, Commerce and Social Science. A knowledge of Actuarial Science will be a strong recommendation.

The salary will be on the scale: Men: £550 × £25–£750; Women: £450 × £25–£650.

There is a possibility that a new scale will be introduced from January 1947.

Men: £650 × £25–£900; Women: £550 × £25–£800.

Current cost of living allowance is paid in addition. The initial salary will be determined in accordance with the qualifications and experience of the successful applicant. Membership of the University Teachers' Provident Fund is compulsory. The appointment will be in the first instance for a probationary period of one year. The successful applicant will be expected to take up duties as soon as possible in 1947. Further particulars may be obtained from The Secretary, Universities Bureau of the British Empire, 24 Gordon Square, London, W.C.1.

## NATAL UNIVERSITY COLLEGE

Applications are invited for the post of Senior Lecturer in Chemistry in Pietermaritzburg.

Duties will be to teach inorganic and physical chemistry and to direct research of post-graduate studies for the M.Sc. and Ph.D. degrees in one of the branches of chemistry. The successful applicant will be expected to assume duty on March 1, 1947, or as soon thereafter as possible. The appointment will be in the first place for a probationary period of one year.

The salary will be on the scale: Men: £550 × £25–£750; Women: £450 × £25–£650.

There is a possibility that, from January 1, 1947, this scale will be increased to: Men: £650 × £25–£900; Women: £550 × £25–£800.

Current cost of living allowance is paid in addition. The initial salary will depend on qualifications and experience. Membership of the University Teachers' Provident Fund is compulsory. Further particulars may be obtained from the Secretary, Universities Bureau of the British Empire, 24, Gordon Square, London, W.C.1.

## CITY OF NOTTINGHAM

NATURAL HISTORY MUSEUM

Applications are invited for the post of Assistant Curator (male) for the Geology section of the Museum. Applicants must be University graduates in Geology, and not over 40 years of age. Experience of museum work will be regarded as an additional qualification. The salary is £450 per annum, plus cost-of-living bonus. The appointment is subject to the Local Government Superannuation Act, 1937, and the successful candidate will be required to pass a medical examination.

Applications, with copies of three recent testimonials, should reach the undersigned not later than December 7, 1946.

J. E. RICHARDS,
Town Clerk.

The Guildhall,
Nottingham.

## IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

Applications are invited for the following appointments.

1. Lecturer in Entomology. The initial salary will be £500 per annum rising by annual increments of £25 to £600 and thence on special report by £25 to £850 maximum. The appointment will carry membership of the F.S.S.U. and will take effect as from January 1, 1947. The main duties of the Lecturer will be to undertake the elementary and part of the advanced course. The applicant should be interested in and prepared to undertake field work.

2. Demonstrator in Entomology. The appointment is for one year in the first instance subject to renewal for not more than 2 years, at a salary of £300. The candidate should hold an honours degree in Zoology and have special knowledge of entomology, particularly of insect morphology. The appointment will take effect as from January 1, 1947.

Applications for both posts should be made in writing as soon as possible and not later than December 9, 1946, to Secretary, Imperial College, South Kensington, S.W.7.

## WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE

The Governing Body invites applications for the following appointments to the full-time teaching staff. Duties will commence as soon as possible.

(a) Geology with special reference to Mining: Senior Assistant.

(b) Botany and General Biology: Assistant.

(c) Geography and Elementary Mathematics: Assistant.

(d) English: Two Assistants. (One, at least, should also be able to teach Latin and History.)

(e) Shorthand and Typewriting: Assistant.

For post (a) a man is preferred. For post (e) a woman is preferred. For posts (d) one man and one woman are desired. Posts (b) and (c) are open to either sex equally.

Preference will be given in every case to candidates who, in addition to teaching experience, hold University degrees and have practical industrial, commercial, or professional experience. Salary in each case in accordance with the appropriate Burnham Technical Scale.

Further particulars and application form will be sent by the undersigned on receipt of a Stamped Addressed Foolscap Envelope. Candidates must state for which post they require the particulars and form. Applications should be sent in as soon as possible. Applications not on the form provided will be disregarded.

J. F. S. ROSS,
Principal and Clerk to the Governing Body.

## CIVIL SERVICE COMMISSION

Applications are invited for the following posts at the Royal Military Academy, Sandhurst:

Head of Department of Applied Science and Electro-Technics
Head of Mathematics Department
Head of Department of Modern Studies
Head of Department of Languages (French, German, Spanish)
Senior Lecturers and Lecturers in Science (Physics, Chemistry, Engineering)
Senior Lecturers and Lecturers in Mathematics
Senior Lecturers and Lecturers in Modern Studies
Senior Lecturer in Languages (French, German, Russian).

The inclusive scales of salary are (Heads of Department) £950 × £30–£1,100, (Senior Lecturers) £650 × £25–£850, (Lecturers) £400 × £20–£600.

Every assistance will be given in finding accommodation.

Candidates must be of British nationality and must have not less than a second class honours degree. Successful candidates should be prepared to take up duty on January 1, 1947, or as soon as possible after that date. The posts are permanent with Superannuation benefits under the Federated Superannuation System for Universities.

Full particulars of the posts and a form of application may be obtained from the Secretary, Civil Service Commission, Burlington Gardens, W.1, quoting No. 1677. Application forms must be returned to him by November 28, 1946.

## UNIVERSITY OF BRISTOL

Applications are invited for the posts of:

(a) Assistant Agricultural Economist. Applicants should possess a degree in Agriculture and/or Economics. Commencing salary not less than £230 per annum (exclusive of cost of living bonus).

(b) Investigational Officer. Applicants should possess a diploma or similar qualification in Agriculture. Experience or knowledge of farm costings or farm accountancy would be an advantage. Commencing salary not less than £200 per annum (exclusive of cost of living bonus).

Further particulars from the Registrar, The University, Bristol 8.

## LEICESTER REGIONAL CENTRE FOR RADIOTHERAPY

Affiliated to
THE SHEFFIELD NATIONAL CENTRE FOR RADIOTHERAPY

Applications are invited for the post of Physicist at the Leicester Royal Infirmary. The salary will be in the Hospital Physicists scale of £500 rising by £25 per annum to £700, the initial salary being according to qualifications and experience. F.S.S. in force. Applications, with copies of testimonials or references, should be submitted by Monday, December 23. Further particulars may be obtained from the House Governor and Secretary, Royal Infirmary, Leicester.

## PORTSMOUTH MUNICIPAL COLLEGE

Principal—LEONARD B. BENNY, M.A.
LECTURER IN PHYSICS

Applications are invited for the post of Lecturer in Physics. The Lecturer should possess a good Honours Degree, and be prepared to teach to the standard of the Special Degree in Physics, of London University. Salary according to Burnham Technical Scale.

Forms of application and details may be obtained from the Registrar, The Municipal College, Portsmouth.

E. G. BARNARD, M.A.,
Chief Education Officer.

## BRITISH IRON AND STEEL RESEARCH ASSOCIATION

Physical Chemist, with some research experience, required by the above Association, on or before January 1, 1947, for work in connection with Steel-making Slags, and Refractories. Previous experience in these particular fields not essential. Work mainly of a theoretical nature including the making of surveys, progressing of researches and developments in various centres.

Age range 24–34. Salary according to age, qualifications and experience. Written applications only, quoting "Chemistry Department," and giving full curriculum vitae to the Personnel Officer, B.I.S.R.A., 11 Park Lane, W.1.

## THE HANNAH DAIRY RESEARCH INSTITUTE

The Council of the Institute propose shortly to appoint an assistant for research in connexion with the nutrition and metabolism of ruminants. The salary offered will be on the Scientific Officer scale which, on confirmation of appointment, commences at a minimum of £370 for men and £330 for women. The salary will be increased by a consolidation addition (in place of War Bonus) of £82 for men and £72 for women, and the post will be superannuated under the Federated Superannuation Scheme for Universities.

Applications, together with the names of two referees, should be sent to the Secretary of the Hannah Dairy Research Institute, Kirkhill, Ayr, not later than November 30, 1946.

## NORTHERN POLYTECHNIC

HOLLOWAY, N.7

The Governing Body invite immediate applications from Graduates of a British University for the post of Lecturer in Chemistry. The lecturer will be required to teach Chemistry to the Intermediate Science standard and Physical Chemistry to the B.Sc. (General) standard.

Salary according to the revised Burnham Scale for Technical Teachers, with London Allowance.

Forms of application, together with full particulars, will be forwarded on receipt of a stamped addressed foolscap envelope.

R. H. CURRELL,
Clerk.

## THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of Lecturer in Anatomy. Candidates must hold a registrable medical qualification. Salary £800 per annum. Duties to commence January 14, 1947, or as soon thereafter as possible. Applications should be sent not later than December 9, 1946, to the Registrar, the University, Manchester, 13, from whom further particulars may be obtained.

## UNIVERSITY OF BRISTOL

RESEARCH STATION, CAMPDEN, GLOS.

Applications are invited for the post of Research Chemist in connexion with the study of problems of fruit and vegetable preservation. Candidates should possess a good Honours Degree with research experience, and preferably should have some knowledge of food analysis. Salary £600 to £750 per annum according to qualifications. Modern house available. Applications should be addressed to the Director, Research Station, Campden, Glos.

## DYERS AND CLEANERS RESEARCH ORGANISATION

The above Organisation invites applications for the position of Research Assistant.

Applicants should hold a science degree or have reached an equivalent standard. Special qualifications are knowledge and experience of analytical chemistry, textiles and textile chemistry, and practical and/or theoretical experience of the dyeing and cleaning industry. Salary £400–£500 per annum, according to qualifications.

Applications should give details of qualifications and the names and addresses of three referees. Replies to be addressed to: The Secretaries, National Federation of Dyers and Cleaners, 7, Laurence Pountney Hill, Cannon Street, E.C.4.

## IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

(CITY AND GUILDS COLLEGE)

There is a vacancy in the Electrical Engineering Department, on the side of electrical machine and power, for an Assistant Lecturer. The appointment is for a period of three years with salary of £400 p.a. with F.S.S.U. superannuation. An Honours Degree and some practical experience of heavy electrical engineering are essential.

Applications, accompanied by full statement of qualifications, and with references, should be sent to the Head of the Electrical Engineering Department, City and Guilds College, Exhibition Road, London, S.W.7.

## UNIVERSITY OF BIRMINGHAM

DEPARTMENT OF BREWING AND INDUSTRIAL FERMENTATION

Applications are invited for the post of Lecturer (Grade IIa or IIb) at a salary of £550–£800, according to qualifications, in the above Department.

Applicants should have special knowledge of Microbiology, and general knowledge of Plant Biochemistry. Further particulars may be obtained from the undersigned, to whom applications should be sent not later than December 21.

C. G. BURTON,
Secretary.
The University,
Edmund Street, Birmingham, 3.

## MIDDLESEX HOSPITAL MEDICAL SCHOOL, W.1

Biochemist required for a research appointment in the Courtauld Institute, to investigate enzymes and tissue metabolism in relation to cancer. Applicants should be university graduates possessing research experience in biochemistry. Salary £600 per annum.

Also Research Assistant, preferably one having some training in the above field, and in chemical analysis. Salary £300 per annum.

Applications, addressed to the Secretary, Courtauld Institute of Biochemistry, Middlesex Hospital Medical School, London, W.1, should be received not later than November 30.

## CHELSEA POLYTECHNIC

MANRESA ROAD, LONDON, S.W.3
DEPARTMENT OF BIOLOGY

Required, full-time Lecturer in Physiology up to B.Sc. standard. Salary will be paid in accordance with the Burnham Scale for Technical Teachers. Full particulars together with application forms may be obtained by sending a stamped addressed foolscap envelope to the Principal of the Polytechnic, to whom applications must be returned not later than November 22.

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

## UNIVERSITY COLLEGE LEICESTER

Applications are invited for the post of Lecturer in Physical Chemistry. The lectureship is a senior one, and the successful candidate will be expected to take charge of the teaching of, and to supervise research in, that branch of the work of the Department of Chemistry. Commencing salary £700 per annum, with family allowances, and participation in the Federated Superannuation System for Universities. Applications (4 copies), including names and addresses of referees and, if desired, copies of testimonials, should reach the Registrar, from whom further particulars may be obtained, by December 9.

## UNIVERSITY OF GLASGOW

LECTURESHIP IN BOTANY

Applications are invited for appointment as a Lecturer in Botany, with special qualifications in Mycology. The Lectureship will be in Grade IIb, the salary range of which is £400–£600, plus family allowance and superannuation. The commencing salary will be fixed according to qualifications and experience. Applications (three copies) should be lodged with the undersigned not later than November 30, 1946.

ROBT. T. HUTCHESON,
Secretary of University Court.

## UNIVERSITY COLLEGE OF SOUTH WALES AND MONMOUTHSHIRE

The Council of the College invites applications for the following posts at the grade of Assistant Lecturer in each, viz.:

(1) Pure Mathematics; (2) Physics; (3) Organic Chemistry; (4) Physical Chemistry; (5) German; (6) Greek; (7) English. Initial salary at present £400 per annum.

Six copies of applications and testimonials (which need not be printed) must be received by the undersigned, from whom further particulars may be obtained, not later than December 15, 1946.

LOUIS S. THOMAS,
Registrar.
Cathays Park, Cardiff.

## UNIVERSITY OF OTAGO

DUNEDIN, NEW ZEALAND

Applications are invited for the following positions:

Senior Lecturers, salary £750 (N.Z.) p.a. rising to £825 (N.Z.) p.a. in Physics and Mathematical Physics.

Lecturers, salary £600 (N.Z.) p.a. rising to £700 (N.Z.) p.a. in Philosophy and Zoology.

Assistant Lecturers, salary £400 (N.Z.) p.a. rising to £500 (N.Z.) p.a. in History, Physics, and Mathematics.

Full particulars and application forms may be obtained on application to the High Commissioner for New Zealand, 415, Strand, London, W.C.2, England.

## B.E.C.C. SOCIETY INCORPORATED

N.Z. BRANCH

Applications are invited for the position of Director of Cancer Research in the Medical School of the University of Otago, Dunedin (New Zealand). Salary £1,000–£1,200, according to qualifications and experience. Further particulars may be obtained from the General Secretary, B.E.C.C. Society, 11, Grosvenor Crescent, Hyde Park Corner, London, S.W.1.

Applications should be forwarded by airmail to reach the Chairman, Cancer Research Committee, Medical School, Dunedin, before December 31, 1946.

## ROYAL NAVAL COLLEGE, GREENWICH

DEPARTMENT OF APPLIED MECHANICS

Applications are invited for an appointment to the Professorial staff at the Royal Naval College, Greenwich, at the earliest possible date as Lecturer in Applied Mechanics. Applicants should possess high Honours degrees in Mechanical Engineering. Every candidate must be a natural born British subject having at least one parent who is, or was at the time of death, a British subject. The salary scale for lecturers is at present £400 × £25–£600 per annum plus consolidation addition of £90. This scale is now under review. Entry will normally be at the minimum of the scale but consideration will be given to the payment of a salary above the minimum for a candidate who is specially suitable. The appointment will be temporary in the first instance but there are some prospects of permanency. Permanent posts carry the benefits of the Federated Superannuation Scheme for Universities.

Applications, accompanied by the names of three referees and a statement of previous experience, should be sent as soon as possible to the Director, Education Department, Admiralty, from whom further particulars may be obtained.

## UNIVERSITY OF DUBLIN

TRINITY COLLEGE

The Board of Trinity College will elect, on Trinity Monday 1947, to Life Fellowships in (a) Physics, (b) other branches of science. In the case of (b) a candidate must be either a graduate of the University of Dublin or a past or present member of the staff of the University. This restriction does not exist in the case of (a).

In the case of (b) work may be submitted in any of the following sciences: Chemistry, Botany, Zoology, Geology, Geography, Bacteriology.

Candidates must be under 40 years of age on May 1, 1947, and must apply to be recognised as candidates not later than January 1, 1947. For full particulars apply to the Registrar, Trinity College, Dublin.

## BEDFORD COLLEGE FOR WOMEN

(UNIVERSITY OF LONDON)
REGENT'S PARK, N.W.1

The Council of Bedford College invites applications for the post of Demonstrator in the Department of Botany, vacant as from January 1, 1947, open to men and women equally. Candidates must hold a Special Degree in Botany or its equivalent. Salary £350 to £400 per annum. Last date for receiving applications November 25. Further particulars from the Secretary.

(*Continued on pages* clxxvi *and* clxxvii)

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are closely associated with the neighbourhood of the luminescence centres and can be formed by the introduction of the impurity giving rise to the centres. (*b*) Retrapping of electrons is usually a negligible process in the luminescence mechanism of zinc sulphide and other specific phosphors. This statement is capable of explanation in terms of that in (*a*).

An earlier communication in *Nature*[3], from Mr. Klasens alone, postulated a theoretical explanation of the energy exchange in sulphide phosphors with more than one impurity. Experimental facts arising from our studies do not support this simple theory. As an example, the figure given in this earlier communication showing the effect of nickel on a zinc sulphide–silver-activated phosphor agrees approximately with our results. However, the increase of nickel content not only affects the ratio of killer centres to emission centres, but also causes a large change in the $E$ value contained in the expression for the parameter $c$. The theory does not explain the fluorescence-excitation intensity relations found for very low excitation of these phosphors in the temperature region where the value of $c$ becomes important.

We believe that Mr. Klasens' views are not adequately supported by experimental evidence, which seems to favour different basic assumptions.

G. F. J. Garlick
A. F. Gibson

Physics Department,
University of Birmingham.
Oct. 5.

[1] Klasens, H. A., and Wise, M. E., *Nature*, **158**, 483 (1946).
[2] Randall, J. T., and Wilkins, M. H. F., *Proc. Roy. Soc.*, A, **184**, 366 and 390 (1945).
[3] Klasens, H. A., *Nature*, 158, 306 (1946).

## Diamagnetic Susceptibility of Isomerides

In a discussion of investigations on the magnetic susceptibilities of aliphatic acids and esters—carried out just before the outbreak of war and published[1] in 1943—Angus and Hill directed attention to certain regular differences between the susceptibilities of straight- and branched-chain compounds and briefly reviewed existing data.

When the study of magnetic susceptibilities was resumed by us about a year ago, investigation of various types of isomerides was planned and, in the first instance, more particularly aldehyde-ketone isomerism and the isomers of methyl benzoate and their analogues, since, from the few relevant published data[2], it appeared that such isomerides had identical susceptibilities. While these investigations were proceeding, there appeared in the issue for March 12 of the *Comptes rendus*[3] a paper by Pascal and Pacault; unfortunately, it was only a few days ago that this paper became available to us. Pascal and Pacault discuss, in a generally adverse manner, the results on isomers of aliphatic acids and esters[1], and suggest the desirability for carrying out further investigation on isomerides which appeared to have identical susceptibilities. This work was, as has been stated, in hand and has now reached a sufficiently advanced stage to make a preliminary report appear to be desirable, although reserving a discussion of the significance of susceptibility differences until the planned programme has been completed and the values now given have been adequately confirmed. It is not proposed to refute here the general criticisms contained in Pascal and Pacault's paper; that can and will be done elsewhere later.

