NATURE

No. 3781 SATURDAY, APRIL 18, 1942 Vol. 149

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Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number : Whitehall 8831
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Advertisements should be addressed to
T. G. Scott & Son, Ltd., Three Gables, London Road, Merstham, Surrey
Telephone: Merstham 316

The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad

Registered as a Newspaper at the General Post Office

RECONSTRUCTION AND THE BUILDING INDUSTRY

NOW that building for war has reached, if not passed, its peak, while the demand for man-power and woman-power is still increasing, it is imperative that an attempt should be made to face the post-war problems if physical reconstruction is to be possible on anything like an adequate scale when hostilities cease. The Central Council for Works and Buildings has already issued a valuable memorandum on "Training and Recruitment for the Building Industry", prepared by Mr. G. D. H. Cole for the Ministry on behalf of the Nuffield College Social Reconstruction Survey. Further, at a time when there is some public uneasiness at the delay in the Prime Minister's promised statement on reconstruction and over the supercession of Lord Reith and Mr. Greenwood, the Ministry of Works has issued a statement on the newly created Directorate of Post-war Building. The statement is reassuring evidence that, in one part of the field, preparation is being made to deal with problems which will become urgent immediately hostilities cease and which are indeed linked intimately with the question of demobilization.

The Directorate of Post-war Building consists of a small skeleton staff of fourteen people, but the statement indicates that it has fully grasped the significance of co-ordinating and unifying the many scattered activities of groups and committees in this field and giving them some coherence and direction, if at the appropriate time contraction is to be turned into rapid expansion and orderly and efficient advance. Its first task is that of collating existing information and co-ordinating all activities pursued elsewhere. Its field embraces the whole technical side of building and will include the planning and design of the many types of buildings; the latest practices in construction; the architectural use of materials (and particularly of the newer materials); the most efficient methods for heating, ventilating, lighting and sound-proofing a building, and generally giving it all the advantages that modern science and production technique have put within the reach of man.

The work will be done through groups or committees, most of which are actually or potentially in existence. Where necessary, new study committees may be created at the invitation of the Ministry, either by Government departments, professional organizations, research associations or other suitable organizations. Only in exceptionable circumstances will the Ministry itself convene a committee. Fifteen such study committees have now been discussed in detail or agreed; eleven have been or are being formed and several are at work. The Minister has already provided for co-ordination and policy through a main co-ordinating and three policy committees. All the major interests affected are represented on the main co-ordinating committee, including the Ministry of Health, the Royal Institute of British Architects, the Institution of Civil Engineers, the Department of Scientific and Industrial Research, and the British Standards Institution.

The three policy committees between them cover all subjects for which study committees have been appointed, and consist mainly of the chairmen of the relevant study committees. One of these policy committees, of which Sir Giles Scott is chairman, covers design; a second, with Mr. Ralph Freeman as chairman, deals with structure; and a third, under Mr. G. Grey Wornum, with installations or services. Of the six study committees in this group, two are convened by the Building Research Station, one by the Institution of Electrical Engineers, one, on illumination, by the Department of Scientific and Industrial Research; one by the Paint Research Association and one by the Plastics Federation.

It is clear therefore that in this attempt to seize the opportunity of a general overhaul which the almost complete stoppage of the mechanism of civil building affords, the Ministry of Works and Buildings is making full use of scientific research and technical experience. Past experience is being reviewed and new ideas examined and tried out. If all engaged in the industry respond to this call to pool their knowledge now, regardless of narrow individual interests, there should be an immense improvement in the value of buildings in Great Britain after the War, and the Director of Post-war Building, Sir James West, and his three assistant directors, have every right to count on the full support of scientific workers in their important task.

The statement of the Ministry goes far to meet some of the criticisms of the Association of Architects, Surveyors and Technical Assistants in a recent memorandum entitled "War-time Building". The programme already contemplated should at least remedy the inadequate exchange of technical information, as well as the lack of unified control of building work and of contact between office and site, and design and user, to which "War-time Building" points as among the factors leading to delay in building, inefficiency and the hold up in arms production. It should promote the provision of the unified control of the building programme and co-ordination of planning requirements and structural research which are among the main proposals of that report. Further, it should facilitate co-operation between technicians, which is one of the immediate steps proposed for professional action.

The great problem of the expansion or adaptation of the building industry is, however, the labour question. This may be described as both qualitative and quantitative. The first aspect involves the proper utilization of the technical or scientific worker, upon which the Association of Architects, Surveyors and Technical Assistants lays particular stress. The second is the main theme of Mr. Cole's memorandum, and both are discussed in a recent P E P broadsheet "Building for the Nation".

The Association of Architects, Surveyors and Technical Assistants maintains that insufficient responsibility is delegated to the technical worker, that initiative is discouraged, supervision inadequate and that the organization of technical workers is defective. Together with the lack of unified control of building work, the inequitable allocation of staff, mistakes in placing technical workers and the placing of unqualified persons in responsible posts, as well as the factors already mentioned, it is urged that these defects in organization are leading to considerable waste and inefficiency in war-time. The proposal for full recognition of the status of the technical worker is substantiated by the P E P broadsheet, and also by reports of the Select Committee on National Expenditure.

There is indeed little reason to doubt that the weaknesses which are at the root of the building industry's troubles to-day are due to failure to define responsibilities, to prevent overlapping of functions and to co-ordinate specialized activities. *Planning* lays down the basic principle that the responsibility for design and for co-ordination of services involved in the preparation of plans and other documents for subsequent general supervision should rest upon the architect or engineer. Responsibility for measurement services—quantities and costs—on the basis of the particulars provided, should, in accordance with the proposals of the Association of Architects, Surveyors and Technical Assistants, be placed entirely on the quantity surveyor. Responsibility for co-ordinating work in progress should be clearly defined, and if it remains a responsibility of the architect, co-ordination must be provided much more efficiently than is possible at the clerk of work's or general foreman's level. *Planning* visualizes three ways of providing the threefold service of co-ordination, design and measurement: by the architect and individual specialists; by groups of architects; and by an inter-professional group. The suitability of these types of professional organization will depend upon the scale and complexity of the work in hand. Responsibility and payment for design, measurement and professional co-ordination services should be kept completely distinct from the provision of building materials and from contracting and sub-contracting work. Further, salaries offered to technicians in public services should compare favourably with those offered for similar work in private employment in order to make it possible to enlist the best brains available. Further scope should be provided for the recruitment of a proportion of senior officials at a more mature age after varied experience of normal private, industrial and professional conditions.

The co-ordination achieved through this reorganization of design and measurement services should be directed to ensure proper particulars as the basis of building policy and of national standards of cost control. The organization of the services of contractors calls for a similar critical analysis, and it is highly desirable that the services of the building contractor should be governed by professional standards comparable with those of the architect, the surveyor and the engineer. The absence of any definite pattern of professional relationship throughout the building industry and the dearth of technical administrators from which building organization is suffering, particularly in the Government service, find pointed comment in the P E P broadsheet, which also emphasizes the vital necessity of greatly extending the existing Government research stations both in

scope and in size to meet the demands likely to arise after the War. Scientific research, statistical investigation and information services should be vigorously developed to bridge the gap between building research and practice, to stimulate attitudes of self-criticism and to accelerate the adoption of up-to-date methods.

The broadsheet lays particular stress upon the great responsibility of the recently created National Council of Building, although it concentrates its attention on a few of the vitally important aspects of the industry, particularly the long-term policies, including education both at the professional and the operative level. The importance of protecting the consumer, particularly by means of scientific research, and the desirability of exorcising haste from building policy, thereby ensuring speed, and the opportunity which the Government now has as the sole building owner in war-time of improving the efficiency of the industry, are other points stressed in this admirable survey.

The quantitative aspects of the labour problem are also visualized. The new forms of organization to be developed are one means of achieving the best output with the minimum of man-power, and the new status for contractors and the improvement of professional standards generally should have as counterpart a new status for labour. This implies the development of trade unions themselves more on the lines of professional bodies, concerning themselves more with education and the ability of their entrants, and with their opportunities for gaining wider qualifications—for example, by training schemes and a more constructive approach to apprenticeship.

Real developments in this field depend upon effective permanent measures to abolish underemployment and to secure to the workers the sure prospect of a steady load on the industry through large-scale planning. It is to this aspect that Mr. G. D. H. Cole's "Memorandum on Training and Recruitment for the Building Industry" directs special attention. The possibility of bringing about without friction an expansion of the labour force of the building industry on the scale required for post-war reconstruction depends, Mr. Cole concludes, on the giving of adequate assurances that building activity will be maintained at a high level over a considerable period of years. The prolonged depression in the industry before 1914 had disastrous consequences both in checking the flow of apprentices into the building crafts and in causing, in the period after 1918, a deep-seated fear that the acceptance of any schemes for dilution or the recruitment of additional workers would only mean heavy unemployment in the years to come. The building workers were not induced to co-operate readily in schemes of expansion until in 1924 Mr. Wheatley gave guarantees of a continuous programme of building at a high level, and thereafter the great trade depression of 1931 dealt a fresh blow to confidence.

Mr. Cole points out that the building worker needs to be satisfied on two points. He wants an assurance that any building policy requiring an influx of additional labour will be maintained for a substantial period; and he wants also, particularly if he belongs to one of the outdoor trades, a guarantee that his earnings will not be seriously affected by loss of time owing to bad weather conditions. These two requirements are not unreasonable. They are in keeping with the four freedoms of President Roosevelt and with the terms of the Atlantic Charter, and should be met as a preliminary to the introduction of ambitious programmes for the expansion of the supply of building labour.

While, as Mr. Cole's inquiry shows, it is quite impossible, apart from considerations of policy, to make any prediction about the total demand for building labour after the War, that very dependence upon policy, both in relation to housing and in relation to industrial and other non-residential building, should facilitate rather than hinder the giving to the industry of a guarantee of employment at a high level for a period of at least ten years. Obviously it is desirable to plan for the physical reconstruction of Great Britain over a considerable number of years, beginning mainly with the repair of damage by bombs and the arrears of repairs and maintenance, and thereafter proceeding to large schemes of urban re-planning and rural development which will involve the complete rebuilding of many congested areas, as well as substantial changes in the location of industry and population. Here Sir John Orr's plan for a 'temporary' housing scheme might be considered. Mr. Cole enumerates fourteen major points of policy requiring decision before any prediction can be made as to the size to which the building industry must be expanded after the War, but he assumes that the basic problem will be that of getting into the industry as many skilled, or fairly skilled, workers as can be made available by extensive measures of training, and that the actual volume of post-war building activity will depend at least as much on the success achieved in expanding the skilled labour force as on any other factor.

The 'wet time' problem should be solved by means of a guaranteed week, financed at least in part by some sort of pool to spread the cost over industry as a whole. Reassurance on these two points, Mr. Cole considers, would ensure trade union co-operation in bringing about the expansion of the industry on the required scale. Any public formulation of post-war policy for the expansion of labour supply should begin with plain declarations on these two questions. The rebuilding of Great Britain should be planned in advance as a process to be spread over a period of years, divided into successive stages; and the 'wet time' question should be tackled simultaneously by the grant in some form of the guaranteed week.

If this be done, the trade unions of the building industry can be safely asked to waive, for the time being, any regulations which seriously restrict the number of apprentices, either for a particular firm or for a whole district, and also to co-operate closely in bringing into the industry an additional supply of skilled labour. Mr. Cole's proposals include working out in advance a scheme for the completion of interrupted apprenticeships, as well as of a national apprenticeship scheme for the various building crafts.

Mr. Cole recognizes the importance of making the fullest possible use of the available technical colleges and other technical institutions, of expanding the facilities for institutional training in the building crafts and professions, and of providing for vocational specialization in building and kindred techniques in both secondary and part-time continuation schools. The possibilities of the junior technical schools, which offer boys of thirteen a three-year course of secondary education with a strong vocational background, have already been emphasized in a preliminary report by the Education Committee of the Central Council for Works and Buildings. The fresh outlook which Mr. Cole brings to the problem in his comprehensive analysis is, however, particularly well illustrated in his proposal that the training of 'handymen' working for small repairing and decorating firms should be recognized by the industry as a problem requiring special action. Such recognition would in effect mean recognizing a new craft, but Mr. Cole urges that definite provision should be made for training workers of this type.

Here as elsewhere, the post-war policy of expansion may involve considerable modifications of the existing rules of demarcation between crafts. The use of the new materials means training in new crafts and processes, and a new and wider outlook on the part of the trade unions as well as of management and professional men. We cannot expect that outlook and the full co-operation essential to success unless, as Mr. Cole insists, we tackle first the problem of social security and, by eliminating the fear of unemployment, bring a new spirit into the industry. This point was stressed by Lord Portal, the new Minister of Works and Buildings, in an address on April 8 to the National Federation of Building Trades Employers, discussing the importance of organization for immediate activity on the close of hostilities, when he stressed the need for ensuring continuous work for the operatives of the industry.

The dominant note of these surveys is one of opportunity. There are many problems of organization to be solved, questions of professional training, of education and research, if we are to realize the possibilities which the new materials have put into our hands, as the Director of the Building Centre, Mr. F. R. Yerbury, showed in a recent paper before the Royal Society of Arts, on the adaptation of design to standardization and mass production. The statement of the Ministry of Works and Buildings shows that the Ministry is fully alive to the opportunities which lie before it. The most important step, however, remains that of creating the right outlook and inspiring the right spirit from top to bottom of the industry. For this reason the Ministry could give no firmer assurance of its determination to discharge its responsibilities than by dealing with this question of social security. Action in that respect now would fortify and intensify the whole national purpose and effort by giving an earnest of the Government's determination to see that the new order to be established after the War will be worthy of the sacrifices now demanded of every man and woman.

PHILOSOPHY AND THE SCIENCES

Hippocratic Medicine: its Spirit and Method

By William Arthur Heidel. Pp. xvii+149. (New York: Columbia University Press; London: Oxford University Press, 1941.) 13*s*. 6*d*. net.

THE exact relationship of philosophy to the sciences has long been a much-debated subject, although there is to-day general agreement among the writers on ancient thought. The older generations of historians tended to regard the earliest philosophy as similar to modern science in object and method, although they admitted, or rather assumed, its strongly metaphysical character. Recently, however, efforts have been made to prove that Greek philosophy was entirely different from modern science. It did not aim, it is contended, at increasing man's control of Nature, but at satisfying his religious instinct; the method adopted was not induction, with observation, experiment and verification, but dogmatic assertion of rational but unverified—sometimes unverifiable—hypotheses. In other words, it was a theology based on faith. This was 'philosophy' in its narrow sense. There was a wider, vaguer meaning, according to which it embraced logic, ethics, education and so on, if studied in a serious and systematic way, but it bore no resemblance to the physics and chemistry of modern times.

In his book on Hippocratic medicine the late Prof. Heidel put forward the theory that, besides being philosophers, early Greek thinkers were also scientists, who tried to classify and explain phenomena and sense-perceptions. His evidence is practically limited to the sphere of medicine, but the seventy works of the Hippocratic "Corpus", written between 450 and 350 B.C., afford plenty of material. While fully realizing their faults, Heidel believes that the writers of these works were scientific (in the modern sense) in (1) their general conceptions, for example, that the nature of man cannot be understood apart from universal Nature of which man is a part; and in (2) their practice of using scientifically the few means and instruments available in their day. In other words, they had the scientific attitude of mind. Their chief faults were that they were dogmatic and speculative, regarding as simple what was really complex.

Without these medical works, says Heidel (p. 18), the fragments of the philosophers are scarcely intelgible. For the influence of Plato and Aristotle—particularly of Plato—was so great that the stress they laid upon a narrow metaphysic has obscured the whole history of thought, casting into oblivion nearly all the evidence for the development of Greek science. The medical treatises alone have survived, having been saved by their practical utility.

Such is the theme of Heidel's book. It has its faults; the author, for example, failed to appreciate the unique character of Greek metaphysics, making rather strange statements about the early philosophers. Nevertheless, if the main contention be correct, much of the history of philosophy must be re-written, and our conception of Greek thought freed from the metaphysical bias due to the outstanding genius of Plato. Heidel knew the Hippocratic treatises through and through, expounding their views and explaining their attitude with accuracy and thoroughness. All future historians of Greek thought must regard these medical works as primary authorities, instead of using fragments of them,

as is the modern practice, as secondary authorities to reinforce conclusions based on very different material. As evidence for the development of thought they are as valuable,or almost as valuable, as Plato and Aristotle. W. H. S. JONES.

AN INTRODUCTION TO METEOROLOGY

Introduction to Meteorology

By Prof. Sverre Petterssen. Pp. ix+236. (New York and London: McGraw-Hill Book Co., Inc., 1941.) 17*s.* 6*d.*

THE author of this book is immediately faced by the problem of deciding how much knowledge of mathematics and physics he can assume his reader to possess, since meteorology is concerned with the physics and dynamics of the atmosphere. Dr. Petterssen has assumed that his reader has a knowledge of the elements of the differential calculus, and of rather more than the rudiments of the theory of heat. On this basis he has written a book which can certainly be added to the relatively short list of good books on the subject of meteorology. The general bias of the book is implicitly in the direction of applications to aviation.

Of the fifteen chapters into which the book is divided, Chapters 8–13 are directly concerned with the synoptic chart and its use, and the first seven chapters have been written with the aim of supplying the theoretical ideas underlying the use of synoptic charts for weather forecasting. The earlier chapters cover the consideration of evaporation and condensation, adiabatic changes, stability and instability, temperature changes and their relation to weather phenomena, and wind systems. These are all discussed rather briefly, but on the whole very clearly. The present reviewer was particularly impressed by those portions of the book which are devoted to types of precipitation, types and modes of formation of fog, the genesis of air masses, weather analysis and the steps in forecasting procedure, and the detailed discussion of examples of charts for western Europe and the eastern Atlantic. The parts of the book which deal with synoptic charts are, as might be expected from one who has taken an active part in the development of the Norwegian methods of forecasting, clear and full of matter of great interest to the student of weather forecasting.

The author's view of what constitutes an elementary treatment of meteorology does not accord with the popular view. His book will demand close attention on the part of the reader, as it is very much concentrated. It would probably have been beneficial, from the reader's point of view, to have amplified portions of the earlier chapters. For example, where the formula for the dry adiabatic lapse-rate is expressed as g/c_p, on p. 52, it is not explained that the specific heat at constant pressure is to be expressed in dynamical units, though the elementary reader would probably think of this quantity as expressed in heat units. The actual values of the constants used in the formulæ are not given, and it would be helpful to the reader to have these constants collected into a table, so that if required their values could be readily ascertained. The numerical value of the dry adiabatic lapse-rate is given, on p. 53, as 5·6° F. per 1,000 ft., instead of 5·4° F. per 1,000 ft., the value which the formula yields.

