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THE FRATERNITY OF SCIENCE

THE early years of the twentieth century saw a recrudescence of the movement towards international intercourse in science. The natural philosophers of previous centuries, so far as they were free to carry on their studies, enjoyed a peculiar individual licence to visit and maintain communication with their brethren in other lands. With the growth of science itself, those associated with it began to band themselves together for the more frequent discussion of the many topics in which they were interested, and it was natural that such groups, at first local, should with the improvement of communications become national in scope. The national bodies continued to maintain a limited amount of intercourse by the exchange of publications and by the election of distinguished men of science as foreign members, but this in turn became inadequate to meet the needs of the rising tempo of scientific discovery and its applications. Thus were born the international associations, with regular meetings held at intervals of a year or more, attended by individuals and delegate bodies, and with international secretariats to transact their business during the intervals between successive meetings.

Into this healthily growing international intercourse of scientific men was injected the Nazi claim for 'Aryan science' and for 'Nordic superiority' in science as in other fields, followed by the exclusion from the calling of science of all who could not prove their purity of 'Nordic blood'. The result is well known to readers of NATURE. Everyone can recall how, in his own particular field, first one, then another distinguished figure, sometimes men of international repute, was forced to leave Germany, often in a state bordering on destitution.

It is worth while examining again the beginnings of this state of affairs. Dr. Julian Huxley traces in brief but telling fashion the rise and decay of science in Germany in a recent pamphlet "Argument of Blood"*. From the fifteenth century onward, the Germanic peoples have made noteworthy contributions to science ; as examples of

* Argument of Blood : the Advancement of Science. By Julian Huxley. (Macmillan War Pamphlets, No. 11.) Pp. 48. (London : Macmillan and Co., Ltd., 1941.) 3*d*. net.

outstanding men Dr. Huxley mentions Albrecht Dürer, Kepler, von Guericke, Leibniz, Goethe, Fraunhofer, Gauss, of the earlier period, and Liebig, Bunsen, Kirchhoff, Abbe, Koch, Ehrlich, Hertz, and Caro, Graebe and Libermann of more recent times. Nevertheless, science was later in achieving organized form in Germany than in England, France or Italy. With the opening of the nineteenth century, however, the modern German university system began to develop under the ægis, and with the aid of, the State, and the attention given to science led, by the middle of the century, to the German university institutions becoming the accepted homes for schools of scientific research built up by the university professors, to which flocked students from other parts of Europe and from the United States. All this time, however, the State retained its hold on the universities, and was able to ensure that research did not lose touch with industrial development.

Incidentally, Dr. Huxley points out that a very substantial part was taken by Jews in this development of science and its applications. Although they formed only about 1 per cent of the population, it is estimated that they have been responsible for some 25 per cent of significant German contributions to science. German anti-Jewish outbursts, Dr. Huxley suggests, may thus be in part a symptom of an inferiority complex.

Their mode of development will account for the difference in outlook between German university institutions and those of Great Britain. The State has always exercised a degree of control which, with the rise of National Socialism, enabled the Nazi Party quickly to abolish all freedom of study. Dr. Huxley refers in particular to events in the Universities of Heidelberg and Göttingen. By 1936, he says, all serious instruction in philosophy at Heidelberg had ceased, and nearly half the staff in that faculty had been dismissed; appointments were being made on political grounds. At Göttingen similar changes were made; within a year, nearly a quarter of the University staff had been dismissed.

Such drastic changes in the university system of Germany were bound to have repercussions on the output of scientific research as regards both quality and quantity. The former is difficult to assess, but the correspondence columns of NATURE will serve as a criterion of the latter. Here it was noticeable that the number of original contributions to science coming from German institutions quickly decreased; allowance must, however, be made for the fact that support in NATURE for a policy of intellectual freedom had brought the journal into disfavour. Dr. Huxley points out that the deterioration in quality has been most marked in mathematics, physics and pure biology; whereas in a subject of direct military value, such as aircraft engineering, a number of valuable contributions to knowledge has been made.

Both staff and students were affected by the changes imposed by the Nazi regime. Although it is difficult to obtain statistics relating to university education in the years immediately preceding the War, it is known from the records of societies assisting displaced intellectuals that nearly 2,000 university teachers were dismissed; many posts were filled with 'safe' Party men, but others were discontinued. As a result, the university teacher lost that security of tenure which hitherto had left him free to pursue his investigations and to teach the truth as he found it without regard to political considerations. The effects on the student body were even more striking. The number of students was reduced to nearly one half of what it was before the Nazis assumed power. Military and semi-military studies were given greater prominence, while the course for medical students was reduced by two years. Another innovation, doubtless made in pursuance of the search for 'leaders' who would be both docile to central Nazi control and also sufficiently immature to be fanatical in their adherence to the new regime, was to appoint student bodies under Party guidance and led by students who in some cases were placed outside the jurisdiction of the university authorities. Normal university life was deliberately undermined.

Apart from these direct attacks on learning, one of the most sinister undertakings of the Nazis has been the deliberate distortion of truth, undertaken with the view of providing a seemingly scientific basis for National Socialist ideology. Dr. Huxley very fittingly deals with the so-called 'racial biology', which is taught from the elementary schools upwards. By a profusion of literature, by lectures and by all the guile of propaganda, the superiority of the 'Aryan', 'Nordic' or 'German' race has been drummed into the minds of a generation who have never been allowed to hear its fallacies discussed. It will be a difficult but essential task to undo this work in the years to come.

With all this coercion and suppression of scientific effort, it is not apparent at first glance why Nazi Germany has been able to make such efficient use of scientific and engineering developments for waging war. The answer Dr. Huxley gives—and it will be generally accepted—is that Nazi success has been based on the large store of technical knowledge and the numerous skilled men trained on scientific principles still remaining in Germany; time will reduce their number and make their training out of date.

So much for effects within Germany itself of

the suppression of freedom of learning. Sir Richard Gregory, president for the duration of the War of the British Association, and formerly for many years editor of NATURE, takes up the tale at this point in "Science in Chains"*, and voices the feelings of men of science outside Germany, who have observed, at first with concern and later with horror, the cramping restrictions imposed on research and the barbaric discipline which have followed in the wake of Nazism.

An early hint of the attitude of the Nazi Party to scientific intercourse was seen in 1934 at the meeting in Berne of the Astronomische Gesellschaft, a body which, though German in origin, is strongly international in character. One of the secretaries was a Jew, and the German delegates to the meeting were ordered to exclude him, and any other Jewish astronomer, from office. The attempt failed, but it conveyed a warning as to the character of German delegations which would attend scientific meetings outside Germany. Indeed, in 1935, by order of the Minister of Propaganda, all representation at congresses, inside or outside Germany, was put under the control of a Science Congress Centre, on the specious excuse as regards foreign travel that lack of foreign currency made such centralization necessary. Further, all who went abroad for purposes of study or to give lectures were required to report themselves to the local German representative and to the Foreign Organization of the Nazi Party. The object of these regulations was immediately obvious : they were to ensure that only politically 'safe' spokesmen would be allowed to interpret scientific developments in Germany to the outside world. Under such conditions there can be no adequate exchange of scientific views, and science degenerates into an instrument of national aggrandizement.

This intellectual blight, as Sir Richard Gregory terms it, has descended on every country which has come under Nazi control. With the occupation of Czechoslovakia in 1939, all scientific work had to cease ; institutes were closed, and equipment was destroyed or transferred to Germany. Similar measures were taken in Poland, and some of the ancient universities of Holland have suffered. There should be no need to enlarge upon such instances of Nazi repression as it affects science, for many have been recorded in NATURE during the past two years.

What has been the reaction of the world of science to this reversal of the whole trend of scientific intercourse ? An early movement was the formation of a body, now known as the Society for the Protection of Science and Learning, to help intellectual workers who have been deprived of their means of livelihood for racial or political reasons This body has done magnificent work in providing for many such refugees the opportunity of continuing their vocation, and thus has preserved for civilization the intellectual powers of a considerable body of men. Another effect, perhaps slow to gather strength, was the appearance of protests in the scientific Press ; these protests were at first cautious, for scientific men did not care to risk the charge of interfering with what might at first appear to be the internal affairs of another country. One result of such protests was, as readers of NATURE will recall, that this journal was "excluded from general use in scientific libraries" in Germany ; it will be noted that the journal was not entirely banned, for apparently it was still of service, and incidentally, as Sir Richard Gregory points out, German publishers continued, until the outbreak of war, to send scientific works to NATURE and other responsible British journals, confident that they would be justly appraised and the reviews accepted by scientific colleagues all over the world.

Another stage in the growing volume of protest was marked by a resolution passed in 1938 by the American Association for the Advancement of Science, in which the democratic principles of science and the need for intellectual freedom in research were strongly urged. "We regard the suppression of thought and of its free expression as a major crime against civilization itself." Since then, the American Association has asked the British Association to collaborate in framing a charter of democracy on scientific principles, and as a first step towards such collaboration, the Division for the Social and International Relations of Science of the British Association has formulated a statement of the democratic fellowship of science.

Freedom of thought and freedom of communication between the scientific workers of all countries are essential to the progress of humanity. Any political system which challenges these cardinal principles threatens the very life-blood of science ; whatever temporary successes it may achieve by tapping existing reservoirs of knowledge and skill, it contains within itself the seeds of decay. Sir Richard Gregory rightly says : "Science would be false to its tradition if it failed to protest against such criminal assaults on the human mind. Its spirit cannot be confined within any national or racial boundaries, and its service cannot be monopolised by any single country, without debasing the principles for which it has always stood. To make race, political convictions, or religious faith, barriers to the pursuit of natural knowledge, means that science in Nazi Germany loses its soul for the purpose of gaining the world."

* Science in Chains. By Sir Richard Gregory. (Macmillan War Pamphlets, No. 12.) Pp. 32. (London : Macmillan and Co., Ltd., 1941.) 3*d*. net.

INDUSTRIAL CHEMICAL ANALYSIS

Lunge and Keane's Technical Methods of Chemical Analysis

Second edition, edited by Dr. Charles A. Keane and Dr. P. C. L. Thorne. Vol. 4. Pp. xv+963. (London and Edinburgh : Gurney and Jackson, 1940.) 84*s*. net.

IN the years immediately succeeding the War of 1914–18, British chemical industry underwent a renaissance the chief features of which included the intensification of research both by individual firms and by the newly constituted research associations, the rationalization of industry, and the formation of merged companies. In many cases products and processes of manufacture were standardized. Methods of testing were reviewed and modernized and new analytical technique developed to keep pace with the ever-increasing range of new products.

Many of these new developments are reflected in the new edition of Lunge and Keane's standard work on "Technical Methods of Chemical Analysis", the fourth volume of which deals in two large sections with textiles and textile chemistry and with coal tar and tar products ; there are, in addition, relatively smaller but equally important sections on coal gas, ammoniacal liquor, explosives, matches and fireworks and on calcium carbide and acetylene. It is essential in a work of this description that the subject-matter should be beyond reproach, and the authenticity of the details in Vol. 4 is guaranteed by the high professional status of the authors of the various sections.

In present circumstances, two of the smaller sections, namely those on explosives and on calcium carbide and acetylene, make a most opportune appearance. The manufacture of explosives must always remain a highly specialized industry in which the most extreme precautions are necessary to ensure not only the safety of the workers but also the stability of the manufactured product. In normal times this manufacture is carried out by a relatively small number of skilled technicians, and the use of explosive material is largely restricted to the engineering profession. War conditions, however, necessitate a very large increase in the number of those engaged on the manufacture, handling and safe storage of these dangerous materials, and the detailed tests described by Prof. O'Reilly not only of the raw materials used but also of the finished products will be of the utmost value to both the technical chemist and the authorities on whom rests the responsibility for the operation of adequate safety measures.

Almost all gas welding operations require acetylene, for which calcium carbide is the necessary basis. A very large expansion in the manufacture of this important industrial gas takes place therefore during times of war, when all branches of engineering operate under high pressure. The details of the tests necessary in the production of acetylene come from the authoritative pen of Mr. C. Coulson Smith, of the British Oxygen Co., Ltd., which hitherto has been almost wholly responsible for this manufacture in Great Britain. The author does not concern himself primarily with any test relative to the production of carbide but devotes himself to those tests required for the examination of the finished carbide and of the acetylene derived therefrom. Particular attention is given to the tests for phosphorus impurities, which are suspected of being the cause of some acetylene explosions. These detailed tests are most timely in view of the increased number of chemists, engineers and other technicians now engaged in this important industry, and assume greater significance in view of the industrial importance of acetylene derivatives such as cyanamide, thiourea, melamine and the vinyl polymers.

The staff of the South Metropolitan Gas Co. are responsible, through Mr. H. D. Greenwood and Mr. P. Parrish respectively, for the sections on coal gas and ammoniacal liquor and ammonium salts. The description of modern methods of analysis in the coal gas industry is noteworthy for the information on the evaluation of refractories and the methods of control during carbonization. As an illustration of the original work always proceeding in the laboratories of the gas undertakings, there is a very clear account of the comparatively recent brilliant research work carried out by H. Hollings and his colleagues of the Gas Light and Coke Company leading to the elimination of gum formation in coal gas.

Many of the new developments in the British chemical industry noted at the outset of this review are to be found in the history of the coal tar industry during the past twenty years. Of all the raw materials of industry, coal tar occupies a unique position, being on one hand a by-product of one major industry—coal carbonization—and on the other the starting material for a whole range of other important manufactures. The general

economics of this raw material are based on the profitable marketing of several well-known fractions such as benzole, naphthas, creosote, cresylic acid, anthracene oil and pitch. To these must be added a surprisingly small list of pure constituents, chiefly benzene, toluene, naphthalene and anthracene, together with phenol, the three cresols and pyridine. Although it was possible for any organization, deriving its tar from a given source, almost to standardize its products, there was obviously much variation in the fractions produced by different organizations, and discrepancies were accentuated by the introduction of new varieties of tar, in particular vertical retort tar. It was realized, therefore, shortly after the War of 1914–18, that the time was ripe for standardization of products throughout the tar industry. Rationalization was carried out by the formation of several large groups, which together with the already powerful tar organizations of the metropolitan gas undertakings, formed the Association of Tar Distillers. This Association, working through several expert committees, proceeded to review and select satisfactory tests for tar products, finally publishing a volume entitled "Standard Methods for Testing Tar and its Products", to the mutual benefit of producers and consumers. The work of these committees provided a shining example of the pooling of general knowledge, and "Standard Methods" crystallizes the accumulated experience of many organizations over a long period.

The 1938 edition of "Standard Methods" forms the basis of the large section on coal tar and tar products contributed to Lunge and Keane's treatise by Mr. A. McCulloch and Mr. R. Murdin Drake. The authors, however, have not restricted themselves to the British standards, but also include some of those accepted in the United States of America and in some cases in Germany. This section, therefore, is most comprehensive and includes, in addition to the technical tests, much general information with respect to the production and utilization of tar and tar products. It is unusual but useful to find descriptions of the tests employed, for example, of the disinfectants and insecticides made from tar products. The authors have also drawn on the results of research carried out, notably by the National Benzole Association and the British Road Tar Association. This latter organization is responsible for much original investigation in the evaluation and improvement of prepared tars, particularly for road construction work, which absorbs by far the largest proportion of the tar produced in Great Britain.

This comprehensive section represents the most up-to-date evaluation of coal tar and its products to be found in any book and will form the standard reference work for all those engaged either in the distillation or in utilization of tar products. Whereas the reader of this section cannot fail to be impressed by the very thorough manner in which the tar industry has standardized the tests for its products, he may on reflection wonder why so few of the many constituents of this material are isolated in a pure condition. Admittedly, the entities described are those for which there is a ready demand, but one hopes that this well-organized industry will develop technique whereby lesser-known but potentially valuable components such as β-methyl naphthalene, higher aromatic hydrocarbons such as pyrene, together with the individual xylenols, or even higher phenols may be isolated and their uses developed.

Of the many trade research associations which were initiated in collaboration with the Department of Scientific and Industrial Research, two of the most successful were those connected with the cotton and wool industries. The results of investigations carried out by these organizations were quickly adopted by industry, with the result that many new processes for the treatment and testing of textiles were developed. How widespread has been the expansion in the technique of textile chemistry may be judged by the fact that no less than 280 pages of the new edition of Lunge and Keane, as compared with only 140 in the old edition, are devoted to the description of the various tests now applied in the manufacture and examination of textile fabrics, including the rayons, which have been wholly developed since the period covered by the first edition of this treatise.