So far our work on aldehyde-ketone isomerides has shown that the aldehyde is slightly more diamagnetic than the isomeric ketone, although, with our present data, the difference shows a small but not a constant value. For example, the value for acetone is $0{\cdot}4 \times 10^{-6}$ less diamagnetic than propionaldehyde, while with methyl amyl ketone and œnanthaldehyde the difference is $0{\cdot}7 \times 10^{-6}$.

The results for the other type of isomerism which we have studied are more self-consistent and give more regular differences, as is shown in the accompanying table showing the values of $-\chi_M$ (multiplied by $10^6$) obtained.

| Phenyl-acetates | | Benzyl esters | | Benzoates | | Phenyl esters | |
|---|---|---|---|---|---|---|---|
| | — | Formate | 81·43 | Me | 81·54 | Acetate | 82·04 |
| Me | 92·73 | Acetate | 93·18 | Et | 93·32 | Propionate | 93·79 |
| Et | 104·27 | | — | Pr | 105·00 | *n*-Butyrate | 105·46 |

These results show clearly that the isomerides do not have identical susceptibilities.

W. Rogie Angus
Geoffrey Stott

Department of Chemistry,
University College of North Wales,
Bangor.
Oct. 7.

[1] *Trans. Faraday Soc.*, 39, 185 (1943).
[2] Pascal, *Ann. Chimie*, 19, 5 (1910).
[3] *C.R. Acad. Sci. Paris*, 222, 619 (1946).

## X-Ray Examination of Self-Recovery in Copper

A communication by L. L. Van Reijen[1] refers to a recovery effect after an interval of some months in filed copper powder. This was shown by X-ray transmission photographs of a thin layer of the powder specimen. He used the same interval of time when verifying his observation, and presumably did not follow the progress of recovery in detail. However, in view of his reference to rotation powder photographs taken by Megaw, Lipson and Stokes[2,3], in which recovery was detected some days after the preparation of the powder, it may be of interest to report that we have detected the self-recovery of filings of electrolytic tough pitch copper several days after filing, in both transmission photographs and rotation powder photographs.

The transmission method is preferable for following the progress of recovery during its later stages; thus the diffraction pattern obtained with the freshly filed copper shows diffuse diffraction rings of uniform intensity, and after six days a number of intense sharply defined spots appear superimposed on a background of the diffuse reflexions. After an interval of eleven days the intensity and size of the individual reflexion spots increase, and after twenty-four days the diffraction rings are beginning to become discontinuous and tend to break up into individual spots.

The presence of very small amounts of impurities is known to exert an appreciable influence on the atomic rearrangement necessary for self-recovery and recrystallization to occur. Some years ago, other investigators[4,5] used X-rays to study the time of recrystallization at room temperature of two different samples of electrolytic copper in the form of cold-

rolled sheets. The copper used in our work contained metallic impurities totalling 0·0055 per cent, but we also made some observations on a sample of copper containing 0·0249 per cent of metallic impurities. Here again self-recovery was detected, but the extent of the change was less after one year than the purer specimen had shown after six days.

J. L. Miller
L. C. Bannister
R. M. Hinde
British Insulated Callender's Cables, Ltd.,
Prescot.
Oct. 11.

[1] Van Reijen, L. L., *Nature*, **157**, 371 (1946).
[2] Megaw, H., Lipson, H., and Stokes, A. R., *Nature*, **154**, 145 (1944).
[3] Megaw, H., and Stokes, A. R., *J. Inst. Metals* **71** 279 (1945).
[4] Eisenhut, O., and Widmann, H., *Z. tech. Phys.*, **11**, 70 (1930).
[5] Widmann, H., *Z. Phys.*, **45**, 200 (1927).

## Behaviour of Hypochlorite and of N-Chloroamines at the Dropping Mercury Electrode

Although Marks and Glass[1] have carried out amperometric titrations using a stationary gold electrode as the polarizable cathode, no results of investigations concerning the behaviour of hypochlorite and of N-chloroamines at the dropping mercury electrode have been recorded.

In investigating methods of distinguishing between hypochlorites and N-chloroamines in aqueous solution, it has now been established that the hypochlorite ion is one of the oxygen-containing anions[2] which are irreversibly reducible at the dropping mercury electrode. Solutions of sodium hypochlorite and of chloramine-*T* (sodium N-chloro-*p*-toluenesulphonamide) have been found to be reducible at *p*H values between 3·6 and 11·0 and at concentrations between 0·001 and 0·01 *N*. The half-wave potentials of neutral solutions in 0·5 *N* potassium sulphate at room temperature are about + 0·08 V. and − 0·13 V. for solutions of hypochlorite and chloramine-*T* respectively, referred to the saturated calomel electrode.

The diffusion currents are proportional to the concentrations and are independent of the *p*H value. The irreversible electro-reduction of each compound involves two electrons per molecule.

The reduction of these two compounds by arsenite was investigated by current-time curves at a potential of − 0·75 V. (sat. calomel electrode). Hypochlorite is rapidly reduced at all *p*H values in the above range, whereas chloramine-*T* is reduced slowly, the rate increasing with diminishing *p*H value, becoming rapid in the presence of iodide. The estimation of hypochlorite in the presence of chloramine-*T* is possible at *p*H 11·0 owing to the great difference in the rates of reduction of the two compounds by arsenite.

The polarographic investigation of the reaction products of sodium hypochlorite, in concentrations varying from 0·008 to 0·020 *N*, and ammonium chloride showed: (*a*) using a deficiency of ammonium chloride, that ammonia is almost completely oxidized in alkaline solution and that N-chloroamines are formed in neutral or weakly acid solutions; (*b*) using an excess of ammonium chloride, that the monochloramine, formed at *p*H 6·8–11·0 [3], is reducible at the dropping mercury electrode; its half-wave potential is about − 0·65 V. (sat. calomel electrode) in *N* potassium chloride solution at room temperature; the electro-reduction is irreversible and involves two electrons per molecule; dichloramine, formed at *p*H 5·0 [3], is not reduced at the dropping mercury electrode under the conditions investigated; trichloramine, present at *p*H 3·6 [3], appears to be reduced at about the half-wave potential of hypochlorite; the reduction of mono- and trichloramine by arsenite is slow, becoming rapid when activated by the presence of iodide.

A detailed account of this and similar work will be published later.

We wish to thank Messrs. Milton Antiseptic, Ltd., for their interest and support.

K. Heller
Edward Davies Chemical Laboratories,
University College of Wales,
Aberystwyth.
E. N. Jenkins
Research Department,
Milton Antiseptic, Ltd.,
London, W.1.

[1] Marks and Glass, *J. Amer. Water Works Assoc.*, **34**, 1227 (1942). Marks, Canadian Pat., 427092 (1944); *Chem. Abs.*, **39**, 2712 (1945).
[2] Kolthoff and Lingane, "Polarography", chapter 23 (New York, 1941).
[3] Chapin, *J. Amer. Chem. Soc.*, **51**, 2112 (1929); **53**, 912 (1931). Metcalf, *J. Chem. Soc.* 148 (1942).

## Volume Flow of Plastic Materials

Swainger[1] has stated recently that an increase in volume occurs during the plastic flow of duralumin specimens under a tensile test. While it is generally assumed that volume is unchanged during plastic flow, we should like to point out that, in 1939, Glanville and Thomas[2] showed that the creep of concrete in compression was characterized by a decrease in volume. The concrete, in fact, flowed into its own voids.

The reverse of this effect has now been observed in specimens of asphalt (consisting of a mixture of fine aggregate with tar or bitumen binder) when subjected to a simple constant-load tensile test. A specimen which showed a total linear extension of 7 per cent before breaking was found to show at the same time a volume increase of about 2 per cent. The volume-change occurred at a roughly constant rate from the moment of application of the load. After breakage, the fractured surface had a rough appearance, in striking contrast to the smooth appearance of a fractured surface broken under impact. It is evident that rupture occurring as a result of plastic flow in tension is due to the progressive weakening of the structure caused by steady dilatation of the material.

It is hoped to publish later a detailed account of this phenomenon as exhibited by bituminous road materials.

A. R. Lee
M. Reiner
P. J. Rigden
Road Research Laboratory,
Department of Scientific and
Industrial Research,
Harmondsworth,
West Drayton, Middlesex.
Oct. 18.

[1] Swainger, K. H., *Nature*, **158**, 165 (1946).
[2] Glanville, W. H., and Thomas, F. G., Building Research Technical Paper, No. 21. (London: H.M. Stationery Office, 1939.)

## Catatorulin Effect of Aneurin Disulphide

ANEURIN disulphide[1], formed by opening of the thiazole ring and oxidation to the —S—S— form, does not give the thiochrome reaction, unless suitably reduced by cysteine; it was reported to have some 60 per cent of the biological activity of aneurin, when given orally to animals. I have found in catatorulin tests, by methods previously described[2], with the deficient pigeon brain that it is at least as active as aneurin (Table 1).

TABLE 1. CATATORULIN TEST WITH BREI, FROM AVITAMINOUS PIGEON BRAIN. SUBSTRATE, SODIUM PYRUVATE

Oxygen uptake $\mu l$/gm./hr. for respiration period 30–120 min.

| | | Change |
|---|---|---|
| No addition .. .. .. .. | 733 | — |
| Aneurin, 0·5 $\gamma$ .. .. .. .. | 1352 | + 619 |
| Aneurin, 0·25 $\gamma$ .. .. .. .. | 1122 | + 389 |
| Aneurin disulphide, 0·5 $\gamma$ .. .. .. | 1524 | + 791 |

TABLE 2. REACTIVATION OF OXIDIZED COCARBOXYLASE FOR CARBON DIOXIDE PRODUCTION. $\mu\lambda CO_2$ PRODUCED IN 15 MIN. FROM SODIUM PYRUVATE IN PRESENCE OF ALKALINE WASHED YEAST, ANEURIN AND MAGNESIUM 28° C.

| Addition | $\mu\lambda CO_2$ |
|---|---|
| Nil .. .. .. .. .. .. .. | 31 |
| + Cysteine, 4 mgm. .. .. .. .. .. | 48 |
| Aneurin disulp. pyrophos. (1·5 $\gamma$) .. .. .. | 35 |
| ,, ,, ,, + cysteine, 2 mgm. .. | 255 |
| ,, ,, ,, + cysteine, 4 mgm. .. | 311 |
| ,, ,, ,, + cysteine, 10 mgm. .. | 348 |
| ,, ,, ,, + glutathione, 4 mgm. .. | 197 |
| ,, ,, ,, + B.A.L., 1 mgm. .. | 226 |
| ,, ,, ,, + cysteine-ester, 4 mgm. .. | 91 |

I have also found that preparations of aneurin disulphide pyrophosphate made by the method of K. Myrback, I. Vallin and I. Magnell[3] by oxidation of cocarboxylase with iodine, when tested by the method of Ochoa and Peters[4] show little or no activity in the decarboxylation of pyruvate by washed yeast; this has been also stated recently by P. Karrer and M. Viscontini[5], so that I can confirm it independently. I have also found that —SH compounds reactivate the preparation for carbon dioxide production, when added immediately after the washed yeast (Table 2); 6 mgm. cysteine hydrochloride per respiration bottle produces a maximum effect (22 mM.); cystine was practically without effect. Myrback *et al.* treated their preparations of aneurin disulphide pyrophosphate with cysteine to reactivate for the thiochrome reaction. As judged by reactivation with cysteine for decarboxylation and restoration of the thiochrome reaction, most of my preparations of this substance were relatively inactive, showing not more than about 10 per cent of the original activity. Upon this basis, catatorulin tests with the dispersion from the avitaminous brain showed an activity corresponding to the amount of aneurin disulphide pyrophosphate present. Since the latter is itself inactive in the yeast test, it is logical to think that it must first be reduced to aneurin before it is active in the catatorulin tests by the —SH compounds present. The fact, however, that *in vitro* these brain enzyme preparations can carry out this change appears still to leave room for the suggestion of Williams and Zima that the —S—S— form of aneurin may play its part in the dehydrogenation.

Synthetic preparations of cocarboxylase (as used here) have been found in this laboratory to give some 60 per cent of the full effect of Lohman and Schuster's cocarboxylase[6]; one possible reason for this is the presence of some oxidized cocarboxylase; since this would be reactivated by cysteine, it is interesting to note that the addition of cysteine to our control synthetic cocarboxylase gives increases of approximately 50 per cent in the carbon dioxide production over the first 10-min. period. L. D. Greenberg and J. F. Rinehart[7] reported an activation of cocarboxylase tests by cysteine.

I am indebted to Messrs. Merck and Hofman le Roche for specimens of cocarboxylase and to the latter for the aneurin disulphide. I am also grateful to R. W. Wakelin for assistance with the tests.

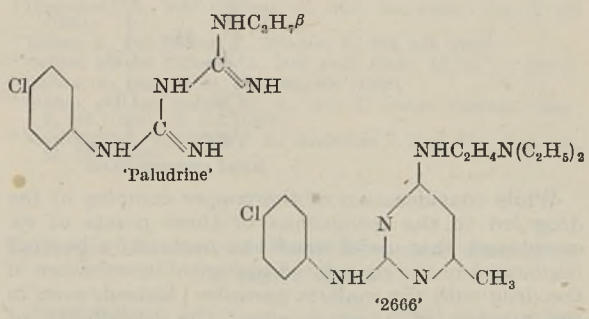
R. A. PETERS

Department of Biochemistry,
Oxford. Oct. 19.

[1] *Ber.*, 73, 941 (1940). (See also, Zima, Ritsert and Moll, *Z. Physiol.*, C, 267, 210 (1941).)
[2] Peters, *Biochem. J.*, 32, 2031 (1938).
[3] *Svensk. Kemisk Tidskrift.*, 57, 124 (1945).
[4] *Biochem. J.*, 32, 1501 (1938).
[5] *Helv. Chim. Acta*, 29, 711 (1946).
[6] Banga, Ochoa and Peters, *Biochem. J.*, 33, 1110 (1939). Weil-Malherbe, *Biochem. J.*, 34, 981 (1940). (Tests by L. A. Stocken, Oxford.)
[7] *Proc. Soc. Exp. Biol.*, 43, 495 (1940).

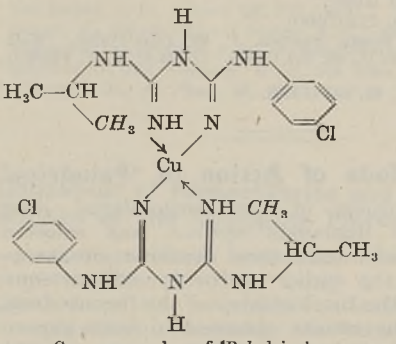
## A Possible Mode of Action of 'Paludrine'

IN the evolution of the antimalarial drug 'Paludrine', the diguanide system was selected because it provided structural features similar to those found in the earlier active pyrimidine compound '2666'[1]. The biochemistry of the former drug, together with the results obtained in both experimental and clinical therapy, indicate, however, that it is biologically distinct from the prototype molecule. Thus, for example, therapeutic potency is many times greater, and is apparent not only against the erythrocytic but also against the exo-erythrocytic forms of the malaria parasite. Further, 'Paludrine' does not show the antagonism for riboflavine exhibited by '2666' (and mepacrine) with respect to the growth of the *Lactobacillus casei*, an effect that we associate with the formal structural resemblance of the latter drugs to the vitamin, and which may also be connected with their parasiticidal activity.

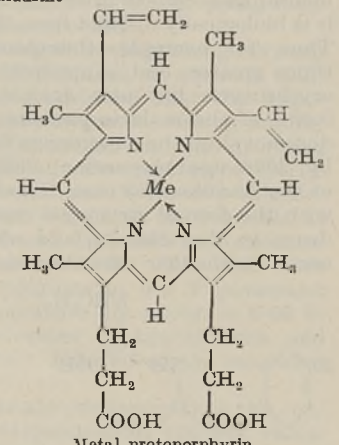



So far, the biochemical and biological researches of our colleagues, Drs. Madinaveita and Davey, have not provided any explanation for these facts. We now suggest, on the basis of certain chemical observations, that the antimalarial activity of 'Paludrine' may be connected in some way with an interference with the porphyrin metabolism or enzyme systems of the parasite. 'Paludrine' forms a copper derivative the analysis of which gives one atom of copper combined with two molecules of the drug. Assuming a symmetrical disposition of the diguanide molecules in a planar structure (compare phthalocyanine), space models indicate the arrangement formulated below. The methyl groups printed in italic type are accommodated either above or below the general plane of the complex, and are therefore separated from the adjacent imino groups by a distance considerably

greater than that apparent in the diagram. We were at once struck by the similarity of the copper complex so formulated to the naturally occurring porphyrin pigments. For comparison, the structure of a metal protoporphyrin is given. The correspondence between the six-membered rings chelating the metal in both systems is apparent, as is also the simulation of the pyrrole rings of the porphyrin by the folding of the anilino- and isopropylamino-groups of the drug complex. In addition, the isopropyl group, which gives maximum antimalarial activity in the diguanide series, provides side-chain methyl groups corresponding with the 1 : 5-dimethyl groups common to all the known natural porphyrins.



Copper complex of 'Paludrine'



Metal protoporphyrin

While consideration of the copper complex of the drug led to the recognition of these points of resemblance, this metal need not necessarily be that implicated in the postulated biological interference of the drug with the malaria parasite. Indeed, even in the absence of a metal atom, the probability of hydrogen bonding between $N_2$ and $N_4$ would cause the molecule to retain some of the structural features of the metal complexes. Finally, it should be remarked that the low toxicity of 'Paludrine' to the animal organism, and its general inactivity against a wide range of other micro-organisms, implies that the postulated antagonism relates to a porphyrin system highly specific to the malaria parasite, so that biochemical proof or disproof of the hypothesis will not readily be forthcoming.

F. H. S. Curd
F. L. Rose

Research Laboratories,
Imperial Chemical Industries, Ltd.,
Manchester, 9. Oct. 11.

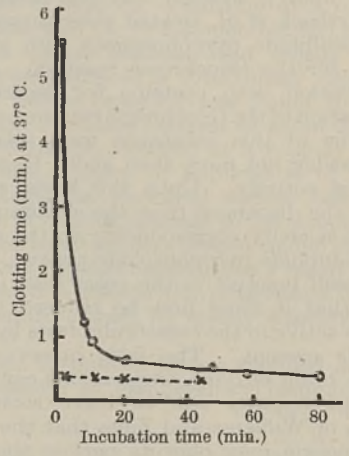
[1] Curd, F. H. S., Davey, D. G., and Rose, F. L., *Ann. Trop. Med. and Parasitol.*, 39. 208 (1945).

