SUPPLEMENT: SHORT REVIEWS and FORTHCOMING BOOKS

NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

Vol. 145, No. 3674. SATURDAY, MARCH 30, 1940 ONE SHILLING

NATURE

Vol. 145 SATURDAY, MARCH 30, 1940 No. 3674

CONTENTS

Editorial and Publishing Offices :
MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2
Telephone Number : Whitehall 8831 Telegraphic Address : Phusis, Lesquare, London
The annual subscription rates are : £2 12 0 British Isles, £2 17 0 Foreign, payable in advance

Advertisements should be addressed to
T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4. Telephone Number : City 4211
Registered as a Newspaper at the General Post Office

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

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 145 SATURDAY, MARCH 30, 1940 No. 3674

WAR-TIME FOOD POLICY

THE publication of "Feeding the People in War-Time" by Sir John Orr and Mr. David Lubbock has served to direct public attention to a subject of the utmost importance in our war effort, namely the need for a sound and consistent policy in regard to food.*

In Great Britain the public has always been interested in food questions. The British Press devoted as much space to reviews and commentaries on the final report of the League of Nations Committee on Nutrition as did all the rest of the world's newspapers. Now rationing has given every individual a personal interest in food supplies; certainly Mr. Morrison will not complain that the country is indifferent to the doings of the Ministry of Food.

Nevertheless, the peace-time structure of the British Government machine was singularly ill-adapted to the evolution of food policies. Food supplies were not within the control of any single Minister, nor were they the principal concern of any Department of State. The Ministry of Health had a food department mainly concerned to safeguard the public from adulteration or from the cumulative effects of small quantities of preservatives. The General Department of the Board of Trade was concerned with food but, at least in recent years, mainly from the angle of the administration of import quota schemes. The Department of Scientific and Industrial Research includes the development of scientific knowledge regarding food preservation among its activities. The Ministry of Agriculture, although mainly concerned with the production of food, had no responsibilities towards the British consumer. There was thus no Ministry which could consider the food problem, either to secure adequate levels of nutrition in peace or to prepare the nation for war. When the series of political crises gave warning of the imminence of war, a Food (Defence Plans) Department was established under the Board of Trade, and this body was the nucleus from which the present Ministry of Food has been developed.

Having regard to this prior history, it was not surprising that the Food (Defence Plans) Department should not have been able to make more adequate preparations for food supplies before the War broke out. It is true that the case for obtaining large stocks of wheat, sugar and other easily stored products was urged by Sir Arthur Salter in the House of Commons and by other authorities in the Press, but it is by no means easy for a hastily constituted department to overcome the resistance of the Government machine to new proposals. As a result, Great Britain entered the War without substantial stocks of cereals, sugar and feeding stuffs, although it is understood that large supplies of edible oils and oil-seeds were obtained.

In considering the food policy during war, it is as well to compare the position of Great Britain with that of Germany. Under peace conditions, Germany produced 80–85 per cent of her total food requirements, while the contribution of British agriculture to United Kingdom requirements amounted to between 30 and 33 per cent when measured on a calorie basis. Such information as is available suggests that the German authorities have realized the importance of the protective foods, and hence, although there has been a falling off in the general standard of living of the German

* "Feeding the People in War-Time". By Sir John Orr and David Lubbock. Pp. vii+88. (London: Macmillan and Co., Ltd., 1940.) 1*s.* 6*d.* net.
The main argument was published in an article by Sir John Orr in NATURE of March 9, p. 374.

people, milk and vegetables have been abundant and cheap. Although Great Britain is far more dependent upon imports than Germany, the former is far less susceptible to blockade. Even if enemy action becomes more serious than it has yet been, we shall be able to rely on large sea-borne supplies reaching at least our western ports. Nevertheless, it is of the utmost importance that British agriculture should be in a position to make a maximum contribution to our requirements. This is equally important from the point of view of shipping and as a relief to the financial drain which must inevitably occur when a country mobilizes all its resources for war and must obtain large supplies of armaments, munitions and raw materials from abroad.

These points have been brought out by Sir John Orr and Mr. Lubbock, but they have laid special emphasis upon another most important factor. For many months before the actual outbreak of war, indeed since the Munich Agreement, Germany has been conducting a 'war of nerves.' This war may well prove to be a contest in endurance between the English and French peoples on one hand, and the German people on the other. In such a contest it is clearly essential to pay special regard to the morale of the poorest sections of the population. Since the conclusion of the War of 1914–18, the newer knowledge of nutrition has thrown a flood of light upon the influence of food, not only on bodily health but also on the psychological reactions of the people. During 1914–18, Governments and General Staffs had little opportunity of knowing anything about such factors as the depressing effect of the lack of vitamin B_1 upon the combative spirit of armies, or the effect of shortages of the fat-soluble vitamins upon the physical, and hence upon the psychological, condition of nations. It should now be clearly realized that the staying power of a nation depends not only upon sufficient energy foods but also upon adequate supplies of minerals and vitamins.

Few will be prepared to dispute Sir John Orr's contention that, owing to the relatively high cost of the protective foods, about a third of the population of Great Britain suffer from some degree of malnutrition. This fact was established in "Food, Health and Income" and is confirmed by more recent dietary surveys. This being the case, it is not possible to disagree with Sir John's further contention that, in order to ensure the solidity of our national effort, not only must the national dietary be maintained on a satisfactory basis, but also steps must be taken actually to improve the diet of the poorest third of the population. To achieve this end Sir John Orr and Mr. Lubbock propose to adopt for food the more general proposals for an 'iron ration' suggested by Prof. J. R. Hicks and commended by Mr. J. M. Keynes. They propose that adequate supplies of a limited number of foodstuffs, selected on grounds of health and availability, should be sold at prices which would ensure that the poorest 10 per cent of the community, who may not have more than 4*s*. 6*d*. a head to spend upon food, should be enabled to purchase their full requirements of these foodstuffs at a price of not more than 3*s*. a head a week ; thus leaving 1*s*. 6*d*. a head to spend according to their tastes on other foods. It is tentatively suggested that the following foods should be selected : milk, potatoes, oatmeal, vegetables, bread, sugar and either butter or vitaminized margarine. It is maintained that, provided everyone could obtain full supplies of these seven foods, there would be no shortage of vitamins, and calcium requirements would be fully met, as well as those for other minerals. Of these foods four, namely milk, potatoes, oatmeal and vegetables, could be wholly produced in Great Britain. There is no suggestion that imports should be limited to wheat, sugar and fats, but rather that these three essentials, together with perhaps cheese and dried fruits, should be given priority on shipping space so that stocks could be built up in the country.

It is of vital importance that the policies of the British Government in regard to food and to agriculture should be so closely correlated as to be, in effect, complementary parts of the same policy. It can scarcely be claimed that this is the case to-day. Apart from the general ploughing-up policy, no clear indication of the part which British agriculture should play in the War has been given by responsible Ministers. On the other hand, the present guaranteed prices are likely to result in an enormous increase in the growing of oats, a substantial increase in wheat, and the maintenance or even increase in the fattening of cattle and sheep.

A simple method of ensuring the fullest possible production of milk, potatoes and vegetables is proposed. Farmers would be offered guaranteed markets at attractive prices for these products, not only for the War, but also for at least a three-year period after the War. This method would secure the aims sought, provided steps are simultaneously taken to discourage, by less attractive prices, an undue concentration upon

cereal production or the feeding of imported concentrates to fatten cattle and sheep.

Vegetables, other than potatoes, constitute a special problem. Allotments will increase supplies, but not nearly to a sufficiently large extent. It is also necessary to stimulate farm production and to ensure that the vegetables are made available for retail sale at low prices. If, to give effect to this latter purpose, vegetable marketing is placed upon a more satisfactory basis, we shall have achieved in war something which has defeated us in peace.

It is not to be expected that the proposed food policy will obtain the support of all authorities, or that it will not encounter the opposition of special interests. The co-ordination of agricultural and import policies is, however, one of the most necessary of war measures, and the proposals under discussion do provide a logical basis for such a policy. It is also important to realize that the orientation of British agriculture towards milk and vegetable production has been advocated in the Astor-Rowntree report and by many other authorities. This war-time policy might, therefore, be expected to need little modification to adapt it to the conditions of peace.

PURE EXPERIMENT

Experimentelle Cytologie

Von Hans H. Pfeiffer. (New Series of Plant Science Books, Vol. 4.) Pp. xii + 244. (Leiden: Chronica Botanica Co.; London: William Dawson and Sons, Ltd., 1940). 7 guilders; 18*s*.

EXPERIMENTAL cytology is both more and less than its name seems to say. To understand why, we have to look into its antecedents. It springs largely from the conflict of fifty years ago between vitalism and mechanism. It derives from the tradition born of this conflict, that the individual processes in the cell were physico-chemical processes and that the cell as a whole, and even the organism as a whole, were to be completely understood by measuring and putting together these individual processes. Inspired by this doctrine, and inspired as well by the missionary zeal of Jacques Loeb, experiments were carried out which achieved their first purpose. They drove vitalism into the philosophical backwoods of biology, and in performing this apparently negative service they laid what should have been the foundations of a new science.

But unfortunately, while this was going on, a cleavage arose in experimental method. It was discovered that experiments of a rigorous kind could be carried out with the cell using biological as well as physical variables. Measurements could be made not only with variations in physical agents, such as temperature and *p*H, using physical properties, such as refractive index, surface tension, permeability, osmotic pressure, viscosity, specific heat and so on. They could also be made with variations in biological agents, such as genes, chromosomes, and nuclei, affecting biological properties measured in different ways and with different degrees of refinement. The methods used with these two kinds of approach became more divergent as the apparatus and the technique of each method became more elaborate. It is therefore important to see after this lapse of time whether the divergence depends on a necessary cleavage of purpose or whether it is perhaps artificial and spurious.

The "experimental" cytology which Dr. Pfeiffer describes is of the physical kind, and we have to admit that it still has the character of transplanted physics. After a lifetime of transplantation it does not appear to have developed an organic or integrated quality. It amounts to little more than a catalogue of measurements of the properties already referred to, a catalogue so disconnected that its several sections can be read in any order without loss of coherence. The method and the apparatus, it seems, are the connecting links, and not the results obtained by them. Where we might hope for analysis we find only description. The wheel has come full turn. Experiment having lost its purpose has lost its design. It has ceased to be an instrument of planned discovery and has become merely a repetitive occupation.

This decay in physical cytology was noticeable to some observers ten years ago. To-day in Dr. Pfeiffer's book it has become obvious by contrast with the biological method. The physical approach has been to the cytoplasm. It has yielded, as we may say, a series of anecdotes. The biological approach has been to the nucleus. It has yielded a connected story. The reason is perhaps a surprising one. The nucleus owes it predominance over the cytoplasm in growth and heredity not so much to a greater complexity of its components as to the permanence and precision of their structure. This precision has been shown by tests of X-ray mutation, ultra-violet spectroscopy and

micro-chemistry combined with the general body of comparative and analytical cell and genetic studies (all of these left out of consideration by Dr. Pfeiffer). This in turn has meant that physical, chemical and biological methods of attack on the nucleus could be used, and used in combination, in a way that has not been possible in dealing with the undefinable cytoplasm; and in this attack, strangely enough, no one is any longer concerned to know whether the analytical operation is experimental or whatever the alternative may be.

Dr. Pfeiffer's book does a service in making the lesson of this contrast clear. The cell is a physico-chemical mechanism, but it is a highly integrated mechanism. This integration can never be understood by means of experiments using variables of one kind alone, external or internal. We have to know it at each level of integration before we can fit the different levels together. Wherever we see a chance of such fitting together we must seize it.

"Dich im Unendlichen zu finden
Musst unterscheiden und dann verbinden."

For this task, planning and co-ordination are necessary at every step. The co-ordination requires that we shall break down the segregation of plants from animals, of chemistry from genetics, and of experiments from less refined demonstrations. The planning requires that we shall not merely ask the right questions but ask them in the right order, without regard to departmental exclusiveness or (may we say it?) technical snobbery. C. D. DARLINGTON.

THE HISTORY OF GEOLOGY

(1) The Birth and Development of the Geological Sciences

By Dr. Frank Dawson Adams. Pp. v+506+14 plates. (London: Baillière, Tindall and Cox, 1939.) 22*s*. 6*d*.

(2) A Source Book in Geology

By Prof. Kirtley F. Mather and Dr. Shirley L. Mason. (Source Books in the History of the Sciences Series.) Pp. xxii+702. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 30*s*.

IT is now more than thirty years since a comprehensive treatise on the history of geology has appeared in the English language. For long Sir Archibald Geikie's admirable "Founders of Geology" and von Zittel's "History of Geology and Palæontology" have been the standard and, in fact, almost the only works exclusively devoted to this subject available for students. Since they were written, fresh studies in the history of geology have appeared from time to time, both in Europe and the United States. These have generally been of a more or less specialized character, and they have by no means exhausted the scope for further research. The appearance of two important new books on this subject is therefore a matter of considerable interest, particularly because both the original German edition of Zittel and the English translation by Mrs. Ogilvie-Gordon have long been out of print.

(1) The "Birth and Development of the Geological Sciences" was written during the author's retirement, after a lifetime of active geological work, and the story of how it came to be undertaken is worth telling. The fantastic theories put forward in past centuries to explain even the most commonplace of geological phenomena, such as the occurrence of minerals and fossils, aroused Dr. Adams's curiosity many years ago. Not content with reading about them at second-hand, he formed the habit of referring, when opportunity offered, to the original text of some of the more important early writers. Ultimately a growing interest in the subject led him to search out the works of other, less well-known authors. Thus, as time went on, he acquired an intimate knowledge of the byways as well as the highways in the early literature of natural science, in which are to be found the germs of present-day geological knowledge. In addition, in order to satisfy the necessity for repeated consultation of some of these early works, Dr. Adams, whenever possible, obtained copies for himself. In taking this course he followed, literally, the advice given as long ago as the fourteenth century by a very early booklover and collector, Richard de Bury, Bishop of Durham, which he quotes as follows, ". . . we secured the acquaintance of stationers and booksellers, not only within our own country, but of those spread over the realms of France, Germany and Italy, for no dearness of price ought to hinder a man from the buying of books, if he has the money that is demanded for them . . ." As a result, during the process of widening his knowledge of his subject, the author built up a specialized library, containing more than a thousand volumes in various languages, many of extreme rarity.

The belief, modestly expressed by Dr. Adams, that the knowledge derived from studies carried out during more than twenty years might prove

of value to others unable to carry out such researches for themselves, fortunately induced him to prepare his notes for publication. The resulting book is, he explains, an attempt to trace the evolution of geological ideas from the first period of which we have any written record in Europe, that of the early Greeks, on through Classical Times, the Middle Ages and the Renaissance, down to about the year 1825, when geology as we know it to-day began its rapid development. The latter limit is not rigidly adhered to, since one or two chapters have been rounded off with a very brief outline of the later history of the particular subject dealt with, but no serious attempt has been made to discuss the period subsequent to this date.

The ground covered is indicated by the following list of chapter headings : bibliography and sources ; geological science in Classical Times ; the conception of the universe in the Middle Ages ; on the generation of stones ; medieval mineralogy ; the birth of modern mineralogy and its development from Agricola to Werner and Berzelius ; the birth of historical geology with the rise and fall of the Neptunian theory ; 'figured stones' and the birth of palæontology ; the origin of metals and their ores ; the origin of mountains ; earthquakes and the nature of the interior of the earth ; the origin of springs and rivers ; quaint stories and beliefs ; conclusion.

Dr. Adams makes the somewhat bold statement that few books likely to contain matter of real importance to his study remain unexamined by him, but after reference to the text no one is likely to dispute this claim, nor, indeed, the truth of the remark that his extensive reading proved the aptness of Bacon's aphorism, "Some books are to be tasted, others swallowed, and some few to be chewed and digested". Obviously some of the works consulted can have contained little that has a direct bearing on the subject, although, no doubt, they provided material to form the background essential for a proper appreciation of much that he has to say. Of this nature is the interesting chapter on the conception of the universe in the Middle Ages.

Dr. Adams deals more fully than previous authors with the ideas prevalent during the centuries preceding the emergence of geology as a separate branch of knowledge. It is impossible to refer in detail to the results of his researches into the early literature of science and natural history but I may mention one example. He discovered, and quotes at length, in translation, a hitherto almost unknown and exceedingly rare little book entitled "De Montium Origine". This was written by Valerius Faventies, and published at Venice in 1561, and, so far as is known, is the first treatise written in Europe dealing exclusively with the origin of mountains. Though its ideas are largely speculative, they are of interest, as Dr. Adams points out, in giving a picture of the manner in which a geological problem was approached in the later years of the sixteenth century. The treatise is cast in the form of a dialogue between two members of a party of friends, in a manner reminiscent of Boccaccio's "Decameron". Neither of the disputants gives any indication that he had ever climbed a mountain in his life, nor that he had any desire to do so. The days of geological field work had not yet dawned.

The formative years of geological science, the eighteenth century and the early years of the nineteenth century, are by no means neglected, and in dealing with this period Dr. Adams again quotes authors not referred to by either Zittel or Geikie, and other sources not available at the time these authors wrote, so that our knowledge of this period also is enlarged. The chapter on the birth of historical geology, for example, contains a particularly interesting and informative account of Werner and his doctrines.

Fortunately for his readers, Dr. Adams combines with a deep knowledge of his subject the ability to expound his store of knowledge in a charming and lucid style, and the result is a book that can scarcely fail to give pleasure to all who read it. Its attractiveness, too, is greatly enhanced by the inclusion of nearly one hundred illustrations, mostly reproductions from old scientific books. Yet the especial merit of this new history of geology is not merely that it is readable, or even that it adds so considerably to existing knowledge, but that the author has in every case gone back to original sources for his information. Thus, though his book does not supersede those of Zittel and Geikie, it must be regarded as the most authoritative work on the particular aspects of the subject with which it deals.

Unfortunately, a few small defects mar this otherwise excellent production. There are a number of typographical errors, some affecting the spelling of proper names, and others the dates of works to which reference is made. In addition, in one or two instances footnote references have been put in such a form as to cause difficulty in tracing the actual work to which it is intended to refer. Further, the value of the book as a work of reference would be correspondingly increased if the index were expanded.

Dr. Adams informs me that he intends to present his library to McGill University, where it will be housed in good company with the late Sir William Osler's collection of books on the history of medicine. It will then be known as the "Adams' Collection". A library of this type can only be

built up after years of patient search, backed by adequate knowledge and sufficient means. It is welcome news, therefore, that Dr. Adams's unique collection is not to suffer dispersal, the fate of many important private libraries. Its value will be better appreciated after publication of the catalogue, on which the author is at present engaged.

(2) Opportunities for reading original texts of the type so largely represented in the Adams Collection are few. Many are written in Latin, and of these only a small number have been translated into any modern language ; and, in any event, they are seldom accessible to the average reader. Those who may wish to consult works of this sort will be interested to learn that their needs have now been met, to some extent, by the publication of Mather and Mason's "Source Book in Geology".

This is the fourth in a series of "Source Books in the History of Science", published under the general editorship of Gregory D. Walcott and an advisory board of American men of science, assisted by special committees for each science. The enterprise has also received financial aid from the Carnegie Corporation of New York. The object of these "Source Books" is to make readily accessible the significant passages from the works of the most important contributors to the major sciences during the last three or four centuries, up to the end of the nineteenth century. Each therefore consists of a large number of quotations, carefully selected with as much finality of scholarship as possible. These are given in English translation when necessary, a decided advantage in the latest volume, in which nearly half the extracts were originally written in languages other than English.

In this volume the term 'geology' has been interpreted in its widest sense, and twenty-nine separate divisions of the science are represented. The compilers, in choosing their material, have attempted to strike a balance between the needs of readers interested in the science as a whole, and those of students concerned only with a particular branch of the subject. Preference has been given, where other considerations are nearly equal, to excerpts from sources least likely to be accessible to the majority of geologists.