The whole section on textiles and textile chemistry has been prepared under the general supervision of Mr. J. M. Preston, of the College of Technology, Manchester, the sub-sections having been prepared by a team of experts. A wide range of information hitherto not to be found within the bounds of one book has been collected, arranged and presented in the logical sequence of: physical and chemical tests of textile fibres and fabrics, tests for dyestuffs, auxiliaries and detergents used in the industry and finally tests for finishes and their defects.

Few, except those directly engaged in the industry, can be aware of the many tests applied to ensure that high standard now expected of and maintained by the textile industry. Microscopical, chemical and mechanical tests are regularly used throughout all the stages of aggregation met with during manufacture, from that of the single fibre to that obtaining in the finished article. In addition, the auxiliaries such as wetting agents and soaps are subjected to rigorous examination, while the testing of dyestuffs, particularly as regards fastness, forms a whole field of chemical technology

itself. Each of these series of tests requires a highly skilled and specialized staff to whom the details of tests applied in the branches of the industry other than their own will be most useful. To those outside the textile industry, the last subsection on the examination of textiles after finishing probably holds most interest. In the past twenty years permanence of colour and finish have been greatly improved and many new finishes introduced, eighteen of which are described in this subsection. As an example, there is the development of the use of synthetic resins, particularly urea-formaldehyde, to yield a fabric with increased resistance to creasing, and the use of formaldehyde in conjunction with an aliphatic amide to produce resistance to wetting.

A book on technical methods of analysis might be considered by the superficial inquirer to furnish rather arid reading except to those experts directly interested, but in this volume the reader will find much of the romance of chemical industry. Many of the new processes and products which have now become familiar names are here described in an accurate, scientific and readable manner to whet the interest and excite the imagination of the reader. Of primary interest to technicians, and written with the object of defining the various tests applied in the selected industries, the book forms a mirror of the achievements of these industries during the past thirty years, and shows once more that there is no finality in chemistry.

D. D. PRATT.

PREPARATION OF ORES FOR METALLURGICAL TREATMENT

(1) Textbook of Ore Dressing

By Prof. Robert H. Richards and Prof. Charles E. Locke, assisted by Prof. Reinhardt Schuhmann, Jr. Third edition, completely revised and rewritten. Pp. xiii+608. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 36*s*.

(2) Principles of Mineral Dressing

By Prof. A. M. Gaudin. Pp. xi+554. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 33*s*.

THE maintenance of the present standard of living of civilized man is dependent upon an adequate supply of metals, without which conditions would return to those of the Stone Age. The production and preparation of food, clothing, transport and other necessities all depend fundamentally upon the provision of the requisite tools. These tools are largely made from metals, and to cover wastage and also expansion in the use of mechanical aids fresh supplies have to be made available continuously.

The use of non-ferrous metal in the arts has so increased in the last hundred years that it is unlikely that there are undiscovered any rich, readily accessible sources from which losses can be made good. Luckily the supplies of iron and coal are still more than adequate to meet all needs in normal times. But man cannot live by iron alone, and other metals have to be provided.

The mineral deposits that are being worked to-day, as distinct from those worked in earlier times, nearly always consist of complicated mixtures of valuable ores and worthless gangue which have to be separated. Further, the individual ores have to be segregated from each other and collected in the form of concentrates. This process is known to mining and metallurgical engineers as 'dressing', a word which occurs in the titles of both books under review.

The term 'dressing' in each case is used to indicate the separation by physical means as distinct from metallurgical treatment in which chemical reactions are employed. Many and varied advances in science and engineering are employed in modern dressing, and in a single book it is impossible to discuss every known principle and practice in use.

It is interesting to recall that up to thirty years ago simple processing by water concentration accounted for 90 per cent of the world's output of non-ferrous metals, whereas to-day, except for alluvial workings, it accounts for less than 10 per cent. Its place has been taken by the froth flotation process: the separation of minerals from one another in a froth by virtue of difference in their surface tension. Up to 1924 the main application of the frothing process consisted of bulk flotation of sulphides in an acid circuit using oils of various kinds as reagents, whereas to-day, selective or differential flotation is the common practice using organic or inorganic chemicals in an alkaline circuit. No solution has, however, yet been obtained to the problem of floating oxides such as cassiterite, which would prove a boon to the Cornish mining industry.

The publication of two new text-books by well-known writers on the subject is always a matter

of interest, and there is an additional piquancy when it is realized that the authors are both members of the Faculty of Mining Engineering at the same institution at Massachusetts.

The method of treatment of the subject-matter is widely different and yet the two books might be considered complementary. Locke's text-book is a welcome and long overdue revision of Richard's standard work, whereas Gaudin's is new and is compiled, as he says, largely from his lecture notes and research activities. It is impossible for the two books not to overlap, but in general it can be said that they cater for different types of readers. Locke will appeal to the works operator, the man who wants to know *how* to do something, whereas Gaudin will be of more assistance to those who wish to know primarily *why* a process works. Broadly, one describes modern practice and the other the principles underlying modern practice, but includes an exceptionally good bibliography of the subject.

Both books follow the conventional lay-out in that, chapter by chapter, they discuss the machines used in each stage of a mineral dressing plant, only differing in the emphasis placed upon the various items.

Thus, stage by stage, they cover the processes by which the crude product of a mine is broken to a sufficient degree of fineness to release the valuable ore from unwanted minerals and then describe various methods employed to collect it.

Both books should be in the library of all metalliferous mining engineers and, in the case of Locke, of coal miners also, because one chapter is devoted to a discussion of the equally important subject of coal cleaning. J. A. S. RITSON.

A GENERALIZATION OF ABELIAN INTEGRALS

The Theory and Applications of Harmonic Integrals

By Prof. W. V. D. Hodge. Pp. ix+281. (Cambridge: At the University Press, 1941.) 12*s*. net.

PROF. HODGE's work on this subject has long been awaited by his colleagues, and will be generally welcomed by them, though perhaps with mixed feelings when its difficulty is encountered. His lectures and papers have already given some idea of the scope the work would have, as well as of the origin of the line of research of which this book is the first important monument. It is in effect an attempt to generalize in a very wide way that aspect of the study of functions (such as Abelian integrals) on a Riemann surface which consists in treating the real and imaginary parts separately, and adjoining to the integrability condition a second differential condition which ensures that the two functions considered are in fact the real and imaginary parts of an analytic function. (This latter we may call the orthogonality condition.) The place of the Riemann surface is taken by a 'Riemannian manifold' of any number of dimensions; this is continuous and has ordinary differential geometry in the small, with metric, affine connexion, and Riemann-Christoffel tensor; while in the large it is a two-sided or orientable space, to which the ordinary combinatory topology applies, with Betti numbers, torsions and intersection matrices.

The first chapter is devoted to recapitulation of these two theories. The second develops the idea of a p-fold integral, and the differential form associated with it, and includes the generalization of Green's and Stokes's theorems, in virtue of which we have first-order differential conditions for integrability, to ensure that the value or 'period' of the integral over homologous cycles is the same; the chapter ends with de Rahm's proof of the existence of an integral with assigned periods on all linearly independent p-cycles. In this no use is made of the metric; but the next chapter defines a harmonic integral as one which satisfies not only the integrability conditions, but also a second set of first-order differential conditions, depending on the metric, and analogous to the orthogonality condition in the simple case; the coefficients in a form which satisfies both conditions may be compared to the components of a vector the curl and divergence of which both vanish. Hodge's own proof then follows of the existence of a unique harmonic integral having assigned periods.

The remaining two chapters are devoted to the applications of the foregoing theory to algebraic geometry, and to the theory of continuous groups. The former (presumably the *raison d'être* of the whole investigation) are, as the author says, isolated, and may at first sight appear somewhat meagre. The bulk of the labour in this chapter is devoted to sorting out which of the harmonic integrals are in fact the real and imaginary parts of algebraic integrals; the metric in the Riemannian manifold of $2m$ dimensions (which represents the complex points of an m-dimensional algebraic variety just as the Riemann surface does those of an algebraic curve) is not invariant, and its possible trans-

formations are not even confined to be conformal, as in the case $m=1$; so that the theory of harmonic integrals contains, in a sense, a good deal of lumber which must be cleared away before the genuine applications to obtain algebraic-geometric results can be made. The definition of the geometric genus in terms of the signature of an intersection matrix, published some years ago for surfaces and here generalized, is however a triumph which would have justified a far more laborious analysis, even had it been the only result ; and the conditions, in terms of vanishing of periods, for a cycle to be algebraic (that is, to be the image on the Riemannian of some algebraic sub-variety on the original variety), though apparently not completely worked out as regards their sufficiency, look as if they might lead to results of great value. The theory is of course in its infancy, and it is hard to say yet how far it may take us ; its chief lack so far, if it is to achieve a comparable power and importance with the classical theory for curves, seems to be anything like a generalization of Abel's theorem ; and it is hard to see what form such a result could be expected to take. The applications to continuous groups seem to consist mainly of new proofs of known results, but here again it is early to say what may be achieved.

The whole book is exceedingly difficult to read —a difficulty which is partly inherent in the subject, but which one feels also is somewhat characteristic of the author. The style is very dry and severe ; the summaries of previous work are too brief and formal to be readily understood unless the reader is already fairly familiar with the work in question ; little time is spared for pointing out the purpose of the steps taken, or of the definitions introduced ; and the notation (which is necessarily very intricate) has not always been selected with sufficient care to avoid confusion—thus on p. 160 i is in one equation a dummy suffix over which summation takes place, and the square root of -1, and there are other pitfalls of the same kind, though less glaring. The printing on the other hand seems admirable, and in all that complicated jungle of formulæ I have not detected one misprint. PATRICK DU VAL.

STEAM, AIR AND GAS POWER

Steam, Air and Gas Power
By Prof. William H. Severns and Prof. Howard E. Degler. Third edition. Pp. vii+511. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 24*s*. net.

WHEN a book such as this has reached its third edition it may be taken for granted that it possesses in high measure those qualities which go to the making of a standard work. Progress in heat engines during recent years has been considerable, but provided the method of exposition of the fundamental principles is sound and the attitude of the author to his subject is a correct one, the main structure of the work will readily carry such new developments, either in theory or in practice, as take place between one edition and another. To this category then it may be said that the present book belongs, for while in large measure keeping pace with progress in heat-power engineering it retains the excellent mode of presentation which has characterized its earlier editions.

Some developments, however, have not received the attention they deserve. In the chapter on steam generators, mention is made of high pressure and of critical pressure steam generation, but there is no reference to the La Mont and Loeffler boilers, which are now fully established types. Their respective principles of operation and details of construction are essential to the present-day student of steam power, to which it may be said that the book gives a disproportionately large space.

Dealing first with general principles, the authors pass on to describe and elucidate the extensive range of equipment which goes to form a complete steam plant. Feed-water, its treatment and heating, chimneys, draught and fans, reciprocating engines and turbines, condensers and pumps are adequately dealt with, and there is a useful chapter on steam-engine power and economy.

Air compression, compressors and engines receive treatment compatible with the importance of the use of air as a source of power in such special cases as in deep mines, where it gives three advantages —its transmission for long distances without great loss, the cooling effect of its exhaust and its help in ventilation. It can scarcely be said, however, that the internal combustion engine has been dealt with as fully as its importance and variety deserve. Apart, however, from this criticism it should be pointed out that the theoretical and practical aspects of this section of the subject have been excellently presented, and the student will receive a good grounding, particularly in the fuels available and their combustion.

An Introduction to Astronomy

By Prof. Robert H. Baker. Second edition. Pp. viii+315. (New York: D. Van Nostrand Co.; London: Macmillan and Co., Ltd., 1940.) 12*s*. 6*d*. net.

THE first edition of this work appeared in 1935, and there have been two reprints since. The second edition follows the general plan of the earlier edition, but a few minor alterations have been made to clarify certain points and various new features have been introduced to bring the work into line with astronomical progress. Two chapters, "The Galactic System" and "The Exterior Systems", have been rewritten owing to the recent rapid developments in these spheres, and of course Satellites X and XI are now included among Jupiter's satellites.

The book commences with the usual aspects of the earth and the sky and then deals with the solar system, the stars, nebulæ and galactic systems. Chapter v contains an excellent description of the constellations with a number of maps and charts which will prove very helpful to those who are commencing a study of the stars in the different seasons. A very important feature of the work is the list of questions which are given at the end of each chapter. These have a direct bearing on the subject dealt with in the chapter and they will make students realize that careful reading is necessary if the text is to be thoroughly understood. Probably many will find it expedient to re-read each chapter to answer the questions satisfactorily, and this will ensure a good foundation in the various branches which are considered. The large number of diagrams and photographs adds considerably to the usefulness of this book.

M. D.

The Francis Walker Types of Trichoptera in the British Museum

Re-described and figured by Dr. Cornelius Betten and Martin E. Mosely. Pp. x+248. (London: British Museum [Natural History], 1940.) 15*s*.

THE descriptions of Trichoptera or caddis flies, made by Francis Walker nearly a hundred years ago, have proved quite inadequate guides to their recognition. It has become increasingly difficult with the lapse of time to associate Walker's descriptions with species now established upon modern conceptions involving the use of more fundamental characters than colour, wing-pattern and the like. Walker's descriptions, however, have formed the basis for all subsequent work on American Trichoptera, since very few of the species had, in his day, been previously named. With the growth of subsequent knowledge much confusion of synonymy has resulted, and the joint authors of this work have made use of their opportunity to clarify the position for the future. They have re-described not only all the North American species, which occupy the greater part of the volume, but have also done likewise for all other recognizable Walkerian species of the order. Accompanying the descriptions are many excellent figures of the genitalia, and of the venation in cases where needed. The work has been well carried out by authors and publishers alike.

Fundamentals of Photography

With Laboratory Experiments. By Prof. Paul E. Boucher. Pp. xi+304+lii. (London: Chapman and Hall, Ltd., 1941.) 16*s*. net.

THIS book is another welcome piece of evidence of the growth of systematic teaching of photography in universities of the United States. It concentrates on the need for exact knowledge of the technique of photography, which requires experimental work as well as reading. The treatment is best illustrated by the author's definition of a good photograph as one which gives correct tone reproduction. The pictorial side is, however, equally fundamental, and a considerable proportion of students taking such a course will apply their knowledge later to work in which this plays an important part. However, the pictorial part must be largely self-taught and, if correct technique is not learned first, the odds are that it never will be.

The book loses some coherence by its order and arrangement. The camera is discussed before lenses and image formation. Developers are dealt with in Chapter ii; development in Chapter vii and again separately for negatives, contact prints, enlargements and lantern slides. The experimental section is excellent and forms a serious investigation of how photography works. It will probably be many years before any university in Great Britain provides the apparatus and facilities for such a course.

The book will then be valuable as a text-book for both teachers and students. There are few errors, but aberrations are described as 'defects in lenses' and the greater tone range made possible by slide projection is explained incorrectly. Reflex cameras are said to be popular among pressmen; the contrary is true in Great Britain and most users of reflexes are agreed that they are unsuited to speed work. The book is reasonably priced but the illustration is poor.

A. S. C. L.

The Statesman's Year-Book

Statistical and Historical Annual of the States of the World for the Year 1941. Edited by Dr. M. Epstein. Seventy-eighth annual publication: revised after Official Returns. Pp. xxxvi+1487. (London: Macmillan and Co., Ltd., 1941.) 20*s*. net.

IN spite of obvious difficulties this valuable annual makes its usual appearance and has not shrunk in size. The States of Europe and the rest of the world appear as they were before the War, and in those that have been the victims of Nazi onslaught statistics have to be confined to an earlier year than last. For the rest the figures have been revised so far as official returns permit, and the book presents a summary of current prevailing political and economic conditions for most of the world. The introductory tables of world production of various commodities are most useful. Two coloured maps show respectively naval and air-bases leased by Great Britain to the United States and the boundaries of Rumania as they were up to September 1940. It is noteworthy that the price of the volume has not been increased.

FUNGI IN RELATION TO MAN*

By Dr. J. Ramsbottom, O.B.E.,
British Museum (Natural History)

Fungi as Food

MOST people in Great Britain would classify the numerous fungi of our woods and fields into two groups, the first including one species, the mushroom (*Psalliota campestris*) which is edible, the other including the rest which are called toadstools and are labelled poisonous. Those who have eaten abroad with a true spirit of gastronomic adventure know that certain toadstools make an attractive dish and even in London continue to sample cèpes (various species of Boletus), morel, chanterelle and truffle. This list, however, can be much extended, and forty or fifty species are far more delicate in flavour than the field mushroom of which, moreover, certain of the wild forms are much superior to those usually cultivated. Formerly, several species were sold in Covent Garden market, and blewits, blue-leg or blue stalks (*Tricholoma personatum*) is still sold in the north-east, midlands and west, though round about Berwick-on-Tweed it is now bought by dyers for the extracting of a blue dye, the price offered being two shillings a stone; it would be wiser to eat them than to sell them at this price.