## Acceleration of Thrombin Formation by a Plasma Component

According to Quick[1], prothrombin is composed of two components *A* and *B*, in combination with calcium. Nolf[2] carried out experiments from which he formed a similar conclusion. On the other hand, Seegers, Loomis and Vandenbelt[3] used purified preparations and concluded that prothrombin consists of a single substance which can act as thrombin precursor.

Determination of prothrombin activity is usually based on the estimation of plasma coagulation time. A method for the determination of actual prothrombin concentration in relation to plasma coagulation time has been developed in this laboratory (Fantl and Nance[4]). It is based on the observation that barium carbonate has the property of preferentially adsorbing prothrombin, together with minimal amounts of other plasma constituents. Prothrombin is estimated as protein in the adsorbate. It was found that the prothrombin concentration in normal human oxalated plasma averaged approximately 2 mgm. per 100 ml. when expressed as protein nitrogen. This result is in good agreement with a calculation of the prothrombin concentration based on the two-stage technique of Warner, Brinkhous and Smith[5] as carried out by Seegers, Loomis and Vandenbelt[3]. Since the barium carbonate technique gives a lower value for protein per unit of prothrombin than any other procedure, it should be possible to test the conflicting views regarding prothrombin constitution.

Elution of prothrombin from the adsorbate was carried out at *p*H 6, and dialysis in the cold yielded a solution which has been tested for prothrombin activity by incubating it with a variety of thromboplastins (homologous and heterologous brain extracts and Russell viper venom) and calcium ions. The resulting thrombin was added to a purified fibrinogen preparation in the range of *p*H 6·0–7·2. The results of a typical experiment are recorded graphically.




Thrombin formation from isolated prothrombin: — o —, assay with fibrinogen *p*H 7·2, incubation at 19° C. — x —, „ „ prothrombin-free plasma.

As can be seen from the graph (continuous line) such a system is active in inducing fibrin formation. However, the reaction-rate of thrombin formation is slow. Preliminary incubation of prothrombin and thromboplastin for approximately an hour yields maximal activity, which remains constant for several hours. When prothrombin concentrations are plotted

on a log scale against incubation times on a decimal scale, a straight line is obtained until 60 per cent of the prothrombin has been converted into thrombin. This suggests that during the early stages the reaction proceeds according to the laws of a reaction of the first order. From these results it is obvious that prothrombin isolated from human plasma is the only precursor of thrombin.

It was found possible to accelerate the thrombin formation in the above system when purified fibrinogen was replaced by plasma from which prothrombin had been completely removed by adsorption. Here maximal activity was reached after a considerably shorter incubation time (broken line). Thus it appears that normal plasma coagulation depends not only on an adequate concentration of prothrombin but also on the presence of an accelerator.

A detailed account of the results will be given elsewhere.

P. Fantl
M. Nance

Baker Medical Research Institute,
Alfred Hospital,
Melbourne.
Oct. 16.

[1] Quick, A. J., *Amer. J. Physiol.*, 140, 212 (1943).
[2] Nolf, P., *Arch. Internat. de Pharmacodyn. et de Therap.*, 70, 5 (1945).
[3] Seegers, W. H., Loomis, E. C., and Vandenbelt, J. M., *Arch. Biochem.*, 6, 69 (1945).
[4] Fantl, P., and Nance, M., in the press.
[5] Warner, E. D., Brinkhous, K. M., and Smith, H. P., *Amer. J. Physiol.*, 114, 667 (1936).

## Aspergillin : a Name Misapplied to Several Different Antibiotics

The name 'aspergillin' has been applied to at least four different antibiotic substances from species of *Aspergillus*. Bush and Goth used the name at first[1] for a compound from *A. flavus* which they later named flavicin[2], and which, when investigated by Fried and co-workers[3] under the name of flavicidin, ultimately appeared to be a double-bonded isomer of penicillin *F*.

Stanley[4] applied the name 'aspergillin' to a crystalline compound from a strain of *Aspergillus* the specific name of which is not given. The compound melted at 272–280° C., contained sulphur, and showed bacteriostatic activity against twelve species of pathogenic bacteria, both Gram-positive and Gram-negative. From Stanley's brief description, his compound appears to differ from previously described sulphur-containing antibiotic compounds.

Soltys[5] referred to a filtrate from *A. fumigatus* (No. 367 of the National Collection of Type Cultures) as 'aspergillin'. It was bacteriostatic against *Mycobacterium tuberculosis* and *M. phlei*, but not against two strains of staphylococci. It is not yet clear whether it is really a new antibiotic material.

More recently, Krasilnikov and Korenyako[6] reported that certain strains of *A. niger* produced an alcohol-soluble antibiotic substance, active against both Gram-positive and Gram-negative bacteria, and stable upon heating or prolonged storage. It was not obtained in crystalline form. They differentiated it from a number of known antibiotic compounds, but unfortunately did not differentiate it specifically from clavacin and aspergillic acid. They, too, gave their active factor the name of 'aspergillin'.

The application of the name 'aspergillin' to four different antibiotic substances might in itself lead to some confusion. However, further confusion arises from the fact that the name 'aspergillin' was originally proposed by Linossier[7] in 1891 for the black, water-insoluble pigment of the spores of *A. niger*. So far as is known, this pigment has never been tested to determine whether or not it possesses any antibiotic activity. However, it has been repeatedly studied under the name of 'aspergillin'[7–12] and has been characterized as a humic acid[11].

Accordingly, it would seem desirable to restrict the use of the name 'aspergillin' to the black pigment of the spores of *A. niger*. The antibiotic of Bush and Goth has already been renamed. If the antibiotics of Stanley, of Soltys, and of Krasilnikov and Korenyako prove to be different from any previously described, new names should be selected for them. It is to be hoped that, in the future, investigators of antibiotic substances will avoid applying the name 'aspergillin' to their materials, in order to avoid useless and troublesome synonyms and to prevent further confusion in the literature.

In a very recent paper[13], it is reported that Stanley's 'aspergillin' is similar to, if not identical with, gliotoxin. If this antibiotic is finally definitely identified as gliotoxin, the necessity for a new name will be eliminated.

Walter C. Tobie

American Cyanamid Co.,
1937 West Main Street,
Stamford, Conn.
Sept. 18.

[1] Bush, M. T., and Goth, A., *Fed. Proc. Amer. Soc. Exp. Biol.*, 2, 75 (1943).
[2] Bush, M. T., and Goth, A., *J. Pharmacol. and Exp. Therap.*, 78, 164 (1943).
[3] Fried, J., Koerber, W. L., and Wintersteiner, O., *J. Biol. Chem.*, 163, 341 (1946).
[4] Stanley, N. F., *Australian J. Sci.*, 6, 151 (1944).
[5] Soltys, M. A., *Nature*, 154, 550 (1944).
[6] Krasilnikov, N. A., and Korenyako, A. I., *Microbiology* (U.S.S.R.), 14, 347 (1945).
[7] Linossier, G., *C.R.*, 112, 489, 807 (1891); 151, 1075 (1910).
[8] Hugounenq, L., and Florence, G., *Bull. Soc. Chim. Biol.*, 2, 133 (1920).
[9] Rippel, A., and Walter, K., *Biochem. Z.*, 183, 474 (1927).
[10] Quilico, A., and DiCapua, A., *Atti Acad. Lincei*, 17, 93, 177 (1933).
[11] Quilico, A., *Gazz. Chim. Ital.*, 63, 400 (1933).
[12] Quilico, A., and Rollier, M. A., *Atti X° Congr. Internat. Chim.*, 2, 446 (1938); 3, 346 (1939).
[13] Stanley, N. F., and Mills, J. A., *Australian J. Exp. Biol. Med. Sci.*, 24, 133 (1946).

## Synergic Action of Penicillin and Bacteriostatic Dyes

Synergistic action of penicillin with other drugs capable of assisting the defence mechanisms of the body against bacterial pathogens has been reported by a number of workers[1–6]. Basic dyes like brilliant green, methylene blue, acriflavine and gentian violet are well known to possess antiseptic properties, and indeed some of them are used in the cure of wound infections. Thatcher[7] has demonstrated a pronounced synergistic effect *in vitro* between sulphanilamide drugs and dyes on Gram-negative bacteria. Though the average therapeutic dose of penicillin now used is sufficient to maintain a higher concentration than is actually necessary to inhibit a particular organism in the blood stream, the fact that there may still be very resistant organisms in certain sites, and also that sufficient penicillin may not reach certain massive infections in localized areas, make it desirable to use a combination of bacterio-

static substances. As the available evidence would suggest that penicillin and the dyes act on bacteria in different ways, it was hoped that the combined action of these would be one of mutual reinforcement or potentiation. In this note we record the results of *in vitro* studies on the bacteriostatic action of penicillin when alone and when combined with bacteriostatic dyes on typical Gram-positive and Gram-negative bacteria.

The experiments were designed to estimate the minimum amount of penicillin which would completely inhibit the growth of the test organisms in plain broth and in broth containing varying concentrations of the dyes. Sterile culture tubes containing different concentrations of bacteriostatic agents under investigation were inoculated with one loopful of a 24-hour culture. The growth was normally observed after 24 hours of incubation at 37° C. The minimum bacteriostatic concentration recorded in the accompanying tables was the lowest concentration of penicillin or dye showing no visible growth.

Table 1

| Organisms ($1 \cdot 5 \times 10^6$ cells) | Minimum inhibiting concentration of | | | |
|---|---|---|---|---|
| | Penicillin | Brilliant green | Methylene blue | Gentian violet |
| *Staphylococcus aureus* | 0·015 units/c.c. | $1 \cdot 75 \times 10^{-6}$ | $2 \times 10^{-4}$ | $1 \cdot 5 \times 10^{-6}$ |
| *Escherichia coli* | Complete inhibition not apparent even with 15·0 units per c.c. | $1 \times 10^{-6}$ | Complete inhibition not apparent at even saturation level | $6 \times 10^{-4}$ |

Table 2

| Organisms ($1 \cdot 5 \times 10^6$ cells) | Minimum inhibiting concentration of dyes in the presence of penicillin | | |
|---|---|---|---|
| | Brilliant green | Methylene blue | Gentian violet |
| *Staphylococcus aureus* 0·01 units/c.c. of penicillin | $2 \times 10^{-6}$ | $2 \times 10^{-4}$ | $2 \times 10^{-6}$ |
| *Escherichia coli* 14·0 units/c.c. of penicillin | $1 \cdot 25 \times 10^{-6}$ | No inhibition even with concentrated solutions | $7 \cdot 5 \times 10^{-4}$ |

The results show that the presence of bacteriostatic dyes helps to reduce the concentration of penicillin required for the inhibition of the growth of the organisms. The increased potentiating effects of the dyes may be due to the synergic action of the individual drugs on the organisms, or less probably to a chemical reaction between the bacteriostatic agents forming a complex with greater bacteriostatic action. The unsatisfactory action of methylene blue tends to suggest that such complexes are probably formed. The precise degree of enhancement of the bacteriostatic action seems to vary with the dye and upon the dye sensitivity of the organisms. It has also been ascertained by separate tests that it depends on the number of organisms present, the strain specificity of the susceptible species and environmental conditions.

Studies on the synergic action of penicillin and other dyes, as also on the bacteriostatic action on other organisms, and the *in vivo* aspects of the problem, are in progress.

Our grateful thanks are due to Prof. V. Subrahmanyan and Drs. K. P. Menon and N. N. De for their interest and helpful criticisms, and to the Council of Scientific and Industrial Research, under the auspices of which this work was undertaken.

Mariam George
K. M. Pandalai

Department of Biochemistry,
Indian Institute of Science,
Bangalore. Sept. 9.

[1] Ungar, J., *Nature*, **152**, 245 (1943).
[2] Bigger, J. W., *Lancet*, **247**, 142 (1944).
[3] Soohoo, G., and Schnitzer, R. J., *Ann. Biochem.*, **5**, 99 (1944).
[4] T'ung Tsun, *Proc. Soc. Exp. Biol. and Med.*, **56**, 8 (1944).
[5] Kirby, W. M. M., *Proc. Soc. Exp. Biol. and Med.*, **57**, 149 (1944).
[6] Hobby, G. L., and Dawson, M. H., *J. Bact.*, **51**, 447 (1946).
[7] Thatcher, F. S., *Science*, **102**, 122 (1945).

## Function of Prostatic Phosphatase

In human semen large amounts of a phosphatase with acid *p*H optimum originating from the prostate has been demonstrated by Kutscher and Wolbergs[1]. The phosphatase activity of semen in optimal conditions amounts to several thousand times the activity of the alkaline phosphatase in serum. No explanation as to the function of this enzyme has so far been advanced.

When the very large amounts of inorganic phosphorus found in human semen (*c.* 100 mgm./100 ml.) is considered, it was an obvious possibility that this inorganic phosphorus might have arisen through the breakdown of some organic phosphorus compound under the influence of the prostatic phosphatase. When semen was examined immediately after ejaculation, it was, in fact, found that the concentration of inorganic phosphate is quite low, and it rapidly increased during the first few minutes. If ejaculation is performed directly in ice-cold trichloroacetic acid, the amount of inorganic P is only about 10 mgm. per 100 ml., whereas the total acid-soluble P amounts to 90–120 mgm. per 100 ml.

The nature of the phosphorus compound thus revealed was investigated by fractionation of the barium salts in the usual way. It was found that by far the greater part of the organic P (60–70 per cent) was present as an alcohol-soluble compound. In living tissue only two phosphorus compounds with this property have been described, namely, the sphingosine choline phosphate of Booth[2], and choline glycerophosphate found in autolysed pancreas by Schmidt, Hershman and Thannhauser[3].

Practically all the phosphorus compound could be precipitated from 90 per cent alcohol by alcoholic mercury chloride. The substance when purified by two or three such precipitations gave a P : N ratio of 1 : 1, thus excluding sphingosine choline phosphate. Hydrolysis showed that it is extremely stable. Boiling with 5 *N* sulphuric acid for two hours only split off about 15 per cent of the phosphorus, and treatment with strong alkali produced a very slow destruction accompanied by liberation of trimethylamine. Choline glycerophosphate very easily splits off choline on treatment with acids and even cadmium chloride. That was not the case with the present compound.

On treatment with prostatic secretion (obtained by digital massage) the substance was split quantitatively into inorganic phosphate and choline. That a third substance should arise during splitting is scarcely probable, since the great stability towards hydrolysing agents strongly indicates a primary phosphorus compound. The properties of synthetic phosphoryl choline have been studied by several investigators[4,5,6],

and agree well with the properties of the substance in semen, although the barium salt has been claimed to be precipitated by one volume of alcohol[4]. This was, however, found to be the case only in rather concentrated solution.

Phosphoryl choline has been demonstrated in beef liver[7]; but only 0·2 gm. of the picrate was isolated from 200 kgm. of liver. It was quite possibly formed from lecithin during the rather drastic isolation procedure.

It has been shown that by far the greater part of the semen phosphorus originates from the seminal vesicles[8]. It must therefore be assumed that phosphoryl choline is formed in this organ. During and after ejaculation, the secretion from the seminal vesicles comes in contact with prostatic secretion, whereby choline and inorganic phosphate are formed. Nothing is known as yet concerning the possible physiological function of choline or phosphate (or both).

Semen from bulls does not contain excessive amounts of phosphatase, and the concentration of choline in one-day-old samples was found to be only about 30 mgm. per 100 ml., thus perhaps indicating that the splitting of phosphoryl choline is the sole function of prostatic phosphatase.

The quantity of choline found in samples of semen from normal men amounts to 250–400 mgm. per 100 ml. This is of interest in connexion with the Florence test (formation of characteristic crystals with potassium tri-iodide) used in legal medicine for the detection of sperm stains. It is generally recognized that this reaction is due to choline, and it has been assumed that the choline responsible was formed through decomposition of lecithin. If this is the case, semen should contain more than ten times the amount of lecithin actually found.

A detailed account of the present work will be published elsewhere.

Frank Lundquist

Institute of Legal Medicine,
University of Copenhagen.

Oct. 11.

[1] Kutscher, W., and Wolbergs, H., *Z. physiol. Chem.*, 236, 237 (1935).
[2] Booth, F. J., *Biochem. J.*, 29, 2071 (1935).
[3] Schmidt, G., Hershman, B., and Thannhauser, S. J., *J. Biol. Chem.*, 161, 523 (1945).
[4] Plimmer, R. H. A., and Burch, W. J. N., *Biochem. J.*, 31, 398 (1937).
[5] Baer, E., and McArthur, C. S., *J. Biol. Chem.*, 154, 451 (1944).
[6] Riley, R. F., *J. Amer. Chem. Soc.*, 66, 512 (1944).
[7] Inukai, F., and Nakahara, W., *Proc. Imp. Acad. Tokyo*, 11, 260 (1935).
[8] Huggins, C. B., and Johnson, A. A., *Amer. J. Physiol.*, 103, 574 (1933).

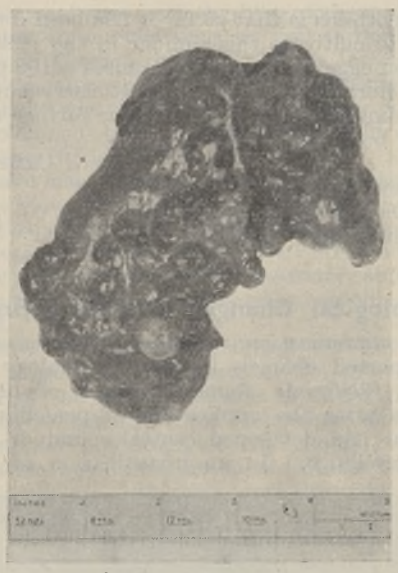


Fig. 1. Cholangiocellular carcinoma of liver. Khaki-Campbell duck

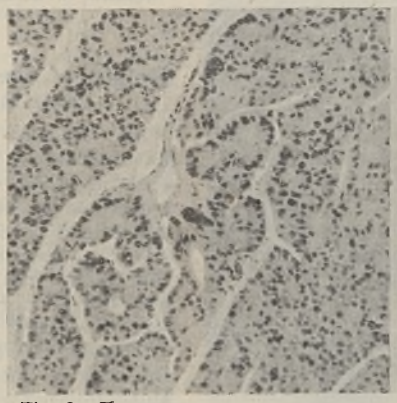


Fig. 2. Hepatocellular carcinoma, × 180. Khaki-Campbell duck

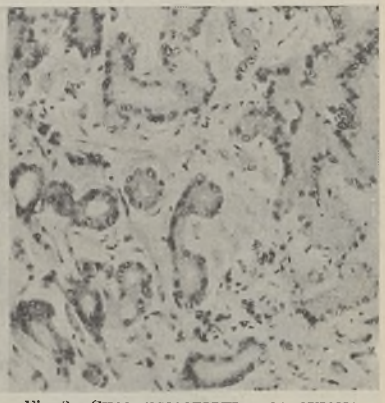


Fig. 3. Cholangiocellular carcinoma, × 180. Aylesbury duck

## Primary Carcinoma of the Liver in the Duck

In recent months, several cases of primary carcinoma of the liver of ducks have been observed. A survey of the relevant literature has not brought to light any mention of this condition in ducks, which may thus possibly be a new disease, hitherto unreported.