The scope of the book may be judged from the fact that it includes three hundred and twenty-nine extracts from more than one hundred British, Continental and American authors, ranging in time from the fifteenth to the end of the nineteenth century. Contributions to geology made since 1900 have not been included, nor those by living authors. The excerpts are, in general, arranged in chronological order according to the date of birth of the authors, and a subject index is provided.

The task of compiling this book must have entailed an immense amount of literary research. Of its kind it is a pioneer work, and it may be said at once that the task has been well done. It is unlikely that complete agreement could have been obtained among the many collaborators as to the final selection of authors whose work should be quoted, and, in fact, this is hinted at in the preface. The compilers, however, accept responsibility for the final choice. In glancing through the pages of the book, one is struck more by the number of names included, many well known, others unfamiliar, than by the few questionable omissions. Yet a few names outstanding in the history of geology are missing. Among these may be noted that of Palissy the Potter, whose observations on fossils, made in the sixteenth century, it would have been interesting to read. The work of Lehmann and Füchsel, too, who made important stratigraphical observations in the eighteenth century, might well have been included. The original writings of these authors are to be found in very few libraries. In contrast, extracts have been given from the works of men of science not usually associated with geology, such as, for example, Robert Boyle. His observations on the conditions prevailing at the bottom of the sea, though of interest, are not original, and can scarcely be said to have had much influence on the development of geological thought. Cavendish, too, was not primarily a geologist, but, with more justification, an extract has been given from the account of his experiments to determine the density of the earth by means of the torsion balance. In reading this account, one is reminded of the interesting fact that this instrument of precision, now the tool of the geologist and prospector as well as the physicist, was actually invented by a geologist, John Michell, in the eighteenth century.

Though, perhaps, to be regarded primarily as a work of reference, this is a book into which any geologist can dip with the expectation of finding something to interest him. It forms a valuable supplement to the existing histories of geology, and the compilers are to be congratulated on the thorough and painstaking manner in which they have carried out their task.

The literature on the early history of geology has been greatly enriched by the publication of the two books reviewed above. Dr. Adams has dealt fully with the long period ending in the early years of the nineteenth century, and Mather and Mason record the chief landmarks in the history of the science from the fifteenth right up to the end of the nineteenth century. The detailed story of the development of geology during the last hundred years, a period of great expansion in every branch of the subject, still awaits an author.

V. A. EYLES.

THE GOLGI APPARATUS

Form- und Stoffwechsel der Golgi-Körper
Von Gottwalt Christian Hirsch. (Protoplasma-Monographien, Band 18.) Pp. xi+394. (Berlin: Gebrüder Borntraeger, 1939.) 28 gold marks.

THE author of "Form- und Stoffwechsel der Golgi-Körper" attracted attention by his papers published in 1931, in which he claimed that the zymogen granules of the pancreas acinus cells originated not inside the Golgi apparatus, but drifted into that position from the base of the cell, where they originated in contact with the mitochondria.

Dr. Hirsch's claim was examined in my laboratory by E. S. Duthie in 1933, who agreed that very small granules were continually drifting across the cell into the region of the Golgi apparatus, where they swelled into zymogen. It cannot be said that Dr. Hirsch's work has been received everywhere with warmth among those cytologists who believed that practically all cell secretion granules originated inside the Golgi apparatus. Recently a strong attack on Hirsch and Duthie's work has been made in the *Quarterly Journal of Microscopical Science* by the competent Indian cytologist, Dr. Subramaniam, as a result of his investigation on the endostyle of *Branchiostoma indicum*. Nevertheless, Dr. Subramaniam fails to show what connexion the zymogen granules in the pancreas of the mouse have with the secretion of mucus in Branchiostoma, and as matters stand at present Dr. Hirsch's results must be accepted.

Following his interesting work on the pancreas, Dr. Hirsch has now written a book on the Golgi apparatus. He has read 2,000 papers on this subject, and appears to be convinced that there is such a thing as the Golgi apparatus. Furthermore, most of his ideas on the actual structure of the Golgi apparatus will be generally acceptable to British and American cytologists.

As is natural, the book deals more fully with the histological aspect of the subject, but Dr. Hirsch has interesting sections on spermatogenesis and oogenesis. One astonishing point about Dr. Hirch's book is the calmness with which he endeavours to harmonize the very different and apparently incompatible results of cytologists who have been sharply at variance in recent years. But Dr. Hirsch has tried to provide a view of this confused subject which might show the results of the workers of all countries in the best light, and he has certainly succeeded in this object very fully. Indeed, it could have been said in happier times that his book would have been certain to have inspired many of the younger zoologists and physiologists to undertake their life's work in this branch of cytology.

It is pleasant to read that Dr. Hirsch accepts the nature and homology of the plant osmiophilic platelets (Golgi bodies) discovered by the American cytologist, the late Robert Bowen. Dr. Hirsch dedicates his book to the curators of the University of Utrecht in gratitude for the opportunity given him of working there.

Dr. Hirsch's book, and the interesting researches of W. Jacobs, W. Buchmann, E. Ries, L. H. Bretschneider, J. W. Sluiter, O. Järvi and many other young Dutch cytologists, bear witness to the very valuable work now being carried out at Utrecht under his leadership.

J. BRONTË GATENBY.

CAPTAIN JAMES COOK, R.N., F.R.S.

The Life and Achievements of Captain James Cook, R.N., F.R.S.
Explorer, Navigator, Surveyor and Physician. By Surgeon Rear-Admiral John Reid Muir. Pp. vii+310+16 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 10*s.* 6*d.* net.

THE consideration of Cook as the 'physician' rather than the astronomer, surveyor and explorer well deserves this pleasant story. It is the central theme, which the author is well qualified to undertake, in the summaries of his three voyages, to the neglect of much consideration of their value to scientific knowledge; however, his bibliography is so short that more cannot be expected. Cook served his apprenticeship in small colliers trading along the English coasts. He chose similar ships for his voyages, and his knowledge of their capabilities was a large element in his success. His observations on the eclipse of the sun as seen in Newfoundland in 1766 caused him to be appointed by the Royal Society as its chief

observer of the transit of Venus viewed afterwards from Tahiti in June 1769. A further object was the discovery of the great southern continents, a current myth at that period, the second expedition having this as its main objective; the third was primarily concerned with the North-West Passage. Cook everywhere found new lands, and nearly every chart of the Pacific is headed by his name. His running survey of New Zealand, which he completely circumnavigated, causes him to be regarded as the leader and greatest of that line of surveyors that has made the Navy famous. This had been especially brought out by the late hydrographer, Admiral Sir W. Wharton, in his studies of Cook, the error in the longitude of the observation station at Tahiti being only two minutes. That Cook attained international fame during his life is seen in that France, the United States, Spain and Russia extended to his third expedition a safe conduct in that war period.

Even the most careful research has yielded little knowledge of the character of Cook, while nothing is known of his domestic life. We judge that he was a reserved and lonely individual. That he was a personality with the necessary power of command is clear, in that the Admiralty gave him *carte blanche* in selecting his stores and crew. Among seamen his reputation was such that he had not to resort to the press-gang and to jailbirds, thus avoiding the danger of typhus then so rife. The result is seen in that his ship was not the prison as naval vessels were usually in those days, shore camps being established and leave frequent.

The great danger was scurvy, and long voyages often had to log a death-rate of 50 per cent or even more. The best authenticated case is Anson's voyage round the world in 1741, in which out of crews numbering 961 more than two-thirds died of scurvy, and on the homeward voyage only 71 were able to stand to their guns. Everywhere Cook's first care was water, which was never rationed; this an essential of a salt-meat diet. Every land was searched for scurvy grass, wild celery and other vegetable products, while fresh meat was purchased wherever possible. The strictest cleanliness was enjoined, Cook inspecting his crew twice weekly, while their quarters were ventilated and fumigated weekly, a proceeding recommended by Dr. Lind in 1753. It was forty years later that the Admiralty commenced the issue of lime juice, which has no antiscorbutic vitamins, a tragic error due to a confusion of names (lemon *v.* lime) that persisted for more than a hundred years. Cook largely relied on portable soup made of desiccated meat and bones, greens stored with salt which was termed "sour kraute", malt and beer concoctions, while fresh meat was everywhere sought. The results are well seen in Cook's voyages, as in all three the loss from scurvy was negligible, far less than that from Batavian dysentery and malaria while repairs were being carried out on the *Endeavour*.

TRIGONOMETRICAL TABLES WITH THE ARGUMENT IN TIME

Seven-Figure Trigonometrical Tables for Every Second of Time

Prepared by H.M. Nautical Almanac Office. (Published by order of the Lords Commissioners of the Admiralty.) Pp. 102. (London: H.M. Stationery Office, 1939.) 10*s.* 6*d.* net.

COMPUTERS are well aware of the difficulties experienced in dealing with right ascension, hour angle, etc., in astronomical work, when trigonometrical functions of these are required. It is necessary to convert them into degrees, minutes and seconds of arc before tables of trigonometrical functions can be used, and tables with the argument in time have been in demand for many years. The present volume supplies a need and is the first seven-figure table to be published which gives the four natural trigonometrical functions chiefly used in astronomy and related sciences, intervals of one second of time being used throughout.

The preparation of the tables was completed about twelve years ago under the direction of Dr. L. J. Comrie, formerly superintendent of H.M. Nautical Almanac Office, but approval for publication was not obtained until 1932, and the printing has been delayed for various reasons. Manuscript tables have, however, been in use in the N.A. Office for about seven years, and the table of tangents has been utilized in the computations of the right ascensions of the sun, moon and planets.

Seven decimals have been retained except in the cases of the cotangent. Here the number of decimals depends upon three desiderata: (*a*) linear interpolation; (*b*) the same number of significant figures as the tangent; (*c*) sufficient figures to enable inverse interpolation to give a mean accuracy of 0·001s., but as the first and

third of these cannot both be satisfied everywhere, the scheme adopted is based mainly on (*b*). In some cases values of the cotangent to more decimals than are tabulated or to more than can be easily interpolated, are required, and to meet this need there is an auxiliary table containing the function $\tau = x^s \cot x^s$ to three decimals, for every second of time up to 30m. Eight significant figures can be obtained from this table by simple interpolation, and the cotangent or tangent can then be derived to seven significant figures by simple division. In both tables the greatest and least differences in any column are given at the head and foot of each column, no interlinear differences being given, and this arrangement enables the complete difference to be obtained from an inspection of the end figures.

The table is naturally intended for use with a computing machine, and computers are recommended to utilize the methods of direct and inverse interpolation which have been explained very fully in the "Nautical Almanac" for 1937, and reprinted in "Interpolation and Allied Tables" (H.M. Stationery Office, 1936). It should be added that the printing and reading of the proofs have been carried out under the direction of the present Superintendent of the Nautical Almanac Office. M. D.

VIRUS RESEARCH

Methoden der Virusforschung

Von Prof. Dr. Henrique da Rocha-Lima, Dr. José Reis und Dr. Karl Silberschmidt. Pp. viii + 384. (Berlin und Wien : Urban und Schwarzenberg, 1939.)

FOR years the study of viruses was closely linked with bacteriology and mycology, descriptions of viruses occupying only minor parts of books devoted mainly to bacteria and fungi. This followed inevitably from the widely held belief that viruses differed essentially from other recognized pathogens only in size, and from the fact that they were investigated almost exclusively by a few enterprising bacteriologists and mycologists. Recently, however, the outlook has changed. A growing appreciation of the economic importance and scientific interest of viruses has attracted workers in other fields, and the need for separating viruses from other pathogens has become more and more obvious. One result of this has been the increased production of books dealing exclusively with viruses, of which that under review is the fifth to appear within two years.

In many ways this book differs from those previously published. One advantage it has is that the subject is treated as a whole. No gross distinctions are made between viruses attacking animals, plants and bacteria, all of which are dealt with under the same general headings, the book being kept to a reasonably small size by the omission of details of disease symptoms. A disadvantage is that the authors neither discuss controversial points nor criticize the work they describe. However, it is more than the description of techniques suggested by the title, for full details of the results obtained are also given, and, with one qualification, it is fairly described as a good, impersonal summary of experimental work on viruses. The gathering together of so much work published in a large number of apparently unrelated journals will be useful to most workers, but will probably be of greatest value to those who have not ready access to good library facilities.

The book is divided into three main sections, dealing respectively with viruses in diseased organisms, infection methods, and the properties of viruses *in vitro*, of which the last occupies about two thirds of the whole. The techniques described range from the construction of insect-proof glass-houses and the culturing of insect vectors, through such subjects as transmission, ultra-microscopy, ultra-filtration, centrifugation, cataphoresis, and serology to tissue culture and the culturing of viruses in developing eggs. Nevertheless, in spite of the variety of methods described, all those used in work on viruses are not included. This is, no doubt, a direct reflection of this book's greatest fault, which is that it is already out of date. Except for a short supplement containing references to a few papers published in 1938, the last papers referred to were published early in 1937. As a result, not only are the many advances made in the last three years excluded, but often undue prominence is given to methods that would no longer be used.

The illustrations are all line drawings and, although some of these may be an aid to the text, it is difficult to see what is gained from the inclusion of others, such as Figs. 1, 31, and 51. As the book is presumably meant as a laboratory handbook rather than one to be read, it is a pity it is not better bound, for it is unlikely that the flimsy paper cover and the loose stitching will withstand much handling. F. C. BAWDEN.

OUTBREEDING AND SEPARATION OF THE SEXES

BY DR. K. MATHER,

JOHN INNES HORTICULTURAL INSTITUTION

GAMETIC DIFFERENTIATION AND SEPARATION OF THE SEXES

THE process of sexual reproduction shows two remarkable features, namely, that in all but some of the lowest organisms there is gametic differentiation, the male and female gametes being morphologically and functionally distinct, and that there is, in some plants and most animals, separation of the sexes, the two kinds of gametes being produced by different unisexual zygotes.

The former phenomenon may very reasonably be interpreted as showing a division of labour. The female gamete is larger and contains, or is associated with, food stores, which may be utilized by the developing embryo, while the small male gamete is more motile and seeks out the less active egg prior to fertilization. Such a division of labour would appear to have a selective advantage and so would be favoured.

The reason for the separation of sexes is, on the other hand, not so easy to understand, more especially as it is far from being a universal property of sexual reproduction. A number of arguments have been put forward seeking to account for the known facts, and nearly all of them, in some way or other, relate unisexuality to differentiation of the gametes. Two fairly recent examples may be mentioned.

Waddington[1] discusses the phenomenon in the following words: "Probably, then, the original mechanism [of sex determination] was an alternative mode of reaction in the gamete itself. . . . Usually, however, the time at which the alternative is decided is pushed further back in the life cycle, probably on a safety first principle. Eventually, in the higher animals and plants, the sex determination of a gamete has been pushed back to the fertilization of the zygophase before". The sexes are separated supposedly in order to ensure that the gametes are differentiated.

In the higher plants, however, separation of the sexes is sporadic rather than regular, although the gametes and their associated tissues are as successfully differentiated, morphologically and functionally, as in animals. Furthermore, in certain plants and animals the sex of a unisexual individual may be controlled environmentally though its gametic differentiation is perfect and regular. Nor should gametic differentiation itself be regarded as a necessary part of sexual reproduction. Many Thallophyta have successful sexual reproduction with no differentiation, or, at least, no morphological differentiation of the gametes. Thus sexual separation can scarcely be considered to be merely a predetermination of gametic differentiation, though this aspect may, of course, play some part in the evolution of the dicœcious state. Any hypothesis seeking to account for unisexuality in most animals must also provide a reason for the widespread hermaphroditism in plants.

Altenburg[2] has advanced a different view. He notes that hermaphroditism is related to sluggishness and sessility. Then by means of a highly ingenious argument he concludes that the moncœcious and dicœcious states are adapted to the minimization of the work involved in reproduction. Thus insect-pollinated plants are, he claims, all hermaphrodite, as they need expend little work in the production of male gametes, the insect ensuring that the pollen is transferred to a stigma; so they can distribute the reproductive load evenly between individuals only in this way. Wind-pollinated plants, on the other hand, expend relatively more energy in the production of pollen, much of which is lost in the air, and, the male and female loads being more nearly equal, they may as economically be dicœcious as moncœcious.

A similar argument is advanced for sessile and motile animals. Sessile forms have, like wind-pollinated plants, a large male load and so are indifferently hermaphrodite or unisexual. Motile animals may minimize the expenditure on sperm production by transference following coition, and so should be analogous to insect-pollinated plants. They are, however, unlike the plants in that they are not in general hermaphrodite. The reason given for this is that they overcome the difference in male and female reproductive loads by polygamy, sexual dimorphism and sexual differences in life-span.

There are a number of objections to this argument. In the first place, it is not clear why freely motile animals should be hermaphroditic less often than sluggish ones, when insect-pollinated plants are supposedly less often unisexual than anemophilous forms. In the second place, Altenburg goes too far in supposing that all insect-pollinated plants are hermaphrodite. *Silene Otites*, *Melandrium dioicum* and *Rubus Chamæmorus* are examples of dicœcious entomophilous forms. Whether separation

of the sexes is actually less common among insect-pollinated species is difficult to say as the available records are not always trustworthy, though some such correlation is suggested (cf. Lewis[3]). Finally, it is far from certain that wind-pollinated plants do in general produce more pollen per seed set than do insect-pollinated ones. Extreme examples of excessive pollen production by both kinds of plant could be cited, but it is doubtful whether statistics adequate to settle the question have been obtained. The same may be said of sperm production by animals. Until these objections have been successfully met, Altenburg's hypothesis cannot be accepted without crippling reservations, though it may be applicable to special cases.

Sexual Reproduction and Separation of the Sexes

There is, however, another approach to the question which helps to make clear the reasons for sexual separation occurring in some cases and not in others.

First of all, it is necessary to dismiss the developmental-genetic idea that separation of the sexes is of necessity related to gametic differentiation. Such differentiation has its own function in relation to nutrition of the ensuing zygote and is present, often in an elaborate form, in both hermaphroditic and unisexual organisms. The morphological analogy between gametic and zygotic differentiation is only misleading.

There is, however, one inevitable consequence of the dicœcious state which enables us to understand its occurrence. If the sexes are separate, fertilization must always involve gametes from different zygotes and, in the vast majority of cases, these zygotes must be genetically distinct. It is essentially a mechanism for the promotion of outbreeding.

Now the importance of sexual reproduction to living organisms is that by its aid a higher degree of hybridity and effective recombination may be achieved than would be possible with purely asexual propagation. An increase in the effective recombination allows of a more rapid response to the action of natural selection (Fisher[4], Muller[5], Darlington[6]). Thus outbreeding is an essential feature of sexual reproduction in that it necessarily leads to greater hybridity and so, ultimately, to a greater response to selection, than does inbreeding. It is not clear that the maximum advantage will always follow from maximum outbreeding. On the contrary, there is some evidence that species have an optimum degree of hybridity, which optimum may depend on the environment. This question is, however, too complex and uncertain to be given detailed consideration here. It is sufficient to note that outbreeding is an essential part of sexual reproduction.

It is, then, easy to see that unisexuality is of advantage by virtue of its ensuring some degree of outbreeding, and hence its occurrence is a simple adaptation for the more successful results of sexual reproduction.