In these days of war, no one could accuse our diet of lacking experiment. Even so, if one suggested that toadstools might be added, there would probably be an outcry about the great danger of poisoning. The fact, however, is that very few of those that anyone would think of cooking are even suspect. But one wholesome-looking species, *Amanita phalloides*, is not only deadly poisonous, but also causes intensive and extensive agonies. One or two allied species such as *Amanita mappa* are usually considered dangerous, but it may be that there has been confusion in identity. The best-known poisonous toadstool is the fly agaric (*Amanita muscaria*) with its scarlet, white-spotted cap, which makes it the most pictured and modelled of all fungi. Here the effects are not deadly though they are severe. The remaining poisonous fungi which grow in Great Britain can be counted on one's fingers and their characters could be learned by any ordinary person with little trouble.

The food value of fungi is not very high if we judge merely by calories, but they serve as an attractive addition to meals or as flavouring and have, moreover, a vitamin content, B and D, and sometimes A, which is appreciable. To purchase cultivated mushrooms at their present exorbitant price is uneconomical for anyone having to consider either food values or his purse, but there is no reason why in rural districts there should not be some organized scheme by which information could be given about edible fungi and various methods of cooking them; they might even be sold in local markets. A little confidence but not rash experiment is all that is needed.

It is strange that in Europe and North America only the field mushroom is cultivated and this by a method which apparently originated in France in the seventeenth century. Attempts have been made to cultivate truffles and other fungi on a large scale but without success. The Chinese and Japanese have cultivated shiitake, an edible fungus, on logs, for more than two thousand years, and in all tropical countries a species of Volvaria may be said to be cultivated, for special beds are prepared for its growth though there is no inoculation.

Parasitic and Saprophytic Fungi

Before it was recognized towards the end of the seventies of last century that bacteria are the main cause of certain diseases, it was known with some certainty that fungi occurred in association with diseases such as ring-worm and were usually regarded as causing them. A century ago, about the time when many of these fungi were first recognized, it was more customary than not to regard what we know now as a parasitic organism not as the cause of a disease but as the result of it. The penetration of one organism by another, with the resulting disease, and the spread of the contagion was first clearly recognized by Bassi, who after long years of research on the muscardine of silk worms showed that it was due to a mould now usually known as *Botrytis Bassiana*. It is difficult to realize that this work was published only a year before Queen Victoria came to the throne. During the following forty years there was as much advance in our knowledge of the nature of disease as there has been in the last forty years in methods of locomotion. There were many false starts and one of these was a tendency to regard all contagious human diseases as due to fungi. However, the true path was shown by a host of investigators whose names are prominent in the history of bacteriology, and the fungi were

* Substance of a Chadwick Public Lecture, entitled "The Interrelation of Man and Fungus in Health and Disease", delivered at the Chelsea Physic Garden on June 19.

gradually relegated to a minor position, though in Great Britain the pendulum has swung too far.

The commonest fungi which affect man are the members of the ring-worm group, some attacking the heads of children, others causing eczema-like eruptions on the skin; a frequent focus for the last type is between the fingers or toes, the usual pathogen then being *Epidermophyton interdigitale*. Infection of the feet by this or allied forms has become more common during the last few years, apparently being picked up on the recently popular sea cruises or in public or school baths, where bare feet encounter contaminated woodwork. The throat trouble 'thrush' is still occasionally troublesome in babies owing to the use of dirty feeding-bottles, but even women of the poorest classes have learned sufficient about hygiene to reduce materially the prevalence of this disease.

An important point about the majority of these mycological diseases is that they are due to fungi which can live either normally or secondarily as saprophytes. Thus *Oidium albicans*, the fungus of 'thrush', occurs in sour milk, and ring-worm fungi affecting cattle have been found growing also on the dung in the byre. The phenomenon is not surprising, having regard to its known frequency with disease-producing bacteria, but it is often overlooked. Not only man but also his ox and his ass are subject to occasional fungal infections, and birds and fish have also a few mycological diseases. Insects are very frequently attacked, one large family (Laboulbeniales) being confined to them as hosts and numerous genera are peculiar to certain insects. Attempts have been made to control insect pests by infecting them with their special fungus parasite.

The most important and numerous diseases caused by fungi are, however, those of plants. Though there are bacterial diseases of plants and also virus diseases, they are few compared with those due to fungi.

Although diseases of crops have been recognized since the earliest times—indeed it would be well-nigh impossible for them to have been overlooked—the urban population of to-day has little idea of the loss that occurs even when every civilized country has its phytopathological service. Estimates of the losses due to fungal disease have been published from time to time. Many of the older estimates refer to years when the losses were exceptional, but modern figures show what enormous losses occur every year. Thus it has been calculated that in the United States more than £10,000,000 is lost in an average year by stem-rust of wheat, whereas it may be five or six times that amount in a bad year; bunt takes an average toll of £2,500,000 and loose smut nearly £1,000,000—and these are not the only diseases which affect wheat, nor is the United States exceptional in the severity of these diseases. The losses in the main crops of the United States are estimated as ranging from two to fifty per cent; 200,000,000 bushels of maize, for example, are lost annually. The figures for world losses are astounding. The downy mildew of the vine has been estimated as causing an annual loss of £500,000,000. The classical example of what a fungus disease can do at its worst was shown a century ago by the potato disease. This disease spread all over Europe causing devastation and dismay. It afflicted Ireland, causing a famine which wrecked a British Cabinet and produced other political and economic effects the results of which are still apparent.

Disease also takes its toll of forest trees. Of the disease-producing organisms fungi are usually the more prominent. The large bracket fungi growing on the boles or roots of trees are for the most part wound parasites requiring some break or crack before they can gain entrance. The result of such an attack is generally a rotting of the heart wood. As the defect occurs in unworked wood it is known as 'wet rot', as opposed to 'dry rot' of worked wood. It should be obvious that the tree trunks which have been so attacked are in a state in which further decay can occur in certain conditions, but sometimes it is the practice merely to remove the parts which are visibly affected. But the filaments of a rot-producing fungus do not stop dead in their progress at the point where their destructive action is apparent, but have usually extended beyond this. Different fungi behave somewhat differently, and it is only a broad general outline that can be mentioned here, and that mainly to stress that care must be taken to ensure that timber affected by wet rot is entirely rid of mycelium before use for structural purposes, or alternatively that it is stored and afterwards used in conditions which do not permit the fungus to renew its growth.

A certain amount of decay takes place in timber yards and there are well-proved practices to reduce this to a minimum. What I have said about the possible continued presence of the mycelium of wet-rot fungi is important, for it is wood stored for use that is affected. Proper sanitation and aeration are the best preventives.

But, from the aspect we are considering, rot in worked wood, that is dry rot, is much more important. There are several kinds of dry rot, but by far the most destructive, the most widespread and the most abundant is that due to *Merulius lacrymans*. Strange to say, this fungus is confined to buildings. An outdoor form has been described, but it is very rare and of no consequence except

taxonomically. It would be difficult to overstress the amount of damage caused in buildings and the ease with which this could be prevented. Wherever there is imperfectly seasoned or damp wood with insufficient ventilation the fungus is almost certain to appear, sooner or later. Having got a start it is able to spread, passing by strands over or through substances from which it cannot obtain nutriment and devouring other woodwork with which it meets. Attacked wood is reduced to powder. Water is formed from the breaking down of the substance of the wood, and this enables the fungus to continue its growth. Excess water is exuded from the fungus as drops, which explains the scientific name of the fungus but puzzles many whose sole knowledge is that their house is said to be suffering from dry rot.

When the strands of Merulius cannot proceed farther they form fruit bodies with an olive-orange coloured honeycomb-like surface. These fruit bodies produce millions of millions of microscopic orange-coloured spores. A fruit-body a foot across, no unusual size, produces more than enough spores to infect every building in the British Isles. Frequently they form a layer on furniture and other objects in a house and often cause alarm where no other effect of the fungus had been noticed. I once had an egg sent to me which was almost wholly orange-coloured, and was able to assure the sender that there was nothing wrong with it but that the cellar where it had been kept was badly in need of attention.

It is well to stress the subject of dry rot at the present time. After the War of 1914–18, when there was a renewal of building, the prevalence of dry rot in some of the building estates was astounding. With proper ventilation and sound seasoned timber there need be no fear after this War of a repetition of the losses of the last building boom, but if precautions are not taken the damage resulting from dry rot will doubtless be even greater.

Not only food plants but also all food may be subject to fungal attack. Mouldiness is one of the commonest phenomena of everyday life, but it is not universally recognized that moulds are living organisms. Moreover, in common with other organisms, they have certain requisites for growth : they need certain food substances, a certain range of temperature and a certain amount of moisture.

The fact that moulds grow only between certain temperatures is acted on in our methods of preservation ; preservation, broadly speaking, is the prevention of the deterioration brought about by fungi or bacteria. If food is kept below a given temperature moulds which can grow only at temperatures above this remain dormant. This is the basis of cold storage. There are many problems of cold storage, particularly with fruit, but these do not alter the general principles.

Not all fungi are incapable of growth at the low temperature at which chilled meat is transported and occasionally there is trouble from these, as, for example, in black spot (Cladosporium), white spot (Sporotrichum) and whiskers (Mucor and Thamnidium). It is noteworthy that *Merulius lacrymans* often occurs in cold storage plant and in refrigerator cars.

Freezing does not ensure the killing of the fungi but only that they are unable to grow, and in growing cause damage. Indeed the spores of many common moulds when dried can be taken down to the temperature of liquid hydrogen without loss of vitality, and are able to withstand the rarefied air, intense cold and blazing sunlight of the stratosphere.

When cold-store meat, fruit and other food is released for use, it is not, therefore, in a sterilized condition ; so far as moulds are concerned, it is more or less in the same state as when it went into storage. The only practical method of sterilizing food is by heat, and to keep it sterilized all organisms must be kept out of contact with it or, as we say, no air should be allowed to get to it.

The spread of knowledge about infectious diseases in recent years has opened the eyes of the general public to the widespread occurrence of germs invisible to the naked eye. Invisible fungus spores, of all kinds, are also present in the air in prodigious numbers and have been shown to occur at a height of several miles. Moulds appear with such consistency on foodstuffs and other organic substances that formerly it was commonly thought that putrescence was universal and inevitable and that moulds are the consequence of the decay. It was partly because of this that the similar view about plant diseases was prevalent.

It may be truthfully said that it would be exceptional for any organic material which was not thoroughly dry to escape decay and destruction. Heat is the only safe sterilizer. The temperature needed is higher than is theoretically sufficient because many spores have highly resistant walls which the heat must penetrate to be effective. Sterilization is the basis of the procedure in fruit-bottling, and similar methods of fruit preservation. But obviously so soon as sterilized material is exposed to the air, so soon is it liable to reinfection. Some foods are more readily attacked by mould than are others ; moisture has a good deal to do with this, especially if the food is enclosed. Thus biscuits if kept in a dry place, either in a tin or on a plate, will remain wholesome, whereas bread, especially when cut, will soon become mouldy in a bread pan, though not so quickly if left free to

the air, but fortunately the time taken is too long for it to affect ordinary household procedure in normal times.

This necessity for moisture was early discovered in man's efforts to preserve his foods, and 'sun-drying' is still practised with numerous fruits. Until 1924, when there was a Government Committee report on the subject, it had become the practice to add such substances as benzoic acid, boric acid and formaldehyde to various foods as preservatives. All these are harmful to some extent and their use was prohibited, except that it is permissible to add small quantities of antiseptics such as sulphurous acid to fruit juices or meat products.

Apart from some chemical solutions which are poisonous to fungi, there are many others in which ordinary moulds will not grow. For this reason fats and oils, vinegar and strong sugar solutions have their use in preserving food.

Use of Fungi

We should be more happy without parasites, at least those which affect us, our animals and the plants we use. But what if there were no saprophytes living on dead material? What if there were no decay and no decomposition?

In natural conditions, decay, paradoxical as it may sound, is a method of sanitation. As things are, we are dependent upon plants with chlorophyll for our existence and equally upon organisms without chlorophyll—the ones to build up organic structures, the others to remove them when life is ended. To take a single example. A forest floor as the trees grow is covered with leaves which are later turned into leaf-mould or soil. As the years pass and a tree's span of life is reached it dies and falls or breaks, or it may succumb to the attacks of parasites. Saprophytic fungi grow on the fallen log or broken stump and gradually, over the years, it is reduced to pulp and finally this is also added to the soil. This has gone on through the ages and to such effect that a primeval forest from this aspect looks very little different from a reasonably old plantation, though forestry sanitation demands that there the fallen trees and broken branches should be removed. But this natural removal of fallen trees, leaves, fruits, shrubs, herbs, as well as dead animals, is carried out by fungi and bacteria living saprophytically.

It is perhaps only in places where man congregates—villages, towns and cities—that there is real danger to himself from putrescent material. If he waits until it disappears by what we may call natural means, then there may result those epidemics which hygiene and sanitary science have taught us to expect.

In the centuries man has discovered that not all the effects of fungal activity result in making wholesome food and drink distasteful or poisonous. Every race has its fermented liquors. Most of these fermentations are brought about by yeasts which act on the sugar present in fruits, cereals, plant juices and such like with the production of alcohol. The infection of the yeasts was haphazard, and with experience some degree of certainty about the resulting products was attained. With increasing knowledge of the biological processes involved in the operations it has become possible to control some of the fermentations so that the same species is used under the same conditions with a more or less standard result. The best understood of these is the production of different kinds of beer, but similar scientific methods have been applied, though not so commonly, in the making of wine and cider. Also it is realized that there are diseases of beer and other beverages which are brought about by the growth of alien organisms.

The raising of dough by yeasts in bread-making and the ripening of rennet cheeses by Penicillium are now often controlled in the strictest manner. Many moulds have been found to be responsible for products which are desirable for various purposes. Sometimes this may be a new substance or it may be one profitable to produce by fermentation. As an example of the second is the production of citric acid by *Aspergillus niger*, a common and abundant mould. Until a few years ago, lemons were used for this purpose, but the fungus is so efficient that it is used even in Italy, formerly the chief source of the acid—and incidentally one which would not be available to us at present.

There are many other products which the study of fungus activity has made available in industry. When the biochemistry of fungi is more fully understood, we shall have the means of producing with ease many substances difficult to synthesize without their aid, and many as yet unknown substances which will have their uses. The achievements of the past give promise that the attempts to harness some of the activities of the organisms will be profitable.

Just as the fungus known as ergot, which causes a disease of rye and other cereals and which when eaten in bread brings about gangrene or convulsions, has so important a place in modern medicine that it is listed in the Medical Research Council's recent memorandum on drugs the production of which in the United Kingdom should be encouraged, so may we hope that eventually we may benefit by turning what at first sight appears unmitigated evil into something beneficial to mankind.

A RECORD OF THE CHANGING FACE OF BRITAIN

By Dr. Vaughan Cornish

THE Committee for the Employment of Artists in War-time, supported by a grant from the Pilgrim Trust, has co-ordinated the work of landscape painters in recording (mostly in water-colour) the architectural gems of rural England with the background of their natural setting. The pictures now on view in the National Gallery, a selection of the first year's work, are arranged according to counties. Such pictures should be multiplied year by year until a complete collection has been made which can be housed for permanent exhibition.

The value of the collection now begun is both historical and educational. The former has, of course, to do with the possible loss of these objects of beauty. This loss may occur in one or other of two ways—destruction by the Huns in war-time, or replanning by Vandals in the succeeding years of peace.

The educational value of this new collection of pictures is especially important in relation to the period of replanning and reconditioning. Whether England's beauty will then be restored or obliterated will depend not only on the accident of individual talent in architecture and administration, but also on the wider diffusion of artistic culture which will ensure that public opinion will not mistake the aberrations of bad taste for the originality of genius.

As we look through the present collection in the National Gallery we find that the subjects recorded as of local or period interest include indoor as well as outdoor scenes of rural architecture—timbered roofs and the paraphernalia of the mills which grind the corn we grow.

The exterior of a windmill is shown in the picture of Dolce Mill, Rochester, by Thomas Hennell. Looking upon this, it is easy to realize the imaginative impression of a four-armed giant which led Don Quixote to emulate the achievement of legendary knights.