To date, eleven cases have been encountered, some having been diagnosed in life. Comparatively few ducks come to this laboratory for post-mortem examination, as may be judged by the fact that only forty-nine ducks were examined in the period 1944–46. Yet in this period eleven cases were observed, or a relative incidence of 22·5 per cent. The comparable figures for the preceding four years are twenty-one ducks examined and no tumours observed.

The liver in such cases is enlarged, and contains multiple discrete green tumours. Metastases have been observed in the kidney and ovary. Histologically, these tumours are seen to be either hepatocellular carcinomata, or cholangiocellular carcinomata (see photographs). In one instance the two types occurred in the same case.

Of these eleven cases, three birds came at comparatively short intervals from one small flock, and three other cases occurred in another small flock. Inquiry revealed that in the first instance the three ducks were all originally obtained from the same poultry farm, and were of related stock; but in the second instance the three affected birds originated from different farms and different stock. This latter observation seems to render unlikely the possibility of a hereditary factor, and tends to favour the hypothesis of an infectious disease of a neoplastic nature. All that can be said at the moment in support of a

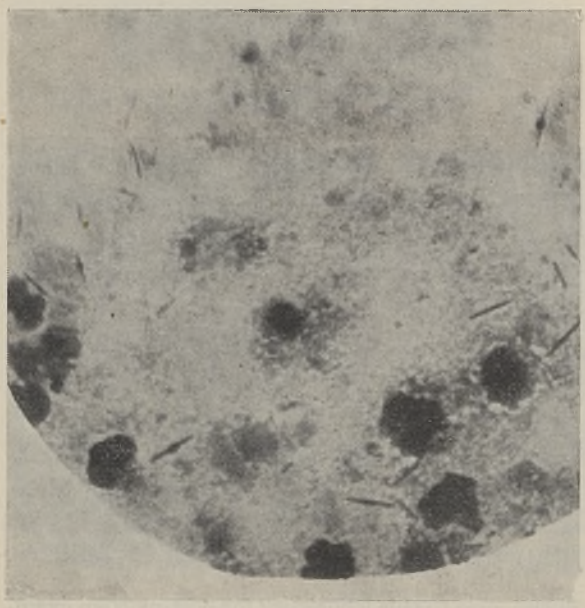
virus hypothesis is that so far it has been found impossible to cultivate this tumour in the yolk sac of fertile hen eggs, as inoculation causes a 100 per cent embryo mortality. It is hoped to carry out transmission experiments as, and when, further suitable material becomes available.

J. G. Campbell

Department of Poultry Diseases,
Royal (Dick) Veterinary College,
Edinburgh. Oct. 11.

## Morphological Changes in *Bacillus fusiformis*

In a communication in *Nature*[1], Webster and Frey have reported changes in the morphology of the *Bacillus fusiformis* found in cases of ulcerative gingivitis after the application of penicillin. The organisms had developed central round or spindle-shaped swellings. In an investigation of tropical



Fusiform bacilli with central swelling; smears from untreated tropical sores. × *c.* 900

ulcer in Madras, I have, however, noted in smears from untreated cases similar changes in the morphology of the fusiform bacillus. The central swelling is seen both by dark-ground illumination and after staining. It would appear, therefore, that the changes in morphology are due to the influence of other factors besides any specific treatment.

N. Seshadrinathan

King Institute, Guindy,
Saidapet Post, India.
Aug. 26.

[1] Webster, J. F., and Frey, H., *Nature*, **158**, 59 (1946).

## *Fusarium oxysporum* on the Oil Palm

In an earlier communication[1] I directed attention to the presence of a vascular wilt disease of the oil palm (*Elœis guineensis*) in the Belgian Congo. In so far as mycological studies could be pursued under the conditions of the investigation, the same species of *Fusarium* was isolated on a number of occasions from discoloured vascular strands. A culture submitted to Dr. S. P. Wiltshire of the Imperial Mycological Institute has now been reported on by Dr. W. L. Gordon of the Dominion Laboratory of Plant Pathology, Winnipeg. The latter, who has been making a special study of this genus, has identified the culture as *Fusarium oxysporum* forma. The organism isolated from infected vascular strands of the oil palm is thus a strain or form of the comprehensive species to which the other wilt-producing *Fusaria* belong. Its pathogenicity has, of course, still to be tested.

A second culture of *Fusarium* was also submitted for identification. This was isolated from a characteristic leaf disease of the oil palm known in the Congo as patch yellow, certain genetical types of palm being apparently highly susceptible. This fungus has also been identified by Dr. Gordon as a form of *Fusarium oxysporum*. It closely resembles the first-mentioned strain, though differences are apparent on certain media. An interesting mycological and pathological situation thus awaits detailed investigation.

C. W. Wardlaw

Department of Cryptogamic Botany,
University of Manchester.
Oct. 21.

[1] Wardlaw, C. W., *Nature*, **158**, 156 (1946).

## Origin of the First European Potatoes and their Reaction to Length of Day

Mr. Hawkes and Mr. Driver[1] believe that the greatest single factor limiting the yield of Andean varieties under British conditions is the day-length requirement, thereby implying that they are, on the whole, good yielders in suitable conditions. This is not our experience, which is that many of them are thoroughly bad, even in short days. The point is material to our argument, and some experimental facts are called for.

Thirteen Andean varieties of *S. tuberosum* from the Empire Potato Collection were grown in winter, and compared with Up-to-Date in identical conditions. Seven (EPC 369, 501, 588, 595, 952, 1094 and 1144) gave less than one third of the yield of Up-to-Date, five of these giving less than one tenth. Only three (EPC 140, 355 and 1407) were in the same class as Up-to-Date, and No. 140 outyielded it. In another test during the fairly short days of the sub-tropical summer, results were worse. None of the seven poor varieties gave as much as one fifth of the yield of Up-to-Date, and only No. 140 was in the same class as the domestic variety. The winter tests were done out of doors at Pretoria (lat. 26° S., altitude 4,500 ft.). Because of the fairly high altitude, non-luminous heaters had to be used at night to give protection against light frosts. The day-length during winter in Pretoria varies from 10½ to 12 hours, but some lines grew a little beyond the vernal equinox into days slightly more than 12 hours long. The winters are sunny and almost cloudless, and in the amount of light Pretoria is similar to areas of slightly lower altitude where winter crops of potatoes are regularly grown. Disease was practically absent in this test. The summer tests were made in a potato-producing district near Pretoria. The altitude was 5,200 ft. and the latitude 26° S., at which the longest day is about 13¾ hours long. Most lines grew for a few weeks beyond the autumnal equinox into days of 11–12 hours, and all were infected with *Alternaria solani* at the end, though, on the whole, to a smaller extent

than Up-to-Date. The choice of the thirteen lines was quite random—they happened to be the first available for testing out of doors—and there is no reason for believing the results to be atypical.

All available evidence considered, it seems fairly certain that there are among the varieties from the Andes some which are very good and also some which are very bad. The exact proportions of good and bad have not been determined, and do not concern us here. What matters is that the varieties are certainly variable and probably, on the average, less well bred and selected than the European. This is to be expected in the circumstances that new seedlings arise comparatively easily in the free-fruiting Andean varieties, that there does not seem to have been any conscious effort to breed new varieties[2], that mixed varieties are commonly cultivated, and that no selection is practised except perhaps in a reverse way by the eating of the large tubers and the planting of the small ones[3]. These circumstances must lower the general standard of varieties in any collection which aims at being fairly representative or complete.

It is therefore felt that the belief that poor yields of Andean varieties in Britain are caused in the main by the long days of summer, even when the growing-season includes weeks of short days in autumn, is charitable to the varieties, but still unproved.

That extreme intolerance of long days had to be removed before potatoes could become what they are in Europe to-day has never been disputed. Tolerance of long days is necessary for earliness, and, by comparison with the first European potatoes, all modern European varieties are early, especially in north-eastern Europe where, in the absence of a long frost-free autumn, earliness is a necessity. (This, as I hinted before[4], may explain why the potato did not go to the north-east for centuries.) But that the incomplete shift from autumn to summer tuber-growth has, by itself and apart from greater care in breeding and selection, improved yields in western Europe is still an assumption by European workers.

Because the opinions of Mr. Hawkes and Mr. Driver are held in such high regard, I am sorry to see that they have not dropped the name *S. andigenum*[1]. It seems fairly satisfactorily proved, both on grounds of photoperiodism[4] and morphology[5], that there is no question of more than one species among the cultivated tetraploid potatoes; this being so, the statement of Mr. Hawkes and Mr. Driver[6] that type herbarium specimens and many rare documents need examination loses its point so far as the immediate problem of discarding invalid names is concerned. The name *S. andigenum* is new, but the hypothesis of the Andean origin of the potato is not. Linnæus gave the habitat of *S. tuberosum* as Peru, and twenty years ago botanists generally believed that the potato came from the Andes. One could slip back twenty years, and lose the name *S. andigenum* without great inconvenience.

J. E. van der Plank

Department of Agriculture, Pretoria.

[1] *Nature*, 158, 168 (1946).
[2] Salaman, R. N., *J. Roy. Hort. Soc.*, 62, 261 (1937).
[3] Hawkes, J. G., Pub. Imp. Bur. Plant Breeding and Genetics (1944).
[4] *Nature*, 157, 503 (1946).
[5] Salaman, R. N., *J. Linn. Soc.*, 53, 1 (1946).
[6] *Nature*, 157, 591 (1946).

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Dr. van der Plank's experiments at Pretoria afford additional evidence for the view, which, incidentally, we have never disputed, that certain Andean potatoes yield better than others, even under short day, and that only the best of them will yield, even under those conditions, as well as the domestic potatoes of Great Britain. It seems fairly obvious that selection for yield with the early European potato should have picked out those genotypes combining both tolerance to long day-length and intrinsic capabilities for high yield.

We have mentioned more than once our agreement with the view, first stated by Dr. Bukasov[1], that the yielding capability of a variety is dependent both on its photoperiodic response and on its inherent yielding capacity; but we have felt it necessary, and still do, to stress the importance of the photoperiodic response on yield.

It seems to us that in paragraph 4 of Dr. van der Plank's letter the significance of the short days at the end of the growing season in Great Britain is too greatly stressed by him. Many short-day Andean potatoes have not progressed far enough with their tuberization by the beginning of October ever to be able to catch up with those varieties more tolerant of longer days. The result with these varieties that do not begin to form their tubers until they get a 12-hour day is that, even if they are not cut off by frost, their growth is soon brought to a standstill and they therefore have no chance to complete their tuber formation owing to the low temperatures and low light intensity. We feel that perhaps Dr. van der Plank does not adequately realize the difference in temperature and light condition between a short autumnal day in Great Britain and a normal short day in his own latitudes.

Finally, on the nomenclature problem, we would respectfully ask Dr. van der Plank to tell us, since he considers it unnecessary to wait until something is published on the subject, how we are to distinguish botanically between the Andean potato (at present known as *Solanum andigenum*) and the Chilean one (known now as *S. tuberosum*). We agree that they are not specifically distinct, but are they to be classed as varieties, forms or subspecies, and what are they to be called? For our part, we totally disagree with any precipitate attempt to modify or delete a validly accepted botanical name without due regard to the precepts laid down by the International Rules of Botanical Nomenclature, since what has once been published requires another refuting publication before it can be abolished. In this case, the adequate publication of the botanical type for *S. tuberosum* would be necessary, as we have already stated[2], and the naming and describing of the Andean and Chilean varieties (or subspecies) within its boundaries. Until that is done we feel that it is better to continue using the name *Solanum andigenum*.

J. G. Hawkes
C. M. Driver

Imperial Bureau of Plant Breeding and Genetics,
School of Agriculture, Cambridge.

[1] Bukasov, S. M., Lenin Acad. Agric. Sci., Inst. Plant Ind., Leningrad (1933).
[2] *Nature*, 157, 591 (1946).

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## Testing the Difference between Two Means of Observations of Unequal Precision

I am sorry my use of the word 'tolerable' should be a difficulty to Dr. Bartlett[1], but the explanation is really very simple.

In 1936[2] Bartlett, discussing what has come to be known as Behrens' problem, put forward a solution which, on examination, can be seen to be invalid

on logical grounds. For example, if two boys are measured and found to differ in height by ¼ in., and if two girls show exactly the same difference in their statures, Bartlett's test gave a probability of 50 per cent of inferring a highly significant sex difference in stature, and this whether the difference between the boys and the girls was great or small. I criticized the proposed test at the time and received from Bartlett the assurance that he would not think of using it in practice. It seemed that the matter was at an end.

Later, I understand that Dr. J. Neyman, sharing Bartlett's objection to Behrens' original solution of the problem, had advocated this proposal of Bartlett's. I could not, therefore, ignore its existence, and so did not say that no solution alternative to Behrens' had been put forward, but only that no tolerable alternative solution had so far been advanced, since the only alternative then available appeared to be manifestly inapplicable to real problems.

I am quite aware that Bartlett, following Neyman, feels bound to identify the populations of samples envisaged in tests of significance with those generated by repeated sampling of a fixed hypothetical population, and I do not expect him to change his opinion, although it appears to me to be logically fallacious. What I commented on, in view of the great confidence with which criticisms of Behrens' solution had been launched, was the long delay in putting forward an alternative solution satisfactory to the Neyman–Bartlett point of view with which that of Behrens could be compared. The fact that Bartlett can now announce a new solution by B. L. Welch which "appears to be exact, at least in the sense . . ." leaves us still some way to go before the two next necessary steps, namely, an examination of the logical basis of the new solution, and the numerical comparison of its consequences with the tables available for that of Dr. Behrens.

R. A. Fisher

Department of Genetics,
University of Cambridge.
Oct. 18.

[1] Bartlett, M. S., *Nature*, 158, 521 (1946).
[2] Bartlett, M. S., *Proc. Camb. Phil. Soc.*, 32, 560 (1936).

## The Rutherford Papers in the Library of the Cavendish Laboratory

This material relating to the late Lord Rutherford was generously presented to the Cavendish Laboratory by Lady Rutherford in 1939, and is preserved in the Library. It has now been classified, and is of such great biographical and historical interest that we are giving a brief account of it here. It covers Rutherford's scientific career from his first research papers on "The Magnetisation of Iron by High-Frequency Discharges" (*Trans. N.Z. Institute*, 1894) to his last contribution in *Nature* of August, 1937 on "The Search for the Isotopes of Hydrogen and Helium of Mass 3".

One set of letters represents correspondence over many years with scientific men such as B. B. Boltwood, N. Bohr, W. H. Bragg, H. Geiger, O. Hahn, S. Meyer, F. Soddy, Madame Curie, H. Moseley and J. J. Thomson. They afford a fascinating study of the development of radioactivity and nuclear physics, and are interesting because they reveal the way these men were thinking at the time the letters were written. In another set there are letters from his pupils, such as J. D. Cockcroft, J. Chadwick, H. Robinson and P. Kapitza, and other letters which he kept for their especial interest.

Among the biographical material are his letter of application and testimonials for the chair at McGill, and correspondence about the Manchester and Cavendish appointments. There is also a short autobiographical note written in 1930, and some of his "Lists of Projected Researches" which he drew up each year.

There are his manuscript sheets of "Radioactive Substances" and the "Radiations from Radioactive Substances", his notes for his Royal Institution lectures between 1921 and 1937 and many popular lectures and addresses. The collection also includes many of his experimental notebooks. Newspaper cuttings cover the whole of his career from 1897 to 1937. Among the items of historical interest one deserves special mention—J. J. Thomson's original letter accepting Rutherford as a research student in the Cavendish.

Future historians of science will find in the collection a rich mine of information, not only about Rutherford himself but also about many famous men of his time.

Elizabeth B. Bond
W. L. Bragg
Cavendish Laboratory, Cambridge.

## The Illustrations of the Australopithecinæ

In *Nature* of June 29, p. 863, there appeared a very appreciative review by Prof. W. E. Le Gros Clark of the recent book on the South African fossil ape-men, by Dr. G. W. H. Schepers and myself. There is only one minor point on which I should wish to comment. The reviewer says: "The illustrations, too, while they give a good general impression of the bones, are not sufficiently accurate for comparative studies. For example, the text-figure of the *Paranthropus* talus, although stated to be natural size, actually represents the bone as somewhat larger than the cast". The reviewer has assumed that the discrepancy is due to the illustrations being inaccurate. Here he is in error. All the drawings of teeth and bones are, I think, accurate to a millimetre, and most to a fraction of a millimetre. The discrepancy complained of is due to the inaccuracy of the cast.

The ankle bone was found in 1943. It was war-time. Our preparator was in North Africa with the army. The discovery was so important that I thought I would attempt to make some casts with latex, and send them to some of the leading anatomists. Unfortunately, owing to shrinking of the latex, the casts, though they give an excellent idea of the shape, are a little smaller than the specimen. It was probably unwise to attempt what I could not do with complete success.

R. Broom

Transvaal Museum, Pretoria.
Sept. 16.

I much regret that, by my assumption that the cast of the talus which Dr. Broom so generously distributed was accurate, I was led to question the accuracy of certain of his illustrations of the Australopithecine material in his recent monograph. Dr. Broom's reference to the slight shrinkage of some of the latex casts (which were produced under exceptionally difficult war-time conditions) explains clearly how this misunderstanding arose.

W. E. Le Gros Clark

# RESEARCH ITEMS

### Hybridization in Rana

J. H. Moore (*Proc. U.S. Nat. Acad. Sci.*, 32, 209; 1946) has shown that hybridization between populations of *Rana pipiens* show increasing numbers of embryonic defects as the latitudinal distance increases. On the other hand, hybrids between *Rana pipiens* and *R. palustris* do not show any signs of defect or of hybrid inviability. The two species occur sometimes in the same area, but despite the absence of an obvious isolating mechanism the two species keep separate in the wild.