There are, however, other mechanisms which will achieve the same purpose. Incompatibility is found in Angiosperms and the Fungi, and also most probably in the sea squirt *Ciona*. In the Fungi it apparently depends on the aversion of the haploid hyphæ, and in the Angiosperms on a rather complex relation of the pollen tube and stylar tissue. The genetical basis of incompatibility varies, though in Angiosperms it is usually of the type first described in *Nicotiana* by East. A related mechanism is that of illegitimacy found, for example, in *Primula* and *Lythrum*. It differs from incompatibility in that it is dependent on the genetical relations of the zygotes bearing ovule and pollen, and not on the genetical relations of male gamete and female zygote. These species, together with others, also show heterostyly, which presumably encourages crossing, though the efficacy of this mechanical method is open to doubt, as it is so frequently accompanied by an incompatibility or an illegitimacy mechanism. Protandry, protogyny, special floral arrangements and other devices could also be listed.

Now these various methods, though widespread, are rarely, if ever, found where the sexes are separated. They are alternatives to unisexuality. So our conclusion that the separation of sexes is simply a method of encouraging cross-breeding is strengthened, as such encouragement is the only effect common to all these mechanisms.

Distribution of Outbreeding Mechanisms

If we are to regard unisexuality simply as one of a number of outbreeding mechanisms, it is necessary to account for the fact that it is frequently found in some groups, for example, the higher animals, but rare in others, for example, the higher plants, being often replaced in the latter case by one or other of its alternatives.

To understand this, let us compare the action of unisexuality and incompatibility. In a dicœcious species an individual can cross with only a portion of the remaining population, namely, those of the other sex. Unless some way is available whereby each individual of at least one sex can seek out a member of the other sex with which to mate, so ensuring that its gametes are not wasted, there must be a large loss of reproductive energy due to maldistribution of the gametes. In most

animals such wastage is, however, much reduced by the presence of such a discriminatory mechanism whereby the motile male seeks out the female and transfers sperm directly to the egg by coition. This cannot be done in higher plants.

The incompatibility mechanism is superior to unisexuality in that it leads to less gametic loss where indiscriminate mating prevails. In the *Nicotiana* type of behaviour, pollen only fails to function when it falls on to the stigma of a plant carrying the same allelomorph of the incompatibility gene as does the pollen itself. There may be a very large number of such allelomorphs. More than a hundred have been found in wild *Trifolium*. The actual gametic loss is inversely proportional to the number of allelomorphs and so may be very small. Hence the incompatibility mechanism has an advantage over unisexuality where no discriminatory mating is possible. On the other hand, no easy mechanism, such as mobility, can be developed to assist discrimination where so many genetic classes are involved. So unisexuality with discrimination may exceed incompatibility in efficiency, in the case of motile organisms, where the loss due to unisexuality can be reduced effectively to zero. Furthermore, there must be some mechanism for sorting out incompatible male gametes before they meet the egg, or otherwise loss of female gametes may result. This is done in the higher plants by the stylar tissues, but it would not be possible in most animals where fertilization takes place in a duct or in open water.

Hence it can be seen that there is a reasonable explanation for motile animals depending mainly on unisexuality while higher plants usually adopt incompatibility or an analogous system of gametic discrimination. In the former case, wastage from separation of the sexes is reduced by means of mate discrimination, whereas an incompatibility mechanism would be difficult to operate. In plants, mating discrimination is difficult but incompatibility easy to operate.

The above remarks about incompatibility apply equally well to the closely allied illegitimacy mechanism. The other outbreeding devices found in plants may also be considered in a similar way. Protandry, for example, discourages self-pollination in the same flower, where its risk of occurrence would be greatest, while ensuring that the rest of the population are capable of receiving the pollen after its release. It is not, however, a fool-proof device for securing outbreeding.

Thus unisexuality may be regarded as one of a number of devices which arise by reason of their encouragement of outbreeding. The one to be adopted in a particular species depends on its special features, though the most suitable mechanism may not always develop. Thus if the disadvantage of wastage following on separation of the sexes in a plant is less than the advantage gained by the encouragement of outbreeding, unisexuality might occur but would be liable to be weeded out as soon as environmental conditions reversed the magnitudes of these opposite effects. So the dicœcious state is a transient feature of some Angiosperms. It is also clear that some species which are in a stable environment, to which they are highly adapted, may find recombination a disadvantage and so suppress outbreeding mechanisms or even substitute inbreeding adaptations as in *Pisum* and *Triticum*, where premature anthesis vitiates a highly developed crossing mechanism. This is easier to do where the sexes are not separated. 'Fertility' allelomorphs are, for example, known at the incompatibility loci of many plants which normally show this particular outbreeding mechanism. But to reconstitute hermaphrodites from highly developed unisexual species would seem to be more difficult. Hence inbreeding mechanisms are commoner, or at least more obvious, in plants than in animals. The marked sexual dimorphism of animals, developed as an ancillary arrangement for the more effective operation of the outbreeding mechanism, has prevented a return to hermaphroditism in any special cases where inbreeding would be desirable, except by the adoption of extreme devices, as in *Pediculus*.

Gynodicœcy should not be confused with unisexuality in this connexion. It resembles unisexuality in that a proportion of the individuals are female, but differs in that the remainder are hermaphrodite, not male. Clearly the females are at a disadvantage as compared with the hermaphrodites, since they produce but one kind of gamete. Hence gynodicœcy will only survive where the females enjoy some compensating advantage, which is most likely to depend on the outbred nature of their offspring. My colleague Dr. Lewis has shown[3] that the equilibrium proportion of females is directly dependent on the magnitude of this advantage ; so such gynodicœcious species have a ready means of adaptation to change in the hybridity optimum. The proportion of females and so of outbreeding increases with increasing advantage of hybridity and decreases as the advantage of hybridity decreases. Thus gynodicœcy, unlike unisexuality, is a highly adaptable outbreeding mechanism.

[1] Waddington, C. H., "An Introduction to Modern Genetics" (Allen and Unwin, London, 1939).
[2] Altenburg, E., "A Theory of Hermaphroditism", *Amer. Nat.*, **63**, 88–91 (1934).
[3] Lewis, D., "The Evolution of Sex in Flowering Plants" (in preparation).
[4] Fisher, R. A., "The Genetical Theory of Natural Selection" (Oxford Univ. Press, 1930).
[5] Muller, H. J., "Some Genetic Aspects of Sex", *Amer. Nat.*, **66**, 118–38 (1932).
[6] Darlington, C. D., "The Evolution of Genetic Systems" (Cambridge Univ. Press, 1939).

A NATIONAL ATLAS OF BRITAIN

By Prof. E. G. R. Taylor,
Birkbeck College, London

WITHIN a few days of the appearance in NATURE of an article upon the proposed National Atlas[1], an afternoon meeting of the Royal Geographical Society devoted to a discussion of the project was opened by the present writer as chairman of the National Atlas Committee. A verbatim report of the proceedings appears in the current (February) number of the *Geographical Journal*, but since the discussion has already borne practical fruit, and since further arguments for pressing forward with the Atlas have been provided by public events, it appears that a useful purpose will be served by examining the points upon which agreement has been reached.

Prof. Kenneth Mason, chairman of the meeting, recalled that the urgent need for a National Atlas was first realized when the Society was asked to give evidence before the Royal Commission on the Geographical Location of Industry and of the Industrial Population. A portfolio of maps was laid before the Commission, including many that were then drawn for the first time, as, for example, the actual distribution of the industrial (as opposed to the general) population, the pattern of unemployment distribution, and maps showing the relative accessibility by rail of the principal towns of England and Wales in terms of time. Accessibility was a point stressed also by a road map on which was indicated the degree of likelihood of interruption of traffic by snow. This particular map, based though it was on the specialized knowledge of Mr. L. C. W. Bonacina and Mr. Gordon Manley, was rather sceptically received, yet the warnings that it conveyed and the silent advice that it offered have been abundantly justified during the present winter. Indeed, it is not too much to say that had this series of maps been consulted, the selection of centres for the location of reserve stocks of food and fuel, and the choice of boundaries for supply regions, could have been made far more efficiently than has seemingly been the case. The excuse so often made by the responsible authorities that not shortage of supplies but delays and difficulties of distribution are responsible for deprivation and distress is one that demands probing.

It is noteworthy, however, that in their recently published report, the members of the Royal Commission put on record their appreciation of the usefulness of the maps placed before them, and their intention of publishing some of them in a later volume. Should the recommendations of the Commissioners be implemented, then the strength of the arguments for a National Atlas must prove irresistible, for it would provide an obviously useful, even indispensable, adjunct to "Collection and co-ordination of information relating to location of industry, now in the possession of the various government departments", to "Research; and collection of information as to the various natural resources—land, agriculture, amenities, etc.—that may be affected by industrial location", to name but two of the tasks with which the proposed new Central Planning Authority would be charged[2]. Moreover, with the National Atlas lying open at the appropriate page, chapter and verse could be given for the "Advice to government, local authorities and industrialists as to problems of location" which the Central Planning Authority would be empowered to offer[2].

It is indeed the case, as the general discussions at the British Association and at the Royal Geographical Society have shown, that, in principle, the plea for a National Atlas finds general acceptance. Nevertheless, an actual Atlas might well fail to achieve usefulness on three or four counts, as, for example, if the information it contained was not entirely reliable or up to date, if the style of the maps was too academic or otherwise unsuited to the general public, if the price of the Atlas put it beyond the reach of all but well-to-do individuals and public bodies.

On all these points the latest discussion has provided information and advice of positive value. In the first instance it is clear that despite the generously offered co-operation of scientists, the Atlas would fail of its object if access could not be secured to official statistics before their publication in Blue-book form. This is essential, not only to avoid a double time-lag, but also because the methods employed in grouping statistics for tabulation often render them unsuitable for plotting on a map. The obvious corollary is that the Atlas must have official status, since such facilities could not be granted to a commercial firm or to private persons.

In respect of the style of the maps, there need be little apprehension, since the long experience and exceptional technical skill of the Royal Geographical Society's drawing-office is generously placed at the Committee's disposal for experimental work. Nevertheless the discussion brought

out an important possibility which had perhaps been overlooked. It was pointed out that the Atlas would undoubtedly be drawn upon frequently for newspaper maps, maps to illustrate articles and lectures, lantern-slides and the like, so that it would be very desirable to bear in mind what would be the appearance of a photostat copy or half-tone block made from any Atlas map: significant detail printed, for example, in blue would, of course, be lost. It is here perhaps not irrelevant to note that the secretary of P E P (Political and Economic Planning) in a written reply to a criticism by the writer of the weak and faulty map illustrations in that body's recent memoir on Location of Industry, took up the point of view that economists did not profess competence in cartography and would welcome a reliable source from which illustrative maps could be obtained at will.

The question of how to make a National Atlas accessible at relatively small cost to all those requiring to use it has not been lost sight of, and there has been a general consensus of opinion that the Atlas should be published serially as and when individual maps or groups of maps are completed. The Director General of the Ordnance Survey, speaking from his unrivalled knowledge of the distribution to the public of national maps and plans, expressed the view that the sale of single sheets should be made possible, thus allowing many people to participate cheaply in the benefits the Atlas could afford to their particular interests. As another speaker remarked, motorists, salesmen, publicity agents, and many others might require the maps dealing, for example, with transport, amenities, or industrial location, while they would have no interest in maps of fisheries, geology, and the like. On the production side, the sale of single maps might introduce difficulties, but there is no doubt of the importance and the feasibility of the second suggestion coming from Major-General Macleod, namely, that the Atlas should be 'tied' to the series of national plans and surveys (the ordnance maps) by the adoption of the metric grid recommended by the Davidson Committee. By the use of a suitable projection, and by substituting the rectangular lines of the grid for the curved and converging lines of the ordinary graticule, a basic source of difficulty, confusion and error to which the non-geographical map user is prone is at once removed. The position of any point can be exactly determined, and since it is proposed to place an identical grid on all the maps in the National Atlas irrespective of scale, a means of accurate enlargement or reduction is immediately at hand when it is required to make comparisons between maps on different scales. The original plan to make the one to a million scale the basic scale of the Atlas has been seriously challenged on two grounds: that it would make the Atlas as a whole too heavy and bulky to handle, besides the individual sheet being too large for the ordinary desk or table, and that it would require the use of sheets of paper of unusual size which would greatly increase the prime cost. Experiment has proved that a scale of 1 : 1,250,000 for the largest map, that of England and Wales, obviates both these disadvantages, disadvantages which would so repel the public which it is desired to reach, that they must be eliminated at all costs.

It is pleasant to be able to record that funds are in sight for the printing and distribution of numbers of blank base maps on which individual scientists will be invited to plot their contributions. When a sufficient number of such manuscript maps is in hand, it is confidently expected that they will provide in themselves convincing arguments for that official approval and for that public or private financial support which, once secured, will quickly bring a National Atlas into being.

[1] NATURE, **144**, 929 (1939).
[2] Report of the Royal Commission on the Distribution of the Industrial Population, 1940, p. 203.

THERMODYNAMICS AND THE STRUCTURE OF MATTER*

By A. R. UBBELOHDE,
ROYAL INSTITUTION, LONDON

THE equilibrium positions of atoms and molecules in condensed phases are the result of an interplay between the forces of repulsion and attraction, and the thermal motions in the substance. This explains why thermodynamic considerations can make important contributions to theories of the structure of matter. Advances in the knowledge of various crystal structures have, on the other hand, led to considerable progress in thermodynamics.

One of the properties of crystals illustrating this statement is the 'lattice energy', which can be defined as the heat of sublimation at absolute zero. The intermolecular forces[1] that lead to

* Based on a course of lectures delivered at the Royal Institution on November 1, 8, 15 and 22.

phenomena such as deviations from the perfect gas equation, capillary and adsorption processes, and the broadening of spectral lines, also lead to the arrangement of all molecules in regular crystal lattices at sufficiently low temperatures. In different crystal lattices, repulsive forces nearly always arise from a common cause, namely, the interpenetration of electron clouds around individual atoms. For discussing energetics, crystals are therefore best classified according to the predominant force of attraction. The highest lattice energies are observed when the predominant force is due to covalency (for example, diamond, 135 kcal./mole), or electrovalency (for example, common salt, 181 kcal./mole). A special case of electrovalency arises for metal lattices, in which the negative ions are electrons, the small mass of which leads to special quantum-mechanical forces (for example, sodium, 26 kcal./mole). When the predominant attraction is due to permanent dipoles, the lattice energy is considerably smaller (for example, ammonia, 7 kcal./mole). If hydrogen atoms are present in the crystal, the close approach of the hydrogen atom, forming part of one dipole, to another polar atom, may lead to 'hydrogen bonds'[2]. Finally, the predominant attractive forces may be due to polarization. In rare but interesting crystal lattices such as chlorine hydrate, $Cl_2.8H_2O$, and krypton hydrate, $Kr.6H_2O$, the non-polar chlorine and krypton are polarized chiefly by the permanent dipoles of water. Polarization due to zero point motion of the electrons around each atom leads to the much commoner 'dispersion forces', such as predominate in the crystal lattices of inert gases and non-polar hydrocarbons.

In principle, the experimental measurement of lattice energies would involve a determination of the heat of sublimation at any one temperature, followed by extrapolation to absolute zero, using the specific heats of crystal and gas. Lattice energies are, however, seldom known with sufficient accuracy at present to give full significance to this correction. This is partly due to the fact that the vapour pressure of most crystals is too low to permit a direct calorimetric measurement of the heat of sublimation. Numerous indirect determinations depend on two thermodynamic rules:

(1) The Clausius Clapeyron equation, which states that the heat, $\triangle H$, absorbed in any change of phase can be calculated from the volume change, $\triangle V$, and the temperature coefficient of the equilibrium pressure, P, according to the formula $\triangle H = T \triangle V(dP/dT)$;

(2) Hess's Law, which states that the total heat required to proceed from any state A to a state B of the system does not depend on the intermediate route.

The first of these rules is commonly applied in evaluating heats of sublimation from vapour pressure curves. Manometric measurements of the vapour pressure are only possible for a few solids, such as carbon dioxide, but for solids with low vapour pressures the effusion method[3] has been used. A lattice energy of great importance is that of solid carbon, which has been tentatively evaluated from vapour pressure measurements on carbon arcs[4]. The Clausius Clapeyron equation is also used in calculating the lattice energy of polymorphs stable at high pressures[5].

An important example of the use of Hess's Law is presented by ionic lattices, for it is difficult to make direct measurements on changes of the type

$$[\underset{\text{solid}}{\text{NaCl}}] \rightarrow \underset{\text{gas}}{(Na^+)} + \underset{\text{gas}}{(Cl^-)} + 181 \text{ kcal.}$$

In this example, the heat of sublimation is calculated by summing the successive steps:

$$[\underset{\text{solid}}{\text{NaCl}}] \xrightarrow{+99 \text{ kcal.}} \underset{\text{solid}}{[Na]} + \tfrac{1}{2}\underset{\text{gas}}{(Cl_2)} \xrightarrow{+53 \text{ kcal.}} \underset{\text{gas}}{(Na)} +$$

$$\underset{\text{gas}}{(Cl)} \xrightarrow{+29 \text{ kcal.}} \underset{\text{gas}}{(Na^+)} + \underset{\text{gas}}{(Cl^-)},$$

for which the heat changes are obtained by calorimetry, vapour pressure determinations, or spectroscopic measurements[6]. An obvious weakness is that errors in the various steps may be cumulative.

Theoretical calculations of lattice energies aim at correlating crystal structures with heats of sublimation, and other properties of the crystal, and have met with considerable success in suitable cases[7].

As the temperature of a crystal lattice rises above 0° K., it acquires various forms of thermal energy. The contribution due to lattice vibrations is best considered separately, before discussing the contribution due to other 'modes of motion'. Among the phenomena which give fairly direct information about the lattice vibrations in various crystal structures are the specific heat, the temperature variation of the intensity of X-ray reflection from various crystal faces, and the thermal expansion.

In the region of temperatures where the law of Dulong and Petit applies, the specific heat is independent of crystal structure. At lower temperatures, the specific heat falls off, and Einstein was the first to calculate the vibrational energy E of crystals in terms of a single frequency ν, characteristic of crystal structure, obtaining the well-known expression, for a crystal of N atoms,

$$E = N\,[h\nu/(e^{h\nu/kT} - 1)].$$

A consideration of even simple models shows, however, that the thermal motions of atoms in a lattice must be interdependent, or 'coupled'. More complete theories of lattice vibrations must take into account the existence of a whole spectrum of

frequencies. In this spectrum there must exist frequencies the wave-length of which is much greater than the lattice spacing, and a maximum frequency the wave-length of which is twice the lattice spacing. Owing to the very large number of frequencies (some 18×10^{23} per gram atom) distributed in the vibrational spectrum, some method of approximation must be devised in calculating their contribution to the vibrational energy. A successful approximation was proposed by Debye, who replaced the spectrum of a real crystal by the more easily calculated spectrum of a continuum. The only reference to a discrete lattice structure was introduced by breaking off the spectrum of the continuum at a maximum frequency ν_M. Debye's expression for the vibrational energy of a crystal

$$E = 9RT\left(\frac{T}{\theta}\right)^3 \int_0^{\theta/T} \frac{x^3 dx}{(e^x - 1)}, \quad \text{where } \theta = \frac{h\nu_M}{k},$$

bears about the same relation to experiment as van der Waals' expression does to actual deviations from the perfect gas equation.

The spectrum of real crystals differs from that of Debye's continuum both in showing a wave velocity decreasing with rise in frequency, in place of the constant value assumed for a continuum, and in showing a preferential distribution of frequencies around certain values, in place of the smooth distribution for a continuum. Formulæ have been proposed for the vibrational energy of crystals, involving more than one θ parameter, but since empirical equations automatically gain in flexibility by increasing the number of adjustable parameters, it is not yet possible to assess their theoretical importance[8] in detail.