The villages and small country towns of Buckinghamshire are charmingly illustrated by Stanley Anderson, R.A.; in Beaconsfield the architectural features surrounding a *place* (for which we have no English name altogether equivalent); in Amersham an interesting Market Hall; and in Long Crendon an old house with the outside chimney shaft which was a picturesque addition to rural architecture at an early date.

The view of Chesham, Bucks, by W. P. Robins, is a landscape proper in which the church spire and neighbouring cottages are minor, decorative features nestling in a well-timbered valley below tree-capped hills.

The street of Hadleigh, by A. Newton, shows the timbered houses with overhanging upper story, which are characteristic of a Suffolk village.

An excellent example of architecture with natural background is seen in Charles Knight's picture of a Sussex farmstead at the foot of the bold slopes of the open chalk downs. Birdham Mill, by W. Russell Flint, R.A., shows a picturesque building set amidst the winding waters of Chichester Channel, a remote corner of Sussex.

Among the line drawings, of which there are a few among the many water-colours, that by S. R. Badmin of a bridge over the Ouse at Chellington, in Bedfordshire, records one of the numerous survivals of medieval arches, the beauty of which is often enhanced by reflexion in the placid streams of the English lowland.

Of buildings in the north of England, the picture of Livesay Hall, in Lancashire, by W. Fairclough, shows an unusually complete preservation of stone-mullioned windows, which are too often replaced by modern woodwork out of harmony with stone fabric.

The market-place of Thame, in Oxfordshire, by Stanley Anderson, R.A., is depicted, as is proper, on market day; for without the gathering of countrymen the picture of a market-place is one of form without function.

From Gloucestershire we have the double dovecote of Coln St. Aldwyn, by George Bissell, an example of the Cotswold style which is a blessed survival of one of the best types of English rural architecture.

A number of interesting examples of the architecture of south-western England are shown in the distinctive water-colours of S. S. Longley: in Dorsetshire the village of Corfe, and the Saxon church of Wareham, which stands in a remarkable position above the sunken road which enters that ancient town. In Devon we have Brixham, with its houses on a steep slope above the little harbour where lies the fishing fleet amidst the reflexions of lapping waves which come gently in from the broad waters of Tor Bay.

Lastly, we come to Longley's simple but charming water-colour of the old farmhouse of Thorn in Salcombe Regis, near Sidmouth, which takes its name from the historic Thorn Tree, close at hand, renewed again and again since Saxon times, and it may even be from yet earlier days.

DIRECT PETROL INJECTION *versus* THE CARBURETTOR FOR THE INTERNAL COMBUSTION ENGINE

REPLYING to the debate upon aircraft supply in the House of Commons, on July 10, the Minister of Aircraft Production, Lieut.-Colonel Moore-Brabazon, mentioned that where the British aero engine industry uses the carburettor, the Germans have adopted the fuel injection system. The use of direct fuel injection, as an alternative to the carburettor of spark-ignition aero-engines, is put forward in some quarters as a cure for the many shortcomings of the carburettor engine, and, in particular, as a means of improved performance at altitude. The injection may be made either before the entry to the supercharger, into the induction manifold, or directly into the engine cylinders. The German systems inject direct into the cylinders, which, having regard to the all-round advantages of the three methods, is probably the best position.

The claims to superiority of the injection system as compared with the carburettor are as follows :

(1) No restriction is offered to the free 'breathing' of the engine, because the pressure drop necessarily incurred at the venturi of the carburettor (and not recovered) is eliminated. This pressure drop is about 1 in. of mercury at ground-level and increases with altitude if the air-flow is constant, because of the fall in air density. It is only significant at altitudes above the 'rated' or full-throttle height. If the venturi is made larger, so as to reduce the 'throttling' at high altitudes, the pressure drop available for fuel metering may be inconveniently small at lower altitudes. Further, eliminating the carburettor gives a clearer entry for the air into the supercharger. The total effect, above the rated altitude, is to increase the height at which a given boost pressure, and therefore power output, is available, and hence to improve the ceiling of the aircraft. It should be noted, however, that the beneficial effect of fuel cooling, in increasing the pressure ratio of the supercharger, is lost, a factor tending to outweigh the gain conferred by reduced restriction to the air-flow. The disadvantage of a low metering pressure can be eliminated by using a 'blown' or pressure carburettor after the supercharger.

(2) The induction system is freed from the hazard of 'refrigeration' icing, because the effect of evaporative fuel cooling is absent. This is a very real advantage as compared with the now obsolescent unheated carburettor, but carburettors are available which are immune from freezing trouble.

(3) There is superior fuel economy due to perfect distribution to individual cylinders. It should be noted that the air distribution is, however, unaffected. Comparative tests indicate that there is little difference in economy between the carburettor and the injection system, at least at normal air temperature. It is possible, however, that at high altitudes, when it is known that distribution becomes poor, the injection system may score. Alternatively, fuel of lower volatility may be used, although it is understood that fuel taken from German tanks indicates that no reduction in knock-rating is being made.

(4) Freedom from inertia effects. This is a definite advantage during fighting manœuvring, but it applies only to the float-type carburettor. Pressure-injection carburettors are available which are equally unaffected by altitude or acceleration.

(5) Reduced risk of vapour-lock at high altitudes, due to the absence of fuel pressure drops in the system and the accompanying risk of vapour evolution. The injection pumps themselves are susceptible to vapour and air in the fuel supply and the Germans fit de-aerators to deal with this risk.

(6) The injection system would be essential for a two-stroke cycle engine in order to eliminate fuel waste during the scavenge period, unavoidable with a carburettor.

It appears that, on balance, the injection system, as compared with many present carburettors, has some slight but definite advantages. Against these must be set the extra complication of the fuel pump and nozzle, and the high standard of accuracy essential to their production and maintenance. This latter question is not without its importance under war conditions. The Junkers system comprises 1,576 parts, 327 being different, and weighs 60 lb., as compared with the Rolls Royce Merlin's 433 parts, 141 being different, and weighing 25 lb. There is also likely to be a definite speed limitation to the injection pump, whereas no such limitation applies to the carburettor.

OBITUARIES

Sir Arthur Evans, F.R.S.

ARTHUR JOHN EVANS was born on July 8, 1851, at Nash Mills, Hemel Hempstead, Herts. The son of John Evans (afterwards Sir John Evans, K.C.B.), the most eminent prehistoric archæologist of his day, he was educated at Harrow and Brasenose College, Oxford, where he took first-class honours in history. It was not, however, formal education that played the most important part in the development of his mind. From his earliest years his surroundings were a training for his future career. In 1859 John Evans was appointed one of a committee of three which crossed to France to pronounce on the origin of the worked flints which Boucher de Perthes had discovered in the valley of the Somme and had claimed to be the earliest known tools and weapons of man; and his home and the great collections of antiquities of the stone, bronze, iron and later ages, which he was then forming, were the centre of the discussions on early man and the earliest evidences of human handiwork in which Sir John Lubbock (afterwards Lord Avebury), Sir Charles Lyell, Boyd Dawkins and others were taking part with him in the earlier years of the latter half of the nineteenth century.

If this atmosphere of archæological discussion played its part in determining the bent of Arthur Evans's intellectual development, no less important was his familiarity with his father's vast collections. There he derived that flair in handling antiquities which gave him an almost uncanny judgment in analysing the formative influences which pointed to their cultural derivation and constituted his great strength in the constructive interpretation of the evidence which he won from archæological sites with the spade of the excavator.

As an archæologist, Arthur Evans was interested in the development of form rather than in the study of the technical processes of production in which his father had excelled. His attention mainly turned in the direction of the bronze and iron ages, the latter then little known in Britain, rather than to the stone age. It was this interest in form which, when he had been for some years a fellow of Brasenose College, Oxford, especially fitted him for his appointment as keeper of the Ashmolean Museum. This post he held from 1884 until 1908, when he became honorary keeper.

Evans's fame as the excavator of Knossos and the discoverer in Crete of the bronze age civilization of the Mediterranean has tended to obscure the eminence of his achievement in British archæology, but his account of his excavation of the iron age burial site at Aylesford in Kent will always be a classic of reference and of crucial importance for the study of the British iron age, while his research on the origins of Celtic art in Britain, which were summed up in his Rhind Lectures of 1895, unfortunately never published, had a fundamental and abiding effect on the future development of that branch of archæological investigation. This department of Evans's research, however, proved to be of even greater and more far-reaching significance, for it was this which first turned his attention in the direction of the Mediterranean and the investigation of the relation of the forms of the prehistoric culture of the Europe of north and west to that of the south and east, a subject to grow under the hands of Oskar Montelius, the Swedish archæologist, and George Coffey, of Dublin.

In carrying out his duties as keeper of the Ashmolean, Evans showed all that vigour, determination of character and capacity for organization which were afterwards to stand him in good stead as an archæological excavator. He organized that venerable institution and made it an integral part of the University. He also undertook archæological exploration in 1873–74 in Finland and Russia, and in the following years he paid the first of a series of visits to the Balkan peninsula.

Evans's early travels of the Balkans were of no little consequence in more directions than one. His experiences were embodied in a series of letters from Illyria to the *Manchester Guardian*, which afterwards appeared in book form, and were thought by some to contain much of his best work as an observer and man of letters. Here he showed acute powers of seizing the essentials of a situation at a time when tension between Italian and Slav under Austrian rule was rapidly attaining breaking point. Like most Westerns who visit the Balkans, Evans became a partisan. Convinced of the justice of the claims of the Slavs, who, though numerically vastly in the majority, had little voice in affairs, he actively espoused their cause, and in 1882 was thrown into prison by the Austrian authorities for his participation in the Crivoscian insurrection. He never lost his sympathy with the Slav, and during the War of 1914–18 he was one of the most active supporters of the movement which led to the formation of the kingdom of Yugoslavia.

In the early 'nineties, Evans began his archæological exploration of Crete. In part he was attracted by the possibility of finding evidence bearing on the origin of the alphabet and early forms of writing, and in 1893 his search was rewarded by the discovery of a pre-Phœnician script. But as time went on, the importance of the island in an archæological sense became increasingly apparent. The excavations of Schliemann at Troy, Mycenæ and Tiryns, which began in 1866 and had been continued on more scientific lines by Dorpfeld, as well as the work of other excavators which was being carried on at other sites in the eastern Mediterranean area, pointed to the existence of a previously unsuspected civilization which was not the Greece of the Homeric age, much less the inheritance of classical times. Evans's personal knowledge of Greece and the eastern

Mediterranean, and the general archæological situation, pointed in the direction of Crete as a strategical strong point; while Petrie's discoveries in Egypt in the later 'nineties demonstrated the existence as a menace to that kingdom in the eighteenth and nineteenth dynasties of some strong maritime confederacy to the north. As was soon to be shown, Evans's confidence and perseverance were justified. In 1900, at Knossos, he discovered the first traces of the Palace and the earliest evidence upon which he was to rear the structure of Minoan civilization, and, in conjunction with material brought by other archæologists, British, American, Greek, French, German, not only from Crete, but also from the mainland and Asia Minor, to reconstruct the whole of the forgotten bronze age culture of the Mediterranean.

From 1900 until 1908, Evans was engaged in the excavation of this site at Knossos, and year by year at meetings of the British Association, the Society of Antiquarians in London and elsewhere, as well as in the publications of the British School at Athens or the Hellenic Society, he reported on his discoveries. So far as was possible, preservation and reconstruction followed exploration, and in 1925 the site, which he had purchased, and the Palace, were handed over on a trust to the British School of Archæology at Athens as a museum and for purposes of archæological research.

At the close of his excavations, Evans had completed the tale of the whole bronze age, so far as revealed on the site at Knossos, covering a period of two thousand years or more and extending from neolithic times down to the final destruction of the Palace at the dawn of the iron age. It is true the one site did not always tell the story in full, but what was lacking was found on other sites of the island, Palækastro, Gournia, Messara, and so forth. Evans's achievement did not rest there, and it is largely due to his genius in interpretation and cultural analysis that we now know the relations of Crete with Egypt and North Africa, with the mainland and islands of Greece, with their Helladic culture, and Asia Minor, and can accept as well founded his reasoned conclusions as to the origins and the influences which built up this great prehistoric civilization.

The work of final analysis and exposition of the evidence from Knossos was long and arduous, and will in itself explain the fact that from 1900 onward, apart from contributions to the periodicals of learned societies, Evans's writings, though all important, were not great in bulk. Of these the most important or considerable are his "Tree and Pillar Cult" (1901) and his "Scripta Minoa" (1909). His account of the excavations as a whole was given to the world in four large volumes under the title "The Palace of Minos", of which the first appeared in 1922 and the fourth in 1935. The completion of the last volume was celebrated at the close of 1934 by Evans's friends and admirers, who presented to him a portrait bust (see NATURE, Dec. 22, 1934, p. 962).

Enough has already been said to make it unnecessary to attempt any further estimate of the value of Arthur Evans's contribution to archæological research. He added a whole chapter, and that one of the most important and crucial, to the history of civilization. From the year 1900 his work became fundamental in determining the course of all future research, not only in the Mediterranean area, but also in the whole region which has been the arena of development of modern civilization. It is perhaps not the least striking evidence of his force of character and strength of intellect that when he made his first discovery at Knossos, he had attained his fiftieth year, and at a time when most who have not already reached the highest attainment can scarcely hope to achieve eminence in a new field, he added to a reputation already established by an achievement second to none in modern archæological investigation.

Arthur Evans naturally and deservedly was the recipient of many honours. In 1911 he was knighted. He was a D.Litt. of Oxford, hon. LL.D. of Edinburgh and Dublin, and hon. Ph.D. of Berlin, a fellow of Brasenose College, Oxford, and fellow of the Society of Antiquaries of London, of which he was president 1914–19. In 1916 he was president of the British Association for the Advancement of Science, an office which he accepted with extreme reluctance, owing to what he felt to be the claim of national duty during the War. So long ago as 1901 he was elected to the Royal Society, which gave him its premier award, the Copley Medal, in 1936. He was awarded the Royal Gold Medal of the Institute of British Architects, the Petrie Medal for archæology, and was Frazer Lecturer in 1930. The more important Continental societies and academies which include archæology within their scope had recognized his work by honorary membership.

By the death of Sir Arthur Evans on July 11, only three days after celebrating his ninetieth birthday, following so closely on the death of Sir James Frazer, archæological and anthropological studies have lost two outstanding figures of international stature.

BOTH in the range of his learning and accomplishments, and in his positive contributions to knowledge, Sir Arthur Evans was an outstanding figure among nearly three generations of archæologists. He owed much to intimacy with his distinguished father, Sir John Evans, whom in some respects he closely resembled; much to the historian Edward Freeman, who encouraged him at Oxford; much to a year's study at Göttingen, to which he would refer with affection and gratitude.

But Evans's peculiar gifts were his own. His eyesight, though not seriously hampering him in field work, gave him a microscopic insight into the finest craftsmanship of gems and coins, enabling him to detect many minute signatures of ancient artists, and so to demonstrate the attribution of similar designs to the same hand. His remarkable flair for objects that interested him had already brought him treasures in other fields of exploration—Illyria and Sicily in particular—before he embarked in middle life on the Cretan adventures which made him known to a wider public.

His strong devotion to freedom and political

justice brought him into close relations with men of many nationalities and creeds, and gave him access to regions and communities which had been visited by few. His interest in the Southern Slavs and in the Cretans began while they were still dominated by the Turks, and he had the satisfaction of witnessing their liberation ; it was indeed appropriate that the Yugoslav State and its Academy should be represented at his memorial service in Oxford. His genius for friendship, and for attracting devoted help from all classes made easy the conduct of archæological excavation on a very large scale, with the large private means which were as generously lavished on the Boy Scout Movement and other social services, as on his expeditions and collections.

Evans's beautiful home at Youlbury became a place of pilgrimage for colleagues from many lands, and a centre of wise counsel and unstinted help, especially to the younger workers. Few men so thoroughly enjoyed a full and strenuous life, or did more to enable others to do the same.

J. L. MYRES.

NEWS AND VIEWS

Reconstruction in Great Britain

IN a statement made in the House of Lords on July 17, Lord Reith, Minister of Works and Buildings, announced the publication of an interim report of the Uthwatt Committee, and stated that the Government is to take immediate steps to implement many of the recommendations. The Government is, of course, already committed to the principle of planning in redeveloping the country, but it is reassuring to learn that the Committee's recommendation that any action taken now to secure the orderly planning of areas which include substantially devastated sites must be planned as a whole, is to be accepted ; and also that the further recommendation to have such areas defined is to be implemented as soon as the necessary legislation can be effected. The Committee has also recommended the setting up of a central authority to control building development by licence. On this point Lord Reith was not inclined to go so far ; the Government view is that emergency powers over building are already stringent, and they have been reinforced by the control of payments made under the War Damage Act ; further safeguards can be given by strengthening the Planning Acts.