### Action of Choline Esters on a Brazilian Amphibian

H. Moussatché has published the results of studies on the action of certain choline esters on the rectus abdominalis muscle of some Brazilian amphibians (*Rev. Brasil Biol.*, 5, No. 4, Dec. 1945). A description of the apparatus employed is given and the results for the frog *Leptodactylus ocellatus* are tabulated. Sensitivity was apparent with a concentration of acetylcholine of the order $10^{-7}$, and, while some choline esters showed nearly the same activity, others displayed considerably less. Experiments were conducted to investigate the influence of temperature on the extent of the contraction induced by the acetylcholine in the rectus abdominalis muscle of *L. ocellatus*, and it was found that this increased with the temperature.

### Induction of Conjugations in *Paramecium*

T. T. Chen (*Proc. U.S. Nat. Acad. Sci.*, 31, 404; 1945) has found that fluid from the culture media of a Russian clone of *Paramecium bursaria* will cause clones of other varieties to become sticky, to clot and to conjugate, although the Russian clone will not itself conjugate with these clones. The conjugation thus induced is not similar to that between two diverse mating-type conjugants. Nuclear fusions have been observed in the induced conjugants. Nuclear changes were observed in a few solitary individuals. Some three other clones of these varieties did not react to the fluid from the Russian culture; there may be differential effects. The phenomena may be related in some way to those in Algæ found by Geitler and Moewus, in Protista by Kimball and in *Paramecium* by Sonneborn.

### New Plant Diseases

Several new fungus diseases of plants have recently been described (*Trans. Brit. Mycol. Soc.*, 28, Parts 3 and 4, Nov. 1945). S. J. Hughes discusses the parasitism of *Pleospora herbarum* on sainfoin and on mangolds. *P. herbarum* and its conidial form, *Stemphylium botryosum*, can attack a variety of hosts, and its presence upon mangolds seems to give a severe disease, especially when the crop is grown on potash-deficient soils. A root-rot of *Cineraria* has been investigated by Moira C. D. Munro. This appears to be due mainly to *Phytophthora cinnamomi*, though *P. cambivora* is a less virulent parasite. *P. cinnamomi* has been isolated upon several types of media; it appears to be most active at temperatures between 16° and 30° C., and can grow over a fairly wide range of *p*H. An interesting occurrence of the potato blight fungus, *Phytophthora infestans*, on leaves and berries of a box thorn, *Lycium halimifolium*, is recorded by W. C. Moore. His description, however, does not suggest that this host may be an economic factor in increasing the spread of blight on potatoes. The same author also discusses briefly the appearance of *Alternaria radicina* as a seedling disease of celery, and the occurrence of a snow rot of wheat due to *Typhula graminum*. The latter appeared in Herts after a heavy fall of snow; the disease is known in Scandinavia, north Germany, the United States and Japan. Leaf spot of spinach caused by *Heterosporium variabile* appears to cause considerable damage on this plant. Ring rot of green walnut fruits, due to *Fusarium* sp., and scale spotting of tulip bulbs, the cause of which is uncertain, are also described.

### Dual Drainage of Lakes

The apparent anomaly of two streams draining from the same lake, or dual drainage as he terms it, is discussed by E. C. Cabot in an article in the *Geographical Review* of July. Evidence is obtained from ground work but more generally from aerial photographs of Alaska, Labrador and Arctic Canada. He points out that a lake may change its outlet for a number of reasons, among which are ice retreat, ice blockage and stream piracy, and that as the shift of outlet occurs it may have dual drainage. Mr. Cabot discusses particularly the Great Bear Lake. To the north the Hare Indian River, the original outlet in the deep gorge, drains to the Mackenzie. It is now partly abandoned and filled with lakes, but recently has reasserted itself and shows a continuous flow. To the south the second outlet is the broad and deep Great Bear River. The explanation lies in the movement of the Keewatin ice of the glacial period. On its final retreat the first outlet of the lake in front of the ice sheet was the Hare Indian River, but with further retreat a lower level in the rim of the lake was exposed and so the new channel functioned and the Great Bear valley was cut. But a considerable time was required before the original small trickle of this outlet was cut deep enough to lower the lake level below that of the original outlet, and the process is not entirely complete, especially in periods of heavy ice and snow melting.

### Correlation Between Coronal Emission and Terrestrial Magnetism

Waldmeier and others have pointed out the extent to which intense emission from the solar corona accompanies large sunspots. A correlation between intense coronal emission and terrestrial magnetic disturbance may therefore be expected. During the War, Government-sponsored research was carried out in the United States to test whether this correlation could be used to forecast magnetic and ionospheric disturbances, and an account of the results has been given by A. H. Shapley and W. O. Roberts (*Astrophys. J.*, 103, 257; May 1946). Intense coronal emission is not a transient phenomenon, for it was found to persist often for several solar rotations; so when it was observed to appear at the east limb of the sun, a correlated magnetic disturbance might be expected a few days later. The correlation was so marked as to offer a very satisfactory means of forecasting. An unexpected feature of the results was that magnetic disturbances tended to reach their peak one or two days before the emitting coronal region reached the central meridian, whereas they occur one or two days after sunspots have crossed the same meridian. Alternative explanations offered for the difference between the results for corona and sunspots are a difference between the types of mag-

netic disturbance considered in connexion with the two, or a difference in longitude, amounting to about 40°, between sunspots and the accompanying coronal emission.

### Surface Tension of Slightly Soluble Fatty Acids

THE surface properties of the intermediate acids with from seven to twelve carbon atoms per molecule have been studied by D. G. Douglas and C. A. MacKay (*Can. J. Res.*, 24, 8; 1946). The surface tensions of normal heptylic ($C_7$), pelargonic ($C_9$), capric ($C_{10}$) and lauric ($C_{12}$) acids above their melting points, and on aqueous solutions of heptylic, pelargonic, capric and undecyclic ($C_{11}$) acids at various concentrations, were measured. The capillary method of A. Ferguson and J. A. Hakes (*Proc. Phys. Soc.*, 41, 214; 1929) was used. It is shown that the surface tension of liquefied fatty acids depends on the length of the hydrocarbon chain, and that all the acids investigated have nearly the same temperature coefficient. It is indicated that the surface films require considerable time to become stable, the time depending on both the concentration and the length of the chain. From the surface tension isothermal for normal heptylic acid at 292° K., it is deduced that the surface film consists of a monolayer, each molecule occupying about 25 A. and oriented with its axis perpendicular to the surface.

### Biotin

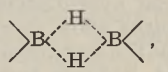
THREE papers by a number of authors working in the Merck Research Laboratories (*J. Amer. Chem. Soc.*, 67, 2096f; 1945) describe the synthesis and resolution of *dl*-biotin and its two stereoisomeric racemates *dl*-allobiotin and *dl-epi*-allobiotin. The starting materials were 4-benzamido-3-ketotetrahydrothiophene and γ-formylbutyrate. The resolution was carried out with the *d*-mandelic acid esters, and the *l*-arginine salts. Quinine methohydroxide was a satisfactory reagent for the separation of *l*-biotin. A stereochemical correlation of the three substances mentioned is described.

### Liquid Racemic Compounds

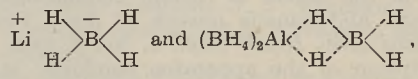
SINCE the work of Ladenburg on coniine, there has been much discussion as to whether racemic compounds of two optically active forms can exist in the liquid state, the solid forms being well known. Bawa Kartar Singh and Onkar Nath Perti (*Proc. Indian Acad. Sci.*, 22A, 170; 1945) have studied the solubility isotherm of camphor β-sulphonic acids at 335°. They present tables and curves which show that the solubilities of the *d*- and *l*-forms are identical, that the solubility curves of the *d*- and *dl*- and of *l*- and *dl*-forms are exact mirror images of one another, and that the shapes of the melting-point/composition and solubility/composition diagrams show that *dl*-camphor β-sulphonic acid has a large range of stability and exists in the fused and dissolved states. This result is of interest, since the evidence for the existence of racemic compounds in the liquid state is very meagre and the previous results are conflicting.

### Structure of Electron-deficient Molecules

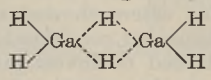
THE hydrogen bridge theory of the structure of diborane, $B_2H_6$, proposed by Bell and Longuet-Higgins (*J. Chem. Soc.*, 250; 1943), and extended by Pitzer (*J. Amer. Chem. Soc.*, 67, 1126; 1945) to the other known hydrides of boron, has been shown by Longuet-Higgins (*J. Chem. Soc.*, 139; 1946) to account for the properties of the borohydrides and the other covalent hydrides of elements in the first three groups of the Periodic Table. The theory assumes that the hydroborons are composed of smaller units (borines) of formula $B_nH_{n+2}$ containing tervalent boron linked by hydrogen bridges:



that this polymerization continues until no free $>B-H$ groups are left except those adjacent to two bridges, and that hydroborons containing rings of fewer than five boron atoms are not stable. Pitzer introduced the conception of the hydrogen bridge linkage as a protonated double bond between boron atoms, represented as a σ bond, together with a π bond with two protons embedded in its antinodes. The borohydrides are now formulated as, for example:



and the covalent hydrides of metals formed by the action of atomic hydrogen on the metals are similarly formulated. The volatile gallium hydride is



and the indium and thallium compounds are similar. The non-volatile aluminium hydride $(AlH_3)_n$ is assumed to be a two-dimensional polymer with units joined by hydrogen bridges. The metal alkyls are also brought into consideration, although the data are scanty in this field. The paper is speculative but contains some interesting suggestions and provides a reasonable co-ordination of a number of compounds. In a paper by G. Silbiger and S. H. Bauer (*J. Amer. Chem. Soc.*, 68, 312; 1946) the electron diffraction results are said to rule out proton bridge structures for beryllium and aluminium borohydrides.

### 'Servo' Systems

ALTHOUGH systems of automatic control actuated by the difference, or 'error', between the actual and desired value of the quantity to be stabilized have been employed in electrical engineering for many years, war-time requirements have stimulated a rapid development of the subject and have led to the introduction of several new types of so-called servo systems. Little information about these developments has been published in Great Britain as yet, so that particular interest is attached to a paper by A. L. Whiteley (*J. Inst. Elec. Eng.*, 93, Part 2, No. 34, Aug. 1946) dealing with the theory of servo systems, with particular reference to stabilization. One of the major problems is that of achieving an adequate degree of stability, and the paper discusses the extent to which the latter is governed by response time-lags in the system and by the basic control characteristic of the servo. The addition of controlling signals proportional to the derivatives of error can theoretically produce stability. Since, however, such derivatives are seldom available, attention has been directed chiefly to the design of passive networks, which when placed at the input end of the servo give approximations to derivatives and/or integrals of error, so that the system performance is suitably modified, and to feed-back methods which achieve similar results and often possess important practical advantages. The paper is supplemented by several contributions to discussion and the author's reply.

# ORIGIN OF RADIO-WAVES FROM THE SUN AND THE STARS

By Prof. M. N. SAHA, F.R.S.
Palit Laboratory of Physics, University of Calcutta

IT has been shown in a previous communication[1] that radio-waves of metre range cannot escape from the quiescent sun unless they originate in the corona, where the electron concentration falls to $10^6$–$10^8$ per c.c. This seems to me to invalidate, at least in the case of the sun, the free free transition theory of the electron in the field of the proton, put forward by Henyey and Keenan[2] to explain the origin of 1-metre waves from regions of the Milky Way. For the corona is a purely 'electron atmosphere', where H-ions cannot exist in any considerable quantity without violating the laws of physics. Pawsey, Payne-Scott and McCready[3] do not consider it likely that these radiations can originate in any atomic or molecular process, but they suggest an origin in gross electrical disturbances, analogous to thunderstorms on the earth. Greenstein, Henyey and Keenan[4] in a note in *Nature* concede that the 1-metre waves emitted from the sun have probably a different origin than in the free free transitions of the electron in the field of the proton.

The object of the present note is to point out that the resources of atomic and molecular processes are not exhausted by the failure of the free free transition process. We have still another group of atomic (or rather nuclear) processes, which can give rise to the radio-waves emitted by the sun and the stars; and these processes are actually stimulated by strong magnetic fields of the type which are characteristic of an active sun. This is the process of excitation by a strong magnetic field of the energy-levels of the nuclei of atoms and molecules, which has been so beautifully demonstrated by the works of Rabi and his school, just before the War[5]. A brief description of the process is given here with the view of bringing out its potentiality for the explanation of the extremely interesting phenomenon of emission of radio-waves by stellar bodies.

The nuclei of many atoms, for example, $H^1$, $Li^7$, $N^{14}$, $Al^{27}$, $Na^{23}$, $Mg^{25}$ (mostly isotopes with odd mass-number, $D^2$, $Li^6$, $B^{10}$, $N^{10}$ being exceptions), possess spin, and finite magnetic moment of the order of $eh/4\pi Mc$, the so-called protonic magnetic moment, though actually the proton has a magnetic moment which is 2·7 times higher. In the absence of a magnetic field, the electron-cloud in the outer incomplete shells of the atom or the molecule react on the nucleus, and give rise to hyperfine structure of spectral lines. As a typical and well-investigated case let us take $Na^{23}$.

This nucleus has been shown to have a spin of 3/2 and a magnetic moment of 2·515 ($eh/4\pi Mc$ being taken as unit). In the normal state, the outermost 3*s*-electron, which is in the $^2s_{1/2}$-state, causes a fine-structure of nuclear levels, characterized by the *hfs*-quantum number $f = |\, i + j \,|$, where $i$ is nuclear quantum number, $j$ is inner quantum number of optical level. For normal $Na^{23}$, $f = |\, \frac{3}{2} + \frac{1}{2} \,| = 2, 1$. The energy difference between the two nuclear levels has been very accurately measured by optical methods, and found to have the value 0·0592 cm.$^{-1}$ in frequency units. This has been confirmed independently[6].

Normal sodium atoms, say those contained in a sodium lamp, will have some nuclei in the stage $f = 2$, some in $f = 1$, and those in the state $f = 2$ are expected to emit spontaneously waves corresponding to the energy difference $\Delta\nu = 0{\cdot}0592$ cm.$^{-1}$, $\lambda = 17{\cdot}15$ cm., 1,773 Mc., the balance between the two states being restored by thermal exchange; but normally such transitions will be extremely rare. We can scarcely expect emission of a single quantum from an excited nuclear level in $10^5$ years.

But the conditions are entirely changed, as has been shown by Rabi and his co-workers, when the atoms are placed in a strong magnetic field, which is being crossed at right angles by a much smaller, but rapidly varying field, its period being comparable to those of the emitted radiation but not necessarily equal to these. What happens is roughly as follows: under the action of the strong magnetic field, the atom takes up various orientations as in a Stern–Gerlach experiment, the energies of the orientations being as given below (formulæ 1 and 2). The varying field causes these orientations to change rapidly, and in this process, radio-frequency waves are emitted. The energy values of the different orientations, however, change considerably with the field, but Rabi has calculated them from an extension of the theory of the Paschen–Back effect. The formulæ for $Na^{23}$ are quoted:

$Na^{23}$: Nuclear spin $i = 3/2, f = 2, 1$.
$m$ = magnetic quantum number
= 2, 1, 0, − 1, − 2 for $f = 2$
= 1, 0, − 1 for $f = 1$.

$\nu_{2m}$ = energy in frequency units of a nucleus with $f = 2$, having the orientation '$m$':

$$= -\frac{\Delta\nu}{8} + g\,(i)\,\mu_B H.m + \frac{\Delta\nu}{2}\,(1 + mx + x^2)^{1/2} \quad (1)$$

This holds for $m = 1, 0, -1$; for $m = 2$, the last term has the value $\frac{\Delta\nu\,(1+x)}{2}$, for $m = -2$, the value $\frac{\Delta\nu}{2}\,(1-x)$.

$\nu_{1,m}$ = energy in frequency units of a nucleus with $f = 1$, having the orientation '$m$':

$$= -\frac{\Delta\nu}{8} + g\,(i)\,\mu_B.H.m - \frac{\Delta\nu}{2}\,(1 + mx + x^2)^{1/2} \quad (2)$$

$\mu_B$ = Bohr-magnetron, $g(i)$ = Lande factor for nuclear magnetism = $\frac{m}{M}\mu_n/i$, where $\mu_n$ is the nuclear magnetic moment in terms of $eh/4\pi Mc$ as unit.

$\Delta\nu$ = separation between the two states in the absence of a magnetic field.

The number $x = \frac{\{g(j) - g(i)\}\,\mu_B H}{h\Delta\nu} = \frac{2\mu_B H}{h\Delta\nu} = \frac{H}{660}$ for $Na^{23}$. Curves of $\nu$-values will be found in *Phys. Rev.*, 57, 769.

The transitions fall in two classes. One set, mostly consisting of those corresponding to $\Delta f = 0$, gives $\nu$-values which vary from 0 at vanishing fields to the limiting value of $\Delta\nu/4$ for large fields. For a field of 660 gauss, the wave-lengths of the lines emitted are grouped round 1·36 metres, whereas for smaller fields, say 100 gauss, they may be as high as 4 metres. When the field is very large, the emission is grouped round $4 \times 17{\cdot}15 = 68{\cdot}60$ cm.

The second set, mostly consisting of radiations corresponding to $\Delta f = 1$, gives $\nu$-values from $\Delta\nu$ to $x\Delta\nu$; these may give rise to centimetre waves; in

fact, for $H = 10{,}000$ gauss, the emission is grouped round 1·1 cm.

These relations have indeed not yet been verified in emission, but in some ingenious absorption experiments by Rabi and his co-workers for $Na^{23}$, $Li^6$, $Li^7$, $Cs^{133}$, $K^{41}$; but there seems to be no reason why it should not be possible to design emission experiments, for example, by putting a sodium lamp in a strong magnetic field, which is then crossed by a feeble oscillating magnetic field at right angles. Such sodium lamp ought to give out strong radio-waves of both metre and centimetre range. It is desirable to carry out such experiments in view of the prospect which they hold out of throwing light on the all-important question of stimulation of transitions.

What we have said with respect to $Na^{23}$ will also apply to the nuclei H, $Li^6$ and $Li^7$, $B^{10}$, $B^{11}$, $N^{14}$, $Na^{23}$, $Al^{27}$, and other nuclei which possess spin and magnetic moment, and therefore when forming part of an atom or molecule can exist in several well-defined quantized states produced by the electron cloud. The details of calculations will, however, widely differ, and cannot be given in this short communication; but as in the case of $Na^{23}$, they will give rise to both metre and centimetre waves.