One disadvantage of specific heat measurements, as a clue to the thermal vibrations of atoms in crystals, is the very fact that a whole series of measurements can be summed in terms of only one parameter—the characteristic temperature θ—which can be related to crystal structure. In principle, much more direct information about the 'mode of motion' of the atoms is obtainable from measurements of the decreased intensity of X-ray reflections with rise in temperature. The intensity of reflection I_T at temperature T from crystal planes with lattice spacing d is given by the expression

$$I_T = I_0 e^{-M},$$

where $M = 4\pi^2 \bar{u}^2/d^2$, I_0 is the intensity at 0° K., and $\bar{u}^2$ is the mean square displacement of the atoms normal to the crystal plane, due to thermal motion. The effect can be demonstrated by a simple model, and has been used in studying thermal vibrations in ionic and metal lattices[9]. It also indicates the zero point motion of atoms in a lattice at 0° K.

The heat motions of the atoms lead not only to a decrease in the intensity of X-ray reflections, but in addition to thermal expansion of the lattice. This is due to the atoms vibrating in a field the law of force of which is non-harmonic. A simple expression relating the coefficient of thermal expansion α with the specific heat C_v, the volume V_0 and the compressibility X_0, is

$$(\alpha V_0)/(C_v X_0) = -d \log \nu_M / d \log V.$$

For most crystal lattices, the maximum frequency ν_M decreases as the volume V increases, and in this case the lattice *expands* with rise in temperature. A correlation of thermal expansion with crystal structure is as yet limited to isolated cases[10].

In crystals containing hydrogen, a special method of studying lattice vibrations involves the replacement of hydrogen by deuterium. This leads to expansions of the lattice in certain cases, and the interpretation is simplified owing to the localization of the change at specific bonds in the crystal[11].

A limited number of crystals have other means of acquiring thermal energy, in addition to vibrations of the lattice. As a rule, these are detected by accurate specific heat determinations. The main features of accurate calorimetry can be summarized under the headings of accurate control of the supply of heat (usually by electrical means), accurate measurement of the rise in temperature of the substance (usually with a resistance thermometer or thermocouple) and accurate control of the heat exchange with the surroundings, obtained by suspending the calorimeter in a high vacuum, and surrounding it with an 'adiabatic' mantle maintained approximately at the temperature of the calorimeter.

When other means of acquiring thermal energy are present in the crystal, they show up on the specific heat curve by a 'hump', that is, a sharp rise in specific heat above the normal vibrational value, followed by an even steeper fall. Other properties of the crystals, such as the magnetic susceptibility, the dielectric constant, and the refractive index may vary rapidly over the same region of temperatures as the specific heat anomaly, and can be used as additional means of studying the phenomena, or for demonstration in a lecture.

Typical examples are the transformation in nickel (ferromagnetic-paramagnetic), the change from ordered to disordered alloy in β-brass, and the (presumed) rotation of methane and other hydrocarbons in their crystal lattices above a certain temperature, though many other cases are known. The almost catastrophic intake of thermal energy in all these cases is due to a co-operative effect between neighbouring molecules, which may be illustrated by reference to the

rotation of methane. The crystal forces restraining rotation are due to the interaction of neighbouring molecules, which maintain preferred orientations in the lattice at sufficiently low temperatures. The thermal energy required by isolated molecules to overcome these restraining forces, and to rotate freely, may be quite large, but once they are rotating their restraint on their neighbours is lessened. Further molecules will thus have to acquire less thermal energy in order to rotate freely; the transition to complete rotation has analogies with an autocatalytic process[12]. This explanation is substantiated by experiments on the specific heat anomaly of methane with increasing amounts of krypton in solid solution[13]. The krypton atoms lessen the mutual restraint of neighbouring methane molecules, acting as lubricants, with the result that the abnormal intake of heat becomes less and less catastrophic.

The problems and results of calorimetry are of importance both for theories of crystal structure, and also in the calculation of equilibrium constants. The entropy of a solid can be written

$$S = S_0 + \int C_p \, dT/T,$$

and for a perfect gas, $S = S_0' + \int C_p \, dT/T - R \log_e P$, where S_0, S_0' are the (arbitrary) entropy constants. In order to calculate equilibrium constants solely from heats of reaction and specific heats, that is, from calorimetric measurements, it is necessary to evaluate these entropy constants. The solution proposed by the Nernst heat theorem can be stated in such a way that S_0 for solids is zero, so that S_0' for gases can be determined from the vapour pressure curve. Cases are known, however, where the assumption $S_0 = 0$ for the crystal does not agree with experiment. The simplest example arises in crystals of molecules such as NO, CO, N_2O, in which the molecules appear to have random orientations below the lowest temperature of measurement[14]. As a result, the experimental evaluation of the integral $S = \int C_p dT/T$ misses out a specific heat 'anomaly', merely because of the experimental difficulty in making measurements at still lower temperatures. The constant S_0 appears to be greater than zero, in compensation.

Interpretation of these and of other departures from the Nernst heat theorem is greatly facilitated by a knowledge of the crystal structures, and presents one more illustration of the interdependence of thermodynamics and theories of the structure of matter.

REFERENCES TO RECENT WORK

[1] Margenau, H., *Rev. Mod. Phys.*, **11**, 1 (1939).
[2] Bauer, E., and Magat, M., *J. Phys. Rad.*, **9**, 319 (1938).
[3] Coleman, F., and Egerton, A., *Phil. Trans. Roy. Soc.*, **234**, 177 (1935).
[4] Kohn, H., and Guckel, M., *Z. Phys.*, **27**, 305 (1924).
[5] Bridgman, P. W., *Proc. Amer. Acad. Sci.*, **72**, 227 (1938).
[6] Mayer, J., and Wintner, I., *J. Chem. Phys.*, **6**, 301 (1938).
[7] Corner, J., *Trans. Far. Soc.*, **35**, 711 (1939).
[8] Blackman, M., *Proc. Roy. Soc.*, A, **149**, 117 (1935).
[9] Brindley, G. W., and Ridley, P., *Proc. Phys. Soc.*, **51**, 73 (1939).
[10] Megaw, H. D., *Z. Krist.*, **100**, 58 (1938).
[11] Robertson, J. M., and Ubbelohde, A. R., *Proc. Roy. Soc.*, A, **170**, 222 (1939).
[12] Fowler, R. H., *Proc. Roy. Soc.*, A, **149**, 1 (1935).
[13] Eucken, A., and Veith, H., *Z. phys. Chem.*, B, **38**, 393 (1938).
[14] Clusius, K., NATURE, **132**, 775 (1932).

OBITUARIES

Sir Charles Hagbert Wright

SIR CHARLES HAGBERT WRIGHT, who died on March 7 last at seventy-seven years of age, was a notable librarian, a man of letters and a characteristic London figure. He was a man of strong personality tempered with kindness. To describe him as a born librarian may be thought to do him less than justice. He possessed that logic of mind, energy of character, organizing ability and power of handling men which are as necessary to the librarian of a great library as to the man of business. To these qualities he added a wide knowledge of languages and a love of literature.

Sir Charles's association with the London Library began some forty-six years ago, when the library was much smaller than it is to-day. His wide circle of friends enabled him to acquire valuable donations of books and to collect necessary funds for new buildings in 1896 and for subsequent extensions. He realized the essential part a large library has to play in the advancement of learning and was successful in inculcating in his staff the feeling that they too were concerned in this work.

From such a library as the London Library long arms stretch out, embracing the globe and gathering continually material for the enrichment of its stores of information. In his extensive travels Sir Charles made and improved such contacts, without which no great library can function effectually. Nor does a sometimes insufficiently appreciative public always realize that the services rendered by such a library depend on the smooth running of a train of mechanism comprising many wheels. I well remember with what interest Sir Charles explained to me, many years ago, the details of the hidden silent machinery in the London Library, much of which he had himself designed.

Russian subjects claimed the first place in Sir Charles's literary interests. Yet his book "Nicholas

Fabri de Peiresc", published in 1926, came within the field of science. As he said, "Here we have the phenomenon of an antiquarian who was equally engrossed in medicine and surgery, in astronomy and scientific research". The combination of naturalist and antiquary in his uncle, Edward P. Wright, may have given him a lead in that direction. Through his brother, Sir Almroth Wright, the celebrated pathologist, Sir Charles had many contacts with the scientific world, and he always endeavoured that the committee of the London Library should include scientific men. Alfred Russel Wallace and Sir Archibald Geikie were among the well-known men of science who served in this capacity in his time.

Although the London Library is essentially a library of general scope, its extent implies that it should contain valuable collections of scientific works. Sir Charles endeavoured especially to secure whatever he thought would be of value to future historians of science, and the Library's extensive representation in the history of science and of medicine is of special value to scientific men. S. C. BRADFORD.

Prof. S. Lees

PROF. SAMUEL LEES held the Chance chair of mechanical engineering at the University of Birmingham from October 1, 1931, until his death on January 27 last. The son of Alderman S. H. Lees, of Salford, he was born in that town on August 26, 1885. He received his early engineering training at Ferranti, Ltd., of Hollinwood and Charles Churchill and Co., Ltd. (afterwards The Churchill Machine Tool Co. Ltd.), of Broadheath, Manchester. Whilst a student of the Manchester School of Technology he gained a Whitworth Exhibition in 1905 and a Whitworth Scholarship in 1906. At about this time he won a prize of £200, open to technical students generally of Great Britain, offered by Messrs. George Newnes, Ltd., in connexion with their periodical *Technics*.

After proceeding to Cambridge he took his B.A. in 1909, and later his M.A. He was awarded the Rayleigh and John Winbolt Prizes in 1911, became Hutchinson Student, and was elected in 1912 a fellow of St. John's College. In 1913 he was appointed reader in applied thermodynamics in the Faculty of Technology of the University of Manchester.

From 1915 until 1918 Lees was with the Navy, first as engineer lieutenant and afterwards engineer lieutenant commander. Most of his war service was spent on research work at Portsmouth Dockyard and concluded with a short spell at Farnborough. After the War he returned to Manchester. From 1919 until 1929 he was Hopkinson lecturer in thermodynamics at the University of Cambridge, and for a number of years director of engineering studies at St. John's College. He left Cambridge to become consultant mechanical engineer to Silica Gel, Ltd., and spent some time in Baltimore, U.S.A., on problems concerning the application of silica-gel to industrial uses.

After two years in industry, Lees returned to academic life to take the chair at Birmingham. Here he reorganized the research work of the Department of Mechanical Engineering and was engaged in the investigation of several problems having a bearing upon air-conditioning and upon internal combustion engine theory and practice. These included the air-cooling of metal surfaces, heat transmission through metals and loose aggregates, the study of delay-period phenomena in compression ignition engines, catalytic and other methods of improving combustion in engines of this type, exhaust noise in internal combustion engines, electrical methods of indicating high-speed engines and the flow of gases through orifices and nozzles with the view of correlating experimental work with dimensional theory. Some of these researches were in an incomplete but advanced state at the time of his death.

Prof. Lees was a man of unassuming disposition and incapable of self-advertisement. A first-class teacher, a profound thinker on his subjects, helpful to the point of self-sacrifice to all with whom he was associated, his early death at the age of fifty-four years is a severe blow to the University of Birmingham and to his colleagues, his staff and his students, especially foreign students, who had an affectionate regard for him. He leaves a widow and two sons.

WE regret to announce the following deaths :

Prof. Alfred Bielschowsky, at Hanover, New Hampshire, U.S.A., for many years professor of ophthalmology at Marsburg and Breslau, and a leading authority on motor disturbances of the eye and the physiology and pathology of space sense, aged sixty-seven years.

Prof. Edouard Branly, the pioneer in radio communication, on March 25, aged ninety-five years.

Mr. E. T. Cottingham, the well-known maker of scientific time-recorders, on March 20, aged seventy years.

Sir Patrick Laidlaw, F.R.S., pathologist to the Medical Research Council, deputy director of the National Institute for Medical Research, on March 20, aged fifty-eight years.

Mr. W. H. Lovegrove, formerly conservator of forests, Kashmir, on January 25, aged seventy-two years.

Prof. E. Mapother, professor of clinical psychiatry in the University of London, formerly medical superintendent of Maudsley Hospital, on March 20, aged fifty-eight years.

Prof. D. S. Margoliouth, F.B.A., Laudian professor of Arabic in the University of Oxford during 1889–1937, on March 22, aged eighty-one years.

Prof. W. S. Miller, emeritus professor of anatomy in the University of Wisconsin, on December 26, aged eighty-one years.

Prof. Michael Siedlecki, professor of zoology in the University of Cracow.

Dr. Werner Spolteholz, emeritus professor of anatomy in the University of Leipzig, on January 12, aged seventy-nine years.

NATURE

SUPPLEMENT

Vol. 145 SATURDAY, MARCH 30, 1940 No. 3674

SHORT REVIEWS

Anthropology of Archaeology

Aboriginal Woman, Sacred and Profane

By Dr. Phyllis M. Kaberry. Pp. xxxii+294+8 plates. (London: George Routledge & Sons, Ltd., 1939.) 15*s*. net.

DR. KABERRY'S observations among the aborigines of north-west Australia, of which certain of the results are given in this volume, mark a new departure in the study of the primitive peoples of that continent. While it is no new thing for women to enter the field of anthropological investigation with the specific object of illuminating the sphere of the woman among backward people—that is a matter of the anthropological history of more than a generation—and Australian records include the names of more than one notable woman observer, Dr. Kaberry has approached the problem of the tribal woman from what in Australia is a new point of view. Hitherto, both in form and content, tribal life and organization have been assumed tacitly to be mainly the province of the male members of the group, with the female as an appendage or adjunct of the male, performing, it is true, certain functions essential to the continuance of the group and to the life of the individual, but otherwise of little significance. Here in Dr. Kaberry's detailed record of the results of observations carried out among various tribes in 1934 and 1935–36 is set out the evidence of how far the female members can be regarded as socially individuals, and how far the functions attributable to them pass beyond the 'profane' in tribal life and enter into the 'sacred' province, in which the male has hitherto monopolized the centre of the picture in anthropological investigation.

If it be said that the results of Dr. Kaberry's investigations enlarge considerably the conception of woman's status and function in the Australian tribe, that need be no matter for surprise, at least for many who have regarded previous records from this aspect with some reserve. She has, however, gone considerably beyond most of her predecessors by transcending the form of tribal institutions and extending her inquiry to 'cases'—in other words, by finding out how far these institutions work, how far they are elastic, so as to admit alternative modes of behaviour, and how far they are flouted by the conduct of individuals. As a result, the aboriginal woman emerges not merely as an anthropological specimen, but also as a human being and an individual—essentially of the feminine order.

Herbert Spencer Betrayed

With some account of the repudiation of the "Descriptive Sociology" by his Trustees. By Alfred W. Tillett. Pp. x+68. (London: P. S. King & Son, Ltd., 1939.) 4*s*. 6*d*. net.

MR. TILLETT vigorously attacks the trustees of Herbert Spencer's will on the grounds: (1) that while the terms of the will required his estate to be applied to completing the publication of "Descriptive Sociology", which was uncompleted on Spencer's death, they acted *ultra vires* in publishing Dr. Rumney's "Herbert Spencer, Sociologist", in which Spencer as philosopher and man is vilified; and (2) that they determined the Trust and distributed the balance of the fund among the residuary legatees before the work, for which the trust was created, had been completed.

Mr. Tillett, though advised to the contrary, still hopes that it will be possible to obtain a judicial pronouncement on the position he has taken up; and it is therefore undesirable to express any opinion here, even if the case were not one involving difficulties of interpretation, legal and other. There is no doubt that in such matters open accusation is better than underground insinuation. It may be pointed out, however, that the trustees had exercised every care in becoming discharged of their trust. Not only had the Court already varied the terms of the will to meet changed conditions, but also the opinion of the Attorney General was sought before the trustees took final action. With the legal position of the trustees thus clarified, in view of recent development in sociological studies, further expenditure in this direction seemed to be largely waste.

Biology

Keys to the Phyla of Organisms, including Keys to the Orders of the Plant Kingdom

By Fred A. Barkley. Pp. iv+40. (Missoula, Montana: Associated Student's Store, 1939.) 75 cents.

IN this pamphlet of thirty-nine pages, Dr. Barkley gives a series of dichotomous keys referring chiefly to the orders of the various 'plant' phyla. The keys have been drawn up to meet the needs of the author's class in plant morphology and have been so constructed as to reflect in large part the views of outstanding authors regarding certain groups. They are intended to give also a more or less comparative treatment of the ordinal category under the various phyla.

Students who have a general knowledge of systematic botany and zoology will find it useful first to get a bird's-eye view of the classification employed by referring to the outline given on pp. 26–27. In this outline the sequence of phyla, classes and orders follows that of the keys, and only in broad outline, therefore, can the classification be regarded as an expression of relationships. Organisms as a whole are divided into four kingdoms: Monera, Protista, Phyta and Zooea. Cohn's old group 'Schizophyta' is retained as a division of the Monera and serves to include Cyanophyceæ, Spirochætæ and Schizomycetes. An unusually wide interpretation is given to the Protista, since this kingdom is made to include not only Protozoa and Parazoa but also all the organisms commonly classed as Algæ and Fungi. Bryophytes head the list of the phyla placed in the kingdom Phyta and are followed in turn by Pteridophytes and Spermatophytes, the last phylum of which—the Anthophyta—includes the large number of orders into which Dicotyledons and Monocotyledons are divided. Apart from an occasional change of name and a different sequence, the orders of flowering plants are the same as those proposed by Hutchinson in "The Families of Flowering Plants". In the keys to the orders a great deal of detailed observation is compressed, much of which will not prove easy reading to the elementary student, but the inclusion of a useful glossary (pp. 29–38) will help to get over the difficulty. J. R. M.

Bibliography of the Larvæ of Decapod Crustacea

By Dr. Robert Gurney. (Ray Society, Vol. 125, for the Year 1937.) Pp. vii+123. (London: Bernard Quaritch, Ltd., 1939.) 12*s*. 6*d*.

THE preparation of bibliographies is often a thankless task, although few would deny their importance. The present example covers the literature of the larvæ of Decapod Crustacea (excluding the Euphausiacea) up to May 1939. It comprises three sections—an alphabetical list of authors, a classified catalogue in which the literature is arranged zoologically, and an index to genera. Some eight hundred titles are recorded.

We have tested the work here and there both as regards completeness and accuracy, and have little criticism to offer. Every bibliographer knows that completeness is unattainable and even accuracy is curiously difficult to achieve. Nevertheless, we have noted only the following errors and omissions: the paper by Audouin and M. Edwards, 1828, on the nervous system of Phyllosoma, Dalyell's "Powers of the Creator", vol. 1, 1851, containing observations on Decapod larvæ, Leach's earlier article on Megalopa of 1814, and Leeuwenhoek's letters of 1686 and 1700 on the development of Crangon are omitted. Crawford and Smidt's paper on Panulirus should be dated 1922 and for "Larvæ, p. 9" read "Larva, p. 309"; Milne Edwards is not a hyphenated name and should be catalogued under Edwards; Hornell's papers on Squilla and Scyllarus were reprinted in a volume of "Microscopical Studies" in 1901; the reference to Linnæus should be to the twelfth edition, Holmiæ, 1767; and Slabber's figure of the zoea larva should be dated 1769.

Dr. Gurney is to be congratulated on the completion of a valuable piece of bibliographical research and the Ray Society for having undertaken its publication. F. J. C.

Basic Methods for Experiments on Eggs of Marine Animals

By Ernest Everett Just. Pp. x+89. (London: The Technical Press, Ltd., 1939.) 6*s*. net.

THE methods used in experimental investigations of the eggs and spermatozoa of marine invertebrates depend very strongly on the adherence to some general rules. Some of these are set out in this little volume, which should be useful for beginners in the field of experimental embryology, and for the specialist whose work demands individual extension of methods. Whilst the techniques described apply to the gametes of American marine species, they are sufficiently general to be applicable also to the gametes of the same species, and to those of closely related species, in European waters. Dr. Just has developed his methods over a period of twenty-five years, so that the issue of this book was to be expected as a necessary supplement to his recently issued "Biology of the Cell Surface". In no wise can it be claimed to be a catalogue of all methods in use, but, nevertheless, the methods described, and especially those relating to preparations of fixed tissues, should be of value to cytologists.