The last two chapters give Köppen's classification of the climates of the world, and a brief historical review of the development of meteorology as a science. Dr. Petterssen concludes his book with an optimistic view of the future of weather forecasting, but whether that view will be justified or not, it is safe to forecast that the book under review will have its part in the spread of knowledge of modern meteorological methods. D. BRUNT.

ENGINEERING DATA

The Engineer's Year-Book of Formulæ, etc.

Originally compiled by H. R. Kempe and W. Hanneford-Smith. 48th annual issue, revised under the direction of L. St. L. Pendred. Pp. xii+2852. (London: Morgan Brothers (Publishers), Ltd., 1942.) 35*s.* net.

SHOULD some future historian wish to write of engineering in 1942, he will find most, if not all, of the important facts in "Kempe". Practically every branch of engineering is represented, as the full title shows, the only notable absentee from the list being chemical engineering which, on the purely engineering side, may be said to derive from certain aspects of other sections—civil, mechanical, electrical and metallurgical—while on the chemical side it belongs to another branch of technology.

The present edition marks the occasion of the quinquennial revision, which is made the opportunity for a thorough overhaul of each of the forty-seven sections in which the information is presented. Obviously, of course, the great bulk of the book remains very largely as before, for much of it is fundamental and almost permanent, and the rest has been carefully selected and tested in previous years. The mining section is one of those that have undergone major treatment and the work of the late Dr. Henry Louis has been revised, considerably extended and brought up to date by Sir Richard Redmayne, whose authority in the world of mining gives assurance that this section is now fully in line with the most recent knowledge and standards.

Other sections which have received similar treatment include those on steam, hydraulics and hydraulic transmission of power, marine oil engines and aero engines. As a result, "Kempe" is not only a larger volume but also has made a definite advance in conformity with the manifold activities of the great body of engineers.

Besides the practical information relating to these numerous aspects of engineering operations and design, the earlier sections are devoted to the more fundamental data which are in constant demand both by the student and by the practising engineer. These include units of measurement and equivalents, the principles of mechanics, measurement of power, heat, optics, acoustics, vibration, noise, the properties of engineering materials and metering and mechanical testing appliances. Then again, in the building section, there is given an abstract of the provisions of the London Building Act, which for some time to come will be the principal guide to conventional and approved practice. By its comprehensive inclusion of engineering information, "Kempe" is equal for purposes of reference to quite an extensive library, and the information is more accessible and more easily applied.

Physical Chemistry for Colleges

A Course of Instruction based upon the Fundamental Laws of Chemistry. By Prof. E. B. Millard. (International Chemical Series.) Fifth edition. Pp. ix+600. (New York and London: McGraw-Hill Book Co., Inc., 1941.) 26*s*.

PROF. MILLARD'S book has now reached its fifth edition. Like many American text-books of science it is excellently printed and bound, but its price is notably greater than that of British books which are of a similar scope.

The treatment follows the usual lines so far as the older 'classical' physical chemistry is concerned, but is noteworthy for the care which has been taken to provide many tables of experimental data and accurate modern values of experimentally determined constants. These are used as the basis for an unusually large number of numerical exercises which are appended to each chapter. Discussions of the states of matter, of the properties of solutions and of thermochemistry and thermodynamics are clearly written and copiously illustrated. The discussion of kinetics is confined to the treatment of homogeneous reactions.

The least satisfactory chapters deal with more modern work, and the discussion of atomic structure does not seem to have been rewritten since the book was first published in 1921. It gives a brief account of the Lewis cubical atom and of the Bohr theory of the hydrogen atom, but does not include even a description of the general Bohr theory of extra-nuclear structure and the periodic law which is now so fundamental for chemistry. This omission should be rectified in any future editions. S. S.

Practical Physics

By the Physics Supervisory Staff, Engineering Science and Management Defense Training, under the direction of the Division of Arts and Science Extension, the Pennsylvania State College. (Foundations of Engineering.) Pp. viii+165. (State College, Pa.: Pennsylvania State College, 1941.) n.p.

THIS course is designed for a very specific purpose, namely, to furnish training in the fundamentals of physics for workers in the defence industries of the United States. The scope of the work includes the usual subjects, with the exception of sound and light, of a standard roughly equivalent to the School Certificate in England and Wales; in some cases the standard is slightly higher.

The first chapter deals quite adequately with fundamental units and their measurements, and this chapter is typical of the thorough manner in which the work of the whole book has been done; each chapter is practically a self-contained unit. The general plan throughout the book seems to be to deal with the theory first, follow this up with a useful summary and a comprehensive set of questions, and then deal with the experimental work. In the examples, emphasis is placed on the practical and ndustrial applications of the principles studied. Many diagrams are given, but several of these are in lighter vein and could easily be omitted.

Much has been attempted in the book, and much accomplished, and one feels that the students for whom the book is intended should derive great benefit from its use. The authors are to be congratulated on their enterprising and sound piece of work.

Elementary General Science

Edited by J. M. Harrison. Book 3. Pp. vii+247. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1941.) 5*s*.

THIS rather high-priced book completes a course in elementary science from which it is suggested that schools select subject-matter to suit their own particular needs. The earlier chapters are arranged so as to interlink the various sciences so far as possible, while the remaining chapters deal with work necessary to meet the requirements of students taking the general science paper in the School Certificate Examination. One distinct asset of the book is the good sectional diagrams which are made as simple as possible so that students can very easily follow them; the diagrams of microscopes and telescopes are particularly good. It must be distracting to students, however, not to find diagrams on the same page as the corresponding descriptive matter; examples of this occur on pages 167 and 169.

Certain omissions, which one feels ought to be remedied, are noticeable. For example, in dealing with the mechanical equivalent of heat, Joule's pioneer work is quite rightly stressed, but a more modern method of determining this important relationship would have been welcome. There is a good selection of questions at the end of the book, though no answers are given to the numerical problems.

Experimental Physical Chemistry

By Dr. W. G. Palmer. Pp. xii+322. (Cambridge: At the University Press, 1941.) 12*s*. 6*d*. net.

DR. PALMER'S new volume is noteworthy for the simplicity of the apparatus used to demonstrate fundamental laws and for the very detailed instructions which are given for carrying out the experiments. Each chapter is prefaced by a condensed account of the relevant theory; this is done so that (to quote from the preface) "the student can readily refer to principles while at work on a problem".

This is a very desirable aim but it is doubtful whether the highly compressed and sometimes inadequate notes on the theory will really help the more earnest student. Dr. Palmer's book will chiefly be valued for the many practical dodges which are described for the construction of home-made apparatus. S. S.

Practical Physical Chemistry

By Prof. Alexander Findlay. Seventh edition, revised and enlarged. Pp. x+335. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1941.) 12*s*. 6*d*. net.

PROF. FINDLAY'S book has now reached its seventh edition; it was first published in 1906 and the last impression of the sixth edition appeared in 1938. The new edition is enlarged by the inclusion of descriptions of modern equipment for thermostats and, *inter alia*, some additions to the sections on surface tension, electromotive force, and binary and ternary equilibria.

The author has wisely resisted the temptation to enlarge the book considerably by the inclusion of many new and specialized topics. After more than three decades of useful life it remains an excellent and inexpensive guide to practical work in physical chemistry. S. S.

A Review of Driers and Drying

By E. F. Bennett. Pp. 90. (London: *Paint Technology*, 1940.) 3*s*. 6*d*. net.

DESPITE the age-old use of linseed oil as a medium for protective and decorative finishes, it is only in comparatively recent times that a serious attempt has been made to study the fundamental aspects of the drying phenomenon. In this review on driers and drying the author has attempted to collect and collate the large volume of published work which by now has accumulated in scattered technical journals, and to present a concise and critical survey of the existing knowledge. The entire field bristles with intricacies. The drying oils themselves are complicated mixtures and the transition from the soluble liquid state to the final insoluble solid film is the result of the interplay of complex physical and chemical changes.

Though small in compass, the book is comprehensive in treatment. It covers the constitution of the various oil types, the general principles of the drying phenomenon, the respective roles of oxidation and polymerization in film formation, the influence of metallic driers, film structure, the constitution of varnishes and the influence of pigments. This admirable compilation of the information on drying oils and driers with its 106 references is interesting and valuable from the theoretical point of view and at the same time it offers much practical and useful information for the guidance of the paint technologist.

The book is highly recommended by two acknowledged authorities on the subject, Dr. J. S. Long and Dr. William Krumbhaar, who in extended forewords contribute lucid and suggestive analyses of the problems awaiting solution by research workers in this field.

The Twin Marchant Calculating Machine and its Application to Survey Problems

By Dr. L. J. Comrie. Pp. 40+3 plates. (London: Scientific Computing Service, Ltd., 1942.) 10*s*.

IT would be difficult to exaggerate the importance at the present time of easy and rapid methods of solving the day-to-day mathematical problems that arise in military survey work. A large number of such methods, many developed by Dr. Comrie himself, depended in the past on the use of the German Brunsviga Twin 13z calculating machine. The fact that this machine is now, naturally, unobtainable might well have seriously handicapped our fighting forces. It is therefore extremely gratifying to learn that a substitute has been provided by the device of building together in pairs the well-known American Marchant machines. As Dr. Comrie remarks, this improvisation does not produce the ideal twin machine, but at least it gives us a serviceable and urgently needed war weapon.

Dr. Comrie's booklet describes this Twin Marchant and deals in detail with its application to about a dozen of the fundamental problems of survey work. The methods, which make full use of the time- and labour-saving possibilities of the machine, are described clearly step by step. The book assumes no knowledge of calculating machines on the part of the reader, and so eleven of its large pages outline fully the use of the ordinary single-hand calculating machine and many of the tricks which experienced computers use to shorten their labours. These pages will be useful, not only to those who have to deal with survey problems, but also to a very much larger class of computers and particularly to beginners.

S. L.

Elementary Physics and Chemistry: for Students of Biology

By Dr. E. A. Woodall and E. C. Denne. Pp. 224. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1941.) 4*s*. 6*d*.

THIS volume is intended as a two-year course to cover the work necessary for students taking biology in the General Schools Examination, the work to be done in the two years preceding the examination year. The chemistry portion is relatively thin, for the authors point out that little subject-matter is required and much of this can be taught in its proper context in the biology course. In the physics portion, on p. 17, the student is told that inertia is a *property*; later he is told that mass is a *quantity* of matter; he will probably be a little fogged when, immediately after this, he reads that "mass and inertia are really the same thing", even though there is a qualifying note. Not everyone will agree that the section on light should start with the spectrum, to be followed by reflexion and refraction, and one wonders why the experimental methods illustrating laws and principles are placed all together towards the ends of the chapters instead of putting them in their proper place in the text.

The diagrams in the book are simple and well done (incidentally Fig. 116 is not quite up to date), and a very useful feature is the use in biology of the principles discussed.

The Story of Electromagnetism

By Sir William Bragg. Pp. 64. (London: G. Bell and Sons, Ltd., 1941.) 1*s*. 6*d*. net.

THIS booklet is a reproduction, with certain modifications, of a lecture given by the late Sir William Bragg to cadets of the A.T.C. in the London area. It must have been a 'red-letter' day in the lives of these youths to have had the privilege of listening to so eminent a personality and one so renowned in the field of science. The purpose of the lecture was to give a sketch of the gradual realization of the fundamental principles of electromagnetism, principles on which a great deal of the future work of the cadets is based. The treatment of these principles is rather unique, and could only have been done in this way by the expert, the master of his subject, as was Sir William Bragg.

In the first chapter the four fundamental principles of electromagnetism are set out, and in subsequent chapters the author follows the course of discovery, observing the events which led up to the recognition of each of the principles. The amount of ground covered in this small book is very extensive, and the book should be studied not only by A.T.C. cadets but also by those who train them and by all students of physics.

Sir William Bragg added here one more notable contribution to the many he rendered to the world of science, and it is characteristic of him that, in his last published book, small though it is, he should have returned to fundamentals, discussing them in his own inimical way chiefly for the enlightenment and stimulation of the younger generation.

RACE AND FASCISM

THE second of the two symposia recently arranged by the Faculty of Science of Marx House (Marx Memorial Library and Workers' School) was held at the London School of Hygiene and Tropical Medicine on Easter Monday, April 6. The session was concerned with "The Scientific Attitude to Fascism with particular reference to Racial Theories", and Dr. C. S. Gibson acted as chairman. Six papers were read. It was understood that the views expressed were not necessarily those of Marx House, and the speakers were united more by a common interest in refuting Fascist ideas than in supporting Marxism.

The three papers read during the morning meeting dealt chiefly with race considered as a biological concept. Prof. J. B. S. Haldane opened with a discussion of "Racial Theories and Biological Fact". His chief concern was in rebutting the Nazi racial theory. This was said to be based on three main propositions: (1) that racial differences are absolute and that they determine cultural differences; (2) that some races are superior to others; and (3) that racial crossing is harmful.

The assertions made under the first head, Prof. Haldane said, are "un-Darwinian and undialectical". Races are nothing fixed: they were formed and evolved through the interaction of isolation and mixture. It is probable that whites and Negroes arose by specialization from brown peoples, and in other instances the existence of populations of intermediate type can be attributed to crossing. That there is no essential correlation between race and culture is demonstrated by the fact that very different races have passed through very similar cultural stages.

In adaptation to climate one race may be supposed superior to another in a particular environment, but there is little evidence for superiority in innate aptitude for civilized life. Many observed differences can be attributed to tradition, diet and, above all, chronic disease. Alleged superiority might be due to higher average performance, or to the greater frequency of gifted individuals. It has not been demonstrated that any race surpasses another in either respect, but even if it had, the overlap found would be too great to justify discrimination against the inferior race. Adequate investigation of these matters would require comparison of large samples under conditions of equality in differing environments.

The third point, regarding the harmfulness of racial crossing, is not substantiated by any genetical evidence. On the contrary, hybrid vigour might be expected in the first generation, though no example of it can be given in man. The mixing of cultures may be as important as that of races, and a hybrid culture may be of great value to humanity.

In conclusion, Prof. Haldane stated that believers in racial superiority commonly believe also in the superiority of their own class within the race, and he stressed the scientific importance of studying the social origins of racial theories as well as the theories themselves.

Dr. G. M. Morant, who followed with a paper on "The Meaning of Race", pointed out first that scientific workers have hitherto failed to reach any general agreement regarding racial problems. They are the special concern of physical anthropologists, who agree to-day in supposing that race is a biological matter which must be judged from body characters and not from cultural evidence. The term is applied to sub-groups of the modern species of man which have to be distinguished in order to discover how the total group evolved. The aim is to construct a pedigree in which the units are populations and the ideal groups may be called races.

The most important conditions involved in defining and classifying races of mankind are: (1) the fact that characters show gradations in conformity with the geographical positions of the populations compared, and (2) the fact that different characters distinguish populations in different ways. It follows from (1) that races can only be defined in an arbitrary way, and there is no agreement yet regarding the conventions and nomenclature which can best be used. Analysis on statistical lines offers the best hope of leading to a satisfactory solution of the complex problem, and this need not conflict with any knowledge regarding heredity in man.

Finally, Dr. Morant pointed out that the biological conception is entirely antagonistic to the view, derived from cultural evidence and used for purposes of national propaganda, according to which races are populations which can be sharply divided from one another.

Dr. P. A. Gorer's contribution dealt with "Disease and Race". He discussed the facts that the incidence of certain diseases varies greatly in different areas and that such differences may exist between different ethnic groups inhabiting the same area. The problem is whether this diversity is genetical in origin or due to other causes.

The case of yellow fever was cited as an example of the difficulty of interpreting the evidence. The high resistance shown by West African Negroes might be attributed solely to genetical factors acquired through natural selection. It is doubtful whether this is entirely true, however, since the disease is much less severe in childhood, so that most of the adults will have been immunized as children. Population differences in the incidence of cancer may be due to environmental rather than genetical factors. Both kinds must be supposed involved in the case of infectious diseases. Knowledge of the etiology of mental differences is less developed, though it is in this field that the most dogmatic assertions regarding racial distinctions are made.

The moral drawn by Dr. Gorer is that appreciation of the difficulties to which he referred should act as a deterrent against hasty deduction from racial differences of other kinds.

Questions asked following these three papers related to 'identical twins', intelligence tests and cancer in Java, among other topics. One speaker raised a current political issue in asserting that an attempt was being made to disrupt India on racial grounds. As a result a resolution was passed unanimously during the afternoon to the effect that: "This meeting . . . deplores any attempt to base political boundaries on alleged racial differences, and in particular the suggestion that the peoples of India should be divided politically on racial grounds".

It cannot be said that the adoption of this motion was an example of the working of a democratic practice at its best. The matter was not discussed, and few people in the audience can have appreciated its implications. Has anyone suggested that India should be partitioned on the basis of race? As Prof. Haldane had pointed out earlier in the morning, it is commonly supposed that there are racial distinctions between castes of Hindus. He and the other speakers had emphasized the point that race is an ill-defined concept, from which it may be inferred

that use of the term in concise statements of political significance should be avoided.

The afternoon meeting was opened by Mr. C. F. C. Hawkes, who spoke on "Prehistory and European Civilization". His theme was the group feeling of nationalism. This is always associated with some sort of belief in a distinctive group ancestry, but its main concern is belief in a distinctive cultural inheritance.

Racial theories used as national propaganda aim at intensifying both beliefs by disseminating dogmas regarding a nation's biological and cultural past conjoined. It is alleged that the doctrine is guaranteed by several branches of learning, of which prehistory is one. Racial nationalism declares that there were distinctive 'pure' races in prehistoric times, even if they cannot be found to-day. In fact what prehistory finds is culturally homogeneous groups. Cultural distinction must embody distinctive factors of habitat, economy and social structure, and it cannot be supposed that these are entirely without a biological counterpart. Nationalist race prehistory is not mere fiction but falsification of something real.

Mr. Hawkes then outlined the cultural development of the German region. In neolithic times it received elements of civilization indirectly from the Near East. A homogeneous Bronze Age culture resulted from the fusion of the neolithic people with invaders from the east who had retained the nomad tradition of the steppes. This encouraged the belief that the distinctive German culture was due to a distinctive group ancestry, although in fact the Bronze Age Germans largely migrated during the Iron Age. The tradition of German culture has always been associated with strong group feeling, and it has been peculiarly compact since prehistoric times. Belief in its distinction is deep-rooted, but it might be modified by re-education. Prehistory can play a part here by emphasizing the truth that progress has been conditioned not by racial exclusiveness but by the mingling and interaction of peoples and cultures.