The urgency of the problems of reconstruction appears to be now fully appreciated. Lord Reith stated that the Government agrees that all necessary preliminary steps for a national plan should be taken as soon as possible in order to ensure that local development shall be in harmony with national requirements. While Mr. Greenwood, Minister without Portfolio, is still to undertake the general study of post-war problems, Lord Reith is to have special responsibility for long-term planning policy in town and country in the sphere of physical reconstruction. To co-ordinate this work of forward planning with current administration, a Council of Ministers, consisting of the Secretary of State for Scotland, the Minister of Health, and Lord Reith (chairman), has been appointed. This Council of Ministers may prove to be the beginnings of the Central Planning Authority urged by the Uthwatt Committee, and indeed Lord Reith himself said he regarded it as having been established in embryo.

Russian Foreign Policy

THREE further Oxford Pamphlets on World Affairs are of particular interest in view of recent events. Miss Barbara Ward's "Russian Foreign Policy" (No. 34), while not dealing with events beyond the Finnish war, is of interest as an attempt to interpret Russian foreign policy free from ideological preconceptions, on the assumption that neither her problems nor her approach to them are in the last analysis very different from those of her neighbours. Miss Ward traces the foreign policy of the U.S.S.R. from the first year of its existence and its preoccupation with keeping its lands intact and its frontiers inviolate, through the failure of world revolution and the period of concentration upon economic contacts and peaceful diplomatic relations with the outside world, to Russia's entry into the European system of collective security. Obstacles to closer co-operation with the West and the influence of the Anti-Comintern Front are discussed as well as the events leading to the isolation of Russia, the Non-Aggression Pact with Germany and the Finnish war, and the underlying principle in Russian policy—security—is stressed.

Italian Foreign Policy

IN a further pamphlet (No. 48) Miss Ward attempts to place in their proper perspective the answers to such questions regarding Italian foreign policy as why Italy waited nine months before declaring war, and why she entered the war against old allies on the side of a hereditary enemy. Miss Ward indicates the consistency of Italy's policy, and states that the failures of her arms and diplomacy to-day were already predictable when she started her career as a great power some seventy years ago. Her reduction to colonial status as a dependency of the German Reich was always inherent in her policy of seeking aggrandizement without the military strength to secure it single-handed. Italy's humiliation will only be banished in a society in which great powers are no longer measured in colonial empire and military strength ; in a fully organized European society of nations, Italy could play a leading part.

Holland and the War

THIS aspect is obviously of interest in relation to the question of European order on which Prof. G. N. Clark's pamphlet (No. 49, "Holland and the War") has an important bearing. Prof. Clark gives a picture of the economic position of Holland, her social structure and her constitution, and against this background describes her foreign policy in recent years and the circumstances under which she entered the War with her powerful material resources in the East Indies. He describes briefly the effects of the German occupation and Holland's aims in the War—a just and stable international order—and emphasizes the value of the freedom of the Netherlands to the civilization of the world. The preservation of that freedom, when restored, depends on the collective strength and wisdom of the friends of justice.

Carnegie United Kingdom Trust

THE twenty-seventh annual report of the Carnegie United Kingdom Trust (Dunfermline: The Trust) covers the year 1940 and emphasizes the aim of its war-time policy to continue so far as possible to foster pioneer experimental work which may be expected to have an enduring effect on the social structure of the country. It also aims at safeguarding its own past work where this has proved to be of value by assisting earlier beneficiaries to maintain their services and, if necessary, extend them to meet special needs arising from the War. The year 1940 was the last year of a quinquennium, and the report briefly reviews the allocations made during that period. The largest single allocation was one of a £150,000 for land settlement schemes to be undertaken in England and Wales by the Land Settlement Association. The policy of this Association had to be completely re-orientated at the outbreak of war. At September 30, 1940, there were 1,054 holders on full-time estates, and the land has been brought under cultivation for production of corn, potatoes and other crops under schemes agreed with the county war agricultural committees. Individual grants to the National Council of Social Service have been rounded into a single block grant of £5,000 for 1940 to cover all those of the Council's activities in which the Trust is interested.

In the field of adult education, the main allocations during the period have been for the adaptation and equipment of Lord Lothian's gift of New Battle Abbey as a residential college for adult education and for two special inquiries into the problems of young people between the ages of eighteen and twenty-five. The preliminary area reports in the Age Group Enquiry reached an advanced stage of completion by the autumn of 1939, and the report covering the Cardiff district is being published independently under the auspices of the South Wales Council of Social Service and the Welsh University Press Board. The continued development of the Regional Library Bureaux presents the most interesting feature of library history of the last five years, and reference is made in the report to the assistance given to these Bureaux as well as to the National Central Library. Bulk allocations approved for 1941 include £8,000 to central libraries, £5,000 to the National Council of Social Service, £20,000 for youth services and £3,500 for land settlements. An immediate grant of £2,700 has been promised to the National Council of Girls Clubs to establish a bursary fund for training potential youth leaders and the salaries and expenses of supervisors of training. A grant of £2,000 for experiments in Oxfordshire on the establishment of a number of youth service camps has also been promised.

Acoustics of Argentine Chamber of Deputies

A DESCRIPTION is given by S. D. Wilburn and S. C. Tenac in *Electrical Communication* (19, No. 3; 1941) of the system of microphones and loud-speakers designed by the Union Telefonica for the Argentine Chamber of Deputies in Buenos Aires and installed late in 1939. Investigation showed that the pronounced acoustical difficulties of the Chamber were due solely to the absence of reverberation. Structural alterations were not feasible and a system including a microphone for each individual had to be devised. The new system was first used officially at the opening session in 1940, and has given great satisfaction. It comprises 193 microphones and four loud-speakers in the Chamber. It has two independent channels of transmission: one with five microphones consisting of one each for the president of the Chamber of Deputies and the two secretaries and two on the ministers' table; the other channel is equipped for 188 individual-microphones for the deputies. The Chamber is completely surrounded by two walls with three-metre corridors between them at various heights. The four loud-speakers are located in the first gallery. A simple schematic circuit diagram of the transmission, switching and power circuits is given. The electric power consumption of the system is only 1·1 kilowatts.

Sylviculture of some Tropical Trees

To the forester versed in tropical forestry and who has had the opportunity of discussing sylvicultural problems with the mixed gathering found at an international forestry congress, perhaps the most interesting section in the *Malayan Forester* (January, 1941) is that in which observations are made on the sylvicultural characteristics of some of the important timber species. The coppicing powers of dipterocarp regeneration show that *Dryobalanops oblongifolia*, *Dipterocarpus Kerrii* and the balan and the white *meranti* groups of *Shorea* coppice fairly freely, while the red *merantis* and *merawan* (Hopea spp.) do not. There appears also to be some indication that ability to coppice and hardiness go together; for example, *Shorea ovalis* is one of the few red *merantis* to show some ability to coppice, whilst it has also shown itself more tolerant of transplanting than most of its group. How valuable are such practical notes is known only to those tropical foresters scattered about in India, Africa and elsewhere, who are dealing with similar problems with

valuable timber trees of the same genera or families, the knowledge of the secrets of the regeneration of which is absolutely vital to the work of replacing the often primeval stands he is dealing with.

It was the Indian forest officer (should we now say the Burman forest officer ?) who first studied the effects of firing the forest floor in the interests of obtaining successful regeneration of a valuable timber species. In Malaya preliminary investigations show that burning of the undergrowth is a prerequisite for the regeneration of *Melaleuca leucadendron*. An intentionally burnt area and one accidentally fired were equally successful in a covering of germinating seedlings ; whilst an adjoining unburnt area appears to be as devoid of regeneration as ever. These practical observations in the forest (they cannot be undertaken in a research laboratory) are of the very greatest importance and of absorbing interest. In the case of the tropical forest they had their first beginnings in India, where a considerable amount of information had been collected by the end of last century. The present century has witnessed in some cases the results being put to a practical use.

Antarctic and Sub-Antarctic Starfishes

THE Asteroidea of the Sub-Antarctic and the Antarctic and a few from South Africa collected by the *Discovery*, *Discovery II* and the *William Scoresby* have been described by W. K. Fisher (Discovery Repts., 20 ; 1940). Seventeen new species and three new forms of previously described species are described. The author gives a critical list of all the valid species from the antarctic and sub-antarctic, which number 114. He himself deals with 113 different forms, not all separate species and not all from the main region, and from the number and wide range of specimens in some of them he is able to add considerably to our knowledge of these animals. The additional information thus gained has enabled him to revise certain groups. Thus the memoir is not merely a record of species obtained but also a noteworthy contribution to our understanding of the asteroids in southern latitudes. Perhaps the most interesting species is *Odinella nutrix*, which is the only known member of the Brisingidæ to possess a marsupium, and this is entirely different from that in any other group of starfish possessing brood chambers. The work is illustrated by twelve photographic plates and eighteen plates of figures.

Earthquake in Japan

DURING the night of July 16–17 a strong earthquake shook the northern part of the Nagano Prefecture, some 140 miles north-west of Tokyo. It is not yet known whether there were any casualties or not, but more than thirty houses collapsed and the railway between Nagano and Niigata Prefectures was interrupted for a short while. Japan is well known at present to be in a seismically active zone for earthquakes of all focal depths. Tremors, minor shocks and even strong earthquakes as in the case cited above are moderately frequent and very large earthquakes are by no means uncommon as, for example, the Kwanto earthquake of September 1, 1923, which nearly destroyed Tokyo and Yokohama, causing tremendous loss of property and the deaths of 250,000 people, the Tango earthquake of March 7, 1927, and the Idu earthquake of November 26, 1930.

Earthquakes Registered in Switzerland during 1939

THE complete bulletin of the Swiss Seismological Stations at Zurich, Chur, Neuchâtel, Basle and Sion for 1939, compiled by Dr. E. Wanner, has just been received. It contains, besides details of equipment, three tables and six maps. The first table and the maps concern earthquakes with epicentres in Switzerland, twenty-one of which were felt by people during 1939. The greatest intensity reached was five on the Rossi-Forel scale, this being on seven occasions : at Brig-Visp on May 18 ; at Martigny on August 23 ; at Unter-Engadin on September 26 ; at Aargau on November 17 ; at Sion Lokalstoh on November 20 ; at Oberes Baselbiet on December 5 and at Innerferrera on December 7. The second table contains a list of the details of ninety-one near earthquakes, whilst Table III contains a list with details of 178 distant earthquakes registered by the Swiss observatories during the year.

Max Jaffé (1841–1911)

PROF. MAX JAFFÉ, an eminent German biochemist and pathologist, was born at Grünberg in Silesia on July 25, 1841. He received his medical education in Berlin, where he qualified in 1862. While still a student he took a keen interest in chemical investigations and worked in the Pathological Laboratory under the direction of W. Kühne. During 1865–1872 he was an assistant in the medical clinic at Königsberg under Leyden, with whom he published a work on putrid sputum which led to the discovery of the spirilla and leptothrix characteristic of putrid processes in the lungs. In 1872 he was appointed extraordinary professor and in 1880 full professor of pharmacology and medical chemistry in the Königsberg faculty. His principal work consisted in the discovery of urobilin and urobilinogen in the urine and their origin in the bile, his studies of indican and creatinin, with the tests with which his name is associated, and his investigations in urocaninic acid in the urine of dogs and of ornithin in the excrement of birds. Jaffé had an extensive consultant practice and enjoyed a high reputation as a teacher. He died on October 26, 1911.

Armauer Hansen (1841–1912)

DR. GERHARD HENDRIK ARMAUER HANSEN, the celebrated Norwegian leprologist, was born at Bergen on July 29, 1841. He received his medical education at Christiania and qualified in 1866. Two years later he was appointed assistant physician to the leprosy home at Bergen under the direction of Dr. D. C. Danielssen, the founder of the scientific study of leprosy. In 1874 he read a paper before the Medical Society of Christiania, which was published in a

special number of the *Norsk Magazin for Laegevidenskaben* on the etiology of leprosy in which he demolished the theory of heredity, brought forward evidence in favour of its being a specific infectious disease, and described rod-like bodies in the lesions, which he afterwards named *B. lepræ* and regarded as the cause of the disease. His results were confirmed by Prof. Neisser of Breslau, who went to Bergen to examine Hansen's material. Hansen's contention that leprosy was an infectious disease was generally accepted, and led to laws being passed enforcing isolation and disinfection as in the case of other infectious diseases, with the result that the number of lepers in Norway showed a considerable diminution. Hansen received many honours, including the doctorate of the University of Copenhagen and the erection of his statue in the gardens of the Bergen Museum eleven years before his death, which took place on February 13, 1912.

Plastics

WE have received a copy of one of the Pelican Books entitled "Plastics", written by V. E. Yarsley and E. G. Couzens (Harmondsworth: Penguin Books, Ltd. Pp. 160+24 plates. 6*d*.). This gives a very interesting account of the chemistry and physics of modern plastics and the methods of manufacture and the application of plastics. It is well illustrated and provided with an index.

The Night Sky in August

FULL moon occurs on August 7 at 5h. 38m. U.T. and new moon on August 22 at 18h. 34m. The moon is in conjunction with Mars on August 12, with Saturn on August 15, with Jupiter on August 17, and with Venus on August 25. At the beginning of the month Jupiter and Saturn are morning stars, their times of rising being soon after midnight and 23½h. respectively; at the end of August the times are approximately 22½h. and 21½h. The planets are easily recognized in the constellation of Taurus. Mercury rises at 3h. at the beginning and at 6h. 15m. at the end of the month and is in superior conjunction on August 19. Venus rises at 9h. and 7½h. approximately at the beginning and end of August and is in conjunction with Neptune on August 18. Mars is in the constellation of Pisces and rises shortly after 22h. at the beginning and at 20½ h. at the end of the month. The Perseid meteors reach their maximum on August 10–12, their radiant point being close to η Persei. The bright star α Tauri will be occulted by the moon on August 16d. 13h. 12m. approximately.

Announcements

THE George Cross has been awarded posthumously to the Earl of Suffolk, chief field research and experimental officer, Directorate of Scientific Research, Ministry of Supply, "for conspicuous bravery in connexion with bomb disposal". Lord Suffolk was the leader of a 'team' of three, the other two being Miss E. B. Morden (secretary) and Mr. F. W. Hards (mechanic), both of whom are commended for their work during the six months before they were killed.

LORD HAILEY has been appointed president of the Royal Central Asian Society, in succession to the late Lord Lloyd. The Lawrence of Arabia Memorial Medal has been awarded to Captain C. E. Corry, Iraq Police, author of "The Blood Feud", for his successful work in the tribal country of Iraq, and his study of the Marsh Arabs.

MR. J. P. R. RICHES, of Clare College, Cambridge, has been appointed to the Frank Smart studentship for research in botany for one year from October 1.

MISS D. F. BLEEK of Cape Town has been awarded the South African Medal and grant for the year 1940–41 by the South Africa Association for the Advancement of Science for her researches on the Bushmen, and is at present busy on her Bushman dictionary.

THE Jones-Bateman Cup for research in fruit-growing is offered triennially by the Royal Horticultural Society for original research in fruit culture which has added to our knowledge of cultivation, genetics, or other relative matters. The work dealt with should have been mainly carried out by the candidate in the United Kingdom, and mostly during the past five years. Candidates should submit accounts of their work by October 31.

THE following officers for 1941–42 of the Institution of Electrical Engineers have recently been elected: *President*, Sir Noel Ashbridge; *Vice-President*, Prof. S. Parker Smith; *Hon. Treasurer*, Mr. E. Leete.

THE Council of the Royal Society of Arts offers under the Thomas Gray Memorial Trust a prize of £50 to any person who may bring to its notice an invention, publication, diagram, etc., which in the opinion of the judges is considered to be an advancement in the science or practice of navigation, proposed or invented by himself in the period January 1, 1936—December 31, 1941. Competitors must forward their proofs of claim, between October 1 and December 31, to the Secretary, Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2. In 1940 the Council offered a similar prize, which was awarded to Mr. H. C. Walker, of Cheam, Surrey, for a device known as the "portable valve lifeboat equipment", a self-contained radio auto-transmitter.

ON July 10, the honorary degree of LL.D. in the University of Aberdeen was conferred on the following: Dr. A. W. Falconer, principal and vice-chancellor of the University of Cape Town (*in absentia*); Prof. J. C. Philip, emeritus professor of physical chemistry in the Imperial College of Science and Technology, London, and president of the Chemical Society; Sir Alfred Zimmern, Montague Burton professor of international relations in the University of Oxford.