Notes on the Genus Dioscorea in the Belgian Congo

By I. H. Burkill. (Extrait du *Bulletin du Jardin botanique de l'Etat*, Vol. 15.) Pp. 48. (Bruxelles: Jardin botanique de l'Etat, 1939.)

THIS important study is by one of the authors of the revision of the Eastern Dioscoreas. It will prove invaluable in compiling any general account of the genus in Africa. Twenty-three species are recorded with several varieties for some of them; two of the species are here described for the first time. These species of the Congo are attributed to six sections of which four twist to the left. A definition of each section is given, and a key to the species is provided for each plurispecific section. A full history and synonymy of every species will be found, together

with a comprehensive statement of the known collectors and its distribution within and without the Belgian Congo. Many interesting notes are furnished on the depth below ground-level at which the tubers are seated, on their edibility and method of preparation for food; poisonous properties; bulbil production and self-protective measures. Of peculiar interest and value are the discussions on the origin, evolution and "ennoblement" (improvement and refinement by selective cultivation) of the most-prized yams. It is indicated that some of the problems involved can only be solved in the field and that "the paper is intended to direct all who are able to study the Congo Dioscoreas alive to points worthy of their particular attention".

A debt of gratitude is due to Mr. Burkill for collating much valuable information from many sources and adding the results of his own patient and extensive research, both in the herbarium and in the field, which has cleared up several obscurities.

Chemistry

Perkin and Kipping's Organic Chemistry

By Prof. F. Stanley Kipping and Dr. F. Barry Kipping. Part 3. Revised edition. Pp. viii+615–1030. (London and Edinburgh: W. & R. Chambers, Ltd., 1939.) 9*s*.

OF late years there has been a marked dearth of works dealing with advanced organic chemistry in a manner suitable for students reading for an honours degree in chemistry. Part 3 of "Perkin and Kipping's Organic Chemistry" can be recommended with confidence to such students and also to research workers. It is a handy volume comprising some four hundred pages and yet not too bulky for an ordinary pocket. Its twenty-three chapters afford concise and up-to-date treatments of a surprisingly large number of subjects of current importance in organic chemistry, including physical properties, isomerism (four chapters) and isomeric change, carbohydrates (two chapters), terpenes and related groups (three chapters), carotenoids, anthocyanins, metallic ketyls, aromatic substitution, etc. The chapter on heterocyclic compounds (12 pp.) is limited to azoles, diazines and vitamin B. In this new edition the configurational formulæ of the sugars (which gave rise to difficulties as expressed in the first edition) have been revised, and two new chapters have been added: one of these deals with the theory of resonance (12 pp.) and the other with sterols, bile acids and other steroids (21 pp.). The text and formulæ are neatly printed, and there is a good index.

A Text-Book of Quantitative Inorganic Analysis

Theory and Practice. By Dr. Arthur I. Vogel. Pp. xix+856. (London, New York and Toronto: Longmans, Green & Co., Ltd., 1939.) 18*s*.

AS would be expected of a teacher with wide experience of students of all grades, Dr. Vogel has produced in this book a notable contribution to chemical literature and a valuable guide to those engaged in chemical study.

The book is divided into six chapters dealing respectively with the theoretical basis of quantitative analysis, the experimental technique required, volumetric, gravimetric, colorimetric and gas analyses. In each of these chapters, the reader will discover a wealth of detail not only of the more classical methods of analysis but also of the most up-to-date modifications and discoveries. Most of the new methods have been tried out in the author's own laboratory. In addition, there is a comprehensive appendix containing chemical data which will be of great value to practising analytical chemists, whilst teachers of chemistry will find much interest in the suggested schemes of study for various examinations.

Dr. Vogel's book can be confidently recommended to students of all grades as a sound, up-to-date and accurate treatise on methods of analysis, a study of which will be amply sufficient for all examinations up to the honours degree. The book should also be on the bookshelf of all industrial analytical chemists, who will find it a useful reference book in modern methods of analysis.

Physikalische Methoden der analytischen Chemie

Herausgegeben von W. Bottger. Teil 3: Chromatographie, Verdampfungsanalyse, Spektroskopie, Konduktometrie, Photoelektrometrie, Polarographie, Potentiometrie. Pp. xx+836. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 65 gold marks.

THIS book is more than merely a description of the application of a number of physical methods to analytical chemistry. This is due to the fact that the editors have taken a very broad view of what constitutes analytical chemistry. The consequence is that much pure physical chemistry finds its way into the volume. There is, of course, emphasis on experimental technique.

The main subjects treated are chromatographic analysis, analysis by fractional evaporation, spectroscopic analysis, photometric methods and analysis by conductometric, polarographic and potentiometric methods. It is absolutely impossible in a short review even to give a list of the contents, for they are so varied. The aim of each contributor is not only to describe methods but also to give enough practical details so that the reader may conduct the experiments with success. Moreover, each section of the book is copiously provided with references to recent literature. For example, the section on potentiometric methods includes at least one thousand references.

There is much in this book to interest physical chemists as well as those who wish to find the most useful analytical technique for any given problem. The index and table of contents make the search among such a mass of material an easy business. The volume is well printed and bound but is rather expensive.

H. W. M.

Engineering

Electricity Meters and Meter Testing

By G. W. Stubbings. (Monographs on Electrical Engineering, Vol. 6.) Pp. x+216. (London : Chapman & Hall, Ltd., 1939.) 12*s*. 6*d*. net.

IT is only of recent years that the question of the metering of electric supply has been seriously tackled. The question itself is a most difficult one, and the introduction of tariffs and the theory of statistics, and attempting an impossible accuracy, have certainly not made it easier. The easiest way is to put a sub-standard wattmeter in series with the consumer's meter for a day or a fortnight and then read them both simultaneously. If they both read the same then everyone is satisfied. But the meter reader who has had his own sub-standard meter tested at a standardizing institution and knows the curve of error of his own meter sometimes wonders whether it is correct or not. The present limits for consumers' meters as described in the Electricity Supply (Meters) Act of 1936 are $2\frac{1}{2}$ per cent plus or $3\frac{1}{2}$ per cent minus. That is, the permissible error when the meter is going fast is less than when it is going slow. The test of the meter at no load should always be taken, and if it is rotating then it is a long and costly business to find out what is wrong.

From what we have said it will be seen that it is no easy matter to meter an electric supply. Even the expert who is thoroughly familiar with the apparatus used in an electrical laboratory, or even in a meter-testing house, will find that there are numerous problems inseparable from the everyday work of the meter-tester that are not yet satisfactorily solved. For example, there are errors due to bearing friction, fluid friction, frequency, phase, self-braking, temperature, varying load, voltage variation, wave distortion, official limits, tariffs, etc. It is no easy task to keep in good working order hundreds of thousands of little meters, and the task of the superintendent of a meter-testing department is no sinecure.

The author of this book has a thorough knowledge of the difficulties in the way in Great Britain and knows well the difficulties in many cases of treating equitably suppliers and consumers. He includes an appendix giving the titles of many recent books on the subject and also of technical papers. The reader will find that it is no easy matter to become a meter expert.

Elements of Practical Aerodynamics

By Prof. Bradley Jones. Second edition. Pp. viii+436. (New York : John Wiley and Sons, Inc.; London : Chapman & Hall, Ltd., 1939.) 18*s*. 6*d*. net.

THIS is the second edition of an American book, the first of which was reviewed in NATURE of July 31, 1937. It is an exceedingly lucid and simply written students' text-book, that should prove useful to engineers or physicists commencing the study of aeronautics. A feature of the book is the large number of worked examples in the text, and further exercises at the end of each chapter. These are carefully graded and form an admirable addition to the book ; one which might well be added to most English books on this subject of the same standard.

The subject-matter has been brought up to date, and most of the more modern developments mentioned in a general way. Some of this later work is superficial, but not unduly so remembering that it is an elementary and necessarily restricted work. Among these are discussions on tapered monoplane wings, methods of working out low drag contours, performance calculations including approximate rapid prediction methods, problems of control and stability from the practical but not the mathematical point of view, and details of the more modern aerofoils (those more popular in the United States). A chapter on "Auxiliary Lift Devices"—about three pages—is disappointing, and makes no attempt to explain the many variations of the allied problems of speed range and control that arise from the use of these. Worked examples, as in some of the other chapters, would have been particularly valuable here.

As in the first edition, the book ends with chapters on such subjects as materials, meteorology, instruments, etc. These are accurate so far as they go ; but are so short as to be of little use. They are illogical in a book with this title, and it seems a pity that the author did not confine himself to aerodynamics, and give fuller discussions upon the aspects of this in the relevant chapters.

Forestry

Principles of Forest Entomology

By Prof. Samuel Alexander Graham. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. xvi+410. (New York and London : McGraw-Hill Book Co., Inc., 1939.) 24*s*.

WE welcome the appearance, after a decade, of a second edition of this well-known handbook. Considerable advances have been made in that period as regards our knowledge of the principles of forest entomology. The European pine sawfly, for example, has become prominent as a forest pest in that short period. Certain chapters of the book have been almost wholly rewritten : others have been revised, and the bibliography has been brought up to date.

Elementary Forest Mensuration

By M. R. K. Jerram ; with a Chapter on The Measurement of Forests, by R. Bourne. Pp. x+124. (London : Thomas Murby & Co., 1939.) 8*s*. 6*d*. net.

IN this little book, Mr. M. R. K. Jerram states that the word 'elementary' has been prefixed to the title as the work is intended chiefly for the professional forester rather than research specialist, and he has been guided in his method of treatment of the subject by this factor. For the greater number of professional foresters, either in being or still in the student stage, forest mensuration is a practical part of their work—the higher branches of the subject are required by the research worker alone.

Still, the author gives an account of a few of the less well-known methods in use by research workers. Otherwise in his treatment of the subject Mr. Jerram deviates but slightly from the ordinary lines, which are not capable of much variation. An interesting chapter on "The Measurement of Forests" is contributed by Mr. R. Bourne, late lecturer in forestry at Oxford University. The book may be recommended as a useful text-book.

Geology

Geology of London and South-East England

By G. M. Davies. Pp. viii + 198 + 4 plates. (London: Thomas Murby & Co., 1939). 7*s*. 6*d*. net.

In a recent broadcast on "Science in Wartime", Sir Albert Seward, then president of the British Association, commended to his listeners the interest and satisfaction that are to be gained from dipping into the history of past ages on the earth, and he chose as one of his examples the study of the London Clay. For those who, for cultural or utilitarian ends, would like to follow up this suggestion in the still rather heavily populated area of south-eastern England (and are prepared to take the risk of being arrested as spies in the course of their field studies), the book under notice appears at the opportune moment.

Instead of adopting the usual historical method of treatment—from ancient to modern—the author reverses the process in the belief that people will find it easier to work back from the known present to the unknown past. His treatment therefore opens with "made ground" and recent deposits, and passes on to the records of early man, ancient river deposits, the relics of the Ice Age, and so to the Tertiary rocks of the London and Hampshire Basins, the Chalk, and finally the pre-Chalk formations that are included within the area from the Fens to Oxford.

Other interesting subjects treated in a simple way are the Palæozoic floor under the east of England, the water-supply, the building-stones of London, and the development of scenery. Abundant photographs, text-figures of characteristic fossils, geological sections, sketch-maps and judiciously selected references to relevant publications (for those who wish to pursue the subject further) enhance the usefulness of the book.

Die Entwicklung der Kontinente und ihrer Lebewelt

Ein Beitrag zur vergleichenden Erdgeschichte. Von Prof. Dr. Theodor Arldt. Zweite, vollständig neubearbeitete und erweiterte Auflage. Band 1. Pp. xviii + 449–1005. (Berlin: Gebrüder Borntraeger, 1938.) 44 gold marks.

The first edition of Prof. Arldt's great work appeared in 1907. Since that time, great advances have been made in palæogeography, biogeography and related sciences. Further, a complete new theory of the origin of continents and oceans has burst upon the geological world. This second edition is therefore a greatly expanded one, the first volume of it alone amounting to a thousand pages. The first part of this volume, issued in 1936, was noticed in NATURE of May 29, 1937, pp. 902–3. In it the question of the permanence of the earth's major features was raised, and the answer is not yet forthcoming even in the thousand pages of the present volume. It seems likely, however, that land-connexions between continental masses will be approved, but for the final answer we must await the second volume, which will contain the geological and cosmological findings.

In these thousand pages, then, we have a very detailed examination of the distribution of present and past life. So far as this colossal mass of information can be handled, it is summarized in a series of tables and charts. The last thirty pages of the volume deal with a few general topics, such as the geological distribution, the regions and the origin of life. By the ordinary geologist, who appreciates at least the quantity of the evidence produced by Arldt, the geological verdict will be awaited with interest.

Mathematics and Astronomy

Modern Machine Calculation with the Facit Calculating Machine Model Lx

By H. Sabielny. Translated and revised by Dr. L. J. Comrie and Dr. H. O. Hartley. Pp. 74. (London: The Scientific Computing Service, Ltd., 1939.) 5*s*.

Apart from the many excellent brochures issued by the leading makers of modern calculating machines, there is very little scientific literature on the subject. This is somewhat strange in view of the increasing use made of these machines in present-day business houses, coupled with the fact that probably the first adding machine was exhibited so early as 1884. The present manual will therefore be welcomed by all who wish to know something authentic about modern machine calculation. Mr. Sabielny's original text was published by Aktiebolaget Facit, Atvidaberg, Sweden, by whom the Scientific Computing Service, Ltd., under the direction of Dr. L. J. Comrie, was requested to prepare an edition suitable for use in English-speaking countries. Whilst the text deals particularly with the Facit Model Lx, much of it is applicable generally to other machines of similar type.

There are four parts dealing respectively with fundamental principles, examples of practical calculations, British currency and tables. The translators have followed the original text on the whole, although certain sections have had to be either cut out or modified. They have also incorporated some important new matter. Part 2, for example, on British currency, weights and measures, is new, whilst the very practical sections on 'short-cutting' in multiplication and division have been extended and a new method given for carrying out the rule of three with one operation without any embarrassment from complements.

The manual has been excellently prepared by the translators and should provide a very practical and scientific guide to the use of the modern calculating machine.

F. G. W. B.

(1) Annuaire pour l'an 1940
Publié par le Bureau des Longitudes. Avec des Notices scientifiques. Pp. viii+550+A16+B26+C54. (Paris: Gauthier-Villars, 1940.) 25 francs.

(2) The Observer's Handbook for 1940
(Thirty-second Year of Publication.) Pp. 80. (Toronto: Royal Astronomical Society of Canada, 1939.)

(1) AMONGST the various handbooks published each year mention may be made of the "Annuaire", published by the French Bureau of Longitudes, and "The Observer's Handbook" of the Royal Astronomical Society of Canada. The former has a long history, being first published in 1795, when it contained about eighty pages. The present comprehensive volume contains 550 pages besides an appendix. Its contents are grouped under the following headings: (1) Calendar for 1940 including astronomical data, tide predictions, etc.; (2) Earth—geodesy, meteorology, terrestrial magnetism, time determination; (3) Astronomy—star charts, minor planets, comets, stellar spectra, etc.; (4) Units of measurement; (5) Physical and chemical data. Two special articles are appended: "L'Espace Interstellaire", by M. Chas. Fabry (being the George Darwin Lecture of the Royal Astronomical Society for 1938), and "Le Bureau Internationale de l'Heure", by M. A. Lambert.

(2) "The Observer's Handbook" is purely an astronomical handbook intended more especially for the use of the non-professional. Besides providing a journal of astronomical events from day to day (datum, 75th meridian civil time), there are several useful tables. One of these gives the principal facts regarding 259 stars brighter than apparent magnitude 3·51. Another gives the position and type of the star clusters and nebulæ contained in Messier's catalogue compiled in 1781. A rough chart directs attention to the remarkable grouping of bright planets which occurred on February 28 (see also NATURE, January 27, p. 146). The transit of Mercury across the sun's disk on November 11–12 receives notice as it will be partly visible in Canada,.

Structure of Algebras
By Prof. A. Adrian Albert. (American Mathematical Society, Colloquium Publications, Vol. 24.) Pp. xi+210. (New York: American Mathematical Society, 1939.) 4 dollars.

NOT only the contents, but even the title of this book may puzzle many good mathematicians of the older school. Algebra seemed to be a stereotyped subject which started with substitution, addition, subtraction, multiplication and division, had a great deal about equations, progressions, the binomial, exponential and logarithmic theorems, and then, after some chapters on miscellaneous topics, concluded with determinants and the theory of equations. There were a few pages headed the "Fundamental Laws of Algebra", which were generally felt to be an unnecessary statement of the obvious. At one time invariants came into fashion, and were spoken of as the "Modern Higher Algebra".

Now recently books have appeared having scarcely anything in common with older books except their titles. In Prof. Albert's "Modern Higher Algebra" (Cambridge University Press, 1938) the subjects dealt with are groups, rings, integral domains, fields and matrices. The subject of matrices, so important in quantum mechanics and factor analysis, is here taken as the starting point for the discussion of abstract entities satisfying the same laws as certain matrices. These entities are known as linear associative algebras. In the book under review a more advanced treatment of these algebras is given, including recent advances due to R. Brauer, H. Hasse, E. Noether, and the author himself.

MEDICAL SCIENCES

Bergey's Manual of Determinative Bacteriology
A Key for the Identification of Organisms of the Class Schizomycetes. By David H. Bergey, Robert S. Breed, E. G. D. Murray and A. Parker Hitchens. Fifth edition. Pp. xi+1032. (London: Baillière, Tindall & Cox, 1939.) 45*s*.

IN the sixteen years that have elapsed since the first publication of Bergey's "Manual" the work has undergone considerable change and amplification; many of the mistakes that detracted from the earlier editions have been rectified and the present edition, under its capable board of editors, shows a marked advance on its predecessors.

The assistance of experts has been made use of in the revision of certain groups—particularly in the realm of serology—and for the first time attention is directed to the serological grouping and typing of the hæmolytic streptococci and to the work of the Salmonella Sub-committee of the Nomenclature Committee of the International Association of Microbiologists on the taxonomy and classification of the genus *Salmonella*. In the latter connexion be it observed, however, that the organism of typhoid fever is still placed in the genus *Eberthella* instead of in the genus *Salmonella*, where by virtue of its serological characters it most certainly belongs, and that notwithstanding the serological identity of *Salmonella pullorum* and *Salmonella gallinarum* the latter is taken out of the genus *Salmonella* and placed in the genus *Shigella*, along with the dysentery bacteria. Furthermore, no mention is made of the significant serological relationship of the organism of tularæmia with the members of the genus *Brucella* and it is relegated to the genus *Pasteurella* on purely negative characters. The curious statement is made, moreover, that this widespread disease is only known in North America.

Strange omissions are still noticeable: one searches in vain for description of the organisms of pleuropneumonia and contagious agalactia and the other members of the group—this in spite of a considerable and growing literature on the subject. No doubt these and other questions will be considered at some future date and necessary action taken by the recently appointed Judicial Commission of the Nomenclature Committee of the I.A.M., of which the editor-in-chief of the "Manual" is one of the joint-secretaries.

RECENT SCIENTIFIC AND TECHNICAL BOOKS

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

Brun, Edmond. Les chaleurs spécifiques. (Collection Armand Colin : Section de physique, No. 224.) Gl. 8vo. Pp. 224. (Paris : Armand Colin, 1940.) 15 francs.*

Colerus, E. Piccola storia della matematica da Pitagora a Hilbert. Traduzione dal tedesco di Casavecchia. 8vo. Pp. 360. (Torino : G. Einaudi, 1939.) 20 lire.