From the questions which were asked regarding the archæology of Europe after Mr. Hawkes's paper, there had evidently been general appreciation of the importance of prehistory in refuting assumptions of the exclusiveness and superiority of Germanic culture. In that way, a study which may appear at first to have no practical applications must be taken into account in examining racial beliefs which are of great practical importance.

Prof. H. Levy dealt with anti-Semitism from the 'materialist' point of view, and he stressed the need for an objective treatment of the topic. Two questions examined were: (1) Why have the Jews survived? and (2) Why does anti-Semitism exist and reach climaxes at different times? Answers depending on the assumption that the Jews cannot be assimilated because they are of a distinctive type, or because they have a divine mission, can obviously be discarded. A proper appreciation of the situation can only be obtained from the history of the people. Their wide dispersion in Europe occurred at a time when the feudal system was in force, and they had no place in it. Consequently they remained without roots in any country. Being 'mobile', they were liable to be used by one party against another at any time of social crisis. The Jews were hence driven inwards and they persisted as a coherent group, clinging to its own traditions. Outbreaks of excessive anti-Semitism have always been associated with national revivals, and the correlation between the two can be traced from the Crusades to modern times. According to Marxist interpretation, a solution of the Jewish problem is essentially linked with a solution of the social problem. Prof. Levy's view is that both have been solved together in the U.S.S.R.

Miss Dona Torr discussed "Race, Nationality and Class" from a Marxist point of view. She was concerned with the political and social concept of race. An outline was given of the way in which historical materialism interprets such questions as the development of national unification and its relation to capitalism, class and international affairs in different historical phases. The social origin of certain racial theories of political significance and the Marxist view regarding the right to national independence were then discussed. In conclusion, she referred to the treatment of 'nationalities' in the U.S.S.R. It was stated that their territorial autonomy is recognized and that their languages and cultures are fostered.

The discussion following the last two papers was concerned with political rather than scientific topics. In winding up the proceedings, Prof. Haldane claimed that this was the first occasion on which any British organization had devoted a whole day to the examination of Nazi doctrines. He regretted the absence of an opposition, which was due to the fact that he had been unable to persuade anyone to speak in support of them.

One general impression gained by the spectator was that the question of race is a focal point where contact is made between specialists in many different branches of knowledge. Some, such as psychologists and demographers, were not represented in the symposium. It is clear that the definition of race and races is primarily the concern of biologists, and several branches of biology are involved. In a secondary way all humanistic sciences are concerned with racial differences, and it is not necessary to stress to-day the importance of the part that dogmas regarding them may play in social, political and international spheres. In order that science may refute the false doctrines with one voice, there is obviously an urgent need for co-operation between the followers of several disciplines, and their deliberations should also indicate a long-term policy of popular education. Marx House is to be congratulated on having encouraged scientific men to abandon their ostrich-like attitude to these matters.

GENETICS AND THE RUSSIAN CONTROVERSY

By DR. K. MATHER

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A CALL to reject in its entirety forty years work in a science which has engaged widespread attention and earned distinction for many, including a Nobel laureate, is both very unusual and very disturbing. Yet this is what Lyssenko and his followers at the Russian Genetical Conference of 1939 would have us do[1]; and, what is still more disturbing, no one other than those directly engaged in genetical research has found it desirable actively to oppose Lyssenko's views. Indeed his allegations have been repeated, and, it would appear, supported, in Great Britain[2].

The situation so created cannot lightly be dismissed by geneticists as the failure of others to appreciate

the fundamentals of their subject. It is true that many of the charges are based on a misunderstanding of genetics and its theory, but we must inquire into the reasons why such a misunderstanding can exist. The study of inheritance must have attracted the sympathetic interest of many biologists, especially those engaged in evolutionary studies and the improvement of crops and stock. Yet genetics has apparently proved so disappointing that they do not feel sufficiently concerned to protest at Lyssenko's attack. This implies a sense of frustration, and in order to see how such a feeling could arise, side by side with the rapid development of a sound genetical theory, it is necessary for us to examine the progress of genetical science during its forty years of active propagation.

Gregor Mendel formulated two laws of heredity from which our theory of particulate inheritance has developed[3]. But to do so he devised an experimental technique for investigating genetical differences, and this is, perhaps, his major achievement. Without the technique he could not have made his own discoveries. With the technique he could solve his problems and, what is more, later geneticists could test, modify and extend his laws into the modern theory. Mendel's technique ensured the development of genetical science.

Now this technique of Mendel's depended on the use of single differences. He treated the differences between tall and dwarf, between round and wrinkled seeds. Only when he understood their individual behaviour did he proceed to investigate joint segregations. Once the 3 : 1 single-factor ratio was understood, the 9 : 3 : 3 : 1 and 27 : 9 : 9 : 9 : 3 : 3 : 3 : 1 could easily be interpreted. Thus his success depended on treating the simplest cases first. It is even clearer that the successful analysis of factor interactions, characteristically modifying the 9 : 3 : 3 : 1 into 9 : 7, 15 : 1, 12 : 3 : 1, 9 : 3 : 4 and so on, was impossible until both single-factor and two-factor segregation was fully understood.

Carried to its conclusion this process of investigating segregations of steadily increasing complexity would have led to an attack on the problems raised by those characters, like stature in man, which can only be interpreted as under the control of many genes, and which are hence termed polygenic. The task would have been more formidable than most early Mendelian researches, for these polygenes have individual effects which are small when compared with non-heritable fluctuations. That the approach was, however, then contemplated we may infer from Nilsson-Ehle's discussion of duplicate and triplicate factors in cereals[4]. Furthermore, Emerson and East soon afterwards published a paper on polygenic inheritance in maize[5], and their example was copied by a few other geneticists. But it happened that circumstances, which we shall discuss in a moment, directed interest into other channels. This was the beginning of loss of touch between genetics and the other branches of biology mentioned above ; for evolutionary change, as well as the improvement of crops and stock, depends on these complex characters. Species differences and the commercial qualities of plants and animals are polygenic, and it is polygenic, not simple, inheritance which evolutionists and breeders wish to see analysed.

Why then was the attention of geneticists directed elsewhere ? There were several contributory reasons. Mendel was not the first man to investigate inheritance, and when his work was re-discovered at the beginning of this century investigations of a different kind were being actively pursued. Galton and Pearson had attempted the analysis of polygenic inheritance, especially in man, by methods quite unlike those of Mendel, and their conclusions were also quite divergent from Mendel's[6]. Thus with Pearson defending biometry and Bateson advocating Mendelism a feud arose, and to geneticists polygenic inheritance assumed a heretical appearance. In the second decade of the century a few geneticists, notably Emerson and East[5] and Fisher[7], showed that the biometrical results could be interpreted as due to the action of many factors behaving in the Mendelian way, but their findings aroused little enthusiasm either in the biometricians or in the Mendelians, who had been, in Great Britain at least, antagonistic for many years. Thus we see that the first reason for the failure to press polygenic analysis was that it had become somewhat improper in the eyes of geneticists.

The second reason was that polygenetics had technical difficulties. Sharp segregations are never shown by polygenic characters and so their analysis requires a combination of genetical and statistical techniques, such as was not then available. If of course interest and enthusiasm had been sufficiently great we may be sure that the necessary technical advances would have been made ; but, in point of fact, we can find no contribution to the combination of genetical and biometrical techniques before that of Fisher, Immer and Tedin in 1932[8]. Genetical theory had by this time developed to a stage at which polygenic analysis of a kind impossible fifteen years earlier could be attempted, but slight use has since been made of the methods of these authors. Indeed there is little reason to believe that even to-day the full technical equipment for polygenic analysis is available. Perhaps no single method will be adequate, though selection experiments have proved of considerable value from the time of Johannsen[9] up to the present[10].

In the meantime Mendel's methods had, in Drosophila, led to an astonishing series of advances. Bateson and Punnett discovered, in 1906[11], that unit factors do not always segregate independently. Sex linkage was found shortly afterwards, and the field was clear for the proof of the chromosome theory of heredity, with all its corollaries, when Morgan and his associates began to apply the back-cross technique to *Drosophila melanogaster*. In a very few years sex linkage, the linear order of the genes, non-disjunction of chromosomes, crossing-over and sex balance had all been investigated by this method, and shown to be attributable to the special properties of chromosomes[12]. Here we have the greatest reason of all why polygenetics was neglected. Its technical difficulties stood in such sharp contrast with the basically simple and highly fruitful methods of the 'Drosophilists'. The trickle of papers on polygenic inheritance which had appeared after 1910 almost ceased when the full value of the Drosophila research was apparent to all. Instead similar work was undertaken in maize and other plants, in some cases by the few who had a short time earlier been pursuing polygenic studies.

The first phase of Drosophila genetics was as good as over by 1925 when triploids and attached *X* females had been investigated. It appeared about this time that interest in polygenic behaviour might be revived by the use of marker genes for the sorting out of complex genetical variation in terms of the chromosomes. In fact one paper of this type, on egg size in Drosophila, appeared in 1924[13], but a new departure in genetical research put paid to this promise. In 1927 Muller[14] announced his discovery that gene

mutation could be induced by X-ray treatment and so started a line of investigation which is still being actively pursued. This was followed by Darlington's re-casting of cytology in an inductive-deductive form in the early 1930's[15], by the use of the giant salivary gland chromosomes by Painter in 1934[16], and by Beadle and Ephrussi's investigations on gene action in 1935[17]. Polygenic characters seemed to have sunk completely out of sight under this competition.

Interest was, however, to be revived once more by the turn which genetics has taken towards the experimental study, as opposed to theoretical discussion, of evolution during the last ten years. Though at first attempted by the use of the familiar major mutations this departure forced geneticists to the conclusion that species differences are polygenic (see Timoféeff-Ressovsky and Muller[18]). The stage is again set for an attack on this complex type of inheritance, and, as result of the extra power given to genetical analysis by the chromosome theory and by Fisher's statistical techniques, the opportunity is greater than ever before. Let us hope that it will be seized.

During these forty years of consistent failure to get to grips with the type of inheritance which is, above all others, of importance to evolutionists and breeders, geneticists have not been slow to point out that their science is basic to the practice of research in these other fields. Much of the discussion has been valuable. The theory developed by Fisher, Haldane and Wright has cleared the ground for the new genetical research on problems of evolution, and Timoféeff-Ressovsky, Sturtevant and Dobzhansky have already shown what can be accomplished. But much of the genetical discussion has been unfortunate and harmful, especially in the absence of any experimental results. Though the later geneticists interested in the question have been, to a man, Darwinists, the earlier writers, notably Bateson[19] and de Vries[20], have left a deep mark on the attitude of the average biologist towards genetics, because they continually emphasized the sharply discontinuous nature of variation, when the practical examples of discontinuity to which they could point were generally mutations which appeared, to all but the geneticist, to be almost pathological in their effects on the organism's viability. Here we can see the origin of Lyssenko's attack.

Mendel's discoveries appeared shortly after the "Origin of Species", and we may take it that they would have profoundly affected Darwin's later work if he had been familiar with them. Fisher[21] has shown that the particulate theory of inheritance provides the solution to Darwin's most troublesome difficulty, that of seeing how the store of variability, which Darwin took to be blending, was saved from rapid decay. Darwin accepted this rapid decay and sought to overcome the trouble by assuming an equally rapid replacement by new, or, as we should say, mutational, variation, under the stimulus of novel environmental conditions. This view he developed in "Animals and Plants under Domestication", which Mendel's findings rendered unnecessary as a central part of the theory of evolution. It is thus necessary when discussing genetics and Darwinism, to state which Darwin is concerned, the author of the "Origin of Species" or the author of "Animals and Plants". Genetics is wholly consistent with the "Origin of Species" but has little concern with "Animals and Plants", which in its turn is unnecessary for evolutionary theory.

This effect of particulate inheritance on Darwinian theory was, however, overlooked in the early years of the century. Mendel's paper was re-discovered at a time when small apparently continuous variations were being decried and the younger biologists, of whom Bateson was one, were turning to the view that the variation from which evolutionary change flowed was sharply discontinuous. Mendelian segregation and de Vries 'mutations' in Œnothera apparently fitted so well to this view that they were immediately seized on as good evidence in its favour. It was only much later, when the true nature of de Vries mutations was known[15], and the effects of natural selection on major genes had been considered, that the superficial nature of this evidence was realized. The return to Darwinism and polygenetics then became inevitable. The speculation of Bateson, de Vries and their followers was vitiated by their failure to assess accurately the evolutionary significance of the major variants which they observed, and there was insufficient experimental information to provide an adequate check on this speculation. It is now clear that discontinuous genotypical variation is not incompatible with continuous phenotypical variation; when each of the many genes has a small effect and non-heritable fluctuations occur. Polygenetics integrates genetical discontinuity and Darwin's smooth variation. Bateson and de Vries failed in not seeing that such an integration was possible.

We are now in a position to see Lyssenko's charges in their true perspective. We are not immediately concerned with the method of plant breeding that he advocates. If it should prove sound, its basic theory must be incorporated in genetics; but this is a matter for the future, and in the meantime cannot affect our judgment on his specific charges against genetical theory.

When Lyssenko states that genetics has not contributed very much to the improvements of crops and stock, we must agree with him. In special cases, like the development of autosexing poultry, genetics has been of great value, but these cases are exceptional. The reason for this failure is not, however, that genetics is unsound, but that its development has, owing to a series of historical accidents, been away from the breeders' problems. This may be deplorable, but it provides no ground for pessimism about the contribution that suitable genetical research can make to breeding technique. To deny the potential value of genetics would be as great a misjudgment as that of any geneticist who tried to maintain that his subject had, in the past, given results on which all breeding work must be based. The reality of the present lack of touch is well shown by the way that, at the Russian conference, the bearing of genetics on breeding technique became a matter of personal testament rather than one of analytical discussion.

Secondly, when Lyssenko holds that genetics is anti-Darwin, he is wrong, at least as regards the "Origin of Species", though when he maintains that geneticists have been anti-Darwin he is obviously right. In the absence of appropriate experimental work, the relation of genetics and evolutionary theory has been a subject for unchecked speculation of which much was superficial and unsound. Perhaps the best evidence of the soundness of the genetical approach, as distinct from genetical speculation, is that, in spite of the lack of polygenic research and in face of the utterances of the early Mendelians, geneticists are to-day realizing more and more that small variations are the material of evolution;

though they realize equally that Darwin's argument in "Animals and Plants" is not essential to the theory and may be removed without weakening the general structure in any way.

Finally we come to Lyssenko's condemnation and rejection of what he calls "Morganism-Mendelism". We can see that it arises from a failure to realize the relations of genetical development and the breeder's requirements. He says, in effect, that genetics is useless to the breeder and therefore should be abolished. But astronomy is of no great use to the breeder and yet we do not consider abolishing that science. The real situation is that the particulate and the chromosome theories of heredity are founded on a vast body of fact. They have been tested and re-tested, but never found wanting. Nor has Lyssenko himself any evidence of their alleged unsoundness, though he may have plenty of their faulty interpretation by geneticists themselves and by others. As a case to point, we may take his rejection of pure-line theory on the basis of his observation that intra-varietal variation exists in self-fertilizing cereals. The existence of such variation cannot in fact vitiate pure-line theory. Indeed Johannsen himself envisaged this very type of variability[22]. It does, however, show that the application of the theory was faulty because, as Lyssenko discusses it, both mutation and the small amount of out-crossing, known to occur in wheat, oats, etc., are overlooked. It is to the investigation of these agents that attention should be turned, rather than to the alleged unsoundness of misapplied genetical theory.

To call for the rejection of genetical theory is useless; for this theory is sound, no matter how disappointed we may feel that, while developing its internal structure, genetics has neglected those aspects which appeal to the breeder. What is required is experimental research on polygenic behaviour, so that genetical theory may be enlarged until the full potential value of genetics to evolutionist and breeder is realized. The task will doubless be laborious, but the need is obvious and the opportunity great.

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ROLE OF PHOTOGRAPHY IN THE DETECTION AND MEASUREMENT OF RADIATION

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LIGHT which falls on a photographic plate causes the crystals of silver halide, which form the essential constituent of the sensitive layer, to be converted by subsequent development to silver grains, and gives rise to a blackening of the exposed areas. The silver grains can be counted under the microscope, but they provide no direct measure of the incident energy. Although much painstaking work, culminating in the recent theory of Gurney and Mott, has led to a fairly complete understanding of the mechanism of the photographic process, many factors enter in to prevent the establishment of a one-to-one, or other simple, relationship between silver grains and absorbed quanta. Thus the photographic plate cannot be used as a method of absolute measurement of radiation: like the part played by the eye in visual photometry, its role is that of a null instrument for the measurement of an unknown source of radiation by comparison with a known. In addition, and unlike the eye, it provides a permanent record of brightness variations, often over an extended field.

How the photographic plate compares in sensitivity with the eye is a question often asked, and one to which no simple answer can be given. Objects of sufficient brightness to be seen at a glance require an exposure of several minutes to be recorded when a photograph is taken using lenses at present available; yet the existence of distant nebulæ is known only through the use of photography. The photographic plate can integrate radiation falling on it over long periods of time, and it is this ability which constitutes one of its greatest advantages, notably in stellar photography and astrophysics. Moreover, it can be used over a far greater wave-length range than the eye; the recording of ultra-violet lines of spectra provided one of its earliest triumphs; its sensitivity extends into the infra-red; and the great convenience of obtaining a record of the many lines of a source, which may be varying rapidly in intensity, has caused the almost universal use of photography in spectroscopy. X-rays were discovered by their action on the photographic plate, which is sensitive also to γ-rays, cosmic rays, electrons and nuclear particles. Over this wide range, comparative intensity measurements can be made. The accuracy attainable depends on the physicist's knowledge of the characteristics and behaviour of the photographic material and on his ingenuity in devising methods which reduce to a minimum the effect of the many possible sources of error. Under favourable conditions, accuracy of the same order as that possible in visual photometry can be obtained.

The light-sensitive unit is the silver halide crystal. The crystals are usually silver bromide, or mixed crystals of silver bromide with a small percentage of silver iodide, and are of the order of a micron in size. After exposure to light they suffer no visible change, but the affected crystals are completely converted to metallic silver by immersion in certain

* Substance of a lecture delivered to a joint meeting of the London and Home Counties Branch, Institute of Physics, and the Royal Photographic Society on Feb. 24.

reducing solutions known as developers, and are said, therefore, to contain a latent image. Since the conversion of any crystal to silver is complete, it is not surprising that the fastest photographic materials are those with the largest crystals; but departures are found, and size is not the only determining factor in sensitivity. The silver halides are conductors of electricity. In the dark the conductivity is ionic: it is temperature-sensitive, and at low temperatures falls to zero. On exposure to light there is conductivity at all temperatures, caused by the liberation of electrons; these tend to congregate at any point of low potential energy and to set up a field. Interstitial silver ions, which, ejected by thermal agitation from their lattice position, are responsible for the ionic conductivity, are attracted to the point and form there a speck of silver. This is the latent image which catalyses the process of development.