The ordinary degree of D.Sc. was conferred on F. Landgrebe, for a thesis entitled "A Comparative Study of the Autocoids of the Pituitary Gland", and on Dr. T. S. Westoll, for a thesis entitled "The Haplolepidæ: a New Family of late Carboniferous Bony Fishes".

LETTERS TO THE EDITORS

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

Diffuse Spots in X-Ray Crystal Photographs

THE pattern of 'diffuse spots' in X-ray crystal photographs which has been recently the subject of much observation and discussion can, so far as has been examined, be calculated from the first principles of wave interference. It is the true diffraction pattern of the crystal lattice considered as a three-dimensional grating. Neither thermal conditions nor elastic properties enter into the calculations. I have discussed the case of sylvine in NATURE, **146**, 50 (1940): I gave the results for diamond and calcite in the course of a discussion at the Royal Society on February 6, 1941; Preston's summary of the discussion appeared in NATURE, **147**, 467 (1941). A more complete account of these comparisons of theory and experiment together with additional examples are in course of publication by the Royal Society.

Up to the present, the agreement between this true diffraction pattern and the observed effects is within the errors of experiment. Every observation finds its correlation in the pattern, though spots are not always observed where correlation could have been found. The correlation extends to such details as those that have been described by Mrs. Lonsdale for diamond (see accompanying letter), where the diffuse spots in some cases show curious extensions and in others break up into groups of smaller spots. Mrs. Lonsdale has recently found that the less common form of diamond, that which is especially transparent to infra-red and ultra-violet, does not present these minor details. In both cases the geometry of the observed pattern shows correlation with the true diffraction pattern so far as it goes: in one case it goes farther than in the other.

It is, of course, true that the effect calculated in this way ought to be far too weak to be observed in a perfect crystal composed of a considerable number of scattering centres as must be the case when the usual Laue pattern is observed. Why, then, is the true diffraction pattern observable after all? A satisfactory theory must answer this general question. It must account, among other things, for the diamond peculiarities.

W. H. BRAGG.

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Diffuse X-Ray Diffraction from the Two Types of Diamond

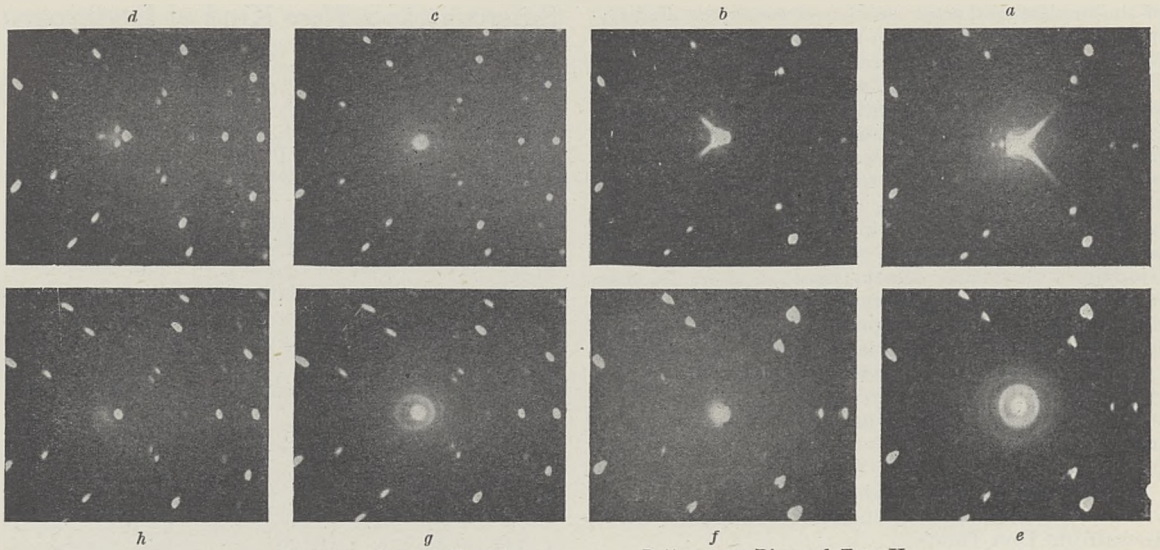
Sir Robert Robertson, Dr. J. J. Fox and Dr. A. E. Martin showed in 1934[1] that in addition to the normal type of diamond, which is always optically anisotropic, there is a rarer type which is much more nearly isotropic and which is more transparent both to infra-red and to ultra-violet radiation.

Observers of the diffuse scattering of X-rays by diamond[2, 3, 4, 5] have not hitherto stated which type of diamond they used. We have recently, through the kindness of Prof. W. T. Gordon, had the opportunity of examining some of the diamonds actually used by Robertson, Fox and Martin, as well as a number of other, smaller diamonds. Several of these diamonds, which were classified[1] as being of the rarer, "transparent" type II, gave results which were quite different from those obtained from type I diamonds. It would appear that the effects previously reported have always been those typical of the normal variety; these we propose to describe first.

The best photographs have been obtained with a small octahedral crystal, mass 1 mgm., using copper $K\alpha$- and β-, iron $K\alpha$- and β-radiations. Laue photographs have been taken at small intervals over a range of up to $\pm$ 20° from the Bragg angle on either side of the {111} {220} {113} [{331} and {004}] planes. The measurements on each series of photographs, when plotted on appropriate reciprocal nets, give in accurate detail the shape and extent of the diffracting regions around the reciprocal lattice points. From the data we find that these points are each surrounded by a small, roughly spherical region of diffuse ("primary") scattering, which only extends to about 3° from the Bragg angle, but that there are, in addition, regions of very sharp, intense ("secondary") diffraction along some or all of the reciprocal [100] [010] [001] axes. There are six such 'horns' extending in reciprocal space from the (111) points, more than half-way across the Brillouin zone in each case. The well-defined streaks, and triangles of sharp spots observed on photographs of diamond in various orientations correspond with great accuracy to the sections of these 'horns' by the sphere of reflexion. It is, however, an extraordinary fact, not as yet explained by any theory, that the {220} and {113} points in reciprocal space are not accompanied by six horns, but only by four. For the (220) and (113) points the [001] horns are missing, for the (202) and (131) points the [010] horns are missing, and the [100] for the (022) and (311) points. These results have been confirmed on crystals definitely classed by Robertson, Fox and Martin as being of type I, including diamond *D* 23, which showed unusually high photo-electric conductivity for that class.

Diamonds of type II show what we have called "primary" diffuse scattering, but the "secondary" effect is entirely missing. There are no sharp streaks, no triangles of sharp spots around a diffuse centre; only the diffuse centre appears, this being somewhat more persistent than in type I. Thus in the reciprocal net corresponding to type II diamonds, the horns of strong diffraction along the cube directions do not exist, either for the (111) or for any other points, so far as could be ascertained. Otherwise, the Laue pictures of the two types of diamond are identical, allowance being made for the very different shapes and sizes of the crystals used.

In the photographs illustrating the ordinary



Top row: Diamond, Type I. Bottom row: Diamond, Type II.

diffraction from the (111) plane in various orientations, (*a*)—(*d*), and its modification in the transparent diamonds, (*e*)—(*h*), the photographic film has been placed either *normal to the reflected beam*, as in (*a*) (*e*) (*b*) (*f*), or at 10° to the incident beam, as in (*c*) (*g*) (*d*) (*h*). In (*a*) and (*e*) the crystal is set at θ_B and in (*c*) and (*g*) at $-\theta_B$, where θ_B is the Bragg angle of incidence for iron $K\alpha$ radiation and the (111) plane (28·05°). In these photographs, rings appear around the (111) reflexion, due to diffraction of the monochromatic reflected beam by the black paper covering the film-holder[6]. These rings, which are evidence both of the intensity of the reflected beam and of the accuracy of the crystal setting, disappear when the angle of incidence θ is more than $\pm 0{\cdot}3°$ from θ_B. Hence they are not present in photographs (*b*) and (*f*), where $\theta = \theta_B + 1$, or in (*d*) and (*h*), where $\theta = -(\theta_B + 2)$. The most remarkable difference between the two types of diamond illustrated by these photographs is that type I gives, in addition to the ordinary (111) reflexion, a diffuse spot accompanied by streaks or surrounded by a triangle of sharp spots, [in (*c*) the triangle is due to iron $K\beta$ radiation, the $K\alpha$ triangle being coincident with the Laue-Bragg reflexion], whereas in type II the (111) reflexion is accompanied only by a diffuse spot, without streaks or triangle. Another important difference is that type II diamonds are much better monochromators than ordinary diamonds (to judge from the intensity of the 'paper' rings), owing partly to the absence of extinction[1], and partly, no doubt, to the almost complete concentration of reflected radiation into a single nearly cylindrical beam.

It may be that what we have called the "primary" and "secondary" diffuse phenomena have different origins; that is a matter for further experiment. The investigation of the diffraction from different diamond planes was undertaken principally in order to find out whether the distribution of scattering power around the various reciprocal lattice points was the same, as the Preston–Bragg block theory would indicate, or different, as allowed by the Faxén–Waller heat theory[7]. Differences *have* been found, but they are not differences which are permissible according to the theory. Moreover, the compltee disappearance of the streaks and triangles in the diamonds of type II definitely eliminates the possibility of these "secondary" effects being due to thermally excited lattice vibrations. Any adequate explanation of the "secondary" spots and streaks (as distinct from the "primary") must account both for the differences between different planes in type I and the absence of the effect in type II.

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Increased Yield of Nucleic Acid-like Substances from Irradiated Yeast

EVIDENCE that yeast irradiated with full ultra-violet light produces nucleic acid-like proliferation-promoting factors[1] led us to compare the yield of nucleic acid from irradiated and non-irradiated yeast in the following experiments.

Starch-free yeast (*S. cerevisiæ*, Fleischmann bakers' strain) was suspended at 300 gm. per litre in distilled water or 1 per cent dextrose. The suspension was divided into two fractions, one of which was irradiated with full ultra-violet from a Hanovia quartz mercury arc until half or more of the cells were killed, while the other was kept at the same temperature without irradiation. Nucleic acid was then prepared from both portions by the method of Johnson and Harkins[2].

In all, three preparations were made. The yield of crude nucleic acid from irradiated yeast (4·5–8·5 gm. per 300 gm. of yeast) was, in each case, greater than that from non-irradiated yeast (3–4 gm. per 300 gm. of yeast). Ultra-violet absorption spectra showed the typical maximum at 2600 A. characteristic of nucleic acids and their derivatives[3]. The extinction coefficient

of the nucleic acid from irradiated yeast was slightly higher than that from non-irradiated yeast, despite the greater yield of the former.

The third preparation was tested for growth-stimulating activity on cultures of yeast grown in rocker tubes in Reader's medium according to the usual techniques[4]. Both the preparation from irradiated yeast and that from non-irradiated yeast showed growth-stimulating activity, contrary to our previous findings for purified nucleic acid[5]. The activity per unit weight of the preparation from irradiated yeast was about twice as great as that from non-irradiated yeast, from which one may deduce that the proliferation-promoting activity was not due to nucleic acid as such but to contaminants (possibly closely related chemically) in the crude preparations.

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Distribution of the Double Linkings in Irone

THE formulation of irene as 1 : 1 : 2 : 6-tetramethyltetralin[1] has recently been established synthetically by Bogert and Apfelbaum[2]. On the basis of this formulation of irene and the production of ββγ-trimethyl pimelic acid by ozonization of irone, structural formulæ have been postulated for this ketone by Ruzicka and his co-workers[3]. Two of the postulated structures contain the chromophoric system C = C − C = C − C = O which should therefore give rise to a characteristic absorption spectrum.

We have recently prepared a specimen of irone from oil of orris and having ascertained that it had the appropriate constants and yielded the characteristic *p*-bromophenyl-hydrazone, we examined its absorption spectrum. This was found to exhibit an intense band at 2280 A. ($\log \varepsilon = 4{\cdot}08$) and an inflexion near 3080 A. ($\log \varepsilon = 2{\cdot}03$), the two together being characteristic of an αβ-unsaturated ketone. The location of the intense band indicates the presence of a monosubstituted αβ-unsaturated ketone[4] (probably R.CH = CH − C(R) = O) and clearly shows the C = C − C = C − C = O structure to be absent. This inference is supported by the fact that the absorption spectrum of α-ionone (λ max. 2285 A.) is almost identical with that of irone (λ max. 2280 A.).

A full account of these results will be published elsewhere.

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Stafford Allen & Sons, Ltd., T. F. WEST.
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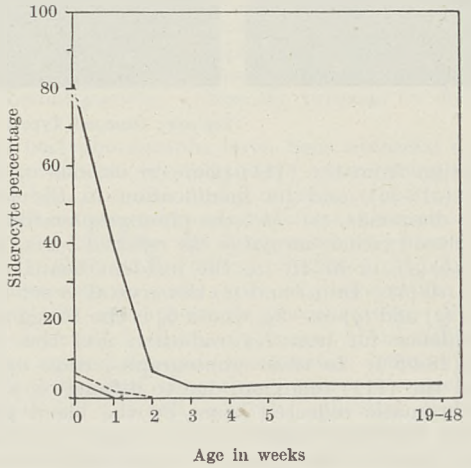
Siderocytes: a New Kind of Erythrocytes

IT is generally known that the presence of iron in the hæmoglobin molecule cannot be detected by the usual histochemical tests, such as the Prussian blue reaction with potassium ferrocyanide. As a consequence, tests for the presence of 'free' or easily detachable iron have scarcely been used in hæmatology.

I have recently investigated the anæmia associated with the recessive gene for flexed-tail and belly-spot in the mouse (*Mus musculus* L.)[1]. The anæmia is of a normocytic hypochromic type; it is severe at birth, but disappears more or less completely during the first few weeks of life; it can be shown that this improvement is inextricably linked up with the transition from the megaloblastic erythropoiesis of



PERCENTAGE OF SIDEROCYTES IN FLEXED-TAILED MICE (HEAVY LINE), NORMAL MICE (THIN LINE) AND NORMAL RATS (DOTTED LINE).

the fœtus to the normoblastic erythropoiesis of the adult, a process which in the mouse, as in the rat, largely takes place after birth.

It has recently been found that newborn flexed-tailed mice have numerous red cells which give the Prussian blue reaction for iron. (Blood films fixed in absolute methyl alcohol were treated with a freshly prepared solution of 1 per cent potassium ferrocyanide in 1 per cent hydrochloric acid at room temperature for 3–5 minutes and counterstained with Biebrich scarlet; the iron reaction is complete after one minute; identical results are obtained with hydrochloric acid concentrations down to 0·05 per cent; with 0·02 and 0·01 per cent hydrochloric acid, only a fraction of the cells will stain.) The 'iron cells' or 'siderocytes' do not stain diffusely, but show blue granules which vary in number from one to a dozen or more and in size from fairly large blobs down to the finest dust-like stipples; no such structures are visible in cells stained with Biebrich scarlet alone or with one of the ordinary hæmatological stains. As shown in the accompanying graph, the percentage of siderocytes diminishes rapidly with age; their reduction in numbers takes place at about the same rate at which the anæmia improves.

It was afterwards discovered that the presence of siderocytes is a normal feature in the embryonic life of the mouse; about 4 per cent are still present

at birth, while by the end of the first week siderocytes have nearly disappeared from the circulation. I am not certain whether in normal mice siderocytes are altogether absent later in life; it is difficult to be sure whether a very occasional dark stipple is or is not an artefact; if siderocytes are still present later in life, their frequency does not exceed 1 : 1,000 red cells. Siderocytes have also been found in new-born normal rats (*Rattus norvegicus*); their decline in number seems to be somewhat slower than in the mouse. Work is under way to discover whether the presence of siderocytes is a feature confined to the embryonic life of rodents.

The iron-containing compound in siderocytes is apparently distinct from the hæmosiderin pigment found in various pathological conditions, which s a brown granular substance visible in unstained preparations; in the majority of cases it is a breakdown product of red cells and has never been found inside intact erythrocytes in the circulation. The most likely suggestion is that normal mouse and rat embryos, and in a grossly exaggerated form flexed-tailed mice, partly furnish their red cells with a hitherto unidentified precursor of hæmoglobin, from which the iron can easily be split off. A less likely interpretation is that the easily detachable iron in siderocytes is the result of an unknown type of hæmoglobin breakdown taking place within the erythrocytes. The relation of the iron-containing compound in siderocytes to the 'labile iron' in blood studied by Legge and Lemberg[2] is uncertain.