Comrie, L. J. On the Application of the Brunsviga Twin 13z Calculating Machine to Survey Problems. Second edition, revised and enlarged. Med. 4to. Pp. 20 +1 plate. (London : The Scientific Computing Service, Ltd., 1940.) 5*s.**

Conway, A. W., and **McConnell, A. J.,** Edited for the Royal Irish Academy by. The Mathematical Papers of Sir William Rowan Hamilton. Vol. 2 : Dynamics. (Cunningham Memoir No. 14.) Demy 4to. Pp. xvi +656. (Cambridge : At the University Press, 1940.) 70*s.* net.*

Duncan, J., and **Starling, S. G.** A Text Book of Physics : for the Use of Students of Science and Engineering. Part 4 : Sound. Demy 8vo. Pp. viii +663–776. (London : Macmillan and Co., Ltd., 1940.) 2*s.* 6*d.*

Kahan, Théodore. Radioactivité et transmutation des atomes. (Collection Armand Colin : Section de physique, No. 222.) Gl. 8vo. Pp. 224. (Paris : Armand Colin, 1940.) 15 francs.*

Klein, Felix. Elementary Mathematics from an Advanced Standpoint—Geometry. Translated from the third German edition by E. R. Hedrick and C. A. Noble. Med. 8vo. Pp. ix +214. (London : Macmillan and Co., Ltd., 1939.) 15*s.* net.*

Larcombe, H. J. Mathematics for Senior Schools. Cr. 8vo. Pp. 192. 2*s.* 3*d.* Answers. Pp. 48. 1*s.* (London : Macmillan and Co., Ltd., 1940.)

Macdougall, F. H. Thermodynamics and Chemistry. Third edition. Med. 8vo. Pp. ix +491. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1940.) 30*s.*

Ribaud, G. Les hautes températures. (Nouvelle Collection scientifique.) Gl. 8vo. Pp. iv +173. (Paris : Félix Alcan, 1939.) 18 francs.*

Spensley, L. R., and **Lawrence, E. N.** A Stage 'A' Geometry. Cr. 8vo. Pp. vi +105. (London : Macmillan and Co., Ltd., 1940.) 2*s.*

Stewart, C. A. Advanced Calculus. Demy 8vo. Pp. xviii +523. (London : Methuen and Co., Ltd., 1940.) 25*s.**

Turner, Ivan Stewart. The Training of Mathematics Teachers for Secondary Schools in England and Wales and in the United States. (National Council of Teachers of Mathematics : Fourteenth Yearbook.) Med. 8vo. Pp. xv +231. (New York : Teachers College, Columbia University, 1939.) 1.75 dollars.*

Vigoureux, P. Quartz Oscillators and their Applications. (Published for the Department of Scientific and Industrial Research.) Demy 8vo. Pp. vi +131 +13 plates. (London : H.M. Stationery Office, 1939.) 4*s.* 6*d.* net.*

Weiss, E. A. Punktreihengeometrie. 8vo. Pp. 232. (Leipzig und Berlin : B. G. Teubner, 1939.) 10.50 gold marks.

Whitman, Walter G. Household Physics. Med. 8vo. Pp. 436. (London : Chapman and Hall, Ltd., 1940.) 18*s.* net.

Wilson, W. Theoretical Physics. Vol. 3 : Relativity and Quantum Dynamics ; Einstein—Planck. Demy 8vo. Pp. xi +276. (London : Methuen and Co., Ltd., 1940.) 21*s.* net.*

Wright, Harry N. First Course in Theory of Numbers. Med. 8vo. Pp. 108. (London : Chapman and Hall, Ltd., 1940.) 12*s.* net.

Engineering

Camm, F. J. The Practical Wireless Encyclopædia. Ex. Cr. 8vo. Pp. viii + 394. (London : George Newnes, Ltd., 1940.) 6*s.* net.

Camm, F. J., Edited by. Motor Car Principles and Practice. Cr. 8vo. Pp. 184. (London : George Newnes, Ltd., 1940.) 3*s.* 6*d.* net.

Cross, Harold H. U. Modern Ignition Simply Explained. Second edition. Cr. 8vo. Pp. 144. (London : The Technical Press, Ltd., 1940.) 5*s.* net.

Department of Scientific and Industrial Research : Building Research. Technical Paper No. 21 : Studies in Reinforced Concrete, 4 : Further Investigations on the Creep or Flow of Concrete under Load. By W. H. Glanville and F. G. Thomas. Roy. 8vo. Pp. vi +44 +6 plates. (London : H.M. Stationery Office, 1939.) 1*s.* net.*

Fowler, W. H., Compiled by. Mechanical Engineer's Pocket Book, 1940. Pott 8vo. Pp. li +597. (Manchester : The Scientific Publishing Co., 1940.) 3*s.* net.

Frier, John D. Definitions and Formulæ for Students : Aeronautics. Second edition. Pott 8vo. Pp. vi +41. (London : Sir Isaac Pitman and Sons, Ltd., 1940.) 6*d.* net.

Gentry, George. Standard Screw Threads and Twist Drills. Cr. 8vo. Pp. 66. (London : Percival Marshall and Co., Ltd., 1940.) 1*s.* 6*d.* net.

Herbert, T. E., and **Proctor, W. S.** Telephony. Supplement to Vol. 2. Demy 8vo. Pp. vi +97. (London : Sir Isaac Pitman and Sons, Ltd., 1940.) 3*s.* 6*d.*

Johnson's Materials of Construction. Eighth edition, by M. O. Withey and J. Aston. Med. 8vo. Pp. xxii +867. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1940.) 36*s.*

Mills, Adelbert P. Materials of Construction. Med. 8vo. Pp. xii +564. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1940.) 24*s.*

Morgan, Alfred P. The Pageant of Electricity. Demy 8vo. Pp. xxvi + 363. (New York and London : D. Appleton-Century Co., Inc., 1940.) 16*s.* net.

Severns, William H., and **Degler, Howard E.** Steam, Air and Gas Power. Med. 8vo. Pp. vii +511. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1940.) 24*s.*

Sikorsky, Igor I. The Story of the Winged-S. Demy 8vo. Pp. 288. (London : Robert Hale and Co., Ltd., 1940.) 12*s.* 6*d.* net.

Teichmann, Frederick K. Airplane Design Manual. Med. 8vo. Pp. v +345. (London : Sir Isaac Pitman and Sons, Ltd., 1940.) 18*s.* net.

Turner, Frederick W., and **Perrigo, Oscar E.** Machine Shop Work. New edition. 8vo. (London : The Technical Press, Ltd., 1940.) 16*s.* 6*d.* net.

Williams, C. G. Collected Researches on Cylinder Wear. Sup. Roy. 8vo. Pp. vii +119. (London : Institution of Automobile Engineers, 1940.) 10*s.* 6*d.**

Chemistry : Chemical Industry

Engelder, Carl J. Calculations of Quantitative Analysis. 8vo. Pp. 174. (London : Chapman and Hall, Ltd., 1940.) 12*s.* net.

Reilly, Joseph, and **Rae, William Norman.** Physico-Chemical Methods. Third edition. Roy. 8vo. Vol. 1 : Measurement and Manipulation. Pp. xv +686. Vol. 2 : Practical Measurements. Pp. ix +580. (London : Methuen and Co., Ltd., 1940.) 84*s.* net.*

Sage, Bruce H., and **Lacey, William N.** Volumetric and Phase Behaviour of Hydrocarbons. 8vo. Pp. 299. (London : Oxford University Press, 1940.) 22*s.* 6*d.* net.

Weiser, Harry Boyer. Colloid Chemistry. Med. 8vo. Pp. viii +428. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1940.) 24*s.*

Technology

Anderson, Paul L. The Technique of Pictorial Photography. Med. 8vo. Pp. 403. (Philadelphia and London: J. B. Lippincott Co., 1940.) 16*s*. net.

British Journal Photographic Almanac and Photographer's Daily Companion, with which is incorporated the Year Book of Photography and Amateurs' Guide and the Photographic Annual, 1940. Edited by Arthur J. Dalladay. Cr. 8vo. Pp. 454 +31 plates. (London: Henry Greenwood and Co., Ltd., 1940.) 3*s*. 6*d*. net.*

Camm, F. J., Edited by. A Dictionary of Metals and their Alloys. Fcap. 8vo. Pp. 245. (London: George Newnes, Ltd., 1940.) 5*s*. net.

Child, I. H. Principles of Electric Arc Welding. Demy 8vo. Pp. 36. (Epsom: The Draughtsman Publishing Co., Ltd., 1940.) 2*s*. net.*

Heaton, Noel. Outlines of Paint Technology. Second edition. Med. 8vo. Pp. x +413. (London: Charles Griffin and Co., Ltd., 1940.) 25*s*. net.

Henney, Keith, and **Dudley, Beverly,** Edited by. Handbook of Photography. (Whittlesey House Publication.) Med. 8vo. Pp. xii +871. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 35*s*. net.*

Heyer, Robert H. Engineering Physical Metallurgy. Med. 8vo. Pp. ix +549. (London: Chapman and Hall, Ltd., 1940.) 25*s*. net.*

Hünlich, Richard. Textile Fibres and Materials: their Properties and Identification, with Special Reference to Rayon and Staple Fibre. Translated by A. J. Hall. Edited by H. P. Curtis. 8vo. Pp. 222. (London: Thomas Skinner and Co., Ltd., 1940.) 8*s*. 6*d*. net.

Low, Kenneth S. Metallurgical and Industrial Radiology. Cr. 8vo. Pp. vii +88. (London: Sir Isaac Pitman and Sons, Ltd., 1940.) 7*s*. 6*d*. net.

Simonds, Herbert R. Industrial Plastics. Med. 8vo. Pp. xii +371. (London: Sir Isaac Pitman and Sons, Ltd., 1940.) 22*s*. 6*d*. net.

Spencer, D. A., and **Waley, H. D.** The Cinema To-day. (Pageant of Progress Series.) Demy 8vo. Pp. 191. (London: Oxford University Press, 1940.) 4*s*. 6*d*. net.

Astronomy

Flammarion, Camille. Annuaire astronomique et météorologique Camille Flammarion pour 1940: exposant l'ensemble de tous les phénomènes célestes observables pendant l'année; avec revue astronomique et météorologique, notices scientifiques, tableaux et documents. (76e année.) Cr. 8vo. Pp. 458. (Paris: Ernest Flammarion, 1940.) 20 francs.*

Kruse, W. Die Wissenschaft von den Sternen: ein Überblick über Forschungsmethoden und Ergebnisse der Fixsternastronomie. (Verständliche Wissenschaft, Band 43.) Cr. 8vo. Pp. xiv +180. (Berlin: Julius Springer, 1939.) 4.80 gold marks.

Meteorology: Geophysics

Cagniard, L. Réflexion et réfraction des ondes séismiques progressives. Roy. 8vo. Pp. xi +255. (Paris: Gauthier-Villars, 1939.) 120 francs.*

Perrier, Général Georges. Petite histoire de la géodésie: comment l'homme à mesuré et pésé la terre. (Nouvelle Collection scientifique.) Cr. 8vo. Pp. 188. (Paris: Félix Alcan, 1939.) 18 francs.*

Geology: Mineralogy

Winchell, Alexander N. Elements of Optical Mineralogy. Part 3: Determinative Tables. Med. 8vo. Pp. xiv +231. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 30*s*.

Geography: Travel

Alexander, William, and **Allan, W. J. D.** The Observer's Handbook on Maps, Charts and Projections. Cr. 8vo. Pp. 91. (London: George Allen and Unwin, Ltd., 1940.) 2*s*. 6*d*. net.

Allen, Van Nes. I Found Africa. Demy 8vo. Pp. 282 +16 plates. (London: Robert Hale and Co., Ltd., 1940.) 12*s*. 6*d*. net.

Carrington, A. H., and **Elliot, M. M.** Five Tales of Empire. (Horizon Readers.) Ex. Cr. 8vo. Pp. 126. (Cambridge: At the University Press, 1940.) 1*s*. 9*d*.

Cressey, George. Géographie humaine et économique de la Chine. 8vo. (Paris: Payot et Cie., 1939.) 100 francs.

Donner, Etta. Hinterland Liberia. Translated by W. M. Deans. Demy 8vo. Pp. 316 +48 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 12*s*. 6*d*. net.

Fahnestock, Bruce and **Sheridan.** Stars to Windward. Demy 8vo. Pp. 288. (London: Robert Hale and Co., Ltd., 1939.) 12*s*. 6*d*. net.

Ferriday, A. A Map Book of Asia: for Middle and School Certificate Forms. Cr. 4to. Pp. 64. (London: Macmillan and Co., Ltd., 1940.) 1*s*. 9*d*.

Forbes, Rosita. A Unicorn in the Bahamas. Demy 8vo. Pp. 244. (London: Herbert Jenkins, Ltd., 1939.) 10*s*. 6*d*. net.

Gibbons, John. I Gathered No Moss. Demy 8vo. Pp. 280. (London: Robert Hale and Co., Ltd., 1939.) 12*s*. 6*d*. net.

Hagen, Victor Wolfgang von. Ecuador the Unknown. Demy 8vo. Pp. 296. (London: Jarrolds Publishers (London), Ltd., 1939.) 16*s*. net.

Hedin, Sven. The Wandering Lake. Translated from the Swedish by F. H. Lyon. Med. 8vo. Pp. x +293 +30 plates. (London: George Routledge and Sons, Ltd., 1940.) 18*s*. net.*

Irving, R. L. G. The Alps. Demy 8vo. Pp. 128. (London: B. T. Batsford, Ltd., 1939.) 10*s*. 6*d*. net.

James, Harlean. Romance of the National Parks. Sup. Roy. 8vo. Pp. xiv +240 (78 plates). (New York: The Macmillan Company, 1939.) 15*s*. net.

Keith, Agnes. Land Below the Wind. Demy 8vo. Pp. 320. (London: Michael Joseph, Ltd., 1939.) 12*s*. 6*d*. net.

Meade, C. F. Approach to the Hills. Demy 8vo. Pp. viii +265 +16 plates. (London: John Murray, 1940.) 10*s*. 6*d*. net.*

Messel, Rudolph. Refuge in the Andes. Demy 8vo. Pp. 285. (London: John Lane, The Bodley Head, Ltd., 1939.) 10*s*. 6*d*. net.

Raven-Hart, Major R. Canoe to Mandalay. Demy 8vo. Pp. 244. (London: Frederick Muller, Ltd., 1939.) 10*s*. 6*d*. net.

Relton, Max. A Man in the East. Demy 8vo. Pp. 288. (London: Michael Joseph, Ltd., 1939.) 10*s*. 6*d*. net.

Reynolds, E. E. Behind the Ranges: Tales of Explorers, Pioneers and Travellers. (Horizon Readers.) Ex. Cr. 8vo. Pp. 126 +10 maps. (Cambridge: At the University Press, 1940.) 1*s*. 9*d*.

Reynolds, E. E. Unknown Ways: More Tales of Explorers, Pioneers and Travellers. (Horizon Readers.) Ex. Cr. 8vo. Pp. 126 +10 maps. (Cambridge: At the University Press, 1940.) 1*s*. 9*d*.

Robinson, William Albert. Voyage to Galapagos. (Odyssey Library.) Ex. Cr. 8vo. Pp. 263. (London: Jonathan Cape, Ltd., 1939.) 5*s*. net.

Salzman, L. F., Edited by. The Victoria History of the County of Oxford. (Published for the University of London Institute of Historical Research.) Vol. 1. Med. 4to. Pp. xiv +498 +29 plates. (London: Oxford University Press, 1939.) 63*s*. net.*

Shuler, Marjorie. A Passenger to Adventure. Demy 8vo. Pp. 261. (New York and London: D. Appleton-Century Co., Inc., 1939.) 12*s*. 6*d*. net.

Sitwell, Osbert. Escape with Me! An Oriental Sketch-Book. Demy 8vo. Pp. xv +340 +16 plates. (London: Macmillan and Co., Ltd., 1940.) 12*s*. 6*d*. net.*

Starkey, Otis P. The Economic Geography of Barbados. 8vo. Pp. 228. (New York: Columbia University Press; London: Oxford University Press, 1939.) 15*s*. net.

Tschiffely, A. F. This Way Southward: the Account of a Journey through Patagonia and Tierra del Fuego. Demy 8vo. Pp. xvi +354 +50 plates. (London and Toronto: William Heinemann, Ltd., 1940.) 15*s*. net.*

Wassermann, Edward. Velvet Voyaging. Demy 8vo. Pp. 316. (London: John Lane, The Bodley Head, Ltd., 1940.) 12*s*. 6*d*. net.

General Biology : Natural History Botany : Zoology

Bounoure, L. L'Origine des cellules reproductrices et le problème de la lignée germinale. (Collection des actualités biologiques.) Fcap. 4to. Pp. xii +272. (Paris : Gauthier-Villars, 1939.) 100 francs.*

Clarke, Hockley. Country Commentary. Ex. Cr. 8vo. Pp. 194. (London : Allman and Son, Ltd., 1940.) 5*s.* net.*

Cory, Harper. Wild Animals at Home. Cr. 4to. Pp. 112. (London and Edinburgh : Thomas Nelson and Sons, Ltd., 1940.) 7*s.* 6*d.* net.

Curtis's Botanical Magazine. Edited by Sir Arthur William Hill. (Published for the Royal Horticultural Society, London.) Vol. 162, Part 3. Sup. Roy. 8vo. Pp. 36 +plates 9579–9589. (London : Bernard Quaritch, Ltd., 1939.) 17*s.* 6*d.* net.*

Darling, F. Fraser. The Seasons and the Farmer : a Book for Children. (School edition.) Cr. 4to. Pp. viii + 72 +4 plates. (Cambridge : At the University Press, 1940.) 2*s.* 6*d.*

Discovery Reports. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Roy. 4to. Vol. 18. Hydromedusæ from the Falkland Islands. By E. T. Browne and P. L. Kemp. Pp. 265–322 +plates 14–19. 12*s.* net. Madreporarian Corals, with an account of Variation in Caryophyllia. By J. S. Gardiner. Pp. 323–338+plates 20–21. 3*s.* net. Vol. 19. A Second Report on the Southern Sea Lion, *Otaria Byronia* (De Blainville). By J. E. Hamilton. Pp. 121–164+plates 26–33. 6*s.* 6*d.* net. (Cambridge : At the University Press, 1940.)

Hueck, Kurt. Botanische Wanderungen im Riesengebirge. (Pflanzensoziologie : Eine Reihe vegetationskundlicher Gebietsmonographien, herausgegeben von der Reichsstelle für Naturschutz, Band 3.) Roy. 8vo. Pp. vi i +116. (Jena : Gustav Fischer, 1939.) 14 gold marks.