Thus, sensitivity depends upon the presence of nucleating centres in the crystals before exposure. Without these centres, which are produced in the course of manufacture and are believed to consist of minute traces of silver sulphide, the halide crystals are comparatively insensitive. It is this two-stage process in the formation of the latent image—the release of electrons and the subsequent attraction of silver ions—which is responsible for many of the complex phenomena that are observed. Any radiation that is absorbed will cause the formation of a latent image. The natural absorption of silver bromide is restricted to the blue and ultra-violet, where it is finally limited by the absorption of the gelatin in which the crystals are suspended. The addition of traces of sensitizing dyes results in the formation of a monomolecular coating of the crystals, and the energy absorbed by the dyes is passed on and utilized; in this way the sensitivity has been extended to a wave-length of $1{\cdot}3\mu$; theoretical considerations indicate that an upper limit will be set at about 2μ by thermal energy. The number of quanta required to produce a latent image is not known with any certainty; it probably varies from a few to many hundreds; and the crystals are found to vary widely in sensitivity even when their size is constant, an effect attributable to the need of a suitable nucleating centre. By comparison, high-energy quanta, X-rays, electrons, etc., appear to cause developability upon a single impact.

The photographic effect is conveniently measured by the density of the layer after development and drying. This is defined as the common logarithm of the reciprocal of the transmission, and bears no simple relationship to the number of grains, depending as it does upon size of the grains and upon the method of measurement. Although the silver grains are black, they scatter light appreciably; and the measured density depends to a considerable extent upon the proportion of the scattered light which is collected by the measuring instrument. The effects of exposure and development are usually represented by plotting the density as a function of the logarithm of the exposure; this results in the well-known *S*-shaped characteristic curve. The position of this curve with respect to the logarithm of exposure axis represents the 'speed' of the photographic material.

Since different materials differ also in the shape of their characteristic curves, the measurement of speed depends to a great extent upon the convention adopted; the choice will be governed by the purpose for which the measurement is required; in spectrography, for example, the reciprocal of the exposure to produce a density of 0·6 is often taken as a convenient measure. The slope of the curve determines the ability of the plate to reveal small object brightness differences; and, by the use of recording materials of high 'contrast', differences of brightness which are invisible can be readily recorded. The shape and position of the curve depend both upon the conditions of exposure and of development, so that it is characteristic of the photographic material in only a limited sense. With increase in the time or temperature of development, the curve increases in slope and tends to shift laterally towards lower exposure values as more and more grains become developed: in general, both contrast and speed increase.

Change of absorption with wave-length can cause the slope of the characteristic curve to change; exposure to ultra-violet light, which is strongly absorbed, leads to curves of much lower slope. The time of exposure is a factor of great importance. The photographic plate is not a perfect integrator of radiation: an x-times reduction in intensity cannot be made up for by an x-times increase in exposure time. Thus intensity and time are not reciprocal quantities, and the photographic plate is said to show failure of the 'reciprocity law'. If, therefore, the logarithm of the exposure (intensity $\times$ time) necessary to produce a given density is plotted as a function of exposure time, instead of a horizontal straight line being obtained, the curve passes through a minimum, which, with many materials, occurs at times of the order of 1 second. At both shorter times (higher intensities) and longer times (lower intensities), more exposure is necessary to produce the given result.

These departures, which are of great importance in many problems of photographic photometry, are the direct result of the two-stage formation of the latent image. At high intensities, the second stage—the moving up of the silver ions—does not take place quickly enough; the capacity of the nucleating centres for electrons is limited; some are repelled before they are neutralized by the silver ions, and the size of the silver speck is therefore reduced. At low intensities, the nucleating centres build up slowly: in the early stages of their growth they are not stable and tend to lose electrons by thermal agitation; considering the same total number of quanta incident on a crystal, the greater the rate at which they are received the greater their effect. In the extreme case, unless the rate of reception of quanta is more than sufficient to counterbalance the loss by thermal agitation, no duration of exposure will give a photographic effect. Thus, in astronomy, success depends upon the size of the telescope used, since this governs the brightness of the stellar image; prolonged exposure with small telescopes fails to reveal the fainter stars detectable by larger instruments. The shape of the so-called reciprocity curve can be modified in several ways. If the temperature is lowered during exposure, the mobility of the silver ions is decreased and the sensitivity at high intensities is thereby decreased, but at low intensities the sensitivity is increased, since the latent image becomes more stable. Use has been made of this effect in astronomy, and plates have been cooled to a temperature of solid carbon dioxide during exposure in order to increase their sensitivity.

The addition of a uniform exposure has interesting and useful results. The sensitivity of the plate may be increased either by a uniform exposure before the camera exposure or after it, depending upon the

actual time of the camera exposure; when this is long, as in the photography of faint celestial objects, the sensitizing exposure must take place beforehand and must consist in a short flashing of the plate; when the camera exposure is relatively short, the uniform exposure must follow and must be to a low intensity for a long time. In either case, the added exposure is adjusted in amount to produce only a small general fogging which does not greatly affect the interpretation of the record. Uniform after-exposure or pre-exposure can thus be useful, if applied deliberately; but equally they may lead to serious errors if they occur accidentally and pass unrecognized.

A manifestation of reciprocity failure that has long been recognized as a source of error in photographic photometry is the intermittency effect: an exposure given intermittently may produce a greater, or lesser, density than when the same total exposure is received continuously. Quite recently it has been shown that, if the interruptions are sufficiently rapid, the effect is the same as that produced by a continuous exposure of an intensity equal to the *average* intensity of the intermittent exposure. The frequency of interruptions must be so high that on the average each grain receives only one quantum during each separate exposure. Owing to the small size of the grains, the critical frequency is not as high as might be imagined: an exposure of one second duration need be interrupted at a rate of only a hundred per second. From being a source of error, valuable use can now be made of the effect: by rotating sectors at high speed, variations in time can be converted effectively into variations in intensity. Apart from the occasional advantages that can be made of these effects of reciprocity failure, the fact of importance in photographic photometry is that the calibrating exposure should always be of the same duration as the exposure to the unknown source. There are only two exceptions to this rule: X-rays, and other high energy quanta, because they make a grain developable by a single impact, show no reciprocity failure; the log It/log t curves for different wave-lengths are always parallel. If, then, during the process of calibration, one spectrum line is reduced in intensity until it matches in density another line of the same spectrum, the relative energy of which is known, the result will be independent of the exposure time; so that, in certain cases, the calibrating exposure need not be of the same duration as the unknown.

The general rules of photographic photometry follow readily from what has been said. The calibrating exposure should always be impressed on the plate used for recording the unknown radiation, so that errors of development may be reduced. Whenever possible, the two exposures should be made on contiguous areas, since the plate may show small local variations in sensitivity. The spectral composition of the calibrating radiation should be identical to that of the unknown radiation, although in spectrophotometry within narrow spectral regions it is permissible to use a mean wave-length for the calibrating radiation, for example, by the use of sharp cutting filters. The time of exposure must be the same for both exposures. apart from the two exceptions mentioned.

It has been assumed that the exposed areas are large and that edge effects can therefore be neglected: the sensitive layer has been imagined to be a two-dimensional continuum, and any effects caused by its finite thickness have been ignored. During the course of manufacture, the photographic 'emulsion', which is a suspension of silver halide in a solution of gelatin, is coated evenly on to its support, and dries down to form a layer about one thousandth of an inch in thickness. During development, the layer swells to some five times this thickness. The images to be recorded are often of comparable dimensions, for example, the image of a star or of a spectral line; and second-order effects arise, owing both to the penetration of the light and the penetration of the developer. The light is strongly scattered on entering the layer, and a sideways spreading of the image results: the developer solution reaches the grains by diffusion, and the products of the chemical reaction diffuse outwards; they inhibit the reaction and produce local variations which may sometimes cause the density distribution of an image to depart seriously from its true form. Full development and vigorous agitation of the developing solution over the surface of the plate will generally reduce these effects to negligible proportions; but the effect of light scatter is not so easily overcome. Use can sometimes be made of this, as in astrophysics, where the growth of the image with exposure is used as a measure of stellar magnitude. More often the scatter tends to destroy the fine detail of the image, and can be limited only by the best choice of materials. The effect depends both on the grain size and the number of grains per unit volume of the layer, as well as on the wave-length of the light; and the finest grain emulsions are not necessarily those which scatter least. The discrete nature of the developed image also plays a part in the detection of fine detail. A microdensitometer record of a uniformly exposed and developed area shows irregularities caused by this granularity of the image; variations due to this cause will be superimposed on those which are the subject of investigation, and will tend to mask them. The graininess increases both with the density of the image and with the size of the grains; its effect on visibility tends to outweigh that of light scatter, so that slower emulsions almost invariably have greater resolving power than faster ones. An additional reason is that slower emulsions generally have higher contrast, and this naturally increases the ability to differentiate small brightness differences.

It is not surprising that an almost bewildering array of photographic materials is available. The choice must depend upon the problem in hand. Sometimes the need is for high resolving power and for low graininess; at other times, these desirable features must be sacrificed for extreme speed for some part of the spectrum; and consequently a compromise must usually be made.

OBITUARIES

Prof. A. W. Nash

ALFRED WILLIAM NASH, professor of oil engineering and refining at the University of Birmingham, died in his fifty-sixth year at his home in Solihull on March 14. After training as a mechanical engineer at King's College, London, he had some experience in dock construction in Hong-Kong, and shortly afterwards joined the (then) Anglo-Persian Oil Company and took part in the building of the great refinery in Abadan, South Persia. In 1913 he proceeded to the Caucasian oil territory and remained in Russia for more than five years, chiefly engaged in field production problems.

UNIVERSITY OF BIRMINGHAM

Applications are invited for the Chair of Oil Engineering and Refining (Petroleum Technology) rendered vacant by the death of Professor A. W. Nash. The appointment will date from October 1, 1942, and the salary will be £1,250 per annum.

It is intended to appoint the most outstanding candidate irrespective of the particular branch of the subject in which he has specialised.

Further particulars of the appointment may be obtained from the Secretary, to whom applications (three copies) must be submitted, with the names of three referees, on or before Saturday, 9 May, 1942.

C. G. BURTON.
The University, Edmund Street, Secretary.
Birmingham, 3.
March, 1942.

HENRY GEORGE PLIMMER FELLOWSHIP

The Governing Body of the Imperial College invite applications for the Henry George Plimmer Fellowship, vacant from September 1, 1942. The Fellowship was founded in memory of Professor Henry George Plimmer, F.R.S., who held the Chair of Comparative Pathology at the College from 1915-18. It is tenable for one or more years at a recognized institution, and is for research which may include Morbid Anatomy, Histological Anatomy, Chemical Pathology, Protozoology, Bacteriology and allied subjects in either Zoology, Medicine or Botany. The annual value is equal to the income from certain War Stock, approximately £217 per annum. The Fellow shall be considered to be attached to one of the Biological Departments of the Imperial College, and shall work under the general supervision of a Professor of that department.

Applications (by letter only) should be sent, before June 1, 1942, to the Rector, Imperial College, Prince Consort Road, London, S.W.7, from whom further particulars can be obtained.

Microscopes, second-hand, a large selection of instruments in perfect condition; 8d. stamp for list.—Chards, Specialists (Est. 70 years), Forest Hill, S.E.23.

HARPER ADAMS AGRICULTURAL COLLEGE

ASSISTANT LECTURER in BOTANY and ZOOLOGY

Particulars of the above appointment, for which immediate applications are invited, may be obtained from The Principal, H.A.A.C., Newport, Shropshire.—Salary, £250 p.a.

UNIVERSITY COLLEGE OF SWANSEA

The Council invites applications for the post of Lecturer in the Department of Mathematics. The salary will be determined according to qualifications and experience, with a minimum of £400 and a maximum of £500 per annum. The appointment will date from October 1, 1942. Further particulars may be obtained from the undersigned, by whom applications must be received on or before Wednesday, April 22, 1942.

EDWIN DREW,
Singleton Park, Swansea. Registrar.

ROYAL HOLLOWAY COLLEGE

(University of London)

Englefield Green, Surrey.

Required student-demonstrator in Botany. The demonstrator will have residence and honorarium and ample time for research. Full particulars from the Principal, to whom applications must be sent by May 1, 1942.

UNIVERSITY OF LONDON

The Senate invite applications for the University Readership in Organic Chemistry tenable at London (R.F.H.) School of Medicine for Women. Salary £500-£700 a year. Applications must be received not later than first post on Tuesday, May 12, 1942, by the Academic Registrar, University of London, Richmond College, Richmond, Surrey, from whom further particulars should be obtained.

Wanted urgently for neuro-surgical E.M.S. unit freezing microtome, to take fairly large size block.—Griffin & Tatlock, Ltd., 7 Cheviot Place, Edinburgh, 1.

BY ORDER OF THE EXORS. OF T. C. T. WALROND

Consulting Engineer (deceased)

ROGERS, CHAPMAN & THOMAS will sell by Auction in the residence, 126 HOLLAND ROAD, KENSINGTON, W.14, on Tuesday, April 28, 1942, at 2 o'clock, A COLLECTION (in first class condition) of OPTICAL AND ELECTRICAL APPARATUS AND INSTRUMENTS by leading manufacturers. Catalogues from Auction Offices, 125 Gloucester Road, South Kensington, S.W.7.

Applications are invited for the post of Assistant Physicist in the Physics Department of the Radiotherapeutic Research Unit of the Medical Research Council at Hammersmith Hospital, W.12. Salary £350 p.a. with yearly increments of £25 to £400, the appointment to commence July 1, 1942. Applications should be sent to the Director of the Unit by April 27.

Physicist and/or Electrical Engineer required for Development Laboratory of large electrical manufacturing company, N.W. London district, must be qualified to undertake detailed research and investigations. Reply with full details of academic and other qualifications, experience, and salary required to Box 844, T. G. Scott & Son, Ltd., Three Gables, London Road, Merstham, Surrey.

Applications invited for the post of Biology Teacher at Giggleswick School, Yorkshire. Good salary offered to well-qualified applicant.—Apply the Headmaster, Giggleswick School, Settle, Yorkshire.

Wanted. "Le Travail des Verres d'Optique de Précision" by Col. Charles Dévé.—Adam Hilger, Ltd., 98 St. Pancras Way, Camden Road, London, N.W.1.

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Then began Nash's long and successful career in Birmingham in the footsteps of that great pioneer, the late Lord Cadman, who had founded the first school of petroleum technology in Great Britain under his charge as professor of mining. When Cadman left, the chair was divided and a separate professorship of oil technology was established, and in 1924 Nash was appointed to the post. A very substantial endowment of £125,000 had been raised by the great British oil companies, and Nash's first task was to erect a block of laboratories, offices, museum and library to house his school. This was opened in 1926 and remains as his chief monument.

During his whole career in Birmingham, Nash was responsible for a constant stream of scientific contributions to oil technology. He was a man of ideas and well able to stimulate his staff and students. With his ample background of first-hand experience in oil-fields and refineries, he was well equipped to sense the relative importance of both practical and academic problems, and to direct a vigorous and progressive school of research, while in the course of his many visits to centres of oil activity in America, Europe and the East he made innumerable contacts with the men on the spot, and thus realized the need for investigation on this or that project.

Throughout his active life he was intimately concerned with the affairs of the Institute of Petroleum —known, when he became a member in 1914, as the Institution of Petroleum Technologists. For many years he served on the Council and as vice-president; three years ago he was elected president, and he died in that office. Most of his contributions to science are to be found in the pages of its *Journal*, but he was a prolific worker, and many of his papers appeared in American technical journals.

In collaboration with his colleague Dr. Bowen he wrote "The Principles and Practice of Lubrication"; with Dr. D. A. Howes, "The Principles of Motor Fuel Preparation and Application"; and he played a great part in the organization and editing of the four volumes of "The Science of Petroleum". His work with Howes on knock-rating of pure hydrocarbons was of great merit; he demonstrated the synthesis of lubricants from the simple olefines by polymerization; with Hunter he developed the fundamental study of solvent extraction, the dewaxing of lubricating oil and the refining of waxes. With Dr. A. H. Nissan he published a valuable paper on the relation between viscosity and constitution. His presidential address on "Petroleum as a Raw Material" showed real insight into the ever-growing utilization of oil and its gaseous by-products as raw materials for chemical syntheses.

This brief note would be very incomplete did I not pay a personal tribute to my old and valued friend and collaborator. Nash had a most lovable nature, and those of us who enjoyed his close friendship for many years feel his passing acutely. Especially will he be missed by his old students who, working in all parts of the world, always kept in touch with him, and were always delighted to visit him on their return home.

A. E. DUNSTAN.

WE regret to announce the following deaths:

Dr. B. M. Griffiths, formerly reader in botany and head of the Department of Botany in the University of Durham, on March 25, aged fifty-five.

Mr. R. W. Haydon, formerly lecturer in agriculture, University of Leeds, on March 28.

Mr. H. J. Hughes, formerly principal of the Muresk Agricultural College, Western Australia, on September 27, aged sixty-seven.

Dr. T. B. Macaulay, formerly president of the Sun Life Assurance Company of Canada, founder of the Macaulay Institute of Soil Research at Aberdeen, on April 3, aged eighty-one.

Mr. F. J. Rae, director of the Melbourne Botanic Gardens and Government botanist for Victoria, on September 18.

Mr. L. Wray, I.S.O., formerly director of the State Museums, Malaya, on March 14, aged eighty-nine.

NEWS and VIEWS

India

THE breakdown of the negotiations conducted by Sir Stafford Cripps on behalf of the British Government with the chief Indian communities for a settlement of relations between the British and Indian peoples is a cause for profound regret. At a time like the present, every jarring note in the concord of the free nations is eagerly awaited in the Axis camp, and is represented by every device of propaganda as a major disaster. This it certainly is not, for although the leading communities in India have been unable to agree either among themselves or with the British Government on any immediate change in the form of government of the country, on the major issue, namely, resistance to aggression, there has been striking agreement. Further, the various parties have been able to put their views to a member of the British Cabinet, and have themselves been able to study concrete proposals for a settlement. The fundamental stumbling block is clearly lack of mutual understanding and sympathy, and, one fears, an under-estimate of the complex factors involved in ruling a sub-continent. The old divisions and the old distrust are still painfully apparent. As Sir Stafford Cripps said in his farewell broadcast to the Indian people: "Someday, somehow, the great communities and parties in India will have to agree upon a method of framing their new constitution". The problem will have to be approached in the scientific manner, assembling all the data and weighing them without prejudice, in the sure hope that a true solution will eventually be found.