A detailed account of this work will be published elsewhere.

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Breeding of Xenopus in the Laboratory

Xenopus lævis is specially favourable for certain types of bio-assay. It is suitable for assay of gonadodesmic[1] extracts[2]. The clawed toad is the only satisfactory test animal for assay of melanophore-stimulating substance, that is, *B* substance [3, 4, 5]. The Hogben test for pregnancy is undoubtedly by far the most economical of those put forward so far, and its reliability is well established [6, 7, 8, 9]. The toad is easily kept in good condition and is an ideal laboratory animal. At the present time the drawback to its use is the difficulty of importing it from the natural habitat. Fortunately, however, Xenopus in good condition[7] ovulates at any time in response to injection of gonadodesmic extracts. So it is possible to produce progeny in large numbers and as required. We adopted the following procedure with successful results.

An injected male and an injected female were placed in a flat-bottomed dish. Coupling occurred within twenty-four hours with the production of fertilized eggs[10]. These were then transferred to a tray kept just under the surface of the water of an aerated aquarium. The temperature of the aquarium was about 22°, and its minute flora and fauna were typical of a well-stocked freshwater pond in Great Britain. Water from a number of other well-stocked aquaria trickled through the aquarium bringing in plankton and keeping the water free from breakdown products. When the eggs hatched young larvæ were transferred from tray to aquarium. Under these conditions tadpoles continued their development through metamorphosis to young adults. The latter were then fed daily with finely chopped fresh liver or muscle. They grew fast—12 months after oviposition the average weight was 9–10 gm. and the body length 4–5 cm. At this stage the toads are easily handled, and can be used for assay of *B*-substance and gonadodesmic extracts. They can replace the frog for many experimental purposes. The tadpoles, which can be obtained at any time of the year, could be used for assay of thyroid and thyrodesmic extracts.

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Plankton as a Source of Food

WHILST it is correct to say that on occasions concentrations of algæ in eutrophic lakes and reservoirs will be very high, it should be remembered that these peaks of production are of short duration. Again, of the dry weight of the diatom *Fragilaria crotonensis*, estimated at 110 tons, quoted by Walker[1], approximately one half is silicon. Further, the fine mesh of any netting that would be necessary to retain algæ would add enormously to the difficulties of collection. I am, therefore, doubtful whether attempts to use phytoplankton as food would be practical or economic, and, in my view, it would be better to investigate the possibilities of large-scale collection of marine zooplankton, as advocated by Hardy[2].

A rich zooplankton is found seasonally in fresh water, but although I have eaten Crustacea tow-netted both from Lough Derg, Ireland, and Windermere and found them not unpleasant, I feel sure that the collection of these smaller forms would present greater difficulties than that of the bigger marine planktonic Crustacea.

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RESEARCH ITEMS

Control of Gonorrhœa

IN an address before the American Medical Association on June 6, W. Bromme claimed that complete control of gonorrhœa is promised by a new treatment. Complete cures in three days of one hundred out of one hundred men were achieved by sulphathiazole treatment. Large doses of the drug, averaging sixty grains a day, were continued in the same dosage for forty-eight hours after the patient is apparently cured. The patients in Dr. Bromme's series were crane operators, foundrymen and others employed in heavy industries. None of them lost a single day from work while taking the treatment. The sulphathiazole is given by mouth. Mild nausea in twenty-three patients and fever of 100·6° F., not enough for most persons to know they had fever, in six patients, were the only reactions to the drug. The author believes that large doses of the sulpha drugs at the start of treatment should be used not only for gonorrhœa but also for meningitis, pneumonia and streptococcus infections. He considers that fewer reactions and more effective cures will result from such doses than from the customary small, often-repeated doses. The small, often-repeated doses of these drugs, which many medical men have used on a cautious basis, provide a chance for the patient to become sensitized to the drug, with resulting untoward symptoms requiring stopping of the drug, and also give the germs a chance to become used to the drug, so that it does not affect them. This is probably the basis of the 'sulphanilamide resistance', which has been reported as a cause of failure of the sulpha drugs in some cases in which patients did not get well even after long treatment.

Artificial Synthesis of Wheat ($n = 42$)

BY combining two dissimilar relatives of wheat, E. J. Britten and W. P. Thompson, of the University of Saskatchewan, have obtained a 'synthetic' hybrid plant closely resembling the common cultivated species (*Triticum vulgare*) (*Science*, May 16). Ordinary cultivated wheat has forty-two chromosomes. It is commonly believed that it originated as a natural hybrid between two other species with lower chromosome numbers. To test this theory, Dr. Britten and Prof. Thompson hybridized a fourteen-chromosome species of wheat (emmer, *Triticum vulgare*) with a wheat-like grass (*Ægilops speltoides*) with only seven chromosomes. This hybrid plant had twenty-one chromosomes, but was completely sterile. The authors then treated the hybrid intensively with a solution of colchicine, making daily injections with a hypodermic needle. This eventually resulted in the formation of heads of grain that had the chromosome number of cultivated wheat (forty-two) and were fully fertile. In external characters, also, the artificially produced plants showed considerable resemblance to ordinary wheat.

Dominance in Gossypium

S. C. Harland and O. M. Atteck (*J. Gen.*, **42**, 21–47; 1941) report the results of a series of backcrossing experiments involving the crinkled mutant of cotton. They believe that dominance has been obtained to crinkled in *Gossypium hirsutum*, *G. purpurascens* and *G. Taitense* by the method suggested by Fisher. In these species, modifiers have been selected in the heterozygote towards modification of the dominance relations and amelioration of the crinkled character. In *G. barbadense*, *G. tomentosum*, and *G. Darwinii*, there is a normal allelomorph of great dominance potency as postulated by Haldane's theory. The recessive condition in these species is relatively unmodified. A discussion of the Fisher effect is given.

Leaf Colours of Coleus

C. L. BONGE (*J. Gen.*, **42**, 191–196; 1941) has published the results of his experiments to elucidate the various colours of commercial Coleus. There is a multiple allelomorph series *Pp–gp*. *P* determines purple colour, which is dominant to p_g which gives green leaves, while the recessive *p* gives a central pattern of colour to the leaf. At another locus, *I* gives a blue-green colour and its allelomorph *i* gives a yellow-green colour to the leaf. Interaction of expressions between these non-allelomorphic genes is observed in certain combinations; for example, *Pp-gI* gives a 'grey' leaf colour, whereas *PpI* gives rise to purple leaves.

Biology of Indian Rust Fungi

LIFE-HISTORIES of two rust fungi attacking the forest tree *Pinus longifolia* have been elucidated by the work of K. Bagchee (*Indian For. Rec.*, Bot., **1**, No. 7, 247; January 1941). *Peridermium himalayense*, on the stem of the tree, is related with a new species of Cronartium upon a species of Swertia as host, as shown by cross inoculation with teleutospores. The other fungus, *P. orientale*, attacks the pine needles, and is the alternative stage of *Coleosporium campanulæ* on *Campanula colorata*. It is interesting that another physiological form of this fungus on *Campanula canescens* cannot induce the æcidia to appear on the pine host.

Solubility Effect in Benzene

KRAUSS and Fuoss since 1933 have shown from conductivity, freezing point and dielectric constant measurements that in cases where acid-base reactions are not involved, the properties of electrolytic solutions depend primarily on the dielectric constant of the solvent, and these properties have been interpreted on the basis of coulomb forces between ions, ion pairs and triple ions. A. W. Vernon, W. F. Luder and M. Giella (*J. Amer. Chem. Soc.*, **63**, 862; 1941) have measured the effect of tetramethylammonium picrate and nitrate on the solubility of tetrabutylammonium iodide in benzene, a solvent of low dielectric constant. Although a common ion is involved, the solubility of the iodide increases rapidly as the picrate or nitrate is added. In the case of the picrate, the solubility of the iodide increases linearly with the picrate concentration. The results indicate that there can be very few single ions present and that the salts are associated in the solvent of low dielectric constant ($D=2·28$). In the case of ethylene dichloride ($D=10·23$) the solubility effect is normal. In benzene there may be association to triple ions, quadripoles and even higher multiples. The conductance measurements show a minimum at

small concentration, the conductance slowly rising as the concentration is increased. The effects are too complex for quantitative treatment at present, but they are in qualitative agreement with the theory. Thus, the solubility of the iodide at first increases more rapidly on addition of nitrate than with the picrate, and the theory indicates a higher association when symmetrical ions are involved.

The Acetyl Radical

THE presence of the acetyl radical, CH_3CO, as an intermediate in the photolysis of some carbonyl compounds, and its instability at higher temperatures have been observed. Not only may it decompose into a methyl radical, CH_3, and carbon monoxide, but it may also disappear by some other reactions which do not liberate carbon monoxide. The carbon monoxide yields in the photolysis of compounds which can form an acetyl radical might be expected to show similarities in their variation with temperature. H. W. Anderson and G. K. Rollefson (*J. Amer. Chem. Soc.*, **63**, 816 ; 1941) have tested this point by measuring the dependence of the carbon monoxide yield on temperature from 0° to 140° in the cases of the photolysis of acetone, diacetyl and acetyl bromide vapour. The conclusion is reached that acetyl radicals are formed with such high energies that some of them decompose spontaneously into methyl and carbon monoxide. If this initial surplus of energy is lost by collisions, the acetyl radicals may either decompose or combine to form diacetyl, the decomposition reaction becoming increasingly important above 50°.

Hydrolysis of Methyl Acetate

ONE of the classical examples of a first-order reaction is the hydrolysis of methyl acetate in presence of a large excess of water, in which the reverse reaction is also neglected: $CH_3.COO.CH_3 + H_2O = CH_3.COOH + CH_3OH$. By working in acetone as a solvent instead of water, where the water concentration changes materially during the reaction, and using sulphuric acid as catalyst, H. B. Friedman and G. V. Elmore (*J. Amer. Chem. Soc.*, **63**, 864 ; 1941) find that the reaction is really of the second order, the velocity being proportional to the ester and water concentrations. It was also found that the velocity coefficient for the second-order reaction was more constant when the reverse reaction (esterification) was taken into account, so that the velocity equation is: $dx/dt = k(a-x)(b-x) - k'x^2$, where a and b are the initial ester and water concentrations and x is the concentration of acetic acid produced by hydrolysis. The value of the equilibrium constant, $K = k/k'$, was found from the equilibrium concentrations in presence of excess of water. Then if $K' = 1/K$, the velocity equation is $(1/k)\ dx/at = (a-x)(b-x) - K'x^2$, from which the values of K were found from the integrated form of the equation.

Activity of Thallous Chloride

THE solubilities of thallous chloride in presence of potassium chloride in solvents composed of ethyl alcohol and water in varying ratio have been measured by E. Hogge and A. B. Garrett (*J. Amer. Chem. Soc.*, **63**, 1089 ; 1941), and the results considered from the point of view of the activity of the thallous chloride. If $m_\pm$ is the mean molality, $\sqrt{m_+ m_-}$ and I the ionic strength of the solution, the graph of $\log m_\pm$ against $\sqrt{I}$ should be a straight line ; or, if this is not the case, the limiting slope should (for infinite dilution or $I = 0$) have a theoretical value given by the Debye-Hückel theory of strong electrolytes. This theoretical value of the limiting slope was not found in any case. The first-order correction for mean distance of ionic approach also gave (as is often found in other systems) impossible negative values. Since thallous chloride is a moderately weak electrolyte, however, a correction for ionic association must be made ; and it was found that when this was applied the results were satisfactory. The effect of the dielectric constant of the solvent was in qualitative agreement only with the theory of Born, and the deviations increase as the dielectric constant decreases.

Stress and Strain Relation for the Atomic Lattice of Iron

S. L. Smith and W. A. Wood (*Proc. Roy. Soc.*, **178**, 93) have measured the lattice spacing of iron by X-ray methods while applying tension to the specimen, and have thus obtained a stress–strain relation for the atomic lattice. The spacing was measured at right angles to the stress and the changes are therefore compared with the lateral contraction observed externally. Up to the yield point the contraction is proportional to the stress ; beyond this point the contraction slows down and eventually reverses into an expansion. It was further found that a permanent expansion may be produced by stressing beyond the yield point. It is concluded that the observed effect of stressing beyond the yield point was due to the superposition of an elastic contraction, comparable with that observed externally, and a lattice deformation leading to expansion. Further experiments showed that the permanent expansion after loading took place along the direction of stress as well as at right angles to it, and hence results in a decrease of density. Recovery of the lattice was produced by gentle heat treatment at temperatures well below those necessary for recrystallization.

Nova Cygni III (1920)

THIS extraordinary star increased its brightness, probably in little more than a fortnight, by a factor of more than 250,000, the greatest rise ever recorded for an ordinary galactic nova. A recent monograph by R. B. Baldwin (*Publ. Obs. Univ. Mich.*, **8**, 61 ; 1941) gives a critical discussion of its spectrum through maximum light and for the six weeks thereafter during which spectroscopic observation was practicable at Ann Arbor. The general development of the star followed that observed in other novæ : great quantities of material were ejected in shells from the central star. In this case no less than eleven shells were detected, their velocities of ejection varying from 400 km./sec. for the first to nearly 3,000 km./sec. for the last. An unusual feature shown by almost all the various spectra is the extreme diffuseness of their absorption lines and emission bands, suggesting a wide range of atomic velocities in the individual shells. Another abnormal development noted by Baldwin is that a year after the outburst (by which time the star showed a visible disk) the velocity shown was not the expected 750 km./sec. of absorption II, the principal feature which had dominated the spectrum since three days after maximum, but 1,200 km./sec., corresponding to absorption V, a relatively transitory feature of the spectrum.

BIOLOGY OF EPIDEMICS*

By PROF. W. W. C. TOPLEY, F.R.S.

THE universe of study which to-day faces the epidemiologist is not, in its essence, composed of a number of cases of a clinically recognizable disease, with a distribution that varies in an observable way in space and time. It is composed of a variety of biological species, some acting as parasites and some as hosts. The parasites may be viruses, or bacteria, or protozoa, or worms. The hosts may be men, or animals, or insects, or plants. The parasite may pass from host to host by direct contact, by indirect mechanical contact, or through the agency of an insect vector. In whatever way it passes, the main factor that determines the occurrence and type of an epidemic prevalence is the frequency of its passage.

If all relevant environmental conditions are held constant, and susceptible hosts are added at a high and steady rate to an infected herd, a steady rate of mortality is attained, with no major waves or fluctuations. If, with a steady rate of addition, the closeness of contact between host and host is changed, increased closeness of contact is followed by the propagation of a major epidemic wave, and decreased opportunity for contact by a rapid fall in the mortality rate. These experimental observations have many analogies in the recorded prevalence of infectious disease under natural conditions.

During an epidemic prevalence the average resistance of the hosts rises with length of exposure to risk ; in part because of the elimination by death of the more susceptible individuals, in part because of the natural immunization of survivors. The resistance attained in this way, though sometimes high, is never absolute. We can, in many cases, attain the advantages of natural immunization, without its risks, by an appropriate method of vaccination.

Differences in severity between different epidemics of the same disease are in part accounted for by biological differences between various strains of a single parasitic species, between different races of a single species of host, or between different races of a single species of insect vector. The biological characters that determine the ability of a parasite to spread from host to host are not identical with the characters that determine its ability to multiply rapidly in the host's viruses, so that virulence and infectivity may vary independently.

In attempting to control epidemics we always strive, in one way of another, to decrease the probability of the passage of the causative parasite from an infected to a susceptible host. We may do this by changes in the distribution of the hosts at risk, or by lessening the population density of an essential insect vector, or by reducing the proportion of susceptible hosts by artificial immunization, or in many other ways. In no case is it necessary, by our own action, to reduce the probability to zero. The epidemic system is in unstable equilibrium. If we tip the balance far enough in favour of the host, the system itself will do the rest, and the disease will tend to become very infrequent, and may sometimes disappear.

* Substance of the Croonian Lecture delivered before the Royal Society on July 17.

LUMINESCENT MATERIALS*

FOR some years before the War there had been increasing interest in the fundamental and applied aspects of the luminescence of solids concurrently with a search for new and better luminescent solids by commercial firms. The possibilities in war of such materials are considerable ; whilst it is obviously impossible now to discuss applications in the Services, there are many which can be made of value to the public at large. Unfortunately, at the outset of war, commercial development outran technical knowledge in the materials presented for sale to the public, and the consequent crop of failures aroused public prejudice against them.