Johnston, Arnrid, Written and illustrated by. Animal Families and Where They Live. Roy. 4to. Pp. iv +27 + 24 plates. (London : *Country Life*, Ltd., 1939.) 7*s.* 6*d.* net.*

Maguinness, Olive Dickinson. Environment and Heredity. (Discussion Books, No. 36.) Cr. 8vo. Pp. 216. (London and Edinburgh : Thomas Nelson and Sons, Ltd., 1940.) 2*s.* 6*d.* net.*

Mayer, Margarete. Ökologisch-pflanzensociologische Studien über die *Filipendula ulmaria—Geranium palustre* Assoziation. (Pflanzengeographische Kommission der Schweizerischen Naturforschenden Gesellschaft : Beiträge zur geobotanischen Landesaufnahme der Schweiz, Heft 23.) Med. 8vo. Pp. 64 +3 plates. (Bern : Hans Huber, 1939.) 4 Schw. francs.*

Parker, John B., and **Clarke, John J.** An Introduction to Animal Biology. Demy 8vo. Pp. 504. (London : Henry Kimpton, 1939.) 18*s.* net.*

Pfeiffer, Hans H. Experimentelle Cytologie. (New Series of Plant Science Books, Vol. 4.) Roy. 8vo. Pp. xii +244. (Leiden : Chronica Botanica Co. ; London : William Dawson and Sons, Ltd., 1940.) 7 guilders ; 18*s.*

Reynolds, E. E., Edited by. Beavers : Pages from the Writings of "Grey Owl". (Horizon Readers.) Ex. Cr. 8vo. Pp. 128. (Cambridge : At the University Press, 1940.) 1*s.* 9*d.*

Reynolds, E. E., Edited by. On the Trail : Pages from the Writings of "Grey Owl". (Horizon Readers.) Ex. Cr. 8vo. Pp. 128. (Cambridge : At the University Press, 1940.) 1*s.* 9*d.*

Roberts, J. A. Fraser. An Introduction to Medical Genetics. (Oxford Medical Publications.) Demy 8vo. Pp. xxiii+266. (London : Oxford University Press, 1940.) 15*s.* net.

Schlieper, Carl. Praktikum der Zoophysiologie. (Jena : Gustav Fischer, 1940.) 8 gold marks.

Spratt, E. R., and **Spratt, A. V.** Textbook of Biology. Second edition. Cr. 8vo. Pp. viii +692. (London : University Tutorial Press, Ltd., 1939.) 11*s.* 6*d.**

Wheeler, W. F. Intermediate Biology. Med. 8vo. Pp. xiii +530. (London and Toronto : William Heinemann, Ltd., 1940.) 15*s.**

Agriculture : Horticulture : Forestry

Abbott, Daisy. The Indoor Gardener. Cr. 8vo. Pp. 117. (London : Oxford University Press, 1940.) 7*s.* net.

Carman, Harry J., Edited by. American Husbandry. 8vo. Pp. 582. (London : Oxford University Press, 1940.) 25*s.* net.

Cheveley, Stephen. A Garden Goes to War. Cr. 8vo. Pp. 104. (London : John Miles, Ltd., 1940.) 2*s.* 6*d.* net.

Hevesy, Paul de. World Wheat Planning and Economic Planning in General. Roy. 8vo. Pp. xv +912. (London : Oxford University Press, 1940.) 38*s.* net.*

Mercer, F. A., and **Holme, C. G.,** Edited by. Gardens and Gardening : *Studio* Gardening Annual. Med. 4to. Pp. 112. (London : *The Studio*, Ltd., 1940.) 10*s.* 6*d.* net.

Snapp, Roscoe R. Beef Cattle. Med. 8vo. Pp. x + 550. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1940.) 24*s.*

Winters, Laurence M. Animal Breeding. Third edition. Med. 8vo. Pp. viii +316. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1940.) 21*s.*

Anatomy : Physiology

Arcieri, G. P. La circolazione del sangue, scoperta da Andrea Cesalpino d'Arezzo. Studio storico-critico in risposta al C. J. Singer. (Piccola Biblioteca di Scienze Moderne, No. 438.) 8vo. Pp. 126. (Milano : Bocca freres, 1939.)

Best, Charles Herbert, and **Taylor, Norman Burke.** The Physiological Basis of Medical Practice. 8vo. Pp. 1872. (London : Baillière, Tindall and Cox, 1940.) 55*s.* net.

Eddy, S., Oliver, C. P., and **Turner, J. P.** Guide to the Study of the Anatomy of the Shark, the Nectunis and the Cat. 8vo. Pp. 100. (London : Chapman and Hall, Ltd., 1940.) 9*s.* net.

Evans, H. Muir. Brain and Body of Fish : a Study of Brain Pattern in relation to Hunting and Feeding in Fish. Roy. 8vo. Pp. 164. (London : The Technical Press, Ltd., 1940.) 15*s.**

Frazer, J. Ernest. The Anatomy of the Human Skeleton. Fourth edition. Med. 4to. Pp. 308. (London : J. and A. Churchill, Ltd., 1940.) 30*s.* net.

Gladstone, Reginald J., and **Wakeley, Cecil P. G.** The Pineal Organ. 8vo. Pp. 528. (London : Baillière, Tindall and Cox, 1940.) 42*s.* net.

Medical Research Council. Special Report Series, No. 237 : 'Breathing Machines' and their use in Treatment—Report of the Respirators (Poliomyelitis) Committee. Roy. 8vo. Pp. 90. (London : H.M. Stationery Office, 1240.) 2*s.* net.*

Thorpe, William Veale. Bio-chemistry for Medical Students. Second edition. Ex. Cr. 8vo. Pp. 472. (London : J. and A. Churchill, Ltd., 1940.) 14*s.* net.

Anthropology : Archæology

Baumann, H., Thurnwald, R., und **Westermann, D.** Völkerkunde von Africa. 8vo. Pp. 666. (Essen : Essener Verlagsanstalt, 1940.)

Bossenbrook, William J., and **Rolf, Johannsen.** Foundations of Western Civilization. Med. 8vo. Pp. xxvi +695. (London : Heath Cranton, Ltd., 1940.) 12*s.* 6*d.*

Chadwick, H. Munro, and **Chadwick, N. Kershaw.** The Growth of Literature. Vol. 3. Part 1 : The Oral Literature of the Tatars ; Part 2 : The Oral Literature of Polynesia and a Note on the Oral Literature of the Sea Dyaks of North Borneo ; Part 3 : Notes on the Oral Literature of some African Peoples ; Part 4 : A General Survey. Roy. 8vo. Pp. xxvi +928. (Cambridge : At the University Press, 1940.) 35*s.* net.*

Duck, Peter Henry. Anthropology and Religion. Cr. 8vo. Pp. 96. (London : Oxford University Press, 1940.) 7*s.* net.

Firth, Raymond. The Work of the Gods in Tikopia. (Published for the London School of Economics and Political Science.) (Monographs on Social Anthropology, No. 1.) Vol. 1. Cr. 4to. Pp. vi +188 +3 plates. (London : Percy Lund, Humphries and Co., Ltd., 1940.) 7*s.* 6*d.**

Philosophy : Psychology

Alexander, Samuel. Philosophical and Literary Pieces. Edited, with a Memoir, by his Literary Executor. Demy 8vo. Pp. viii +390. (London : Macmillan and Co., Ltd., 1939.) 15*s*. net.*

Bidney, David. The Psychology and Ethics of Spinoza. 8vo. Pp. 454. (London : Oxford University Press, 1940.) 17*s*. net.

Carrington, Hereward. Laboratory Investigations into Psychic Phenomena. Demy 8vo. Pp. 255 +25 plates. (London : Rider and Co., 1939.) 15*s*. net.*

Clarke, E. R. Predictable Accuracy in Examinations. (*British Journal of Psychology* Monograph Supplements, 24.) Sup. Roy. 8vo. Pp. vi +48. (Cambridge : At the University Press, 1940.) 5*s*. net.*

Cohen, Morris R., and **Nagel, Ernest.** An Introduction to Logic and Scientific Method. Abridged edition. Demy 8vo. Pp. vii +245. (London : George Routledge and Sons, Ltd., 1940.) 7*s*. 6*d*. net.

Dasgupta, Surendranath. A History of Indian Philosophy. Vol. 3. Med. 8vo. Pp. xiii +614. (Cambridge : At the University Press, 1940.) 35*s*. net.*

Dawson, W. S. Aids to Psychiatry. Fourth edition. Fcap. 8vo. Pp. vii +320. (London : Baillière, Tindall and Cox, 1940.) 4*s*. 6*d*. net.

Engels, Frederick. Dialectics of Nature. Translated and edited by Clemens Dutt. Demy 8vo. Pp. xvi +383. (London : Lawrence and Wishart, Ltd., 1940.) 15*s*. net.*

Fyfe, Hamilton. The Illusion of National Character. Demy 8vo. Pp. v +274. (London : Watts and Co., 1940.) 8*s*. 6*d*. net.*

Joad, C. E. M. Philosophy for Our Times. Ex. Cr. 8vo. Pp. 367. (London and Edinburgh : Thomas Nelson and Sons, Ltd., 1940.) 7*s*. 6*d*. net.*

Jones, Rufus M. The Flowering of Mysticism : the Friends of God in the Fourteenth Century. Ex. Cr. 8vo. Pp. vii +270. (New York : The Macmillan Company, 1939.) 12*s*. 6*d*. net.

Kanga, D. D., Edited by. Where Theosophy and Science Meet : a Stimulus to Modern Thought. A Collective Work. Part 4 : Some Practical Applications. Demy 8vo. Pp. lxix +223. (Adyar, Madras : Adyar Library Association ; London : Theosophical Publishing House, 1939.) 2.4 rupees.*

MacTaggart, Malcolm. Man, Mind and Psychology. Cr. 8vo. Pp. ix +83. (London : Watts and Co., Ltd., 1940.) 3*s*. 6*d*. net.

Mallik, B. K. The Real and the Negative. Demy 8vo. Pp. 539. (London : George Allen and Unwin, Ltd., 1940.) 21*s*. net.

Mass Observation. War Begins at Home. Edited and arranged by Tom Harrisson and Charles Madge. Cr. 8vo. Pp. ix +426. (London : Chatto and Windus, 1940.) 9*s*. 6*d*. net.*

Medical Research Council : Industrial Health Research Board. Report No. 84 : A Study of Accident Proneness among Motor Drivers. By E. Farmer and E. G. Chambers. Roy. 8vo. Pp. iii +47. (London : H.M. Stationery Office, 1939.) 9*d*. net.*

Negro, T. La concezione platonica della scienza. (Piccola Biblioteca di Scienze Moderne, No. 441.) 8vo. Pp. 124. (Milano : Bocca freres, 1940.) 8 lire.

Scott, Cyril. Man is my Theme. Demy 8vo. Pp. 303. (London : Andrew Dakers, Ltd., 1940.) 10*s*. 6*d*. net.

Tulchin, Simon H. Intelligence and Crime : a Study of Penitentiary and Reformatory Offenders. Med. 8vo. Pp. xiii +166. (Chicago : University of Chicago Press ; London : Cambridge University Press, 1939.) 12*s*. net.*

Vernon, Philip E. The Measurement of Abilities. Demy 8vo. Pp. xii +308. (London : University of London Press, Ltd., 1940.) 10*s*. 6*d*. net.*

Wager, C. E. Secrets of the Mind. Cr. 8vo. Pp. v + 159. (London : Watts and Co., Ltd., 1940.) 5*s*. net.*

Wallas, Graham. Men and Ideas : Essays. Demy 8vo. Pp. 221. (London : George Allen and Unwin, Ltd., 1940.) 8*s*. 6*d*. net.*

Miscellany

Arraud, C.-A. Diathermie chirurgicale. (Les actualités physiothérapiques, 1 : Électrothérapie, 7.) Ex. Cr. 8vo. Pp. iv +216. (Paris : Gauthier-Villars, 1939.) 50 francs.*

Bennett, H. Standard Chemical and Technical Dictionary. Roy. 8vo. Pp. 638. (London : E. and F. N. Spon, Ltd., 1940.) 60*s*. net.

Crowther, Geoffrey. Paying for the War. (Oxford Pamphlets on World Affairs, No. 25.) Cr. 8vo. Pp. 32. (Oxford : Clarendon Press ; London : Oxford University Press, 1940.) 3*d*. net.*

Curwen, E. Cecil, Edited, with an Introduction and Notes, by. The Journal of Gideon Mantell, Surgeon and Geologist, covering the Years 1818–1852. Demy 8vo. Pp. xii +315 +4 plates. (London, New York and Toronto : Oxford University Press, 1940.) 12*s*. 6*d*. net.*

Darby, H. C. The Draining of the Fens. (Cambridge Studies in Economic History.) Demy 8vo. Pp. xix + 312 +31 plates. (Cambridge : At the University Press, 1940.) 21*s*. net.*

Darby, H. C. The Medieval Fenland. (Cambridge Studies in Economic History.) Demy 8vo. Pp. xvii + 200 +11 plates. (Cambridge : At the University Press, 1940.) 12*s*. 6*d*. net.*

Dennison, S. R. The Location of Industry and the Depressed Areas. Demy 8vo. Pp. vii +216. (London : Oxford University Press, 1939.) 10*s*. net.*

Einzig, Paul. Economic Warfare. Demy 8vo. Pp. x +151. (London : Macmillan and Co., Ltd., 1940.) 7*s*. 6*d*. net.*

Gaines, Helen Fouché. Elementary Cryptanalysis : a Study of Ciphers and their Solution. (Sponsored by the American Cryptogram Association.) Roy. 8vo. Pp. vii + 230. (London : Chapman and Hall, Ltd., 1940.) 21*s*. net.*

Glover, Capt. C. W. Civil Defence : a Practical Manual presenting with Working Drawings the Methods required for Adequate Protection against Aerial Attack. Second edition, completely revised and enlarged. Demy 8vo. Pp. xviii +764 +74 plates. (London : Chapman and Hall, Ltd., 1940.) 36*s*. net.*

Hatfield, H. Stafford. European Science. (Published for the Orthological Institute.) Cr. 8vo. Pp. xiii +152. (Cambridge : The Basic English Publishing Co., 1939.) 3*s*. 6*d*. net.*

Holmstrom, J. Edwin. Records and Research in Engineering and Industrial Science : a Guide to the Production, Extraction, Integrating, Storekeeping, Circulation and Translation of Technical Knowledge. Demy 8vo. Pp. xii +302. (London : Chapman and Hall, Ltd., 1940.) 15*s*. net.*

Richmond, Admiral Sir Herbert. The Naval Role in Modern Warfare. (Oxford Pamphlets on World Affairs, No. 26.) Cr. 8vo. Pp. 32. (Oxford : Clarendon Press ; London : Oxford University Press, 1940.) 3*d*. net.*

Royal Society of London. Year Book of the Royal Society of London, 1940. (No. 44.) Demy 8vo. Pp. 323. (London : Royal Society, 1940.) 5*s*.*

Salvemini, Gaetano. Historian and Scientist : an Essay on the Nature of History and the Social Sciences. Cr. 8vo. Pp. ix +203. (Cambridge, Mass. : Harvard University Press ; London : Oxford University Press, 1939.) 9*s*. 6*d*. net.*

Seaver, George. Scott of the Antarctic : a Study in Character. Demy 8vo. Pp. 194. (London : John Murray, 1940.) 10*s*. 6*d*. net.

Smythe, F. S. Edward Whymper. Med. 8vo. Pp. 256. (London : Hodder and Stoughton, Ltd., 1940.) 21*s*. net.

Soutar, George. Nature in Greek Poetry : Studies partly Comparative. (Published for St. Andrews University.) Demy 8vo. Pp. xix +258. (London : Oxford University Press, 1939.) 10*s*. 6*d*. net.*

Thompson, Sir D'Arcy W. Science and the Classics. (St. Andrews University Publications, No. 44.) Gl. 8vo. Pp. viii +264. (London : Oxford University Press, 1940.) 5*s*. net.*

Wheeler-Bennett, John W. The Treaty of Brest-Litovsk and Germany's Eastern Policy. (Oxford Pamphlets on World Affairs, No. 14.) New edition, revised and enlarged. Cr. 8vo. Pp. 39. (Oxford : Clarendon Press : London : Oxford University Press, 1940.) 3*d*. net.*

William B. Wherry, Bacteriologist

By Martin Fischer. Pp. x+293. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall & Cox, 1938.) 27*s*.

THIS is in its way a quite unique biography of a bacteriologist, W. Buchanan Wherry (1875–1936), professor of bacteriology and hygiene in the Cincinnati College of Medicine, by an author, Prof. Martin H. Fischer, who was his subject's colleague and lifelong friend and has already earned for himself distinction in biographical literature. Though Wherry's services to bacteriology can scarcely be said to have been of an outstanding nature—perhaps his most important contributions were his recognition, practically simultaneously with McCoy, of bubonic plague among the ground squirrels of California and his isolation for the first time of *B. tularense* from a human case of tularæmia (Wherry and Lamb, 1914)—he had acquired in the course of his career as a bacteriologist in Manila, California and Mexico a very varied experience of tropical diseases and their methods of study.

Wherry must undoubtedly have had a great genius for friendship, and Fischer's tribute to his friend's life-work, based as it is on the numerous letters that passed between them since college days, and written in the very glowing terms employed by some American biographers of scientific men both living and dead, is sure to exert a powerful popular appeal. Perhaps the most interesting portions of the book are those that recount the life-story of Wherry's father, a missionary in India of strictest orthodoxy, and of his mother, sisters and brother. Letters that passed between the parents and the son—for they were all carefully preserved—throw a penetrating light on the daily doings of an Indian missionary and the financial struggles that seemed always to be pressing. For these revelations alone the book deserves a wide audience. It is beautifully produced—it represents in fact the last word in typography—and numerous excellent photographs relieve its 300 pages of text.

The Anaerobic Bacteria and their Activities in Nature and Disease

A Subject Bibliography. By Elizabeth McCoy and L. S. McClung. Vol. 1: Chronological Author Index. Pp. xxiii+295. Vol. 2: Subject Index. Pp. xi+602. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1939.) 50*s*. net.

THE material assembled in these two volumes consists of an index to the bibliography of a subject which is unusually scattered. Spore-forming and non-spore-forming species of anaerobic bacteria have come under review and 10,500 original articles published up to the end of 1937 are cited. In vol. 1 is found a chronological list of all the references arranged alphabetically under the authors' names; complete cross-reference entries are included for each of the joint authors together with the full title of each paper, a task involving approximately 120,000 entries. Vol. 2 consists of a general subject index, the references again being listed chronologically under the author's names; in this volume, however, the title of the paper is not given but can be obtained by reference to vol. 1.

On first inspection the subject index outline appears adequate, but in practice the inherent difficulties of the system are all too quickly apparent. For example, if one desires to know the published work concerning the production of *Cl. welchii* antitoxin, one turns to vol. 2 and finds under the general heading of "Antitoxins" more than 400 entries on the general problem of antitoxin production for any of the anaerobes. Further, the absence from vol. 2 of the titles to papers compels one to refer for each entry to vol. 1; obviously an impracticable task. In the absence of a more clearly defined classification of both spore-forming and non-spore-forming species, it is difficult to see how the authors could have overcome this practical problem. If in future editions of this work vol. 1 was allowed to lapse and remained in the archives as a historian's guide, and the subject-matter of vol. 2 was expanded to include the title of papers the difficulty would, in part, be solved and our searchings simplified. The authors could not have hoped that the system of indexing they have adopted would be generally acceptable by all classes of workers, but they must be gratefully thanked by research workers and historians alike for undertaking the formidable task of collecting and collating such diffuse material.

Everyday Fare for Fitness

By Dr. Stanley B. Whitehead. Pp. 166. (London: John Lane, The Bodley Head, Ltd., 1939.) 5*s*. net.

THIS little book, of which the author is an advocate of meatless fare, is divided into two parts. The first deals with what he regards as the merits and demerits of everyday food from the point of view of fitness. Everyday meals which he considers suitable for the manual worker, brain worker and nervous type are described, and tables are included of body-building foods, energy-providing foods, heat-producing foods, and health-protective foods. The second part contains more than two hundred recipes under the headings of breakfast dishes, salads, savouries, roasts and entrées, soups and broths, egg dishes, sweets, puddings and health drinks among which alcohol finds no place.

Physics

Rheology of Suspensions

A Study of Dilatancy and Thixotropy. By Hugo Levin Röder. Pp. xiv+86. (Amsterdam: H. J. Paris, 1939.)

DILATANCY (the Osborne-Reynolds phenomenon) has proved more difficult to measure quantitatively than has any other rheological anomaly, and the author's failure to obtain satisfactory data for dilatant systems with a modified Stormer viscometer is therefore not surprising.