Science and Ethics: A Hindu View

THE symposium on science and ethics, opened by Dr. C. H. Waddington, which appeared in these columns during September and October of last year, aroused world-wide interest. We have already published a communication from Prof. Chauncey D. Leake, who was chairman of a discussion on the same topic by American biologists; and we hear that the Aristotelian Society is arranging a meeting early in June at which Dr. Waddington will be invited to defend his views. A comment on the symposium by D. V. Gundappa was published in the Indian journal *Current Science* in December last, and

a revised and enlarged reprint of his remarks has just reached us. Mr. Gundappa emphasizes the lack of agreement between the contributors to the symposium, and states his own view "that the data which science in its present state can furnish . . . for a theory of ethics or metaphysics are a field of quicksand". He then presents an extremely valuable summary of the Hindu philosophy of ethics, which, as he rightly points out, is only too little understood in Great Britain. Its elaborate structure and the mystical nature of its concepts will probably always make it difficult for non-Hindus to comprehend, but Mr. Gundappa's account, which is short and admirably clear, should serve as a most useful introduction to this important phase of human thought.

Federal Union and Peace Aims

WRITING with reference to recent articles in NATURE on reconstruction, the Federal Union Ltd., 3 Gower Street, London, W.C.1, has forwarded to us a resolution relating to the "Peace Aim—War Weapon" report prepared by its Peace Aims Committee, and passed by representatives of 150 branches of this movement at the annual general meeting held at Eastertide. The resolution reads: "Lack of unity among the United Nations can lose both the war and the peace, and we therefore call upon the Government to cement their unity by the following methods: (1) Inviting Russian and Chinese representation on the joint commissions directing Anglo-American strategy and supply. (2) Pressing our Allies to set up an Allied Political Warfare Board. (3) Appointing an Allied Reconstruction Commission whose task would be to draw up a draft treaty outlining the world organization which should arise out of this war; this treaty to include plans for a nucleus democratic federation open to the members of such a world organization. The Allied Reconstruction Commission should define in a Twentieth Century Charter of Rights the political and social objectives which must be the foundation of both world organization and democratic federation. (4) Setting up, in conjunction with those of their Allies which have democratic governments in control of their countries, an International Consultative Parliament to advise the various Governments on the conduct of the war and to draft a provisional federal constitution."

Books for Damaged University Libraries

THE Committee on International Relations of the British Federation of University Women, at present at 16 King Street, Reading, Berkshire, points out that during the present hunt for salvage many books and journals are being sent for pulping which would yield only a small contribution to the War effort but a much greater contribution to the restoration of universities. The British Federation of University Women is therefore trying to collect books and journals suitable for academic libraries. The Committee would like to have particulars of suitable books and spare sets, volumes, or even odd numbers of scientific and similar journals. If possible, the Committee would like the donors to keep these books until the end of the War, as it is safer to have them dispersed, but depots will be arranged if necessary to which the books may be sent. The British Federation of University Women hopes by these steps to be ready, when peace comes, to help fill the many gaps made in university libraries in Great Britain and elsewhere by enemy action; this would be an important step in the reconstruction of university life.

Feeding Factory Workers in the United States

THE Council on Foods and Nutrition and the Council on Industrial Health of the American Medical Association have condemned the indiscriminate giving of vitamin pills to factory workers. They state that at the present time there is no body of scientific information on which to base the recommendation that industry as a whole adopt such a practice, which is irrational from the therapeutic point of view, unwise from the nutritional point of view and uneconomical; instead, firms should support research on nutrition among their workers. The Councils recommend a balanced diet of natural foods, and it is stressed that calories are the most important consideration. "No amounts of vitamins and essential mineral nutrients can obviate this need for energy. Furthermore, if wholesome natural foods are used as the source of the needed calories, the required vitamins and minerals will be secured automatically because they are contained in these natural foods." Reference is made to the stress laid in Great Britain on the provision of factory canteens where at least one good meal each day is provided; it is suggested that employers avail themselves of accurate data on diet from authorized Federal or State agencies, and, under proper direction, teach individual workers the bases of nutrition and through them their wives. The report closes with a reminder that nothing in the Councils' statements is intended to belittle the significance of vitamins in nutrition, or the value of the proper use of added vitamins in improving staple foods such as bread and flour.

Technically Trained Chemists in the United States

THE Defense Committee of the American Chemical Society has issued a report on a survey of one hundred and eighteen colleges and twenty-nine chemical corporations in the United States in connexion with the American war effort. It is reported that essential industry needs in 1942 from 2,000 to 3,000 more chemists and chemical engineers than will be graduated or are otherwise available. The official statement reads: "The Army and Navy are deeply concerned. Investigations made by this organization prove that trained personnel to produce this material [munitions] is lacking. Not only the finished product but also the raw material going into smokeless powder, rubber, etc., can be produced only under the active control of experienced chemists and chemical engineers. There is far greater immediate danger to the ultimate outcome of the war from shortages of such man-power than there is from any lack of officers and men in the combat force. Without production of essential materials the war will be lost, since the combat forces can not exist without material."

Earthquake in New Guinea on January 27

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has provisionally determined the epicentre of the earthquake of January 27 last, which occurred at 13h. 29·4m. U.T. The determination was based on instrumental reports from seismographic stations at St. Louis, Tucson, College, Logan, San Juan, Pasadena, Philadelphia, Lincoln and Fordham. The epicentre appeared to be in the region of Geelvink Bay in western New Guinea. The region of and around New Guinea appears to contain, in addition to active centres of activity, both

active and semi-active volcanoes. An earthquake with epicentre some two miles south-east of Rabaul (New Britain) occurred on May 7, 1919, in the neighbourhood of the semi-active volcano Glaie or Tavurur. One previous to this was on January 1, 1916. The line of disturbance is south-west from the volcano Glaie to the large active volcano called the Father on the north coast of New Britain. Earthquakes appear to be most severe when the Father is quietest. The line extends then westerly towards the west end of New Britain, where there are semi-active volcanoes; thence on to the island of Manam off the coast of New Guinea, where there is a very active volcano. The present seismic activity appears either to be on another branch of this line of activity, or along a westward extension of the line.

Earthquake in the Philippines

An earthquake of considerable severity was registered at both the Riverview and Perth Observatories in Australia on April 9 early in the day. At Perth the seismograph pendulum boom swung five inches, and at Riverview the seismograph showed earthquake waves passing the observatory for four hours. It was tentatively suggested that the earthquake might have had its epicentre under the sea south-west of Luzon in the Philippines.

Rainfall Flooding and Health

A Chadwick Lecture under the Bossom Gift was given on April 14 by Mr. D. C. Graham, who discussed the dangers from rainfall in urban areas, the prevention of flooding of buildings and of its insanitary consequences. Mr. Graham dealt with the subject under four headings: (1) faulty design of buildings and omissions of essentials; (2) overflowing of streams and rivers; (3) damp and flooding by land water; (4) backing up of rainwater in drains and sewers. The first two causes were touched on and the two last discussed in detail. Reference was made to the importance of the building by-laws in this connexion and to the necessity of careful inspection and repair of river walls. As regards the third cause, there is considerable difficulty in ascertaining in dry weather whether a building site will remain dry and whether there are any land drains or filled-in ditches that will cause dampness or flooding after heavy rain. The varying levels of the land water due to drought, pumping near the site and to wells and the great importance of constructing the lowest floors of building either above the maximum water level or making the walls and floors waterproof and of sufficient strength, were dealt with, as well as the laying of sub-soil drains near a building, and what they should and should not do. It is not practicable for financial and other reasons to provide sewers of sufficient capacity to carry away the heavy rainfalls that occur from time to time, especially during thunderstorms, as rapidly as they fall, and there are a number of unknown factors, such as the storage capacity of the sewers and drains and the fact that during a storm the flow in the sewers may be backwards as well as forwards, which prevent precise calculations being made. Where it is necessary to construct basements with floors below the possible flood level in the sewers, there are advantages in not draining such basements; where such basement drainage is required in old or new buildings, the risk of flooding can be reduced to a minimum at no great expense.

Freshwater Fish Farming

The Freshwater Biological Association of the British Empire has just published a pamphlet on the "Production of Freshwater Fish for Food" by Dr. T. T. Macan, Dr. C. H. Mortimer and Dr. E. B. Worthington (Freshwater Biological Association, Wray Castle, Ambleside, Westmorland, Sci. Pub. No. 6, pp. 36. Price to non-members 1*s.* 6*d.*) Fresh water covers about 340 square miles in England and Wales and about a similar area in Scotland. The total area is, therefore, comparatively small; but in war-time these inland waters should not be neglected since they can yield crops of food at the cost of little labour. The chief aim of the pamphlet is to make available some of the methods, especially those involving the use of manures, by which crops of fish from fresh water can be increased. The most suitable fish for stocking ponds are carp (*Cyprinus carpio*), tench (*Tinca tinca*) and rainbow trout (*Salmo irideus*). Other freshwater fish are considered, though most of them are unsuitable for rearing in ponds. Perch, for example, tend to become too numerous, and a method of perch trapping is described in the pamphlet (see also Nature, 148, 651; 1941). Improvements in eel fishing are also discussed. Other topics considered in the pamphlet are: the food chain in natural waters, productivity of natural waters, methods of increasing productivity, pond management and construction, stocking and cropping, lay-out of a carp farm, sewage fishponds. Anyone possessing a pond or concerned in any way with areas of fresh water of reasonable size should obtain a copy of this pamphlet.

Air-raid Damage and Electricity Supply

In its issues of March 13 and 20, the *Electrical Review* publishes the results of a works investigation by E. A. Beavis of cable breakdowns due to bomb damage and the resulting short-circuits, the implications of which, on a cable of comparatively small cross-section, seem to warrant careful consideration by power distribution engineers (see also Nature of February 7, p. 173, and March 28, p. 362). This cable, having an area of 0·023 sq. in., was insulated for 11 kv. and provided with a B.O.T. sheath and a lead sheath which was double steel-tape armoured and served. It had operated since 1926 on a 6·6 kv. system. During a severe raid, a bomb explosion damaged the cable at a point 708 yd. from the main sub-station and also a 0·10-sq. in., 3-core, 6·6 kv. cable running close by along the same route. The switch controlling the 0·023-sq. in. cable did not trip, although the 0·10-sq. in. cable was tripped out on short-circuit protection. Excavation disclosed damaged places in the 0·023-sq. in. cable at five points within a distance of about 150 yd. from the main sub-station. The faults were cut out and removed for examination. With the exception of No. 5—the farthest from the station—all the failures showed similar characteristics and in appearance were more like bursts or blow-outs than true electrical faults.

At fault No. 5 the cable had burst completely, one steel tape only holding the parts together. At the break, the conductor strands showed signs of fusing, while the lead sheath also had been partly melted; a short-circuit had evidently occurred at this particular spot. From the collected evidence, it seems that two distinct breakdowns occurred, the first of which was at the crater caused by the explosion and

the second at fault No. 5. From a consideration of the circuit conditions prevailing it was concluded that from the very outset the 0·023-sq. in. cable was too small to be able to deal with the large fault kva. capacity available—approximately 260,000 kva. at the main sub-station. A factor contributing largely to the excessive damage occasioned was the comparatively long time-delay in the switch tripping arrangements; with a minimum relay setting of practically 0·9 sec. and a switch action taking 0·4 sec., the total clearance time was almost 1·3 sec. Had this operation been much quicker, say 0·4 sec. or less, the temperature would not have reached 200° C. and the deterioration in the cable would not have been excessive. The second part of the article gives a theoretical study of the factors involved in co-ordinating cable size with system characteristics from the point of view of the large fault kva. likely to be experienced.

Bio-Physics in the United States

THE growing importance of bio-physics is recognized in a new feature of the *Review of Scientific Instruments*, published by the American Institute of Physics. Starting with the new volume, 13, the scope of the journal is enlarged to include physical instruments useful in biological research. In the issue dated January 1942, Detler W. Bronk discusses physical instruments for the biologist. Reference is made to the outstanding work of Helmholtz, Keith Lucas and A. V. Hill in the combined fields of physics and biology. Progress in the physical sciences is soon reflected in the advance of biology and medicine. As these sciences become more analytical, more revealing methods of observation, more precise instruments for measurement and more accurate means for the control of experimental conditions are needed. Investigators have extended their large-scale analyses down to the small scale of the activity of the cellular units of the organism and their molecular structure. This requires extraordinary sensitivity and high resolving power in the instruments. Furthermore, some of the phenomena occur with great rapidity.

One of the great faults of extreme specialization lies in the tendency to produce journals of similar extreme specialization, so that workers in the restricted field need 'waste' no time in reading outside their subject. As a result they are often ignorant of fields where their own specialized knowledge would be of the greatest help. The danger is very great in biophysics. Whereas every medical student must spend a part of his time studying physics, it is quite unusual for the physicist ever to have studied biology. Time-tables in universities often prevent a student including one of the biological sciences in a course involving both physics and mathematics. The new development, by which papers on biophysics will be included in a journal devoted to general physics, will prove unusually valuable in directing the attention of physicists to a new field containing problems of which many may be quite unaware. The first three papers in the new section deal respectively with an analyser for 1 c.c. of respiratory gas, with volumetric microrespirometers capable of an accuracy of the order of 1/100 mm.^{3} an hour and with an electrical capacitance diaphragm manometer for direct pressure measurements in the arterial blood stream. This latter instrument uses a radio-frequency, crystal-controlled oscillator and a pressure-sensitive condenser in the pick-up unit.

The Direct-Current Amplifier in Industry

IN a paper read before the Institution of Electrical Engineers on March 6, D. C. Gall describes the design and behaviour of a direct-current amplifier, entirely alternating-current mains-operated, and having an accuracy independent of mains' fluctuations or change in valve characteristics. The voltage to be amplified is applied to a reflecting galvanometer in series with a resistance. The light from the galvanometer strikes a photo-cell which controls the grid voltage of a thyratron valve, this voltage shifting according to the illumination of the photo-cell. The grid voltage makes the thyratron conducting between its anode and filament circuit for part of the positive half-wave and, as the phase of the grid voltage advances, the conducting period lengthens, giving a larger effective rectifier current output. This current is fed back through the resistance so that the voltage drop opposes the applied voltage, the drop rising until the input voltage is balanced. Output current is thus proportional to input voltage. The thyratron anode current is supplied from a 250v.-section of the mains transformer and it operates the amplifier output circuit apparatus. Smoothing condensers and inductances convert the thyratron unidirectional current pulses into steady direct current and suppressing circuits eliminate radio interference from these pulses. The amplifier has an output of three watts and a power gain of about 10^{10}. It can be used as a voltage- or current-amplifier and is extremely stable. It has been applied to high-speed temperature-recording of liquid steel, to the metering of heat transport in large hot-water plants, to optical pyrometry, measurements of illumination by barrier-layer type photo-cells, to the polarograph and to many other problems in which very small E.M.F.'S are available as a function of the quantity to be measured. The departure from linearity of response is of the order of only a few parts in 10,000, and voltages of a few microvolts and currents as low as 0·01 microamp. can be amplified and thus used to operate recorders and controllers.

Uses of Laminated Densified Wood

AN article by A. E. L. Jervis in the *Electrical Review* of March 27 describes the insulating properties and tooling applications of the so-called densified woods. In contrast to the mechanical shortcomings of solid wood, the laminated densified varieties are very strong and can be good electrical insulators, resisting corrosion and acid as well as moisture absorption, in which respect those produced under greatest pressure with the largest resin impregnation content appear to afford the best results. They can be substituted for metals, being more suitable (one sixth the weight of steel) in some cases, easier to machine and modify, and more quickly produced in a variety of thicknesses and shapes, so lending themselves to mass fabrication. Laminated densified woods can have tensile strengths up to 34,000 lb. per sq. in. and compressive strengths between 18,000 and 30,000 lb. per sq. in., depending upon veneer orientation with respect to the direction of the wood grain. Fanwise arrangement of the veneer laminations is suited to the manufacture of circular articles; 45° stacking is a simplification, and a 90° arrangement is the standard for material used for aircraft tool-making.

Two varieties are made by Moulded Components (Jablo), Ltd., both being produced hot under pressure.

One grade, 'Jabroc', consists of alternate laminations of wood veneers and glue films and is used primarily for its mechanical superiority when electrical stressing is light. The dielectrically better 'Insul-Jabroc' consists of impregnated veneers only and is essentially an insulator for use indoors, out of doors, or under oil. Electric strength tests made on two 0·25-in. thick 'Insul-Jabroc' boards selected at random, each consisting of twenty-one veneers of beech wood, resulted in puncture at 65 kv. when impregnated with cresol resin, and at 62·5 kv. with phenol resin. Applications of densified wood are generally similar to those of the better-known moulded plastic substances; a typical electrical example is instrument panels aboard ships, while as a secondary dielectric it can be used for insulator spindles for overhead power lines. It also finds application in the fabrication of air screws and in the manufacture of tools for the aircraft industry, where its lightness can be an important factor in the increasing amount of female labour being employed in factories. In some cases in which girls have been unable to handle large steel jigs, for example, the introduction of laminated materials may effect up to 80 per cent saving in tool weights.

Cellulose Acetate Yarn for Wire Insulation

IN an article by D. R. Brobst (*Bell Lab. Rec.*, 20, No. 5; 1942) it is pointed out that, about twenty years ago, a preliminary investigation was made on cellulose acetate yarn samples which indicated that its electrical properties are superior to those of silk. By 1925 the trend towards the use of acetate yarn in the textile industry was accompanied by the establishment of several plants in the United States to produce this yarn. Trial installations were made in several telephone offices, primarily to determine the handling characteristics of the material during manufacture and installation, and to obtain data on the service ageing properties. At first, mechanical difficulties experienced in handling the wire offset the price difference between the silk and acetate yarn so that no economic advantage could be obtained by its adoption. With further expansion in the use of acetate yarn in the textile industry and the resulting reduction in price, methods of handling were developed so that the yarn could be used in regular manufacturing processes without difficulty. The advantage to be gained from the use of acetate yarn from the point of view of electrical characteristics and price not only warranted substitution of this material for silk in silk and cotton insulated wires, but also amply justified the use of a wire with double wrappings of acetate yarn, a single wrapping of cotton and a lacquer coating, in place of wire which had been made with a double wrapping of cotton and cellulose acetate coating.