The most important part in the sun and the stars will, however, be played, not by Na, but by hydrogen, because this forms, according to well-verified astrophysical arguments, 95 per cent of total number of atoms in the atmosphere of the sun; in the stars, also, hydrogen forms in the majority of cases more than 90 per cent of the atmosphere. Na was chosen simply to illustrate the phenomenon. In the spots, on account of lower temperature, the hydrides CH, MgH and SiH (and possibly $H_2$) are formed in great abundance, and their spectra form characteristic features of spots, but the greater proportion remains in the atomic state. For the H-atom, $\Delta\nu$ cannot be obtained from hyperfine structure experiments, but it has been calculated to have the value of $0{\cdot}0163\ \mu_p = 0{\cdot}0474$ cm.$^{-1}$, $\lambda = 21$ cm., $x = H/500$, and calculation shows that both centimetre and metre waves can be emitted by the H-atom, corresponding to $\Delta f = 0$, $\Delta f = 1$. But in the case of hydrides, $N_2$, CN, no experimental data or theoretical calculations are yet available; but it can be surmised that the characteristic radio-frequency waves would be much longer.

In addition to waves arising out of nuclear transitions, the rotational states of the molecules have also been shown by Rabi and his pupils to be capable of radio-frequency transitions in magnetic fields.

We consider next the possibility of nuclear emission of radio-waves of both centimetre and metre range from the sun and the stars. It now appears extremely probable that the radio-waves observed can be emitted only from the sunspots. The spots show in the centre of the umbra large magnetic fields which vary with the size of the spot[7], and may reach values as high as 4,500 gauss. The direction of the field is axial (that is, perpendicular to the surface of the sun) in the centre of the umbra, but it becomes inclined to the solar radius as we proceed towards the penumbra, and also diminishes in value. The values of the fields are exactly such as will promote the emission of centimetre and metre waves according to the schemes given above, and the intensity of emission will be large enough if we can postulate the existence of a small cross-field, having frequencies of the same magnitude as those of the radio-waves. It is not improbable from what we know of the physical nature of sunspots that such variable fields do actually exist, and may partly be provided by the fields of the 'ordinary'-waves, and the 'extraordinary'-waves corresponding to the condition $f(f - f_h) > \frac{4\pi Ne^2}{m}$ coming from below, which may, however, find it impossible to penetrate the electron barrier above (see ref. 1).

These speculations, though far from being established on a sure basis, are given on account of their promise of being able to throw light on a series of extremely interesting phenomena, the origin of which has so far appeared to be wrapped in mystery; the moment is also opportune because experiments on the subject are being undertaken all over the world. If the speculations are on the right lines, it appears that sunspots would also strongly emit radio-waves of the centimetre range. I am not aware if any such observation has yet been made. Further, the emission of centimetre waves by the stars of the Milky Way probably indicates the development of spots in these stars, which should belong to the *G*, *K* and *M* classes. But no spectroscopic observation in verification of such a hypothesis is known to me, and from the nature of things it appears extremely unlikely that any such observation is possible, unless the spots in these stars possess gigantic proportions.


[1] *Nature*, 158, 549 (1946).
[2] Henyey and Keenan, *Astrophys. J.*, 91, 265 (1940).
[3] Pawsey, Payne-Scott and McCready, *Nature*, 157, 158 (1946).
[4] Greenstein, Henyey and Keenan, *Nature*, 157, 806 (1946).
[5] See, for example, Kusch, Millman and Rabi, "Radio-frequency Spectra of Atoms and Molecules", *Phys. Rev.*, 57, 765.
[6] *Phys. Rev.*, 53, 441.
[7] Nicholson, *Pub. Astro. Soc. Pacific*, 45, 51 (1933).


## SOME AMERICAN FOSSIL FORAMINIFERA AND CORALS

UNDER the general title "American Old and Middle Tertiary Larger Foraminifera and Corals" (*Geol. Soc. Amer., Mem.* 9; 1945), Dr. Thomas Wayland Vaughan and Dr. John West Wells have produced a notable contribution to science. Part 1, "American Paleocene and Eocene Larger Foraminifera" (pp. x+175+46 plates) is by Dr. Vaughan; Part 2, "West Indian Eocene and Miocene Corals" (pp. iii+25+3 plates), is by Dr. Wells. It is a far cry from the brief list of foraminiferal and coral species published by Matley in 1932 (*Geol. Mag.*, 69) from the Scotland Beds of Barbados to this splendid double monograph by two well-known specialists on their respective groups.

### Part 1

Morley Davies's two species of foraminifera (in Matley) have entirely disappeared, to be replaced by twenty-two species and varieties, most of which are new. Study of the handsome plates with which the paper is illustrated is sufficient to convince those familiar with the groups concerned that most, if not all, of the new forms are so distinct as to be worthy of separation.

The portion of the work devoted to the foraminifera is itself divided into two parts; the first is entitled "Paleocene and Eocene Larger Foraminifera from Barbados", and is concerned to describe the material collected by Dr. Alfred Senn during his mapping of the Scotland formation in detail. The age of this has

long been established as Eocene; but the new data presented permit a more precise correlation:

| | | |
|---|---|---|
| Scotland Formation | Upper | Middle Eocene |
| | Lower | Low Middle or Lower Eocene |
| Boulders from the Joes River mudflows | | Palæocene. |

In the systematic section of this part occurs a considerable discussion of the genus *Miscellanea* Pfender, in the synonymy of which is placed Caudri's genus *Ranikothalia*; the reviewer holds the opinion that *Ranikothalia* is valid and distinct from *Miscellanea*; that *Pellatispirella* Hanzawa 1936 is closely related to, if not identical with, *Elphidium* (*Polystomella*); and that *Sulcoperculina* Thalmann 1938 is, as Vaughan is inclined to recognize, a valid genus: however, these opinions cannot yet be substantiated, and the task of elucidating the distinctions between these five genera will probably have to await the discovery of 'hollow' material of each of the generic types, suitable for the elaboration of the 'gelatin preparations' of Dr. Earl H. Myers, a new method which is briefly described in Part 2 of this memoir.

Six years ago, the old genus *Discocyclina* (*Orthophragmina* auctt.) was raised to family status as the Discocyclinidæ Vaughan and Cole (Cushman, 1940). Here, in the second part, under the title "Catalogue of American *Discocyclinidæ*", Vaughan provides a complete review—almost a text-book—of the family. Almost twenty pages are allotted to a general account embracing structure, classification and ecology; while after thirty pages of species descriptions (including six new species and two new varieties), there is a final chapter of twelve pages on "Stratigraphic Zonation and Geographic Distribution of the Species".

The presence of intra-mural canals in the genus *Discocyclina sensu stricto* is now fully established both by means of Canada balsam preparations—decalcified—and by the novel method of 'gelatin reimpregnation' already referred to. The reviewer considers that the absence of similar canals from *Pseudophragmina* (*Proporocyclina*) is equally certain, since the most careful preparations (Canada balsam decalcified) by Vaughan, by Wright Barker, and by himself have failed equally to expose the faintest trace of this feature either in *Proporocyclina perpusilla* (Vaughan), or in *P. cushmani* (Vaughan), both of which species occur in perfect preservation in eastern Mexico. Further attempts will undoubtedly be made, and this question settled. Should the absence of canals in *Pseudophragmina* (*Proporocyclina*) be proved beyond all reasonable doubt, the homogeneity of the *Discocyclinidæ* at once becomes suspect.

A further point bearing upon this latter theme is the early co-occurrence of the two genera *Discocyclina* and *Pseudophragmina* in the Chicontepec formation of eastern Mexico. Vaughan's stratigraphy of the Chicontepec, based upon Muir's, cannot be compared satisfactorily with that known to the reviewer, but this cannot be entered into here. The deepest (oldest) occurrences of Discocyclinids known to the reviewer have included both *Discocyclina* (*Discocyclina*) spp. and *Pseudophragmina* (*Athecocyclina*) sp.; they lie at about 1,800 ft. below the top of the series containing *Rzehakina epigona*, *Globorotalia velascoensis*, etc. (the Velasco fauna of Cushman), and about an equal distance (thickness) above the Velasco base, where it rests upon the Mendez, in the country south of the Chumatlan River. This clear distinction between the genera at so deep a level in the Palæocene is not suggestive of a monophyletic origin for the family; but at present it is difficult to suggest even one possible source from which this remarkable group might have evolved, and this provides a fascinating object for future research. Certain characters in *Vaughanina* D. K. Palmer 1934 recall the equatorial chambers of a Discocyclinid; but this is mere speculation.

The foregoing remarks embody a few minor points of difference between the author and the reviewer. Their mention must not be allowed to overshadow the enormous value and importance of this work for all palæontologists and stratigraphers studying the American Older Tertiary rock succession. With by far the greater portion of the information and opinion contained therein the reviewer desires to express his full agreement; for the author's achievement he has the deepest admiration and respect.

List of new foraminiferal species in Part 1

Orbitolinidæ
*Orbitolinoides senni* gen. et sp. nov.
Discocyclinidæ
*Discocyclina* (*Discocyclina*) *harrisoni* sp. nov.
" " *mestieri* sp. nov.
" " *turnerensis* sp. nov.
" (*Asterocyclina*) *barbadensis* sp. nov.
" " *franksi* sp. nov.
*Pseudophragmina* (*Proporocyclina*) *schomburgki* sp. nov.
" (*Athecocyclina*) *soldadensis* Vaughan and Cole, var. *calebardensis* var. nov.
*Pseudophragmina* (*Athecocyclina*) *jukes-brownei* sp. nov.
Asterigerinidæ
*Amphistegina senni* Cushman sp. nov.
Orbitoididæ
*Lepidocyclina* (*Polylepidina*) *barbadensis* sp. nov.

In Part 2

Discocyclinidæ
*Discocyclina* (*Discocyclina*) *caudriæ* sp. nov.
" " *fonslacertensis* sp. nov.
" (*Asterocyclina*) *rutteni* sp. nov.
*Pseudophragmina* (*Pseudophragmina*) *bainbridgensis* (Vaughan), var. *angusta* var. nov.
(*Pseudophragmina*) *bainbridgensis* (Vaughan), var. *obsoleta* var. nov.
" (*Pseudophragmina*) *novitasensis* sp. nov.
" (*Proporocyclina*) *palmeræ* sp. nov.
" (*Athecocyclina*) *macglameriæ* sp. nov.

T. F. Grimsdale

## Part 2

In Part 2 of the work, Dr. John W. Wells describes the corals, which include eighteen named species and one variety, one comparable species, and seven indeterminate species from the Upper Scotland formation of Barbados, and two species from the Miocene of Martinique. The collection extends very much our knowledge of the Scotland formation corals. Previously only one had been figured by Trechmann in 1925 and five other species (only one named) mentioned by Matley and described by Wells himself in 1934; but their revision in the light of the present suite might be useful now that more is known of the age of the Scotland formation.

The new corals are mostly from the Chalky Mount member, but one form, a new species of *Madracis*, occurs lower down in the Murphys member as well (and, according to Vaughan, p. 20, in the Mount All member also). They are distributed among twenty-two genera and sub-genera, of which two are new. The eighteen named species are new with the exception of two, but as the corals fortunately occur with foraminifera, their Eocene age can be fixed. The sixteen new species are, however, related to Eocene (mainly Middle Eocene) corals of the United States and the West Indies. *Endopachys maclurii* (Lea), one of the previously existing species, and *Balanophyllia irrorata* (Conrad), with which one species is compared, are well known in the American Middle and Upper Eocene, while *Trochocyathus* (*Aplocyathus*) *obesus* (Michelotti) ranges from Eocene to Recent. Of the two new genera, *Sideroseris* is remarkable in being

structurally like *Siderastræa*, but simple. The other, *Barbadiastræa*, is probably a faviid.

Wells discusses the probable temperature and depth conditions under which the coral fauna lived. He rightly concludes that the evidence favours "a tropical shallow-water, but not littoral, environment", and suggests "a depth at or beyond the minimum temperature (21° C.) necessary for vigorous growth of reef corals, which is now approximately 75 metres in the Windward Islands, with a maximum of nearly 200 metres elsewhere in the West Indies".

The two species of Miocene corals from Martinique are interesting. One belongs to *Eusthenotrochus*, a peculiar sub-genus of *Sphenotrochus*, hitherto known only from a Recent South African species and from an Eocene species from the Paris Basin. Wells notes an undescribed specimen, probably identical with his new species, from the Miocene Bowden marl of Jamaica. The other species, *Dominicotrochus dominicensis* (Vaughan), occurs in numbers enabling its range of variation to be determined. It also suggests that Vaughan's original, ill-localized specimen from the Dominican Republic is also of Miocene age.

H. Dighton Thomas

## FOOD AND AGRICULTURE ORGANISATION

THE report of the special meeting on urgent food problems summoned by the Food and Agricultural Organisation of the United Nations at Washington during May 20–27, 1946, as a sequel to a resolution of the General Assembly on February 11, includes an appraisal of the world food situation during 1946–47, issued on May 14, 1946 (Washington: Food and Agricultural Organisation). This emphasizes that a critical world food shortage will continue at least until crops are harvested in 1947, even assuming average or somewhat better than average weather for the rest of 1946 and 1947. In spite of some prospective increases compared with 1945 in both Continental Europe and the Far East, production in 1946 in continental Europe generally as well as rice production in the Far East will still be well below the pre-war level. World stocks of food have been seriously depleted to meet the current crisis, and the incidence of any widespread drought in the months immediately ahead might well be even more disastrous than the effects of the droughts which developed in 1945 and early in 1946.

As regards Continental Europe, the report points out that, even if the production estimates are realized, imports equivalent to about 16 million metric tons of wheat would be required to bring the average consumption to about 90 per cent and of French North Africa to about 95 per cent of the pre-war level. Assuming that sufficient meats, fats and oils, and sugar were available to bring consumption for these commodities to about 80 per cent of the pre-war a head level, some 12·5 million metric tons or 450 million bushels of wheat would be required. Moreover, even with imports at this volume and average consumption at a level ranging from 2,250 calories a head daily in the European–Mediterranean area to 2,550 calories or more in Western Europe, non-farm consumption in some countries would still be under the emergency subsistence level. The urban food situation over wide areas in Continental Europe will thus again be disastrous in the spring of 1947 unless livestock feeding is held to a minimum and supplies are evened out as between different consumer classes and over the year.

The situation in the Far East is equally serious. With average yields the production of paddy (unhusked) rice may be 7 per cent higher than in 1945, but the bulk of this rice will not be harvested until November onwards, and estimates are still 10 per cent short of the pre-war level. Even under favourable conditions, not more than 2·5 million metric tons of paddy is expected to be available for shipment, as against 10 million metric tons in the pre-war period 1935–39. Current reports indicate that the wheat and other grains crops harvested in India are short; and so far as can be estimated, some 25 million tons (wheat equivalent) of cereals or other staple foods would be required to raise Far Eastern diets even to their full pre-war level in 1947—diets which themselves were usually too low for promoting health and working efficiency.

Discussing the export situation, the report notes that supplies are unlikely to be greater in 1946–47 than the amounts actually moved in 1945–46 unless effective measures are taken to reduce the amounts used in the exporting countries. Supplies of wheat are likely to be smaller, and of fats and oils no greater than in 1945–46. Supplies of cane-sugar available for shipment should be about 20 per cent greater, but supplies of meat and manufactured dairy products from the Americas, Australia and New Zealand are unlikely to be any greater. On the other hand, it is anticipated that fish production in 1946–47 will be substantially greater than in 1945–46. Fertilizer supplies are likely to be short in every major producing area, and in very large areas agricultural rehabilitation is necessary to achieve production possibilities.

The survey is completed by a summarized report from the Nutrition Committee which puts the emergency calorie intake requirements at about 2,200 a head daily at the retail level to prevent sections of the population from falling below the danger point. This level may be somewhat lower in eastern and tropical countries generally.

This appraisal provides the basis on which the special meeting during May 20–27 of the Food and Agriculture Organisation framed its recommendations. Those of its first committee related to the establishment of a Research and Information Service to provide the Organisation with further appraisals, to help keep the situation under review, and assist the International Emergency Food Council with information in the same way. Detailed recommendations from the Second Committee, on the Conservation and Expansion of Supplies, include extraction-rates of at least 85 per cent for wheat and rye in all countries for the consumption year 1946–47, and further curtailment of the use of wheat and other grains for feeding animals, as well as proposals for increasing the supplies of food products from the 1947 harvest, covering fertilizers, seeds and equipment. A further section of this report deals with principles and policy to be adopted by individual countries and by the International Emergency Food Council in regard to the production, collection, procurement, allocation and distribution of foodstuffs; if the measures recommended are adopted forthwith and applied consistently throughout 1946–47, a repetition of the hardship and privation of 1945–46 can largely be avoided. The report of yet a third committee is concerned with future machinery;

in addition to recommending close co-operation with U.N.R.R.A., it recommends the establishment of an International Emergency Food Council and a survey of existing organisations dealing with long-term problems with the view of providing any further international machinery required.

## SCIENCE AND HUMAN WELFARE

A REPORT of the proceedings of the conference, sponsored by the Association of Scientific Workers, supported by the British Association of Chemists, the Institution of Professional Civil Servants, the Association of University Teachers, the Physical Society, the Nutrition Society and the Institution of Electronics, held in London during February 15–17, has now been published under the title "Science and Human Welfare"*. The four sessions of the conference dealt successively with science and world needs, the implications of recent scientific development, the responsibilities of men of science in modern society and international organisation of science; the addresses given have been somewhat compressed. It is unfortunate that there is no index or contents page.

In opening the first session, Sir Robert Robinson asserted that while the active help of the Governments is needed, the initiative must come from the men of science. He suggested a start might well be made in the battle against malnutrition and disease, and endorsed the Government's decision not to set up a comprehensive Ministry of Science. Mr. Herbert Morrison said that upon a scientific approach to human problems depends the future of man, and that there has been far too little general appreciation of the value of the scientific method. We need over the whole field of science a combination of freedom, initiative and social responsibility. The position of science in China was described by Dr. T'U Chang Wang, while the needs in South Africa were discussed by Miss P. M. Cooke. Prof. J. M. Burgers dealt with the Dutch scene, M. Mathieu with developments in France, Dr. G. Lathe with Canada and Dr. J. A. Simpson with American views.

At the second session, Dr. S. Taylor discussed trends in medical research, Dr. H. L. Richardson dealt with agriculture, Mr. F. Le Gros Clark with food and famine, Prof. M. L. Oliphant with atomic energy, stressing that the first problem here is the control of the nuclear bomb, and Sir Alfred Egerton with chemical engineering, using penicillin manufacture as an outstanding example. Colonel Ungerson commented on the necessity for collaboration between the natural scientists and social scientists, and Dr. Bunting on Britain's need for a vast increase in national productivity and the demand for both the highest levels of existing skill and for new kinds of skill.

Opening the third session, Prof. A. V. Hill dealt with the need for men of science to evolve a common standard of ethical behaviour. Prof. B. Farrington, suggesting that science is the main agency in building the human conscience, which is a product of the development of human society, pleaded for the establishment of chairs of history of science. Prof. J. D. Bernal discussed planning and democracy, and said that the most important social responsibility of the man of science is to be aware of what he is doing and to take part in determining what it is. He emphasized the importance of free and rapid communication between all branches of science, and of a really efficient organisation for that purpose.