The subject has been under investigation by a specially formed expert committee of the Civil Defence Research Committee, which has now issued a bulletin largely to explain how luminescent devices can best be used in present circumstances. The work of the Committee has covered both a comprehensive study of the theory of the subject including, in particular, the laws of phosphorescence ; an attempt to make good the deficiencies in luminescent materials and improve their method of manufacture ; and an indication of possible applications. The bulletin in particular names the materials available and their properties, sources of irradiation, and enumerates a large number of possible applications, though the list is by no means exhaustive or complete.

The theory of the subject has been studied particularly by Dr. J. T. Randall at the University of Birmingham in recent years, where a method has been developed of studying the electronic 'traps' in luminescent solids. Such solids owe their properties to the presence of minute traces of an impurity, and their preparation depends on the addition of an activator to the pure matrix materials followed by a heat treatment which causes an intimate association of impurity atoms and matrix lattice.

The commoner luminous pigments fall into two main classes : (i) zinc and zinc cadmium sulphides ; (ii) alkaline earth sulphides. The former have a high fluorescent brightness but relatively short periods of afterglow ; the latter exhibit lower initial brightness but have longer periods of afterglow. To make these materials really useful in practice there must be uniformity in behaviour from batch to batch and, in the long run, their properties must be improved. In

* Luminescent Materials and their War-time Uses. Bulletin C.17, Ministry of Home Security, Research and Experiments Department, Princes Risborough, Bucks.

simple language, the number of 'traps' has to be increased and a means of control of the rate of their discharge found. It is to this end that an understanding of the theory of phosphorescence is required; success will mean that better powders are possible. The stimulus to manufacturers given by the existence of the Committee is said already to have resulted in a marked improvement of the commercial products.

But it is not enough to make the active products; they have to be incorporated into paints, plastics or enamels, and shielded in a manner which gives protection against weathering if they are to be exposed out of doors. In addition, the greatest care has to be taken during the incorporation lest the activity of the phosphors be lessened.

The problem has still another side when fluorescent materials are used, since these have to be continuously energized by ultra-violet radiation. The types of source of this which are available are indicated in the bulletin. A minor point here is the relatively short useful life of the argon lamp: probably research is already going on in other quarters to improve this. It is suggested that, could this be realized and the lamp 'mass-produced', a great stimulus would be given to the use of fluorescent materials rendered visible by such means.

It is clear that the scope of what at first sight might appear to be a limited investigation is in reality quite wide and that the existence of the Committee is fully justified. It is to be hoped that the results of its work will be made available at least in quarters where this can be applied for the public weal. This is the more desirable since it is known that luminescent materials were widely applied in France and Germany last winter, whereas little use was made of them in Great Britain: this in spite of the fact that there was no lack of knowledge of them in scientific circles in England.

THE ROYAL OBSERVATORY, GREENWICH

Annual Report of the Astronomer Royal

THE annual report of the Astronomer Royal, just published, refers to the work of the Royal Observatory during the period May 1, 1940–April 30, 1941. To those who know the position of the Observatory, in the midst of military and industrial objectives, it will come as no surprise that much of the work has been curtailed by enemy action. The last report mentioned the dismantling of much of the optical apparatus; most of the mirrors and lenses have now been sent away from Greenwich for safety. Since heavy bombing of London started last September, night observations have been impossible on such of the telescopes as had not already been dismounted at the outbreak of hostilities; in fact, the only observing programmes still carried on at Greenwich are daylight ones, namely, the routine meteorological work and the photographic and visual solar observations.

The public time service functions well from two emergency outstations, as the familiar 'six pips' regularly testify. The Rugby rhythmic signals, however, in present circumstances fall short of the high precision needed for control of frequency standards, though they are, of course, quite adequate for navigation. Rating of chronometers and watches and their issue to the Royal Navy continue as usual, though the entire establishment concerned has been moved for the second time in two years.

Work has ceased on the Airy transit circle after continuous observation with this instrument for ninety years. More than 650,000 observations have been made with it, forming the most important contribution from a single instrument to fundamental positional astronomy. The new reversible transit circle which is to take its place has obtained nearly 10,000 transits during the last three years. When observing ceased in September 1940, the work of determining the division errors had been completed and an investigation started on the irregularities of the pivots. These latter have already been found to be extremely small.

The photoheliograph and spectrohelioscope observations show the expected decline in solar activity from the 1937–38 maximum, the sunspot frequency having dropped to about half that at maximum. Nevertheless, twenty-one large groups of spots occurred, six of them being later associated with magnetic storms. One of these latter, that of March 1, 1941, ranks high among the most severe disturbances of the past ninety years. The associated spot could not be extensively observed because of cloud, but the number of short-wave radio fade-outs occurring during its central meridian passage suggests that it was chromospherically very active. Over the year as a whole, however, both chromospheric eruptions and radio fade-outs were few.

The meteorological department of the Observatory has celebrated its centenary of routine observations. Features of the year's weather include an August drier than any for 122 years, and a period from December to April during which each month was considerably colder than normal, the temperature in the Stevenson screen never reaching 59° F. for the whole five months.

Discussion of the photographic material, comprising nearly 3,000 plates, obtained during the 1931 opposition of Eros, is now practically complete. The solar parallax deduced from these observations at stations all over the world is 8·790″ ± 0·001″, the previously accepted value being 8·80″.

The "Nautical Almanac" office continues its essential work, though it has had to contend with the destruction by fire of the whole of the type and plates for all its publications except the "Astronomical Navigation Tables". The consequent delay in publication is being rapidly made good, in some cases by using photographic reproduction in lieu of printing from type.

Astronomers all over the world will join in sympathizing with the Astronomer Royal and his staff on the interruption of many of their long-established programmes, and in congratulating them on their maintenance of essential services throughout a very trying period.

FORTHCOMING EVENTS

SATURDAY, JULY 26

BRITISH PSYCHOLOGICAL SOCIETY (at Tavistock House, Tavistock Square, London, W.C.1), at 10.30 a.m.—Discussion on "Psychological Problems of Air Raid Shelters and Evacuation".

APPOINTMENTS VACANT

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

LECTURER IN CIVIL AND MECHANICAL ENGINEERING—The Secretary, Woolwich Polytechnic, Woolwich, London, S.E.18 (July 30).

ASSISTANT LECTURERS (TWO) IN SCIENCE, MATHEMATICS AND DRAWING in the Halesowen County Technical School—The Clerk to the Halesowen Local Higher Education Committee, 21 Great Cornbow, Halesowen, Worcestershire (July 30).

PHYSICIST FOR THE BRADFORD REGIONAL RADIUM CENTRE—The House Governor and Secretary, Bradford Royal Infirmary, Bradford.

REPORTS AND OTHER PUBLICATIONS

Great Britain and Ireland

Children's Nutrition Council (Edinburgh Branch). Food and the War : a Report on an Enquiry into the Adequacy of the Incomes and Expenditures of One Hundred and Three Families on Low and Moderate Incomes, during the Period April to November 1940. Pp. 28. (Edinburgh : Children's Nutrition Council.) 3*d*. [17

Philosophical Transactions of the Royal Society of London. Series A : Mathematical and Physical Sciences. No. 803, Vol. 239 : The Theory of the Division in Saturn's Rings. By G. R. Goldsbrough. Pp. 183–216. 5*s*. 6*d*. Series B : Biological Sciences. No. 576, Vol. 231 : Foraminifera from the Green Ammonite Beds, Lower Lias, of Dorset. By Dr. W. A. Macfadyen. Pp. 73+4 plates. 15*s*. (London : Cambridge University Press.) [17

Lister Institute of Preventive Medicine. Report of the Governing Body, 1941. Pp. 26. (London : Lister Institute.) [17

Annual Reports on the Progress of Chemistry for 1940. Vol. 37. Pp. 525. (London : Chemical Society.) 15*s*. [17

Jealott's Hill Research Station. Bulletin No. 3: Home Production and Use of Feeding-Stuffs in War. By W. R. Peel and S. J. Watson. Pp. 36. (Bracknell : Imperial Chemical Industries, Ltd.) [77

University College of Wales, Aberystwyth : Welsh Plant Breeding Station. War Food Production, Advisory Bulletin No. 4 : The Best Utilization of Hill Land. By Moses Griffith. Pp. 20. (Aberystwyth : Welsh Plant Breeding Station.) 1*s*. [77

British Electrical and Allied Industries Research Association. Technical Report, Reference L/T 100 : Dielectric Properties of Experimental Resin-Paper Boards. By Dr. L. Hartshorn and E. Rushton, with N. J. L. Megson. Pp. 14. 2*s*. 6*d*. Technical Report, Reference L/T 121 : Dielectric Loss in Dipolar Solids, 1 : Solutions of Dipolar Molecules in Solid Paraffins. By H. Fröhlich. Pp. 12. 11*s*. 6*d*. (London : British Electrical and Allied Industries Research Association.) [87

Emergency Medical Services Instructions. Part 1 : Medical Treatment and Special Centres. Pp. 60. (London : Ministry of Health.) [107

The National Trust for Places of Historic Interest or Natural Beauty. Report 1940–1941. Pp. 104. (London : The National Trust.) [107

My Work and Ideas (1908–1941) : a Brief Account of Notions or Points of View on which Pioneer or Explanatory Work has been done in England and the West Indies, with some Account of the Results and of the Circumstances that led from one Notion to Another. By W. R. Dunlop. Pp. 18. (London : The Author, 57 Gordon Square.) [147

Other Countries

Forest Research in India, 1939–40. Part 2 : Reports for Burma and Indian Provinces. Pp. iii+218. (Delhi : Manager of Publications.) 3.12 rupees ; 6*s*. [17

Uganda Protectorate. Annual Report of the Forest Department for the Year ending 31st December 1940. Pp. 8. (Entebbe : Government Printer.) 1*s*. [17

Commonwealth of Australia : Council for Scientific and Industrial Research. Pamphlet No. 106 : A Report on Agricultural Features of the Australian Potato Industry. By Dr. J. G. Bald. Pp. 72. (Melbourne : Government Printer.) [17

University of California Publications in Zoology. Vol. 42, No. 7 : Structural Adaptations in Thrashers (Mimidæ : Genus Toxostroma) with Comments on Interspecific Relationships. By William L. Engels. Pp. iii+341–400. 75 cents. Vol. 42, No. 9 : Geographic Variation in Bushy-tailed Wood Rats. By Emmet T. Hooper. Pp. ii+407–424. 25 cents. Vol. 44, No. 1 : A Biogeographical Study of the Ordinoides artenkreis of Garter Snakes (Genus Thamnophis). By Henry S. Fitch. Pp. iii+150+7 plates. 1.50 dollars. (Berkeley, Calif. : University of California Press ; London : Cambridge University Press.) [77

Occasional Papers of the California Academy of Sciences. No. 19 : The Rabbits of California. By Robert T. Orr. Pp. iii+228. (San Francisco : California Academy of Sciences.) 3.50 dollars. [77

Proceedings of the American Academy of Arts and Sciences. Vol. 73, No. 8 : Amphibians and Reptiles in Nevada. By Jean M. Linsdale. Pp. 197–258. (Boston, Mass. : American Academy of Arts and Sciences.) 1.85 dollars. [77

Proceedings of the United States National Museum. Vol. 90, No. 3106 : New Fishes of the Family Callionymidæ, mostly Philippine, obtained by the United States Bureau of Fisheries Steamer *Albatross*. By Henry W. Fowler. Pp. 32. (Washington, D.C. : Government Printing Office.) [77

Commonwealth of Australia : Council for Scientific and Industrial Research. Bulletin No. 138 : The Economic Biology of some Australian Clupeoid Fish. By M. Blackburn. (Division of Fisheries : Report No. 6.) Pp. 152. (Melbourne : Government Printer.) [77

Ontario Research Foundation. Report for the Year 1940. Pp. 33. (Toronto : Ontario Research Foundation.) [77

Imperial College of Tropical Agriculture. Report of the Governing Body and the Principal's Report to December 31st, 1940, and the Accounts for the Year ended August 31, 1940. Pp. 32. (Trinidad : Imperial College of Tropical Agriculture.) [77

Cornell University : Agricultural Experiment Station. Bulletin 743 : Instalment Credit in the Sale of Washing Machines. By Mabel A. Rollins. (Contribution from the Laboratories in Home Economics.) Pp. 36. Bulletin 747 : Some Facts concerning Costs of Operation of Farm Motor Trucks. By M. P. Rasmussen and P. S. Williamson. Pp. 30. Bulletin 751 : Costs of Farm Power and Equipment. By J. P. Hertel and Paul Williamson. Pp. 38. Memoir 232 : A Catalogue of the Plecoptera of the World. By Peter Walter Claassen. Pp. 235. Memoir 233 : Germination of the Conidia of *Sclerotinia fructiola*, with Special Reference to the Toxicity of Copper. By Ch'wan-Kwang Lin. Pp. 34. (Ithaca, N.Y. : Cornell University.) [87

U.S. Office of Education : Federal Security Agency. Leaflet No. 57 : Know Your Community as a Basis for Understanding the School's Problems. By Bess Goodykoontz. (Know Your School Series.) Pp. iii+35. (Washington, D.C. : Government Printing Office.) 10 cents. [87

United States Department of Agriculture. Technical Bulletin No. 769 : Peat Resources in Alaska. By A. P. Dachnowski-Stokes. Pp. 84. (Washington, D.C. : Government Printing Office.) 15 cents. [87

Carnegie Institution of Washington : Department of Terrestrial Magnetism. List of Publications for the Year 1940. Pp. 14. (Washington, D.C. : Carnegie Institution.) [87

University of Illinois : Engineering Experiment Station. Bulletin Series No. 326 : An Analytical and Experimental Study of the Hydraulic Ram. By Prof. Wallace M. Lansford and Warren G. Dugan. Pp. 70. 70 cents. Bulletin Series No. 327 : Fatigue Tests of Welded Joints in Structural Steel Plates. By Wilbur M. Wilson, Walter H. Bruckner, John V. Coombe and Richard A. Wilde. Pp. 86. 1 dollar. Bulletin Series No. 328 : A Study of the Place Factors in the Fractional Distillation of the Ethyl Alcohol-Water System. By Prof. Donald B. Keyes and Leonard Byman. Pp. 64. 70 cents. Reprint Series No. 21 : Seventh Progress Report of the Investigation of Fissures in Railroad Rails. By Herbert F. Moore. Pp. 79. 15 cents. (Urbana, Ill. : University of Illinois.) [117

Canada : Department of Mines and Resources : Mines and Geology Branch. Report of Mines and Geology Branch for the Fiscal Year ended March 31, 1940. Pp. 60. Geological Survey Memoir 228 : Nelson Map-Area, East Half, British Columbia. By H. M. A. Rice. (No. 2460.) Pp. v+86. 25 cents. Geological Survey Paper 41–1 : Preliminary Report, MacKay Lake Area, Northwest Territories. By J. F. Henderson. Pp. iii+6+1 map. 10 cents. Geological Survey Paper 41–2 : Preliminary Map, Great Slave Lake to Great Bear Lake, Northwest Territories. 10 cents. Geological Survey Paper 41–3 : Preliminary Report, Ingray Lake Map-Area, Northwest Territories. By C. S. Lord. Pp. iii+12+1 map. 10 cents. Geological Survey Paper 41–4 : Preliminary Map, Brazeau, Alberta. By B. R. MacKay. 10 cents. (Ottawa : King's Printer.) [147

Catalogues

Photography Applied to Plan Copying in Engineering and other Industries. Pp. 12. (Ilford : Ilford, Ltd.)

Special Products for Nutritional Research. Pp. 12. (Chagrin Falls, Ohio : S. M. A. Corporation.)

Annotated Catalogue of Works on Exact and Applied Science. (Sotheran's Price Current of Literature, No. 868.) Pp. 120. (London : Henry Sotheran, Ltd.)

The Significance of Vitamin K in Prothrombin Deficiency. Pp. 4. Modern Vaccine Treatment in Skin Injections. Pp. 4. (Greenford : Glaxo Laboratories, Ltd.)

Catalogue of Books on Botany, Entomology, Ornithology and General Natural History. (No. 284.) Pp. 28. (Oxford : Dulau's Department of B. H. Blackwell, Ltd.)

Colour Plate Books : Rare, Curious, Beautiful. (Catalogue No. 656.) Pp. 26. (London : Francis Edwards, Ltd.)

Old Science and Medicine, including many Association Copies. (Catalogue 62.) Pp. 42. (London : E. P. Goldschmidt and Co., Ltd.)

Cooke Optical Clinometer. (Publication No. 889.) Pp. 4. (York : Cooke, Troughton and Simms, Ltd.)

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