Card Index of X-ray Diffraction Data

A 4,000-CARD file index of X-ray diffraction data for use in the Hanawalt method of chemical analysis by X-ray diffraction has recently been published by the American Society for Testing Materials. This compilation is sponsored by a joint committee of the Society and the National Research Council, under the chairmanship of Prof. Wheeler P. Davey, Pennsylvania State College. The data include not only those obtained by Dr. J. D. Hanawalt and his associates and contributed by the Dow Chemical Co., with later corrections, but also additional data that have been contributed by the Aluminum Co. of America, the New Jersey Zinc Co., together with data taken from the technical literature in the English language. The cards give all pertinent data found in the sources, with provision for insertion of accessory data such as crystal structure, density, etc. The index identifies the strongest three lines in the X-ray diffraction pattern of some 1,300 crystalline compounds, the chemical names and symbols of which are as given by the various sources. The Hanawalt method has been described in the technical literature and a committee of the American Society for Testing Materials is perfecting a tentative recommended practice for the identification of crystalline materials by the X-ray diffraction method. Copies of the index, packed in finished container boxes, can be obtained from the American Society for Testing Materials, 260 S. Broad Street, at 50 dollars per set.

Leeches

UNLIKE the L.M.B.C. Memoirs, from which they admittedly received their inspiration, the Indian Zoological Memoirs are not confined to the description of marine organisms, and the most recent to be published under the able editorship of Prof. K. N. Bahl is No. 8 on Hirudinaria, the Indian cattle leech (Lucknow, 1941), by Dr. M. L. Bhatia. Those instructors in Great Britain faced with providing senior students with class material will read with envy that *H. granulosa*, the type chosen, is common in India and that fully grown specimens attain a length of 12–14 in. This monograph is a straightforward and readable account of Hirudinaria from a number of different points of view, and the frontispiece is a coloured plate of the entire animal. In the first chapter the classification is dealt with, and an adequate review of the systematics of the Hirudinea is provided in order to show the position and relationships of Hirudinaria to the other leeches. The family Hirudidæ, to which it belongs, and the genus Hirudinaria are naturally more fully dealt with than the remainder. The main part of the book contains a very good account of the anatomy and histology of the leech illustrated by clear drawings, but it is permissible to pick out two chapters as being exceptionally useful. These are the ones dealing with the cœlom and hæmocœl system and the excretory system, matters that receive inadequate treatment in most text-books. Altogether the monograph reaches a high level, and is particularly welcome since the information it contains, most of which applies with slight modification to Hirudo, is not readily available to the ordinary student. Author, editor and publisher alike deserve the congratulations and thanks of zoologists not only in India but in other countries as well.

Medical Advances in the Argentine

IN a recent paper (*Bol. Ofic. San. Panamericana*, 20, 1265, 1941) Dr. B. A. Houssay, director of the Institute of Physiology in the University of Buenos Aires, surveys some of the more important contributions to medical science in the Argentine during the last few years. The work at the Institute of Physiology includes studies of the role of the anterior pituitary lobe in carbohydrate metabolism and diabetes, hypertension of renal origin, fluorosis, the role and regulation of plasma potassium, the normal and patho-

logical physiology of urobilin and bilirubin, the sex hormones and the interaction of the glands of internal secretion. At the Institute of Nutrition directed by Prof. Escudero research work was done on milk, dietetics of childhood, national foods and vitamin C. At the Institute of Experimental Medicine directed by Prof. A. H. Roffo investigation was carried out on the carcinogenic action of tars (from coffee, tea, maté and tobacco), of derivatives of irradiated cholesterol, of diets based on cooked fats and of the production of cutaneous cancer in rats repeatedly subjected to the action of the sun and ultra-violet rays. The Bacteriological Institute of the National Department of Health directed by Prof. Sordelli not only prepares sera, vaccines and hormones, but also carries out research work on various infectious diseases such as brucellosis, bacillary dysentery, enteric fever, sylvatic plague, psittacosis, trypanosomiasis, uncinariasis, influenza and typhus. Important investigations have also been made on the adrenals and vitamin A at the Institutes of Physiology and Pharmacology of Rosario, and on endocrinology, electrocardiography and blood groups, at the Institute of Physiology at Córdoba.

Artificial Insemination of Cattle

ARTIFICIAL insemination of animals has been applied for some years in a number of countries. Advantages claimed for the practice are the lessening of the risk of spread of disease in livestock, reduction in sterility and increase in fertility, facilitation of improvement in quality, and economy in livestock management. Trials of artificial insemination of cows on a practical scale have been recommended by the Agricultural Improvement Council for England and Wales to be carried out in the first place at two centres, Cambridge and Reading, by the Cambridge School of Agriculture and the National Institute for Research in Dairying respectively, under the guidance of a supervisory committee and with the assistance of local committees for the two areas. The supervisory committee is as follows : Prof. J. Scott Watson (chairman), Prof. J. F. Craig, Mr. J. H. Everall, Dr. John Hammond, Mr. Robert Hobbs, Mr. P. A. Mytton, Mr. C. Nevile, Capt. J. Templeton.

Horticultural Composts

WORK upon the scientific mixing of composts performed at the John Innes Horticultural Institution has been condensed into a useful short paper by W. J. C. Lawrence (*J. Roy. Hort. Soc.*, 67, Pt. 3 ; March 1942). The new composts involve the use of sterile peat and very coarse sand for the improvement of texture, partial sterilization of turf loam by steam to eliminate harmful organisms and substances, and the addition of "John Innes base", a mixture of fertilizers. This base consists of a slowly available nitrogenous manure, a preponderance of superphosphate, and a little sulphate of potash. Details for the mixing of seed and potting composts are given in the paper, and fuller details are available in a leaflet (from the Institution, 31 Mostyn Road, London, S.W.19, price 6*d*.).

Two Early Plant Collectors

A SHORT paper by the Right Rev. J. W. Hunkin, Bishop of Truro (*J. Roy. Hort. Soc.*, 67, Pt. 2; Feb., 1942) describes the work of William and Thomas Lobb, two of the first plant collectors employed by James Veitch and Sons about 1840. William was responsible for such familiar introductions as *Berberis Darwinii* and *Escallonia macrantha* from Chile, while Thomas brought many new rhododendrons and orchids from Malaya.

Royal Society of Edinburgh Year Book

IN 1940 it was decided that the *Proceedings of the Royal Society of Edinburgh* should be published in two sections, "A" (Mathematical and Physical) and "B" (Biological), and the appendixes and certain other matter issued separately. The first issue of this additional material has now appeared under the title of "Year Book of the Royal Society of Edinburgh, 1940–1941" (price 5*s*.). It includes obituary notices, brief 'proceedings' of the meetings held during the session, lists of recent awards of the Society's medals, etc., membership list, and the laws of the Society. It will be very convenient to have these details of the constitution and activities of the Society in separate and handy form for reference purposes.

Announcements

DR. CHARLES OLMSTED, of the Department of Botany of the University of Chicago, has been appointed botanical editor of *Ecology*. He succeeds Prof. Francis Ramaley, of the University of Colorado. Prof. Thomas Park, of the Hull Zoological Laboratory of the University of Chicago, remains editor for zoology.

PROF. ADOLF WINDAUS, professor of chemistry in the University of Göttingen, well known for his researches on vitamins, has been awarded the Goethe Medal for Art and Science on the occasion of his sixty-fifth birthday.

THE following appointments and promotions have recently been made in the Colonial Service : W. S. Luke, to be veterinary officer, Kenya ; R. Johns, agricultural officer, Fiji, to be director of agriculture, Leeward Islands ; C. W. Elliot, assistant conservator of forests, to be senior assistant conservator of forests, Kenya.

THE following awards have been made by the American Institute of Electrical Engineers : Edison Medal to Dr. J. B. Whitehead, professor of electrical engineering at the Johns Hopkins University ; Alfred Nobel Prize for 1940–41 to Robert F. Hays, jun., of the research laboratories of the Sperry Gyroscope Company, for his paper entitled "Development of the Glow Switch".

THE immediate establishment of a Scientific Advisory Council for the war effort has been officially announced in Jerusalem. The Council will work in close co-operation with the Palestine Government. Dr. Judah L. Magnes, president of the Hebrew University, has been appointed president, and Prof. Farkas secretary of the Council, the membership of which will consist of representatives of the Hebrew University, the Technical High School at Haifa, and the Agricultural and Daniel Sieff Institutes at Rehovot.

ERRATUM. In NATURE of April 4, p. 383, "Linkage of Physico-Chemical Processes in Biological Systems" by Prof. E. J. Conway, equation 4 should read : $2_K = C_Y + \sqrt{C^2_Y + 4(C'_K{}^2 + C'_K C'_N)}$.

LETTERS TO THE EDITORS

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

Behaviour of Lipoids in Human Serum

FILTERED human serum gradually becomes turbid through the formation of a precipitate which is mainly lipoid. The presence of approximately 7 gm. of lipoid in 1 litre of human serum is shown by shaking with a mixture of ether and alcohol[1], when the protein is precipitated and the lipoid goes into solution. When ether alone is used, the protein is not precipitated, and negligible amounts of lipoid are contained in the ether extract. It has not hitherto been believed possible to remove lipoids in any quantity from serum by the use of ether alone.

If serum is shaken with ether and the mixture frozen below −25° C., on subsequent thawing a coloured ether layer forms on the surface containing large amounts of lipoid. Freezing at temperatures above −20° C. fails to produce lipoids in the ether layer, and freezing at temperatures down to −70° C. does not increase the amount in the extract. There is no apparent advantage in freezing for longer than is required to bring the bulk of frozen material uniformly to below −25° C. From 1 litre of human serum shaken with 300 ml. ether and frozen to −25° C., 3·5 gm. lipoid is obtained in the extract which forms on the surface after thawing in cold water and allowing to stand at room temperature for 6–8 hours. The underlying serum is siphoned off and will give another 0·85 gm. lipoid if shaken with 100 ml. ether and frozen. On repeating this, another 0·2 gm. lipoid is obtained, each successive extract containing approximately one quarter the lipoid of its predecessor.

A litre of serum which has been exhaustively extracted in this way gives a further 2·5 gm. lipoid on treatment with ether-alcohol. The serum separated at each stage is not clear to transmitted light but may be clarified by centrifuging. The final product contains 11 per cent dissolved ether, which can be removed in various ways. Freezing once more and thawing after removal of the ether causes the deposition of a gelatinous material of low solubility in cold water, and if this is removed by filtration in the cold through an ordinary filter paper the siphoned as well as the centrifuged product is perfectly clear at all temperatures and filters readily through a bacteria-retaining filter.

Electrophoresis photographs of human serum before and after the extraction show only one difference, namely, that the concentration of β-globulin has been reduced by the extraction. It follows that much of the apparent β-globulin of human serum is a lipoid-β-globulin complex so orientated that the protein determines the surface properties of the complex; or alternatively, that β-globulin itself is a compound of lipoid and a serum protein having surface properties different from those of its constituents. It is not possible to decide between these views on the evidence available, but it is at least clear that in the β-globulin fraction of human serum much lipoid is associated with a hydrophylic substance in such a way that it behaves atypically, that is, as a water-soluble and ether-insoluble material.

In the region of the eutectic temperature (−23° C.) of sodium chloride, serum becomes truly solid and, after thawing, the previously clear serum is cloudy. Similarly, serum which has been dried from the frozen state but not from the liquid state is reconstituted with water to form a milky suspension. This suggests that the association of lipoid with a stabilizing substance depends on the presence of liquid water and is destroyed by freezing. On subsequent thawing, unprotected lipoid is able to aggregate to visible particles or droplets. These, however, soon re-acquire the same stabilizer from solution, because the initial rate of aggregation is not maintained and the formed particles can be observed with the naked eye to migrate with the β-globulin boundary. The lipoid of these particles is also not extractable with ether unless accompanied by freezing.

After freezing and thawing, it must be assumed that a lipoid phase has been created in equilibrium with the aqueous phase, and if dissolved ether is present in the serum it will redistribute itself between the two. Lipoid aggregates containing dissolved ether rise to the surface and merge with the excess of ether there to form a solution of lipoid in ether. It may be suggested as an alternative to this that ether droplets containing dissolved lipoid are formed between the ice crystals on freezing, and owing to the low miscibility of ether in water these are able to rise to the surface carrying lipoid with them without re-solution of the ether taking place. This is contra-indicated by the observations that an extracted serum saturated with ether does not form an ether layer after freezing and thawing, and an unextracted serum saturated with ether but having no excess of it on the surface has the appearance after freezing and thawing of an emulsion and on standing a fatty layer collects at the surface.

The method of extraction has been used to clarify blood-grouping sera which had become cloudy, and these showed little or no reduction in agglutinin titre and remained clear in ether for nearly a year. Extracted human serum after drying from the frozen state is reconstituted with water to form a clear solution, and there is no evidence that the physical properties of the serum proteins have been affected by either process. For reasons not understood, most of the excess fat in a lipæmic serum is extractable with ether without freezing and the same has been found for the serum of nephrotics[2]. Details of the application of the method to citrate plasma are being published elsewhere.

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March 31.

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[2] Longsworth, L. G., and MacInnes, D. A., *J. Exper. Med.*, **71**, 77 (1940).

Metabolic Products of 3 : 4-Benzpyrene

IN 1936, Peacock[1] observed that animals receiving intravenous injections of 3 : 4-benzpyrene excreted in the bile an alkali-soluble product (*BPX*) possessing specific fluorescence bands which differed from those of the parent hydrocarbon. Subsequent investigations by Chalmers[2,3] demonstrated the existence of a similar phenolic derivative in the fæces, and this led to its isolation and purification. From recent crystallographic analysis[4], this metabolic product is considered to be a monohydroxy-benzpyrene.

In a study of the oxidation of benzpyrene by ascorbic acid *in vitro*, Warren[5] has found, in addition to the two known quinones (5 : 8- and 5 : 10-), a phenolic substance, soluble in alkali, giving a strong

green fluorescence. In view of the apparent similarity of this synthetic phenol to the metabolic phenol *BPX*, and since *in vitro* the formation of the quinone preceded that of the phenol, Warren suggested that *BPX* might be a partially reduced quinone.

Previous work on the isolation of metabolic derivatives of benzpyrene has been hampered by the small yields of the products, due partly to their instability and partly to the small amounts produced. The latter was due, in the case of intravenous injection of benzpyrene, to the small amounts which can be injected by that route, and in the case of subcutaneous injection, to the slow rate of metabolic change under those conditions. From a study of the fate of benzpyrene in the animal body under different biological conditions[6], it was found, however, that the body metabolizes benzpyrene about fifteen times more rapidly when injected intraperitoneally than when injected subcutaneously. By taking advantage of this difference, it became possible to investigate the nature of the metabolic products of benzpyrene on a more extensive scale.

The fæces of rats which had previously been injected intraperitoneally with large amounts of benzpyrene were desiccated, ground to a fine powder, and continuously extracted with cold benzene. On purification of the extract by chromatography, etc., it was possible to isolate, in addition to the phenolic product *BPX*, a red crystalline substance, possessing similar properties to the synthetic red quinone (5 : 8-) obtained by the method of Vollmann *et al.*[7]. On reductive acetylation or methylation, strongly fluorescent compounds with distinctive spectra were obtained, those derived from the synthetic quinone being similar in type to those derived from the metabolic quinone. They both appeared to be very different, however, from the acetyl and methyl derivatives obtained directly from *BPX*. This is in keeping with the conclusion reached by Chalmers and Crowfoot[4] that *BPX* is a monohydroxybenzpyrene, since, on acetylation or methylation, such a substance would be expected to yield the corresponding mono-derivatives, in contrast to the di-derivatives which may be expected from the quinones.

On the other hand, on standing in air (and, more rapidly, by treatment with oxidizing agents), *BPX* tends to change partially into the red quinone, a reaction which rather suggests that it is a dihydroxybenzpyrene.

While further investigations are still in progress, the results so far available are not incompatible with the view that both a mono- and a di-hydroxybenzpyrene are produced in the body, the former being slowly converted into the latter, and the latter being rapidly converted into a quinone.

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March 21.

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Effect of Chorionic Gonadotropin on the Pouch of the Marsupial *Trichosurus vulpecula*

THE pouch of the sexually mature, non-pregnant common Australian phalanger or possum (*Trichosurus vulpecula*) shows a marked reaction towards the administration of gonadotropic hormone obtained from human pregnancy urine. The immediate response during the period of administration is a decrease in the size of the pouch, but after about three injections of 200–500 I.U., the pouch expands markedly within a few days after the final injection. The increase in size in the caudal direction extends down to the pubis; in the lateral direction the cavity may expand over the whole of the lower abdominal wall. In such cases the extended pouch would be capable of housing a large pouch young of about one eighth of the body-weight of the mother. With the expansion of the pouch, mammary glands and nipples also increase in size and the interior of the pouch becomes very moist due to the secretion of a fluid which at first is colourless and then turns brown. This enlarged pouch persists for about a week, then slow involution takes place extending over several weeks.

In comparing the action of œstrogens[1] and progesterone[2] with that of gonadotropin, it may be pointed out that œstrogens bring on a contraction, and progesterone, after a slight preliminary expansion, a relaxation and eversion, while gonadotropin brings on an enlargement of the pouch. It therefore appears that the same hormones may control the activities of the pouch and of the eutherian uterus.

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Heterothallism and Reproduction in Fungi

WE are grateful for the clear genetical interpretation of heterothallism given by Dr. K. Mather[1], and may perhaps be allowed to carry his conclusions regarding reproduction in fungi a step further. We have been thinking on these lines for some time, and in a joint discussion held by Sections D and K at a meeting of the British Association in 1937, the suggestion put forward by one of us[2], that the heterothallism of some fungi might be compared with the incompatibility of some angiosperms, was not received sympathetically by the mycologists.