At the final session, Dr. Julian Huxley discussed the organisation and functions of the United Nations Educational, Scientific and Cultural Organisation, and his plea for world co-operation for science was echoed by Dr. Dorothy Needham in dealing with the situation in China, Dr. D. P. Riley as regards France, and Mr. N. S. Bannerjee as regards India. Dr. Ossowski stressed the growing importance of collaboration in the social sciences, especially co-ordination of research, and Miss L. Ridehatch urged the endowment in Great Britain of more schools of sociology and social science, and greater use of the present theories and findings of social science. Prof. P. M. S. Blackett reviewed the effect of the atomic bomb on the United Nations Organisation and the prospects of control. French views were expressed by Dr. Bonet-Maury and Prof. F. Joliot, while Dr. J. A. Simpson put forward the American views on the possibility of an inspection system.

Sir Robert Watson-Watt, summing up, suggested that the basic prescription is for a fuller and better-balanced education. While the scientific man must learn more of the humanities and of the similarity of method in the natural and the social sciences, we need to bring the scientific method within the understanding of the ordinary educated person: there is danger that the intentions of Ministers alive to the possibilities of science may be frustrated by misconceptions in the Civil Service. Finally, referring to atomic energy, he emphasized the need for something more than good aspirations in working out the formulæ required to convert the Atomic Energy Commission into an effective force, and in elaborating any system of control and inspection.

* Science and Human Welfare. Pp. 72. (Temple Fortune Press, Herbal Hill, London, E.C.1.) 2*s*. 6*d*.

## EARLY GREEK SCIENCE

PROF. BENJAMIN FARRINGTON'S Friday evening discourse at the Royal Institution, entitled "The Character of Early Greek Science", was delivered on February 23, 1945, and has recently been published. It deserves to be widely known; for it corrects some popular misconception, and relates the scientific achievements of early Greeks to their social background. The misconception arose from Aristotle's presentation of the 'physical' philosophers of Ionia as primarily metaphysicians concerned with the general nature of things, and as pioneers in his own line of philosophic thought. Probably even in his time, those early Ionians were represented mainly by summaries of conclusions, without the observations and experiments on which they were founded. But the Ionian objective was more limited, to give "an operational rather than a rational account of the nature of things". Their question was "How it works", and the answer was supplied, not by myths or abstractions, but by practical knowledge within their own control. Thus "technology drove mythology off the field", not indeed from all aspects of Nature, but from those which could be illustrated by the technical equipment of the age. Hence the nomenclature and imagery of science, derived from arts and crafts, which Prof. Farrington illustrates from Lucretius,

the Roman interpreter of Anaxagoras; from the caricature of the method by Aristophanes in the "Clouds", by the experimental basis of Pythagorean mathematics, and by the Hippocratic physiology, "to observe the invisible by means of the visible".

This revolution in outlook on Nature was the counterpart and outcome of the contemporary society of Ionia, a great social experiment by a mixed "people without a past", superseding tribal society by reasoned constructions and processes. The two revolutions, intellectual and political, went hand in hand. The working of iron popularized craftsmanship, the alphabet popularized law and justice. "The men who built the cities of Ionia were a new type of men", to be compared with the men of the age of Francis Bacon, intent alike on a "history of nature constrained and vexed by the art and agency of man" and a new age in human history, to be controlled by the same "art and agency" breaking down medieval dogma and prejudice.

Conversely, the premature decay of Greek science, after this bright beginning, accompanied the growth of industrial slavery, and the contempt for craftsmanship among free citizens, encouraged by fourth-century philosophers: whereas medicine, which had become a menial art, remained in touch with the craftsman, and progressed.

Thus it was "practice, not mere observation" that lay at the basis of Greek science. Even Plato admitted at last, after decrying human "improvements on nature", that "those of the arts that *do* produce something serious are all those that blend their power with that of nature, like medicine, agriculture, and gymnastics"—a curious assortment. Man here, as elsewhere in Greek practice, co-operates with Nature. His knowledge of Nature and his power over her are but two aspects of the same thing; and this includes the social background, man's human environment. In Ionia, as in the revival of learning, "for the first time political power was in the hands of free men, who were also masters of productive techniques", and could realize that the creation of man's civilization rests in his own hands—a tremendous responsibility, for 'labour' in other periods also.

## FORMAL GENETICS OF MAN*

MAN has obvious disadvantages as an object of genetical study. The advantages are that very large populations are available, and that many serological differences and congenital abnormalities have been intensively investigated.

Some characters are found to obey Mendel's laws with great exactitude. In others the deviations are such as to suggest the existence of a considerable selective mortality, perhaps pre-natal. In yet other cases the observations are biased because we only know that we are investigating the progeny of two heterozygotes when the family includes at least one recessive. Statistical methods which eliminate this bias were described.

Still more complex methods are needed for the detection and estimation of linkage. Several such cases have been detected with greater or less certainty, and the frequency of recombination between the loci of the genes for colour-blindness and hæmophilia is now estimated at 11 $\pm$ 4 per cent. If the theory of partial sex-linkage be accepted, it is possible to make a provisional map of a segment of the human sex chromosome.

When a gene is sublethal, as are those for hæmophilia and achondroplasic dwarfism, its elimination by natural selection is in approximate equilibrium with its appearance by mutation, and the frequency of the latter process can be estimated. The mutation-rates at five human gene loci lie between $4 \times 10^{-5}$ and $4 \times 10^{-6}$ per locus per generation. These are the only estimates available for vertebrates. The rates per generation are rather higher than those in *Drosophila*, but those per day are so small that much, or even all, human mutation may be due to natural radiations and particles of high energy.

* Substance of the Croonian Lecture of the Royal Society delivered by Prof. J. B. S. Haldane, F.R.S., on November 7.

## ACQUISITIONS AT THE BRITISH MUSEUM (NATURAL HISTORY)

THE following notes on recent acquisitions have been issued by the British Museum (Natural History); this material will not be shown yet in the galleries open to the public.

Zoological acquisitions of special interest include two specimens of the Kutch wild ass specially procured and presented to the Trustees by the Maharao of Kutch; this animal is found in the Runn of Kutch, a desert waste in western India between Sind and the State of Kutch. Other additions to the Department of Zoology include 131 mammals from the Gold Coast, including some rare squirrels, presented by Mr. G. S. Cansdale; a collection of birds from Syria and Palestine made by Mr. J. G. Williams; 130 birds from Sierra Leone, containing one new species, presented by Dr. W. Serle; a pale grey variety of the red grouse from Aberdeenshire, presented by Capt. Keith Caldwell; two Komodo dragons, originally presented to the Zoological Society by the late Lord Moyne, who had obtained them from the Island of Flores; a minnow which had lived for twelve years in an aquarium; a valuable collection of a hundred slides of foraminifera purchased from Mr. A. Earland.

The Department of Entomology has received from Mr. Thornley an important collection of Cornish insects, comprising some 26,300 specimens, together with thirteen manuscript diaries and an extensive card index of records. Mr. Thornley is a well-known naturalist now in his ninetieth year, and for the last twenty years he has specialized on the insects of Cornwall. In his earlier years he played a prominent part in the encouragement of nature study in elementary schools. His collection of Cornish insects has already formed the basis of a number of scientific papers, and others are in course of preparation.

The Department of Geology has purchased a large series of sections of petrified fossil plants from the British Coal Measures made over the last fifty years by Mr. W. Hemingway of Derby.

The Department of Mineralogy received numerous gifts of specimens during the war period. Among these may be mentioned two beautiful examples of native gold from Southern Rhodesia: one from Old West Mine, Umtali, presented by Mr. D. V. Burnett in 1941, and the other presented by Mr. Percy Tarbutt, after whom the mineral tarbuttite was named. A very large piece of dark amber which had been bought in Canton in 1860 was presented by Major

J. F. E. Bowring. Another recent acquisition is a large amethyst said by its former owner to be a bringer of bad luck. Fine crystals of emerald in matrix from Columbia were acquired in 1943, and the "Devonshire Emerald", on loan for exhibition before the War, will again appear when the Mineral Gallery can be opened. A similar loan of a magnificent specimen of precious opal weighing 696 carats has been made by Mr. W. Howarth of Lostock, Lancashire; this gem has been named "Pandora", also "Light of Australia". It was found in 1928 at Lightning Ridge in New South Wales, and is of additional interest since it formed part of an opalized fossil bone of a Plesiosaur. It will be exhibited as soon as practicable. A valuable collection of minerals, ores and rocks has been bequeathed to the Museum by the late Gilbert Rigg. This collection includes minerals and ores from mines in many countries—Australia, South Africa, United States, China, Japan, Java and Spain, the zinc mines of New Jersey being particularly well represented. There is also a set of minerals and ores from some lead mines in Wales collected in 1894 and 1896. Several Australian 'tektites' are included in the collection, and there is a large specimen of opal from Australia which in due course will make a fine addition to the exhibited series in the Mineral Gallery.

## DISEASES OF FLAX

THE dreaded Pasmo disease was first described from the Argentine in 1911, reached Europe in 1936, and spread to five countries by 1942. It has not yet appeared in Great Britain, but was found on wild flax in Eire in 1944, and afterwards it was seen on cultivated flax (Loughnane, J. B., McKay, R., and Lafferty, H. A., *Proc. Roy. Soc. Dublin*, 24 (N.S.), 10, 89; 1946).

All parts of the plant are affected by the disease, and the seeds may bear pycnospores externally, and mycelium internally. It was established that the latter effects entry by means of the funicle. The disease on young seedlings resembles the effects of *Colletotrichum linicolum* and can be quite severe; but if the plants survive there is then a high degree of resistance until flowering, when they again become susceptible. Spread of disease in the field can be very rapid under conditions of high humidity, evidently by wind-borne and splash-borne spores, and leads to total destruction of the leaves and infection of the bolls. Seed dressings are ineffective against the internal fungal mycelium, but hot-water treatment may prove to be effective. All infected stubble should be destroyed, as the fungus can overwinter and remain virulent until the following spring.

Although Pasmo disease did not reach Eire until 1944, 'flax browning' has been reported regularly since it was first described by Lafferty in 1921, who named the causal organism *Polyspora Lini gen. et sp. nov.* Browning has also been recorded in Britain and in most of the flax-growing regions of the world, and *P. Lini* has always been presumed to be responsible. Isolations from flax plants in Tasmania produced a number of fungi, with species of *Pullularia*, *Cladosporium* and *Alternaria* dominant (H. N. White, *J. Council Sci. and Indust. Res.*, Canberra, 18, No. 2, May 1945). *Pullularia* and *Polyspora* are evidently closely related, and the author made a comparative study of the morphology, physiology, serology and pathogenicity of a number of isolates from different sources, including Irish material of *Polyspora*. It was not found possible to separate *Pullularia* and *Polyspora* as distinct entities, and the pathogenicity claimed by Lafferty for *Polyspora Lini* could not be confirmed. It was suggested, rather, that *P. Lini* is a saprophyte or very weak parasite which takes an active part in the retting process, but can only attack living plants when the conditions are particularly unfavourable.

H. R. Angell (*ibid.*) grew flax plants in metal drums and found that moderate or scanty supplies of water never resulted in browning, but after flooding, symptoms appeared in about three weeks; and further, that correct drainage following a period of flooding did not prevent the appearance of the disease.

H. F. DOVASTON

## FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

### Monday, November 18

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 5 p.m.—Dr. E. G. Richardson: "Supersonic Vibrations and their Applications" (Cantor Lectures, 2).

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (in the Reynolds Hall, College of Technology, Manchester), at 5.30 p.m.—Prof. J. Proudman, F.R.S.: "The Tides".

SOCIETY OF CHEMICAL INDUSTRY (joint meeting of the LONDON SECTION and the FOOD GROUP, at the Royal Institution, Albemarle Street, London, W.1), at 6.30 p.m.—Mr. F. P. Dunn: "British Chemical Publications" (Jubilee Memorial Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, LONDON STUDENTS' SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 7 p.m.—Mr. A. H. Mumford: "The Trend of Modern Telecommunication".

### Tuesday, November 19

INSTITUTION OF BRITISH AGRICULTURAL ENGINEERS (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 2 p.m.—Mr. J. C. Hawkins: "Ploughs and Ploughing".

SOCIETY OF CHEMICAL INDUSTRY, AGRICULTURE GROUP (in the Physical Chemistry Lecture Theatre, Royal College of Science, South Kensington, London, S.W.7), at 2.30 p.m.—Dr. L. R. Bishop: "Post-War Barley Problems".*

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. James Gray, F.R.S.: "Locomotory Mechanisms in Vertebrate Animals, 4, Relationship of Limb Form to Habit and Environment; Evolution of Types for Climbing and Running".*

EUGENICS SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Prof. Tage Kemp: "Fifteen Years' Experience of Negative Eugenics in Denmark".

INSTITUTE OF PETROLEUM, NORTHERN BRANCH (at the Engineers' Club, Albert Square, Manchester), at 6 p.m.—Mr. J. B. J. Dunn: "Greases".

SOCIETY OF DYERS AND COLOURISTS, HUDDERSFIELD SECTION (at Field's Café, Huddersfield), at 7.30 p.m.—Mr. W. Lodge: "Wrinkles".

### Wednesday, November 20

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. R. Davis, Dr. A. E. Austen and Prof. Willis Jackson: "The Voltage Characteristics of Polythene Cables".

INSTITUTION OF MECHANICAL ENGINEERS, GRADUATES' SECTION (at Storey's Gate, St. James's Park, London, S.W.1), at 6.30 p.m.—Mr. S. C. Herbert: "A Hydraulic System applied to the Automatic Control of Water Gas Manufacture".

ROYAL INSTITUTE OF CHEMISTRY (in Room 1, Gas Industry House, 1 Grosvenor Place, London, S.W.1), at 6.30 p.m.—Annual General Meeting.

SOCIETY OF DYERS AND COLOURISTS, MIDLANDS SECTION (at the Midland Hotel, Derby), at 7 p.m.—Mr. C. C. Wilcock: "Preparing, Dyeing and Finishing of the New Fibres".

CHEMICAL SOCIETY, EIRE SECTION (joint meeting with the LOCAL SECTION of the ROYAL INSTITUTE OF CHEMISTRY, in the Chemical Department, University College, Upper Merrion Street, Dublin), at 7.30 p.m.—Dr. T. G. Brady: "Biochemical Microtechnique".

SOCIETY FOR VISITING SCIENTISTS (at 5 Old Burlington Street, London, W.1), at 7.30 p.m.—Discussion on "The Outlook in Physics" (to be opened by Prof. M. L. E. Oliphant, F.R.S., and Dr. E. C. Bullard, F.R.S.).

### Thursday, November 21

CHEMICAL SOCIETY, NOTTINGHAM SECTION (joint meeting with the UNIVERSITY COLLEGE PHYSICAL AND CHEMICAL SOCIETY, in the Large Chemistry Theatre, University College, Nottingham), at 4.30 p.m.—Dr. F. L. Rose: "Some Aspects of the Chemistry of Paludrine".

INSTITUTION OF MINING AND METALLURGY (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr. J. C. Allan, Mr. G. A. Smith and Mr. R. I. Lewis: "The Panasquiera Mines, Portugal—Wolfram Mining and Milling; Labour Organization".

LINNEAN SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Dr. Frank W. Jane: "A New Species of *Chlororhabdion*"; Mr. A. H. G. Alston: "Systematic Botany and Botanical Collections in Germany"; Dr. A. Tindell Hopwood: "Contributions to the Study of some African Mammals, 4, The Skulls of Lion, Leopard and Cheetah".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. N. F. Mott, F.R.S.: "Problems before Theoretical Physics, 1".*

CHEMICAL SOCIETY, NORTH WALES SECTION (joint meeting with the UNIVERSITY COLLEGE OF NORTH WALES CHEMICAL SOCIETY, LIVERPOOL SECTION, and the UNIVERSITY OF LIVERPOOL CHEMICAL SOCIETY, in the Department of Chemistry, University College, Bangor), at 5.30 p.m.—Dr. G. M. Bennett: "Nitration in Sulphuric Acid".

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. C. Lawton and Mr. V. H. Winson: "The Development and Design of Colonial Telecommunication Systems and Plant" and "The General Planning and Organization of Colonial Telecommunication Systems".

BRITISH INSTITUTION OF RADIO ENGINEERS (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 6 p.m.—Prof. G. W. O. Howe: "The Ionosphere and the Transmission of Radio Waves".

SHEFFIELD METALLURGICAL ASSOCIATION (joint meeting with the SOUTH YORKSHIRE SECTION of the ROYAL INSTITUTE OF CHEMISTRY, the SHEFFIELD SECTION of the CHEMICAL SOCIETY, and the SHEFFIELD UNIVERSITY CHEMICAL SOCIETY, in the Chemistry Lecture Theatre, The University, Western Bank, Sheffield), at 6 p.m.—Dr. C. H. Desch, F.R.S.: "Chemistry in the Metallurgical Industries".

SOCIETY OF CHEMICAL INDUSTRY, ROAD AND BUILDING MATERIALS GROUP (at Gas Industry House, 1 Grosvenor Place, London, S.W.1), at 6 p.m.—Mr. L. H. Griffiths: "Latex Cement and other Flooring Compositions".

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 7.30 p.m.—Mr. H. D. C. Waters, Mr. A. R. Caverhill and Mr. P. W. Robertson: "The Kinetics of Halogen Addition to Unsaturated Compounds, Part 12, Iodine Catalysis of Chlorine and Bromine Addition to Ethyl Cinnamate"; Mr. A. Robertson and Mr. W. A. Waters: "Evidence for the Homolytic Bond Fission of 'Positive Halogen' Compounds".

CHEMICAL SOCIETY, SOCIETY OF CHEMICAL INDUSTRY and ROYAL INSTITUTE OF CHEMISTRY, EDINBURGH AND EAST OF SCOTLAND SECTIONS (at the North British Station Hotel, Edinburgh), at 7.30 p.m.—Prof. F. S. Spring: "Some Developments in the General Methods of Organic Chemistry".

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 8 p.m.—Laboratory Meeting.

TEXTILE INSTITUTE, MACCLESFIELD, LEEK AND DISTRICT SECTION (joint meeting with the LEEK TEXTILE SOCIETY, at Nicholson Institute, Leek), at 8 p.m.—Mr. A. B. Armstrong: "Motion and Time Study".

## Friday, November 22

INSTITUTE OF PHYSICS, INDUSTRIAL SPECTROSCOPIC GROUP (in the Department of Applied Science, The University, St. George's Square, Sheffield), at 2.15 p.m.—Annual General Meeting. Mr. D. M. Smith: "The Spectrographic Analysis of High-purity Materials".