The evolution of heterothallism in fungi, a phenomenon not necessarily the outcome of sex, but possibly an independent and alternative process, has brought with it the problem of the bringing together of opposite strains: a problem intensified by the non-motile 'gamete' of the majority of fungi, and of peculiar importance in parasitic forms. Various mechanisms have been evolved which achieve this end, and it is in the interpretation and naming of these mechanisms that confusion has arisen between heterothallism and sex. The process whereby the

strains are brought together has been spoken of as the actual sexual process, whereas in many instances it no more represents a sexual process than does the carrying of a pollen grain to the stigma of an angiosperm. In many forms the strains are brought together by the dispersal of asexual spores such as oidia and papulospores which multiply the individuals of one or other strain and serve to disperse them so that intermingling will be more assured. When the appropriate strains meet, one of two things may happen: (*a*) sexual organs are formed as soon as contact is established (Mucor, Dictyuchus) or (*b*) mycelial fusions occur in vegetative hyphæ mingling the protoplasm and associating the nuclei of the two strains, which fusions may be between two hyphæ, or two spores, or hypha and spore. A further development of this last type of fusion might give rise to a hypha specialized to catch the spore. Such a mechanism does not convert the spore into a gamete or make it necessary to assume that in *Pleurage anserina*[3,4], for example, we have a trichogyne catching a spermatium, particularly as in *Neurospora tetrasperma*[5] the trichogyne may fuse with ordinary vegetative hyphæ.

The analogy of the transference of pollen in seed plants and the transference of oidia in the higher fungi becomes very close when the 'devices' of colour, scent, and nectar are found in the pycnidium of rusts as well as in the flower, and when insects are found to serve as the agents of transference in both.

These vegetative fusions give rise to the peculiar condition found in numerous Basidiomycetes and Ascomycetes, where two different kinds of nucleus are found within a thallus, and nuclear fusion is delayed. Here there is no need of sexual organs and it is possible to argue either that sexual organs have been lost or that sexual organs have never arisen in this line of evolution. The plant secures nuclear association without them. The recognition in some Ascomycetes of an oogonium without antheridium can be used as evidence in support of the former view. On this argument antheridia have disappeared first and the oogonium has been retained either (*a*) as a sorting-out place of the pairs of nuclei or (*b*) as a place of fusion. The assumption that this 'oogonium' is a normally functioning sexual organ may explain the theories of double fusion and brachymeiosis in Ascomycetes—a phenomenon universally unacceptable to geneticists. The evolution of the clamp connexion renders unnecessary the presence of an oogonium even as a sorting-out place for the nuclei, and it is significant that in forms with conjugate division of dicaryons (even though there be no clamp connexions) there appear to be no sexual organs. They may have been lost but possibly they never existed.

MARGARET A. P. MADGE.
ELIZABETH BLACKWELL.

Royal Holloway College,
(University of London),
Englefield Green,
Surrey.
March 24.

[1] Mather, D. K., NATURE, **149**, 54 (1942).
[2] Madge, M. A. P., B.A. Report Nottingham, 423 (1937).
[3] Ames, L. M., *Mycologia*, **26**, 392 (1934).
[4] Dodge, B. O., *Mycologia*, **28**, 284 (1936).
[5] Dodge, B. O., *Mycologia*, **27**, 418 (1935).

External Genitalia of the Diptera

IN medical and veterinary entomology specific and generic determination of flies is dependent upon the structure of the genital apparatus. There is no recognized standard for naming the modified terminal segments and appendages (terminalia) of the abdomen in the Cyclorrhapha. Morphologists have found no conclusive evidence to settle the nature of, nor have taxonomists managed to agree upon the naming of, these sclerites and other parts concerned. Nevertheless there are four papers that have, between them, covered the groundwork required to solve this problem. Together they make an entirely new approach and I have co-ordinated the data. The following conclusions that are drawn from this study are surprising, but logical.

(1) The normal Nematocera have ten observed abdominal segments, the tenth being the proctiger, which includes the anal papilla. The ninth segment incorporated the ædeagus, and these two together form the hypopygium. The ten abdominal segments lie in a rectilinear series with the anal papilla, lying in a plane above that of the ædeagus which points posteriorly, that is, away from the head of the fly.

(2) The first change to take place is in the hypopygium, which rotates on its longitudinal axis through 180°, becoming inverted as in mosquitoes. Here the ædeagus lies in a plane above that of the anal papilla, and retains its character of pointing posteriorly.

(3) The terminal segments of the abdomen, usually from the sixth onwards, change their line of direction to a curvilinear series, so that the hypopygium is turned to point laterally, dorsally and ventrally, and hence the ædeagus no longer points posteriorly, numerous examples of which are found in the Empididæ and Dolichopodidæ.

For the purpose of the present discussion, it is necessary only to consider the case where the abdomen curves through a half circle in a lateral direction, so as to have the ædeagus pointing anteriorly, that is, towards the head of the fly as in Syrphidæ.

(4) In the Orthorrhapha, every fly that has the anteriorly directed ædeagus always has a simple curvilinear form of the abdomen, so far as known. The hypopygium here is never inverted, so the eighth and ninth tergites are adjacent one to the other.

In the Cyclorrhapha, on the contrary, the hypopygium is invariably inverted, the ninth tergite always being adjacent to the eighth sternite. Metcalf has given the evidence for Syrphidæ very clearly, but he marks the eighth sternite as being the ninth urite, having had doubts about its nature.

The course of the spiracles and the loop of the genital tract over the alimentary canal are found to be common to all the Cyclorrhapha, showing that fundamentally the terminalia of the Syrphoidea and those of the Muscoidea are based upon common ground.

(5) By following this evidence logically, it can be seen that the apical segments of the Muscoidea must have their eighth and ninth sternites on the dorsal surface, comparable to that already shown for Syrphoidea by Metcalf. The ædeagus moves forwards to lie under the eighth sternite in both cases. The so-called 'cerci', that is, the styles of Metcalf, are derived from lobes of the ninth tergite which is, itself, retained in vestige by the Syrphoidea, but is obsolete in Muscoidea. Similar lobes are derived

from the eighth sternite and sometimes from the seventh sternite too, the *Calliphora sternalis*-group being an example.

This sequence of changes that takes place in the terminalia was seen when studying the four following papers :

(*a*) C. L. Metcalf, *Ann. Ent. Soc. America*, **14**, 169–214 (1921), who discusses "the genitalia of male Syrphidæ ; their morphology, with special reference to their taxonomic significance". Metcalf adds an extra segment to the base of the abdomen and produces a numbering of segmentation that is not followed by other authors. Reduction of his numerals by one brings the numbering to that of the above notes.

(*b*) G. C. Lamb, *Proc. Roy. Soc. London*, B, **94**, 1–11 (1922), who uses the order in his account of "the geometry of insect pairing". Lamb overlooked the fact that the ædeagus is inverted on Syrphidæ, so his ideas on the terminalia are in need of adjustment. The correlation between the ædeagus and vagina is not direct but inverse, as Richards found.

(*c*) H. J. Feuerborn, *Zool. Anz.*, 189 (1922), who discusses "das Hypopygium inversum und circumversum". Feuerborn has overlooked the fact that the "circumversum" form of hypopygium can equally be gained by combining his "inversum" form with the curvilinear form of terminalia described by Metcalf and by Lamb. The hypopygium does not turn through 360° relative to the eighth segment as Feuerborn states, but is derived directly from the Syrphid type as Lamb suggests.

(*d*) O. W. Richards, *Biol. Rev.*, **2**, 322–328 (1927), who discusses "the mechanical relations of the male and female genitalia" when reviewing "sexual selection and allied problems in insects". Richards reaches several conclusions that cannot be retained. The twist of the hypopygium is restricted to one way only throughout the Brachycera, namely from left to right, and the curvilinear development in Cyclorrhapha takes the same direction. Three segments each take 60° twists, not two at 90° each which Richards suggests.

The treatment of the so-called 'cerci' of authors, as reviewed in the above notes, is in alinement with my manuscript "The Copulation and the Terminal Segments of Diptera" ; typescript copies (about 10 pages and 25 text figures) will be made available to authors interested, on application being made to me personally, for with present printing restrictions it is not likely that the paper will be printed for many years.

G. H. HARDY.

University of Queensland.
Jan. 18.

Colour Measurement

MR. J. W. PERRY[1] quotes previous statements by me in contradiction of the view expressed by T. Smith, R. Donaldson and myself[2] that the C.I.E. standard-observer tables are not restricted in their application to a specified field size or other observing conditions.

The apparent contradiction arises from failure to appreciate the essential difference between measurement of the quantities occurring in the psycho-physical relations which determine an observer's personal experience of colour and brightness matching, and measurement of quantities of the kind defined by the C.I.E. tables. It is to the former class of measurements that the statements in question apply ; measurement in terms of a public standard, conventionally accepted for technical purposes, was not within the scope of the paper quoted by Perry.

Adequate discussion of the points at issue within the limits of a letter is impracticable, and inadequate discussion would only leave room for further controversy. I propose, therefore, to prepare a statement for submission to the Physical Society Colour Group, where a full discussion may be possible.

Meanwhile it is sufficient to say that there is nothing in Mr. Perry's letter which appears to us to warrant modification of the views which we have expressed in these columns.

J. GUILD.

National Physical Laboratory,
Teddington, Middlesex.
April 7.

[1] NATURE, **149**, 247 (1942).
[2] NATURE, **149**, 76 (1942).

First Publication of the Geological Society

IT is interesting to learn[1] that an original copy of the "Geological Inquiries", said to be the first publication of the Geological Society, has been discovered in the library of the Sedgwick Museum. When Woodward stated that "No records appear to have been preserved of the printed geological inquiries that were circulated among the members", he was evidently unaware that this pamphlet had been reprinted, apparently verbatim, in A. Tilloch's *Philosophical Magazine*, 49, 421–429 (1817). The queries were also included in full (unnumbered, and without the introduction) by Thomas Walford, F.A.S., F.L.S., in his "The Scientific Tourist through England, Wales and Scotland", London, 1818, 2 vols., 12mo. (vol. 1, pp. 50–55), a copy of which is in the library of the Geological Society. It may perhaps be of interest to add that the latter publication also includes a folding plate, "Geological Table of British Organised Fossils . . . with reference to Mr. Smith's Geological Maps". This is almost identical with Smith's well-known table which appeared in the later issues of the memoir accompanying his map and was also published separately.

One would like to know if the pamphlet is dated, or bears any evidence to show that it was actually published in 1808, or before 1811 (the year in which the first volume of *Transactions of the Geological Society* appeared). It seems strange that it should be included in a monthly scientific journal, without comment, nine years after it had been circulated to the fellows of the Society. It would be most interesting if Dr. Hawkes could provide evidence, either from the pamphlet itself or from the early minute books of the Society, to confirm the date of publication.

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[1] NATURE, **149**, 377 (1942).

NEW ZEALAND EARTHQUAKES DURING 1940

AN interesting and informative account of New Zealand earthquakes and seismology during 1940 is given in Bull. No. R–26, of the Dominion Observatory, Wellington, published in the annual report of the Department of Scientific and Industrial Research, 1940–41 (New Zealand).

Data for the study of earthquakes are obtained locally in New Zealand from instrumental records of three main types and from personal experiences as follows: (1) from teleseismic instruments of varying sensitivity installed at Arapuni, Wellington, Christchurch and Chatham Islands; (2) from local strong-motion recorders, mostly Jagger seismographs, installed at Rotorua, Hastings, Bunnythorpe, Takaka, Greymouth and Monowai; (3) from sensitive local recorders of Wood-Anderson design situated at Tuai, New Plymouth, Wellington and Christchurch; (4) from reports of felt earthquakes from non-instrumental reporting stations established with the co-operation of the Post and Telegraph Department.

Periodical reports of felt earthquakes are also received from Dr. C. E. Fox in the Solomon Islands, and also from the Kermedecs. During 1940, 90 earthquakes were reported felt in the North Island, 40 in the South Island, 10 in both islands and 120 over the whole of New Zealand. In the North Island, maximum numbers were in March, July and August, in South Island in February, and in the whole of New Zealand in July.

The ten most important earthquakes occurred: (1) January 12 at 00h. 05·4m. N.Z.M.T., with maximum intensity 5 on the Rossi-Forel scale, felt extensively from Hawera to Akaroa, with maximum at Wanganui and Blenheim; (2) February 26 at 17h. 46·6m. with intensity between 6 and 7, felt throughout Hawke's Bay, with maximum at Hastings; also felt at Taihape and Wanganui; (3) March 20 at 02h. 23·5m. with intensity 7, felt in most eastern districts of North Island as far south as Dannevirke, with maximum in North Hawke's Bay; also felt in parts of Wanganui and Manawatu districts; (4) April 19 at 18h. 11·5m. with intensity 6, felt widely in North Island south of Napier, Taihape and Hawera, with maximum at Dannevirke (possibly two shocks); (5) July 10 at 05h. 28·1m. with intensity 6, felt at Whakatane; (6) July 23 at 01h. 01·5m. with intensity 4, felt in western areas of North Island from New Plymouth to Wellington, and at isolated points in northern part of South Island; (7) August 2 at 04h. 28·8m. with intensity 6, felt in Gisborne region and parts of northern Hawke's Bay; (8) August 2 at 04h. 37·4m. with intensity 6, felt in Gisborne and parts of northern Hawke's Bay; (9) October 7 at 12h. 55·65m. with intensity between 6 and 7, felt widely in North Island, except Auckland Peninsula; also at isolated places in South Island to Banks Peninsula; maximum in region between Opotiki and Hawke's Bay; (10) October 22 at 06h. 16·9m. with intensity 6, felt about Cook Strait.

From all the available information it will be seen that the main features of the activity may be summarized as: (1) Two strong shocks centred in the Gisborne coastal regions on August 2. (2) Fairly continuous activity beneath the volcanic zone extending from near White Island to the region south-west of Lake Taupo from March onwards, with a particularly strong shock on October 7. This shock had a focal depth of 160–170 km. and was widely felt. Shocks at intervals centred in the Taumarunui region are considered to be part of the activity connected with the volcanic zone. (3) Activity in Hawke's Bay region reached a climax with the shock on March 20. It was followed by a swarm of minor aftershocks recorded at Tuai, most of which were too weak to be felt. Following this disturbance there was a steady decline in the intensity and frequency of the shocks, and between August and the end of the year only one shock was definitely located in Hawke's Bay. (4) Occasional minor activity centred in north-eastern Taranaki, probably associated with the shocks in the Taumarunui region. (5) Fairly frequent slight or moderate shocks in the Wanganui-Rangitikei region, many of which were centred in the Wanganui Bight. (6) Rather frequent shocks in the Wairarapa, Wellington, Marlborough and West Nelson regions during the latter half of the year, none of which exceeded Rossi-Forel 5. The coincidence of renewed activity in all these regions about June points to some common cause affecting shock activity in the whole area. (7) Activity in the submarine region east and north-east of the North Island in July–August, and again from October to December.

During 1940, tests were carried out near Greymouth and at Monowai with Milne-Shaw and Wood-Anderson seismographs. Both places were found unsuitable for the Milne-Shaw but suitable for the Wood-Anderson. The co-operation of the Public Works Department has been sought with the view of establishing a Wood-Anderson near Greymouth. Tilt recording has been carried on continuously at Wellington with the aid of the Ishimoto tiltometer and the Milne-Shaw seismograph. The Lands and Survey Department has furnished information on levels taken across geological faults at various points in the Wellington District during the period 1930–40. A study of these level readings, together with seismic data, indicates that certain level changes may have been associated with definite seismic disturbances, though more frequent level readings will be required to confirm this. Since 1936, systematic observations of the north and south meridian marks have been made with the transit instrument. Relative horizontal movements of any one of these points would be revealed by the observations. No appreciable displacements have so far been detected.

CHEMICAL ASPECTS OF TUBERCULOSIS

DR. FLORENCE B. SEIBERT, associate professor of physiological chemistry at the Henry Phipps Institute, Philadelphia, read a paper during the fiftieth anniversary celebrations at the University of Chicago in September last describing the results of recent chemical studies of the bacillus of tuberculosis.

Dr. Seibert stated that it is now possible to separate the polysaccharides and nucleic acid from the protein of the bacillus, and this has led to the discovery that there are several types of proteins derived from the tubercle bacillus, varying in potency. She also posed the new problem of whether the 'fast component', one of the tuberculin protein types, may be related to an unidentified 'extra' component in the blood serum of persons sensitized to tuberculosis.

This 'extra' substance, with a mobility slightly greater than that of the albumin normally present in the blood serum, is found to have exactly the same rate of mobility as the 'fast component' of the tuberculin protein.

There is no longer any doubt, Dr. Seibert said, but that the protein fraction is of paramount importance in many reactions accompanying the disease. The whole question of hypersensitivity and allergy is interlinked with sensitization to the protein. For this reason much effort has been spent in attempts to isolate the protein in pure form. This work has been carried on for many years, first at the University of Chicago and during the past nine years at the Henry Phipps Institute, with grants from the Medical Research Committee of the National Tuberculosis Association.

Each succeeding stage in the purification, however, has brought with it the realization of its great complexity. Through the use of some of the modern physico-chemical methods, especially the ultracentrifuge and the Tiselius electrophoresis apparatus, it has been possible to formulate a definite picture of the complex composition of the tuberculin protein and to obtain some leads for further purification.

The free polysaccharide and nucleic acid have been shown not to be responsible for the biological reactions so characteristic of tuberculin. However, they form very definite combinations with the protein, some of which dissociate only at certain hydrogen ion concentrations. For example, it was shown in a heated fraction that nucleic acid and protein travelled in electrophoresis as a single component at hydrogen ion concentrations more acid than *p*H 5·0, whereas on the alkaline side they existed as two separate components with very different mobilities. This protein can exist in various molecular sizes and shapes. In general, larger, less denatured, and more spherical protein molecules in the bacillus are more dangerous than smaller, more denatured, and more elongated molecules. Among the effects produced are the stimulation of the body to produce antibodies and the heightening of susceptibility to later exposures to the disease.

The tuberculin protein has a doubly dangerous effect because when introduced into a body never previously infected, it proves more poisonous than most ordinary proteins, and in addition, infection causes a heightened sensitivity to this protein when it is formed in the disease in later exposures, rather than immunity. For example, 100–150 mgm., given intraperitoneally, will kill a normal guinea-pig. Ten times this amount of a protein from another acid-fast bacillus, the timothy grass bacillus, was not lethal. The toxicity of the tuberculin protein is increased about a hundredfold in the tuberculous animal, the sensitivity of which has been greatly enhanced by the infection. There seems to be no evidence that the antibody which can be demonstrated in the blood stream is directly associated with immunity. In fact, animals highly sensitized to the protein did not possess an immunity to infection. They showed a lessened immunity.

Furthermore, there is no evidence for a bactericidal effect by the blood serums of highly immunized animals on the tubercle bacillus *in vitro*. On the other hand, there is evidence from the work of Dr. Max B. Lurie (also of the Phipps Institute) that the body fluids of tuberculous animals are bacteriostatic in experiments with living animals.