PHYSICAL SOCIETY, OPTICAL GROUP (in the Physics Department, Imperial College, Imperial Institute Road, London, S.W.7), at 3 p.m.—Dr. E. H. Linfoot: "The Diffraction Theory of the Phase-Contrast Test"; Mr. E. W. Taylor: Demonstration of a New Phase-Contrast Microscope; Phase-Contrast Films.

INSTITUTE FOR THE STUDY OF ANIMAL BEHAVIOUR (at the Zoological Society, Regent's Park, London, N.W.8), at 4 p.m.—Dr. R. Braude: "Some Observations on the Behaviour of Pigs in an Experimental Piggery"; Mr. R. Phillips: "Some Observations upon Behaviour in Sheep with particular reference to Grazing Habits and to Climate".*

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Geophysical Discussion on "English Oilfields" (Speakers: Dr. E. C. Bullard, F.R.S., Mr. L. H. Tarrant, Dr. J. Phemister and Mr. J. E. R. Wood).

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL (in Lecture Theatre No. 1, University Street, Gower Street, London, W.C.1), at 4.30 p.m.—Dr. P. A. Owren: "New Factors concerned in the Coagulation of Blood".*

CHEMICAL SOCIETY, NEWCASTLE AND DURHAM SECTION (at King's College, Newcastle-upon-Tyne), at 5 p.m.—Dr. J. L. Simonsen, F.R.S.: "Insecticides" (Bedson Club Lecture).

GENETICAL SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 5 p.m.—Prof. Tage Kemp: "Multiple Factors in Morbid Inheritance" (accompanied by a film "The Rat Dwarf").

INSTITUTION OF ELECTRICAL ENGINEERS, MEASUREMENTS SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. F. M. Bruce: "The Design of an Ellipsoid Voltmeter for the Precision Measurement of High Alternating Voltages" and "Calibration of Uniform-Field Spark-Gaps for High-Voltage Measurement at Power Frequencies".

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. Harold Waghorne: "Continuous Braking of Trains"; Mr. R. I. D. Arthurton: "Automatic Couplers for Railway Rolling Stock".

INSTITUTE OF FUEL, SCOTTISH SECTION (at the Royal Technical College, Glasgow), at 5.45 p.m.—Mr. G. C. Scolding: "Underfeed Stokers"; Mr. A. Bujnowski: "Gas Firing"; Mr. A. B. S. Laidlaw: "Oil Firing".

INSTITUTE OF THE PLASTICS INDUSTRY, NORTH-WESTERN SECTION (at the Engineers' Club, Albert Square, Manchester), at 6.45 p.m.—Chairman's Address.

## Saturday, November 23

INSTITUTE OF PHYSICS, INDUSTRIAL SPECTROSCOPIC GROUP (in the Department of Applied Science, The University, St. George's Square, Sheffield), at 2 p.m.—Mr. Braudo and Mr. Clayton: "The Development of the Metro-Vick Spark Unit".

## Friday, November 22—Sunday, November 24

WOMEN'S ENGINEERING SOCIETY (at Birmingham).—Conference on "Education and Training for Engineering".

Saturday, November 23

(At the University, Edmund Street, Birmingham).—Mr. C. A. Harrison: "The Aims of Education"; Mr. John Maslin: "Practical Steps in the Inauguration of a Training School"; Miss Verena Holmes: "The Co-ordination of Theory and Practice in Engineering Training".

# APPOINTMENTS VACANT

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

WILLIAM JULIEN COURTAULD CHAIR OF HELMINTHOLOGY tenable at the London School of Hygiene and Tropical Medicine—The Academic Registrar, University of London, Senate House, London, W.C.1 (November 21).

LECTURER IN PHYSIOLOGY up to B.Sc. standard—The Principal, Chelsea Polytechnic, Manresa Road, London, S.W.3 (November 22).

CHEMIST for fundamental researches in connexion with a small team of Marine Biologists at Millport, Isle of Cumbrae, on anti-fouling composition for marine use—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1 (November 23).

LECTURER IN BIOLOGY, a LECTURER IN PHYSIOLOGY or BIOCHEMISTRY, and a LECTURER IN HISTOLOGY AND EMBRYOLOGY—The Secretary, Glasgow Veterinary College, Inc., County Buildings, 149 Ingram Street, Glasgow, C.1 (November 23).

AGRICULTURAL ASSISTANT to the Education Committee—The Chief Education Officer, Shire Hall, Cambridge (November 23).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING—The Registrar, College of Technology, Manchester (November 25).

LECTURER IN BOTANY, with special qualifications in Mycology—The Secretary, University Court, The University, Glasgow (November 30).

LECTURERS (1 or 2) to teach PHYSICS or CHEMISTRY, with some APPLIED MATHEMATICS or MATHEMATICS, to students up to general B.Sc. standard—The Registrar, Loughborough College, Loughborough, Leics.

LECTURER IN THE DEPARTMENT OF MECHANICAL ENGINEERING—The Clerk and Treasurer, Dundee Technical College, Bell Street, Dundee.

SENIOR LECTURERS IN PHYSICS AND MATHEMATICAL PHYSICS, LECTURERS IN PHILOSOPHY AND ZOOLOGY, and ASSISTANT LECTURERS IN HISTORY, PHYSICS AND MATHEMATICS, in the University of Otago, Dunedin, New Zealand—The High Commissioner for New Zealand, 415 Strand, London, W.C.2.

TECHNICIAN IN THE CHEMISTRY DEPARTMENT—Prof. C. S. Gibson, F.R.S., Chemistry Department, Guy's Hospital Medical School, London Bridge, London, S.E.1.

LABORATORY TECHNICIANS (2) IN THE PHYSIOLOGY DEPARTMENT—The Warden and Secretary, London (Royal Free Hospital) School of Medicine for Women, 8 Hunter Street, London, W.C.1.

ASSISTANT LECTURER AND DEMONSTRATOR IN PHYSIOLOGY—The Secretary, King's College of Household and Social Science, Campden Hill Road, London, W.8.

LECTURER IN EDUCATION (Science graduate, experience in use of visual techniques essential)—The Registrar, University College, Leicester.

METEOROLOGISTS for service in the Sudan—The Sudan Agent, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Meteorologist'.

TECHNICIAN FOR DEPARTMENT OF MEDICINE—The Professor of Medicine, Medical School, The University, Birmingham 15.

HONOURS GRADUATE IN CHEMISTRY (young), to carry out research on adhesives and emulsions in connexion with the sizing for weaving of synthetic yarns, and a JUNIOR RESEARCH OFFICER (Hons. Graduate in Physics or Applied Mathematics), for research on the weaving behaviour of textile yarns in relation to their mechanical and physical properties—The Director, British Cotton Industry Research Association, Shirley Institute, Didsbury, Manchester 20.

EXECUTIVE SECRETARY—The Honorary Secretaries, Royal Meteorological Society, 49 Cromwell Road, London, S.W.7.

LECTURER IN ELECTRICAL AND MECHANICAL ENGINEERING—The Principal, Faraday House, Southampton Row, London, W.C.1.

SENIOR ASSISTANT IN GEOLOGY, with special reference to Mining, an ASSISTANT IN BOTANY and GENERAL BIOLOGY, and an ASSISTANT IN GEOGRAPHY AND ELEMENTARY MATHEMATICS—The Principal and Clerk to the Governing Body, Wigan and District Mining and Technical College, Wigan.

LECTURER IN MECHANICAL ENGINEERING, and a LECTURER IN ELECTRICAL ENGINEERING—The Principal, Marine School, South Shields.

LECTURER IN APPLIED MECHANICS at the Royal Naval College, Greenwich—The Director, Education Department, Admiralty, London, S.W.1.

SCIENTIFIC OFFICERS (2) for the Fuel Technology Section of the Plant Engineering Division, to carry out operational research in the Iron and Steel Industry—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1, endorsed 'Plant Engineering Division'.

(*Continued from page* iii *of Supplement*)

## UNIVERSITY OF LONDON

A lecture entitled "Research and the Farmer" will be delivered by Professor J. A. Scott Watson, C.B.E., LL.D., at 5 p.m. on Friday, November 22, 1946, in the Large Chemistry Theatre, Royal College of Science (Imperial Institute Road, South Kensington, S.W.7). The Chair will be taken by Dunstan Skilbeck, Esq., M.A. (Principal of Wye College). Admission Free, Without Ticket.

JAMES HENDERSON,
Academic Registrar.

## UNIVERSITY OF LONDON

A course of two Lectures on "The Unity of Petrarch's Thought" will be given by Professor Etienne Gilson (Collège de France) at 5.30 p.m. on November 18 and 20, 1946, at King's College (Strand, W.C.2). At the first lecture the Chair will be taken by The Very Rev. the Dean of St. Paul's. Admission Free, Without Ticket.

JAMES HENDERSON,
Academic Registrar.

## UNIVERSITY COLLEGE, LONDON

Applications are invited for the post of Assistant Lecturer in the Department of Geography. Salary in accordance with existing scale. Duties will commence in January 1947. Applications should be submitted forthwith (and in any case by November 20), addressed to the undersigned, from whom further particulars may be obtained.

E. L. TANNER,
Gower Street, W.C.1. Secretary.

## THE UNIVERSITY OF LIVERPOOL

Applications are invited for the post of Laboratory Technician in the Department of Physiology. The position is a responsible one, and previous laboratory experience is essential. Salary from £5 10s. to £6 10s. per week.

Apply, giving full particulars of education, training and experience, together with copies of three recent testimonials, not later than November 30, 1946, to the Registrar, The University, Liverpool.

## BEDFORD COLLEGE FOR WOMEN
(UNIVERSITY OF LONDON)
REGENT'S PARK, N.W.1

The Council of Bedford College invites applications for the post of Laboratory Assistant, Grade I, now vacant, in the Department of Physiology; salary £5 10s.–£7 per week. Initial salary according to qualifications. Applications, stating age, qualifications and experience, to the Secretary.

## LONDON (ROYAL FREE HOSPITAL) SCHOOL OF MEDICINE FOR WOMEN
(UNIVERSITY OF LONDON)
8 HUNTER STREET, BRUNSWICK SQUARE, W.C.1

Wanted Urgently: Animal cages, all metal, in good condition, suitable for rats. Full particulars with prices to be sent to the Warden and Secretary.

## Printing and Allied Trades Research

Association invites applications, including those from the present staff, for the following posts:

(1) Research Superintendent who will be responsible for the "day-to-day" supervision of the longer range scientific and technological research programme, which concerns both the Printing and Packaging Industries. Most items of research are concerned with branches of physical chemistry or physics. Candidates should be graduates with wide scientific interests and capable of leading a research team. Knowledge of the Printing and/or Packaging Industries would be an advantage.

(2) Information Officer who will be responsible for the co-ordination of the various departments of the Association concerned with the answering of members' enquiries and the dissemination of the results of scientific and technological research to members of the Printing and Packaging Industries. Candidates should have wide scientific and technical interests, preferably with a knowledge of the Printing and Packaging Industries, and must be able to express the results of scientific investigations in a clear and concise form.

Salary in each case £950–£1,150. Superannuation under the F.S.S.U. Applications, stating age, qualifications, experience and particulars of present and past appointments, should be addressed to the Director of Research, P.A.T.R.A., Charterhouse Chambers, Charterhouse Square, London, E.C.1.

## Electronic Development Engineer required.

Practical ability with a good general knowledge of valve circuitry and experience of high gain L.F. amplifiers is desired. Qualifications must include a degree in Physics or Engineering (or suitable equivalent) and several years' research experience. Salary according to qualifications. Write stating age, qualifications, experience and salary required. Sir Howard Grubb, Parsons & Co., Optical Works, Walker Gate, Newcastle-upon-Tyne, 6.

## The Civil Service Commissioners

announce that a special competition will be held for appointments as Assistant Engineer (New Style)—Male—in the Post Office Engineering Department and Assistant Traffic Superintendent in the Telephone Department of the General Post Office. Approximately 100 vacancies in each grade will be filled by examinations spread over a period of two or three years.

Candidates must have been born on or after August 2, 1915, and have attained the age of 18 by January 1 of the year in which they compete. Allowance will be made for service in H.M. Forces prior to September 3, 1939.

Men only are eligible to compete for appointment as Assistant Engineer (New Style). The salary scales are as follows: Assistant Engineer (New Style): London: £280 rising by annual increments of £20 to £580; Provinces: £265 rising by annual increments of £20 to £560 (including consolidation addition). Assistant Traffic Superintendent: Men: London: £190 rising by annual increments of £18 to £465; Provinces: £180 rising by annual increments of £18 to £435. Women: London: £190 rising by annual increments of £12 to £375; Provinces: £180 rising by annual increments of £12 to £345 (including consolidation addition). There will be prospects of promotion to higher grades.

Candidates now serving in H.M. Forces must send in their application forms in time to reach the Civil Service Commission not later than six months after the completion of their service. All other candidates must send them in by April 1, 1947, except that for candidates who are under 18 years old on April 1, 1947 the latest date for sending in the form is January 1 following their 18th birthday.

Copies of the Regulations and Forms of Application may be obtained from the Secretary, Civil Service Commission, Burlington Gardens, London, W.1, or from the Chief Officer, Civil Service Commission, at the following addresses, quoting No. 1679: (India) 10 Underhill Lane, Delhi; (Egypt) 8, Sharia Tolumbat, Garden City, Cairo; (Italy) c/o G.H.Q., C.M.F.; (Germany) c/o 2nd Echelon, G.H.Q., B.A.O.R.

## (1) Vacuum Physicist to organise and

carry out fundamental investigations and measurements in problems relating to the manufacture of radio valves and special thermionic devices. Applicants must be not less than 27 years of age and not more than 35 years, and must possess an honours degree in Physics with several years experience in original research.

(2) Physicist or Engineer to organise and carry out work in the first instance on the development of ultra-high frequency valves. Applicants must be not less than 27 years and not more than 35 years and possess an honours degree in Physics or Electrical Engineering and with several years experience in original research. Previous experience in electronics is not essential but applicants must have a thorough knowledge of fundamental physics and light electrical engineering and be capable of original work. Salaries paid will be in accordance with the firm's scale and are based on age, qualifications and experience.

Applications in the first instance should be in writing and addressed to Works Personnel Officer, Mullard Radio Valve Co., Ltd., New Road, Mitcham Junction, Surrey. Please quote reference K.b.

## The British Scientific Instrument

Research Association has vacancies in their new laboratories for scientists with first class academic and professional qualifications. The following appointments will shortly be made in the electrical instruments and electronic departments located in the outskirts of South East London.

(A) Physicist with at least four to five years experience in electronic instruments or electronic circuits.

(B) Physicist or engineer with at least four to five years experience in electrical (non-electronic) or magnetic instruments.

(C) Junior physicists or engineers with some experience in the field of electrical or electronic instrument technology.

The appointments will be made in the first instance in the Scientific Officer grade: £300–£550 and carry F.S.S.U. benefits after a probationary period. Application in writing only giving full details to Director of Research and Secretary, B.S.I.R.A., 26 Russell Square, W.C.1.

## Physicist required.

A good general knowledge of Physics, particularly Optics and Electricity, is necessary with practical ability. Experience of electronic devices and/or infra-red technique will be an advantage. Qualifications must include a degree in Physics (or suitable equivalent) and several years' research experience. Salary according to qualifications. Write stating age, qualifications, experience and salary required. Sir Howard Grubb, Parsons & Co., Optical Works, Walker Gate, Newcastle-upon-Tyne, 6.

## A Research Association invites applications for Abstractors (male or female) for the Intelligence Section.

Their duties will consist mainly of abstracting and summarizing technical and scientific papers in shipbuilding, marine engineering, naval architecture and general physics and engineering, and also of dealing with technical enquiries relating to published material in these fields. Ability to translate from German, French and/or Russian would be an advantage. A degree in engineering or physics is desirable, but persons without degrees but suitably qualified otherwise will also be considered.

Appointment will be made within the range of £250–£500 according to age and qualifications. Superannuation under F.S.S.U. Box 749, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

## Entomologist or medical officer required

by a major oil company for development work in overseas areas in connexion with mosquito control. Experience in the tropics as a Field Malariologist would be advantageous. Age between 30 and 35, salary £1,200 to £1,500, according to experience and qualifications together with cost-of-living allowances. Provident Fund and Pension Scheme benefits, overseas service three to four years, with prospects of permanency and a career. Apply in writing stating age and full particulars of education, qualifications and experience to Box ZW.607, Deacons Advertising, 36 Leadenhall Street, E.C.3.

## Physicist with some general knowledge

of manufacturing in various branches of Electrical Engineering, required by large organization. Knowledge of Patent procedure an advantage. Applicants should write giving fullest details of qualifications and previous experience, also stating age and salary required, to Box 747, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

## Physicist required for the Research

and Development Laboratories of a Speciality Paper Mill in S. Bucks. Applicants should have graduated with Physics as main subject, and should preferably be not over 25. Salary according to age and experience. Write with full particulars of qualifications, experience, etc., to Box 754, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

## Required for Research Department of

Roche Products Limited, two experienced typists to type technical/scientific reports; scientific journal abstracting, and to assist in the library. A knowledge of French and German an advantage. Five day week of 40 hours. Canteen; good working conditions, and good prospects. Particulars of education and experience to: Roche Products Limited, Welwyn Garden City, Herts.

## Wanted: Research Assistant to the

Wheatstone Professor of Physics to take part in biophysics research. Skill and familiarity with physics apparatus, instrument construction and reliable powers of observation required. Some knowledge of, or interest in, biology desirable but not essential. Salary £6 10s.–£7 10s. per week according to qualifications. Apply, The Secretary, King's College, Strand, London, W.C.2.

## Laboratory Assistant required for the

Official Seed Testing Station. Commencing salary £240 p.a. plus bonus. Pension scheme in operation. Apply as soon as possible, giving particulars of qualifications and experience, to the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

## Chemist, graduate of Sorbonne, 37,

seeks position in or near London. Experience in microanalysis, molecular structures by light absorption methods; investigation of light alloys by spectrochemical and X-ray analysis and electron microscope. Write Box P.217, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

## Wanted by major oil company Honours

Graduate Chemists for initial employment in United Kingdom and later transfer to Middle East. Must be British born and parentage. Age 20–25. Salary £400 in U.K. Reply stating qualifications, etc., to Dept. H. 10, Box 750, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2. (Stamped addressed envelope should not be enclosed).

## Engineer or physicist with university

degree required by London Metal Spraying Company to develop new apparatus and to direct research. Salary £500 to £750 per annum. Reply giving full particulars of career. Box 751, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

## University College, Southampton, have

a vacancy for a Shorthand-typist with an interest in Chemistry and/or Zoology, and preferably some knowledge of scientific terms. Remuneration according to qualifications and experience. Applications, giving two references, should be made in writing and addressed to the Registrar.

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