Analysis and sorting out of the molecule comprising the tubercle bacillus is made extremely difficult by the presence, and even association, of the polysaccharide and nucleic acid with the protein. However, with the development of a satisfactory method for removing these two impurities without harming the protein, a very active protein can now be isolated. The potency can be carefully standardized, and a quantity of such a preparation for general standardization purposes has been prepared. But it is still obvious that more research must be done in order to be able to separate the different kinds of protein molecules from each other and then to develop satisfactory methods for producing them at will and in desired quantities.

PALÆOLITHS FROM THE WORTHING ARCHÆOLOGICAL AREA

By F. W. H. Migeod

PALÆOLITHIC implements of early types have been found recently by two local residents in the Worthing archæological area. One collection was made on the Worthing shore by Mr. Barclay Wills. His work came to an end when access to the beach was prohibited in the early days of the War. Mr. R. K. Stevens was able to begin his at Angmering-on-Sea, about five miles to the westward, when grassland was ploughed up for cultivation. Most of his finds were on the surface, a few only, but they of large size, coming from ditches. I had practically completed a detailed description of Mr. Stevens's finds before Mr. Wills's came to my notice. As a result the joint collection here briefly reviewed consists of a hundred of Mr. Stevens's flints and thirty-three of Mr. Wills's.

The cultures were mainly similar. A glance at them shows the great variety of uses to which the flints were adapted. The flaking is bold, and minor chipping in general rare. Their time-range is wide. Some seem to be of eolithic type. The majority, however, may be classed as Chellean. Three may be Clactonian, one Acheulean and one Mousterian. There are also some intrusions, which is only to be expected from the proximity of the neolithic flint mining industry on the nearby downs. Although there are time distinctions, the absence of a clear stratification at Angmering-on-Sea renders precision in this respect out of the question.

The technique of the main body of implements from both sites is in the first instance cleaving a piece off the flint block with a single blow, thus producing a smooth lower surface. The outer and crustal surface is then flaked as required. The smooth under-surface is retained whatever may be the nature of the resulting implement. What sort of implement will emerge depends on how the maker views the possibilities of the fragment he proposes to work on. This factor disappeared when in the later stone age the core of the flint nodule was principally used for implement making.

A wide range of implements has thus emerged, among which may be identified a variety of series as hand picks, hand axes (single and double), hand choppers, knives and saws, borers, spear heads, (?) sickles, side scrapers, hammer stones, planes, gravers, spheres (somewhat angular), hooks, and

miscellaneous small cutting flakes and pygmies. At Angmering-on-Sea intrusions include a sandstone axe head and a banded-chert implement, possibly an adze, with a cutting edge at one end and a point at the other; also some few neolithic implements.

The first series I shall describe consists of eight nodule implements, seven from Angmering-on-Sea and one from Worthing. These are similar to those found by Dr. E. Hugh Kitchin in the Bournemouth area. I use the name he gave to them. These are flints with the crust left, except at points where flaked. He considered his finds covered a wide range of time; and this seems to be the case here too, as some are patinated and others not. The few implements I have doubtfully called eolithic fall into this series.

The Clactonian flaked cores are from Angmering-on-Sea and have a rich patination.

An interesting series for which I selected a dozen specimens out of a larger number consists of what I have called 'worm-eaten' flints. They are deeply indented and the material is most refractory. Nevertheless implements were produced in the same technique as in the main body of the collection. The difficulties of excrescences and deep indentations were successfully overcome, especially as regards the latter, by ignoring their presence. The result is in some cases a veritable *tour de force*. There are what are intended for spear heads, (?) an adze, beaked implements of rostro-carinate type, a borer, a side-chopper, and axe head, (?) a plane, and a double-tailed implement as if for scraping down a pole to size. All this series comes from Angmering-on-Sea.

Another feature from the same locality, where numerous finds are of mint-like sharpness, is a series of crude implements, many of them picks, which have suffered from abrasion. They must for that reason be assigned a position among the oldest. The sharp edges of the facets are worn down, not necessarily on all sides. Whether the cause was moving ice requires further consideration.

As to the various classes of implements, there is an axe weighing 5½ lb., and measuring 194 mm. × 150 mm. × 70 mm. It is a natural block thinning towards what was adapted as a broad cutting edge. At the butt end a vertical cutting edge was contrived. It might have been used for killing elephants or other large animals. The knives and saws consist of a flint with a flat cleavage surface on one side, a rougher one on the opposite side, and crust left on the back. In one specimen there is clearly right and left chipping to make the saw edge. A fine and unique specimen is from the Worthing shore, measuring 208 mm. × 57 mm. × 30 mm. There is a gradually thickening blade which is about three fifths of the total length and 40 mm. wide with two edges. The handle widens abruptly, and there is no crust. A claw-shaped knife from Angmering-on-Sea, with flanged sides, measuring 95 mm. × 72 mm. × 21 mm. is also an interesting specimen.

The borers are of three kinds. A common form has a broad flattened point projecting from the middle of a long edge. Judging by the varying patination, this kind had a long time-range. The points of others are rectangular or prismatic, and at Angmering-on-Sea are found a number of water-rolled beach flints backed to the latter specification, their altered texture being helpful in this respect. Other points are more suitable for boring small holes.

Seven spear heads show some waisting near the base. One is especially outstanding in this respect. They, too, have in most cases one flat surface. In two or three flints, crescentic cutting edges may suggest their being sickles. The planes are of various shapes, specimens with a 'two-humped camel back' being among them. The plane surface is in some cases of a perfect smoothness. The 'steep-nosed' type of plane is common. Two hooks from Angmering-on-Sea, of thin tabular flint, the larger 118 mm. × 35 mm. × 20 mm. would suggest use as harpoons were they sharper.

The range in size of these implements is considerable, extending from the 5½ lb. axe, some hand picks being nearly as large, down to small borers and knife-like flakes, and to minute flint points half an inch long which might have served as gravers. A further feature is that some of the implements have a dual use, some of the knives or saws having a point as well as a cutting edge. As to the Worthing shore flints, they are commonly stained a blue-black, while a few are ochreous, which may only be on one side. Some have serpulæ and coralline growths on them. From the known history of the shore they cannot have been very many centuries under water, and that only at high or half tide. Mr. Wills considered he had found two hearths, around which he made most of his finds. He also considered knapping had been done on the spot. There were difficulties in examining a particular spot. The shifting sand on the chalk rock would for a few days facilitate the work, and then the site might be buried even for years.

In going over the many hundreds of flints brought in by Mr. Stevens, I was fortunate in finding two implements which had on them secondary growth, a comparatively rare occurrence. As the growth was on the sharp edge produced by flaking, a time value is forthcoming. I had not long before found a natural flint in a newly cut trench on a ridge near Cissbury also with such a growth on it, and all three specimens are now in the British Museum (Natural History).

Several industries may be tentatively identified from these collections. There was especially hunting and the preparation of skins. Agriculture cannot be entirely ruled out. Woodworking is also indicated, as there are stones suitable for the sawing and scraping of sticks and boring the wood. These early folk presumably lived in houses of some kind, a supposition all the more tenable seeing that there were no caves or other natural protection for them. The grouping of the flints would further seem to indicate village life.

Connexion with the flint industry on the downs is slight, as the industry up there is mainly neolithic, though the implements be not ground or polished. The mining operations on the chalk downs in search of good flints, which possibly did not begin before neolithic times, were elaborate. Shafts were sunk and galleries driven. The core of the flint nodule was wanted as opposed to the outer part used by the early coastal plain inhabitants. These latter could occupy the plain during the glacial period or periods when the hill tops were under ice or snow. In later ages when the névé disappeared the hills were preferred for living on to the damp and forested lowlands.

The discoveries of Mr. Stevens and Mr. Wills are of great interest. It is not possible in a short article to enter into more detail. They will, however, serve to shed a new light into the darkness enveloping palæolithic man on the Sussex coastal plain.

FORTHCOMING EVENTS

Saturday, April 18

BRITISH INSTITUTION OF RADIO ENGINEERS (at the Federation of British Industries, 21 Tothill Street, London, S.W.1), at 3 p.m.—Mr. P. P. Eckersley: "Future Developments in Communication Technique".

Monday, April 20

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. E. Ambrose: "The Distribution of Electricity" (Cantor Lecture, 1). (Subsequent Lectures on April 27 and May 4.)

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Major the Hon. R. A. B. Hamilton: "Six Weeks in Shabwa".

Tuesday, April 21

ROYAL STATISTICAL SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 5.15 p.m.—Mr. M. G. Kendall: "The Future of Statistics".

Wednesday, April 22

INSTITUTE OF PHYSICS (LONDON AND HOME COUNTIES' BRANCH) (JOINT MEETING WITH THE GEOLOGICAL SOCIETY OF LONDON) (in the Geological Society's Rooms, Burlington House, Piccadilly, London, W.1), at 3 p.m.—"Some Aspects of Geophysical Survey". Dr. J. M. Bruckshaw: "Some Factors limiting Geophysical Prospecting"; Dr. A. F. Hallimond: "Magnetic Explorations of the Geological Survey"; Prof. V. C. Illing: "Geophysics Applied to Oil Geology"; Dr. D. T. Germain-Jones: "Seismic Refraction Technique"; Prof. O. T. Jones, F.R.S.: "The Relation of Geophysics to Geology".

ROYAL METEOROLOGICAL SOCIETY (at 49 Cromwell Road, London, S.W.7), at 4.30 p.m.—Major H. C. Gunton: "Report on the Phenological Observations in the British Isles from December 1940 to November 1941"; Dr. Maung Po E: "The Foreshadowing of the Rainfall of Burma".

Thursday, April 23

BRITISH SOCIETY FOR INTERNATIONAL BIBLIOGRAPHY (at the Institution of Electrical Engineers, Savoy Place, London, W.C.2), at 2.15 p.m.—Annual General Meeting; Presidential Address; Symposium with demonstrations on the Photographic Reproduction of Documents.

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1) at 4.30 p.m.—Sir Arthur Keith, F.R.S., will exhibit Cranial Casts of South African Anthropoids, discovered by Dr. R. Broom, F.R.S., possessing Characters hitherto regarded as Human. Mr. R. E. Smith and Prof. C. N. Hinshelwood, F.R.S.: "The Detection and Inhibition of Free Radical Chain Reactions". Mr. W. S. Bullough: "The Starling and Foot-and-Mouth Disease".

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 6 p.m.—Dr. O. E. Buckley: "The Future of Transoceanic Telephony" (Thirty-third Kelvin Lecture).

Friday, April 24

ROYAL SOCIETY OF ARTS (INDIA AND BURMA SECTION) (at John Adam Street, London, Adelphi, W.C.2), at 1.45 p.m.—Sir Hassan Suhrawardy: "The Development of Medical Education in India".

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Prof. C. H. Lander: "A Review of Recent Progress in Heat Transfer" (to be followed by a Discussion).

APPOINTMENTS VACANT

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

SENIOR ENGINEERING ASSISTANT TO THE STAFFORDSHIRE POTTERIES WATER BOARD—Mr. P. Wilkinson, Engineer's Offices, Albion Street, Hanley, Stoke-on-Trent (endorsed 'Senior Engineering Assistant') (April 22).

LECTURER IN THE DEPARTMENT OF MATHEMATICS—The Registrar, University College of Swansea, Singleton Park, Swansea (April 22).

PRINCIPAL of the Durham Road Senior Technical and Commercial Evening Institute and Day Technical Classes—The Director of Education, Education Offices, Prince Consort Road S., Gateshead 8 (April 24).

ASSISTANT MASTER TO TEACH MATHEMATICS AND ELEMENTARY SCIENCE in the Junior Technical School—The Secretary for Education, Tudor House, Friar Street, Worcester (April 25).

UNIVERSITY CHAIR OF OIL ENGINEERING AND REFINING (PETROLEUM TECHNOLOGY)—The Secretary, The University, Edmund Street, Birmingham 3 (May 9).

UNIVERSITY READERSHIP IN ORGANIC CHEMISTRY tenable at London (R.F.H.) School of Medicine for Women—The Academic Registrar, University of London, Richmond, Surrey (May 12).

UNIVERSITY CHAIR OF RADIOLOGY (THERAPEUTIC) tenable at Middlesex Hospital Medical School—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (May 26).

SECOND ASSISTANT PORT ENGINEER by the Iraq Government for the Basrah Port Directorate—The Central Register, Ministry of Labour and National Service, Queen Anne's Chambers, Tothill Street, London, S.W.1 (quoting E426).

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

The Old World and the New Society: a Report on the Problems of War and Peace Reconstruction. Pp. 32. (London: The Labour Party.) 3*d*. [113

Tin Research Institute. Publication No. 108: Surface Hardness of Metals. By Dr. Bruce Chalmers. Pp. 20+2 plates. (Greenford: Tin Research Institute.) [123

Institution of Gas Engineers. Communication No. 242: 2nd Report of the Chairmen's Technical Committee, 1940–41. Pp. 12. Communication No. 243: 18th Report of the Gas Education Committee, 1940–41. Pp. 36. Communication No. 244: Institution Gas Research Fellowship Report, 1939–40. Pp. 36. Communication No. 245: Institution Gas Research Fellowship Interim Report, 1941. Pp. 32. (London: Institution of Gas Engineers.) [123

Gas Research Board. Communication GRB4: 2nd Annual Report of the Council of the Gas Research Board. Pp. 16. Communication GRB5: 32nd Report of the Refractory Materials Joint Committee. Pp. 92. (London: Gas Research Board.) [123

Young Farmers' Club. Booklet No. 2: Bee Keeping. By Reginald Gamble. Pp. 48. 6*d*. Booklet No. 6: Grassland. By J. O. Thomas. Pp. 50. 6*d*. Booklet No. 8: Goat Keeping. Pp. 48. 6*d*. Booklet No. 9: Garden and Farm Insects. By A. J. A. Woodcock. Pp. 48. 6*d*. (Radlett: National Federation of Young Farmers' Clubs.) [123

University of London: University College. Annual Report, February 1941–February 1942. Pp. 47. (London: Taylor and Francis, Ltd.) [133

London Shellac Research Bureau. Technical Paper No. 21: Reaction of Lac and Lead Tetra-Acetate. By Dr. B. S. Gidvani and Dr. R. Bhattacharya. Pp. 16. Technical Paper No. 22: Reaction of Lac with Metallic Oxides, Part 1. By N. R. Kamath and Dr. R. Bhattacharya. Pp. 16. (London: London Shellac Research Bureau.) [133

British Rubber Producers' Research Association. Publication No. 14: The Number of Configurations of a Cooperative Assembly. By A. R. Miller. Pp. 109–124. (London: British Rubber Producers' Research Association.) [163

Proceedings of the Royal Irish Academy. Vol. 47, Section A, Nos. 3, 4: Exchange and Spin, by Erwin Schrödinger, with a Note by James Hamilton; The Factorization of the Hypergeometric Equation, by Erwin Schrödinger. Pp. 39–54. 1*s*. Vol. 47, Section A, No. 5: A Class of Groups. By Ernest Best and Olga Taussky. Pp. 55–62. 1*s*. Vol. 47, Section B, No. 6: Salmon of the Owenduff (Ballycroy) River. By Arthur E. J. Went. Pp. 161–178. 1*s*. Vol. 47, Section B, No. 7: Excretion of Glucose by the Rabbit Kidney, Part 3: The Influence of Urethane, Insulin, and Adrenalin on the Kidney Threshold for Glucose. By T. W. T. Dillon and S. Feric. Pp. 179–204. 1*s*. 6*d*. Vol. 47, Section B, No. 8: Characteristics of Irish Soil Types, Part 1. By Patrick H. Gallagher and Thomas Walsh. Pp. 205–250+plate 3. 2*s*. 6*d*. Vol. 47, Section B, No. 9: The Influence of Temperature on Animal Oxidation. By J. M. O'Connor and D. K. O'Donovan. Pp. 251–274. 1*s*. Vol. 47, Section B, No. 10: Expansion of Monomolecular Layers of Mixed Saturated Fatty Acids. By F. Kane. Pp. 265–274. 1*s*. Vol. 47, Section B, No. 11: *Thomondia*, a new Trilobite Genus from Co. Clare. By J. C. Harper. Pp. 275–278+plate 4. n.p. Vol. 47, Section B, No. 12: The Granite Drift near Brittas, on the Border between County Dublin and County Wicklow. By A. Farrington. Pp. 279–292+plate 5. 1*s*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [233

Other Countries

Field Museum of Natural History. Zoological Series, Vol. 22, No. 8: The Amphibians and Reptiles of British Honduras. By Karl P. Schmidt. (Publication 512.) Pp. 473–510. 40 cents. Zoological Series, Vol. 27: Papers on Mammalogy. Published in honor of Wilfred Hudson Osgood. (Publication 511.) Pp. 395+12 plates. 3 dollars. (Chicago: Field Museum of Natural History.) [93

Forest Bulletin No. 98: An Indirect-heated Internal-fan Furnace Kiln (Blower-cum-Furnace Kiln) for Drying Packing-Case Timbers. By M. A. Rehman, assisted by Inder Kishen Kapur. Pp. vi+7+1 plate. (Delhi: Manager of Publications.) 5 annas; 6*d*. [133

Durban Museum and Art Gallery. Annual Report for Municipal Year 1940–1941. Pp. 12+4 plates. (Durban: Durban Museum and Art Gallery.) [163

South Australia: Institute of Medical and Veterinary Science. Third Annual Report of the Council, July 1940—June 1941. Pp. 8. (Adelaide: Institute of Medical and Veterinary Science.) [183

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 47: Definition and Characteristics of Dhanni and Khillari Cattle and Nili, Ravi and Surti Buffaloes. Pp. iv+20+14 plates. (Delhi: Manager of Publications.) 1.6 rupees; 2*s*. [193

Science and Ethics. 1: A Biologist's View; 2: The Hindu View. By D. V. Gundappa. Pp. 32. (Bangalore: Karnataka Publishing House.) [193

U.S. Department of Agriculture. Circular No. 615: Studies on the Control of Cabbage Caterpillars with Derris in the South. By W. J. Reid, Jr., C. E. Smith, L. B. Reed and C. O. Bare. Pp. 27. 10 cents. Technical Bulletin No. 788: Relative Effectiveness of Acid Lead Arsenate and other Materials as Stomach Poisons for the Larvae of the Japanese Beetle. By Walter E. Fleming. Pp. 32. 10 cents. (Washington D.C.: Government Printing Office.) [203

U.S. Office of Education: Federal Security Agency. Vocational Division Bulletin No. 212 (Occupational Information and Guidance Series No. 5): Occupational Information and Guidance Bibliography, 1937–38. Compiled by Pedro T. Orata assisted by Waldo B. Cookingham. Pp. xi+521. (Washington, D.C.: Government Printing Office.) 55 cents. [233