Röder goes on to describe an apparatus in which a small sphere, rigidly attached to a car drawn on rails by means of a weight, is swept through the material

to be investigated. The friction of this arrangement is considerable, but in the case of a true fluid there is satisfactory proportionality between the applied weight and the rate of shear if a constant friction term is subtracted from the weight. Aqueous pastes of quartz and rice starch give initially a rise in rate of shear as load is increased, but finally settle to a constant rate independent of further loading. In carbon tetrachloride, the same materials show a thixotropic, instead of a dilatant behaviour, and comparison is made with the thixotropic properties of paints. In dilatant systems, the material 'builds up' in front of the shearing body like snow against a snow-plough, a phenomenon similar to that described by Jordan as occurring in the straining of muscles. The thesis ends with a rather inadequate summary of selected books and papers on thixotropy and dilatancy.

Röder's work will be welcomed as making definite progress towards a solution of the important industrial problem of the measurement of dilatancy, but it is to be regretted that the author does not deal more adequately with earlier work, the thesis giving the impression of having been written somewhat hastily. G. W. S. B.

Décharge électrique dans les gaz

Par Prof. Marcel Laporte. (Collection Armand Colin, Section de physique, No. 216). Pp. 222. (Paris : Armand Colin, 1939.) 15 francs.

ELECTRIC discharge in gases is the subject of the new volume which Prof. Laporte has added to the useful series of monographs published by Armand Colin. It is remarkable how much information is contained in each of these small and inexpensive books ; both the editor of the Physics Section, M. Ch. Fabry, and the author are to be congratulated on this addition to the collection. The first six chapters deal with the ionization of a gas in its various aspects, then come five chapters on various forms of discharge, and the last two are concerned with gas discharge tubes as sources of light, including white light. Honours students of physics would do well to study this book.

Theory of Heavy Quanta

Door Frederik Jozef Belinfante. Pp. xii + 126. ('s-Gravenhage : Martinus Nijhoff, 1939.)

SINCE 1937, the evidence from the study of cosmic rays has increasingly pointed to the existence of a particle about a hundred times more massive than the electron, giving support to a suggestion of Yukawa's in 1935 that the forces binding protons and neutrons together in atomic nuclei might be connected with particles of about that mass. Since Yukawa's first paper, much theoretical work has been done and the subject has now reached a stage when a general survey is possible. Unluckily the new particle does not readily lend itself to direct laboratory investigation, and there are still many possible formulations of the theory, all of which have to be elaborated until further indirect comparison with experiment is possible.

It is therefore natural that this tract should deal mainly with mathematical methods and be more useful to the theoretical physicist than to the experimenter. Actually the latter will get even less from it than would have been possible had the material been more suitably presented. The exposition lacks conciseness, and the discussion of the practical conclusions from the theory suggests wide but ill-digested reading. The mathematical style is not elegant ; too many symbols are introduced, and equations which could be written more concisely confusingly cover half a page in vector notation at a stage when this is unnecessary. At the present stage of the theory it is of course difficult to choose the best mathematical apparatus ; the author advocates the use of "undors", which are expounded in a preliminary chapter.

Psychology

New Ways in Psychoanalysis

By Dr. Karen Horney. Pp. 313. (London : Kegan Paul & Co., Ltd., 1939.) 12*s*. 6*d*. net.

THIS book is an attempt to evaluate critically some of the main assumptions underlying the Freudian system. After a somewhat verbose discussion, the author arrives at the conclusion that most of these assumptions have to be discarded and others substituted in their stead.

The argument begins with the assertion that Freud was too much influenced by the mechanistic philosophy of the nineteenth century. His theories of fixation, regression, repetition-compulsion, and of the supreme importance of infantile experience are instanced as types of mechanistic rather than of dialectic thinking. According to Freud, present manifestations of neurotic behaviour are not merely conditioned by the past, they contain nothing but the past. The mechanistic biology of Freud's early days, according to which evolution was merely a redistribution of existing elements, found in his theories a psychological expression. Likewise, his tendency to view psychic processes as pairs of opposites appears to the author as an expression of the dualistic thinking prevalent in the last century, whilst his notion of behaviour as the direct derivative of instinctive patterns is regarded as without basis in fact.

The reader will welcome this critical approach to the subject. He will also welcome the new stress upon sociological and cultural influences in fashioning human behaviour, for he will find this in accord both with current experimental results in the field of conditioning and with the growing realization among social psychologists that the key to motivation is to be sought in the nature of the social environment rather than in innate patterns of conduct. That neurosis arises in particular as a result of the struggle to cope with a hostile competitive environment is perhaps the most interesting point raised in the book. This belief is based on the author's assumption that the dominant human need is for security—principally in the economic sphere.

Laboratory Investigations into Psychic Phenomena

By Hereward Carrington. Pp. 255+25 plates. (London : Rider & Co., n.d.) 15*s*. net.

THIS volume is a useful handbook for those psychical researchers who want to have by them a well-documented and fairly critical account of the attempts that have been made to bring so-called supernormal phenomena into the laboratory and to subject them to tests made by instruments of precision.

After a brief historical introduction the author continues by describing the results of his own experiments, which consisted for the most part of an investigation of the validity of the instrumental tests which had been devised in the past. It is in this section that we meet again with the rather pathetic attempts to demonstrate such alleged phenomena as special human radiations proceeding from hands or eyes ; the effect of the will on material objects ; or some sort of instrumental communication with the spirit world. In his experiments, designed to repeat the results claimed by earlier enthusiasts, Mr. Carrington met with but little success, and he points out how, in a number of cases, the previous results may have been due to mechanical defects in the apparatus employed, faulty procedure during the experiments, or more simply still to a false interpretation of the readings given by the various devices.

In trying to repeat many of these attempts Mr. Carrington has done a useful work, and the record here printed, even though largely negative (and indeed because of it), will be found to be a wholesome corrective to those who follow in the path of his predecessors, and again attempt to introduce dynamoscopes, magnetometers, sthenometers, volometers and the rest.

Technology

Photography, its Principles and Practice

A Manual of the Theory and Practice of Photography. By C. B. Neblette. Third edition. Pp. xi+590. (London : Chapman & Hall, Ltd., 1939.) 30*s*. net.

ALTHOUGH photography enters very largely into all branches of scientific research, many investigators have only the most rudimentary knowledge of the characteristics of the materials with which they work. No doubt much time and trouble might have been saved had that information been available at the time of experiment. This well-known book—now in its third edition—is just the kind of manual for a scientific worker who is not specially interested in the theory of photography, but who desires a proper scientific account of all the processes of photography in order that he may use the tool to the best possible advantage.

The volume deals with every phase of photography, beginning with the camera and its optical system, emulsions, latent image and sensitometry. The whole of processing to the finished print is given in detail. Even the less usual types of printing process are described in such a manner that they may be practised. Colour photography is dealt with, but in less detail. One very good feature of the book is the system of quoting references. The necessary references immediately relevant to the text are given, but in addition there is on nearly every page a series of references to general articles so that any given topic may be followed up in the photographic literature. 'Neblette' is therefore a useful addition to the library of anyone having to practise photography in a scientific laboratory. It is no less useful to the serious amateur photographer with a limited knowledge of chemistry and physics.

Theory and Design of Valve Oscillators

For Radio and other Frequencies. By Dr. H. A. Thomas. (Monographs on Electrical Engineering, Vol. 7.) Pp. xvii+270. (London : Chapman & Hall, Ltd., 1939.) 18*s*. net.

THE thermionic valve occupies a unique place in the field of communication engineering, in which its use in the generation of oscillations is a particularly important aspect.

The present monograph aims at bringing together all the important work which has been done on valve oscillators of the usual types. Particular attention is given to a detailed theoretical examination of the factors which affect the character of the oscillation. Here, then, one finds, after a preliminary survey of fundamental principles, chapters devoted to efficiency, wave-form and frequency of oscillator systems. In dealing with frequency, the treatment is very full. The frequency changes induced by time changes in the oscillatory circuit itself are given the importance they deserve in a scientific presentation of the subject. Finally, the question of frequency stability is surveyed in all its ramifications.

Dr. Thomas has presented his subject in a clear and ordered way. Due to his expert knowledge, he is able to lay bare the core of a problem with a conciseness that is admirable. This is a book which radio engineers, particularly those on the research side, will find really helpful. L. J.

A Handbook on Ventilation, including Air Conditioning

By Percy L. Marks. Pp. viii+138+1 plate. (London : The Technical Press, Ltd., 1938.) 7*s*. 6*d*. net.

THIS short treatise is not concerned with theories but confines itself to established facts and usage and, in some cases, expresses the views of consulting engineers and manufacturers recognized as experts. The author has adopted a discursive style and, after presenting the general considerations, goes on to describe the several methods employed in various circumstances and the fittings and material used. On the activities of dry rot some valuable information is given, and there is a chapter of ventilation suggestions for different classes of buildings which should prove useful. While the book does not go nearly far enough into detail to constitute an independent guide, it would make a valuable addition to a more formal text-book by reason of the numerous practical ideas it contains.

FORTHCOMING BOOKS OF SCIENCE

Mathematics : Mechanics : Physics

GEORGE ALLEN & UNWIN, LTD. The World and the Atom—C. Moller and E. Rasmussen (translated by G. C. Wheeler). Atoms in Action: the World of Creative Physics—George Russell Harrison. Statistical Methods for Medical and Biological Students—Gunnar Dahlberg.

CAMBRIDGE UNIVERSITY PRESS. Odd Numbers, or Arithmetic Revisited—Herbert McKay. British Association Mathematical Tables, Vol. 8: Number-Divisor Tables—J. W. L. Glaisher; Vol. 9: Table of Powers. Electron Inertia Effects—F. B. Llewellyn. Surface Tension and the Spreading of Liquids—R. S. Burdon. Magnetism and Very Low Temperatures—H. B. G. Casimir.

CHAPMAN & HALL, LTD. Statistical Mechanics—Mayer. Seventh Summer Conference on Spectroscopy—edited by G. R. Harrison. General Physics—R. B. Lindsay. Fundamental Processes of Electric Discharge in Gases—L. B. Loeb. Tables for the Identification of Molecular Spectra—R. W. B. Pearse and A. G. Gaydon. Mathematics of Statistics—John F. Kenney. The Fluorescence and Phosphorescence of Solids—Elemer Forbat. Practical Applications of Spectroscopy—Herbert Dingle.

ENGLISH UNIVERSITIES PRESS, LTD. Physical Science in the Service of Art and Industry—E. G. Richardson.

MCGRAW-HILL PUBLISHING CO., LTD. Differential and Integral Calculus—R. R. Middlemiss. Statistical Procedures and their Mathematical Bases—C. C. Peters and W. R. Van Voorhis. Survey of Mathematics—R. S. Underwood and F. W. Sparks. The Modern Theory of Solids—F. Seitz.

MACMILLAN & CO., LTD. Intermediate Practical Physics—T. M. Yarwood. Commercial Arithmetic—F. G. W. Brown.

METHUEN & CO., LTD. The Physics of Blown Sand and Desert Dunes—R. A. Bagnold.

OXFORD UNIVERSITY PRESS. A History of Geometrical Methods—J. L. Coolidge. The Theory of Group Characters and Matrix Representations of Groups—D. E. Littlewood. Electronic Processes in Ionic Crystals—N. F. Mott and R. W. Gurney.

SIR ISAAC PITMAN & SONS, LTD. Modern Physics (Definitions and Formulæ for Students)—E. E. Widdowson.

UNIVERSITY OF LONDON PRESS, LTD. London Mathematical Series, Book 1: Arithmetic—R. T. Hughes; Book 2: Geometry—E. R. Hamilton and A. Page.

Engineering

D. APPLETON-CENTURY CO., LTD. Getting Acquainted with Radio—Alfred Morgan.

CHAPMAN & HALL, LTD. Hydraulic Measurements—Herbert Addison. Aircraft Engines in Theory and Practice—Arthur W. Judge.

CONSTABLE & CO., LTD. The Practical Design of Simple Steel Structures—David S. Stewart.

MCGRAW-HILL PUBLISHING CO., LTD. Construction Planning and Plant—Adolph J. Ackerman and Charles H. Locher. Principles of Television Engineering—Donald G. Fink. Aircraft Instruments—George E. Irvin. Television Broadcasting—Lenox R. Lohr. Radio Directing—Earle McGill. Mathematical Methods in Engineering—Theodor von Kármán and Maurice A. Biot. Electric Distribution Fundamentals—Frank Sanford.

SIR ISAAC PITMAN & SONS, LTD. Aero Engines for Pilots and Ground Engineers—O. Caudwell. Electricity in Aircraft—Flight-Lieut. W. E. Crook. Elementary Aerodynamics—Group-Capt. D. C. M. Hume. Protective Gear Handbook—A team of Metropolitan-Vickers engineers. Power Steam Interconnection (Transmission Problems)—H. Rissik. The Calculation of Fault Currents in Electrical Networks for Circuit-Breaker Selection—R. T. Lythall.

Chemistry : Chemical Industry

D. APPLETON-CENTURY CO., LTD. Things a Boy can do with Chemistry—Alfred Morgan.

EDWARD ARNOLD & CO. Boilerhouse and Power Station Chemistry—W. Francis. Applied Chemistry for Engineers—E. S. Gyngell.

CHAPMAN & HALL, LTD. Organic Syntheses, Vol. 20—edited by C. F. H. Allen. Introduction to Chemical Science—Hatcher. Introductory College Chemistry—Gordon and Trout. Chemical Computations and Errors—Crumpler and Yoe. Twelfth Report of Committee on Catalysis—edited by Burk. Pandemic Chemisty—Hatcher. Chemicals of Commerce—Foster D. Snell and Cornelia T. Snell. Chemistry and Technology of Urea—F. C. Wood. The Manufacture of Compressed Yeast—F. G. Walter. Forensic Chemistry—Henry T. F. Rhodes. Starch and its Derivatives—J. A. Radley. Micro-Chemistry—Janet W. Matthews and William F. Stephenson.

ENGLISH UNIVERSITIES PRESS, LTD. Modern Chemistry—B. C. Saunders and R. E. D. Clark.

MCGRAW-HILL PUBLISHING CO., LTD. Quantitative Analysis—H. S. Booth and V. R. Dammerell. Physical Organic Chemistry—Louis P. Hammett. Electronic Structure and Chemical Binding—Oscar K. Rice.

MACMILLAN & CO., LTD. An Introduction to Chemistry, Part 1—A. C. Cavell.

OXFORD UNIVERSITY PRESS. The Design of High Pressure Plant and the Properties of Fluids at High Pressures—D. M. Newitt. Kinetics of Chemical Change—C. N. Hinshelwood.

Technology

D. APPLETON-CENTURY CO., LTD. Modern Photography: its Science and Practice—John R. Roebuck and Henry C. Staehle.

CAMBRIDGE UNIVERSITY PRESS. The Economic History of Steel-Making—D. L. Burn.

CHAPMAN & HALL, LTD. Principles and Practice of Chromatography—translated from the German of L. Zechmeister by A. L. Bacharach. Non-Ferrous Foundry Practice—J. Laing and R. T. Rolfe. The Metallurgy of Deep Drawing and Pressing—J. Dudley Jevons.

ENGLISH UNIVERSITIES PRESS, LTD. Teach Yourself Photography—Stanley W. Bowler.

MCGRAW-HILL PUBLISHING CO., LTD. The Alloys of Iron and Chromium, Vol. 2: High Chromium Alloys—A. B. Kinzel and R. Franks. Elementary Photography—Gilford C. Quarles.

SIR ISAAC PITMAN & SONS, LTD. Wood Finishing: Staining and Polishing and Cellulose Wood Finishes—H. T. Davey. Steel Manufacture Simply Explained—Eric N. Simons and E. Gregory.

Astronomy

GEORGE ALLEN & UNWIN, LTD. The Story of Astronomy—Arthur Draper and Marion Lockwood.

ENGLISH UNIVERSITIES PRESS, LTD. Life on Other Worlds—H. Spencer Jones. Teach Yourself Astronomy—Alan Hunter.

WILLIAM HEINEMANN, LTD. The Glass Giant of Palomar—David O. Woodbury.

GEORGE PHILIP & SON, LTD. Philips' Map of the Stars—designed by E. O. Tancock.

Meteorology : Geophysics

ROBERT HALE, LTD. The Weather Eye—C. R. Benstead.

OXFORD UNIVERSITY PRESS. Geomagnetism—S. Chapman and J. Bartels.

Geology : Mineralogy

ADAM & CHARLES BLACK, LTD. An Introduction to the Study of Fossil Plants—John Walton.

Geography : Travel

B. T. BATSFORD, LTD. British Hills and Mountains—J. H. B. Bell, E. F. Bozman and J. Fairfax-Blakeborough (British Heritage Series). South-Eastern Survey (Sussex, Kent and Surrey)—Richard Wyndham (Face of Britain Series). Chiltern Country—H. J. Massingham (Face of Britain Series).

CHATTO & WINDUS. Helvellyn to Himalaya—F. Spencer Chapman.

J. M. DENT & SONS, LTD. Adventures of a Mountaineer—Frank Smythe. The Rough with the Smooth—Douglas Duff.

VICTOR GOLLANCZ, LTD. The Geography of the War—J. F. Horrabin (Tracts for the Times Series).

ROBERT HALE, LTD. Five Miles High : the Story of an Attack on the Second Highest Mountain in the World—edited by Robert H. Bates. Cherry Kearton's Travels—Cherry Kearton. The Verge of Western Lakeland—William T. Palmer. Memories of Many Lands—John Gibbons. Ten Years in the Congo—W. E. Davis. Sky Over Jungle—W. J. Makin. Feudal Island—Desmond Holdridge. The Orchid Hunters—Norman Macdonald.

GEORGE G. HARRAP & CO., LTD. To the Lost World—Paul A. Zahl.

HODDER & STOUGHTON, LTD. Alpine Holiday—Frank S. Smythe. Himalayan Honeymoon—Bip Pares. Arabian Waters—Alan Villiers. O.Z.Y.U.—Alain Gerbault.

HURST & BLACKETT, LTD. Sahara Unveiled—Patrick Turnbull. Journey Westward : the Record of a Tour in the Welsh Marches—William Ellis.

HUTCHINSON & CO., LTD. The World I Knew—Louis Golding. Nine Pounds of Luggage—Maud Parrish. Ellis in Wonderland—Vivian Ellis. The Alps—Arnold Zweig. In Old Romania—Henry Baerlein.

JARROLDS PUBLISHERS (LONDON), LTD. Peasant Europe—H. Hessell Tiltman.

JOHN LONG, LTD. I Searched the World for Death—Gordon Cooper. Dare to Live—Ida Hurst. The Out Trail—Nevill A. D. Armstrong.

MACMILLAN & CO., LTD. The Complete Geography (Book 1 : The World ; Book 2 : The Americas)—Alys Mamour. An Introductory Geography—L. B. Cundall. On Old Routes of Western Iran—Sir Aurel Stein.

METHUEN & CO., LTD. Once in Sinai : the Record of a Solitary Venture—J. M. C. Plowden. Unsentimental Journey—Nora Cundell. Companion into Hampshire—L. Collison-Morley. Australia : a Study of Warm Environments and their Effect on British Settlement—Griffith Taylor.

JOHN MURRAY. Winter in Arabia—Freya Stark. In Sara's Tents—Walter Starkie. Deeds that Held the Empire : Exploration—A. D. Devine.

OXFORD UNIVERSITY PRESS. The First Mate's Log : being an Account of a Voyage to Greece in the Schooner Yacht *Fleur de Lys* 1939—R. G. Collingwood.

GEORGE PHILIP & SON, LTD. Loose Leaf Revision Notes in Geography—L. B. Cundall and H. V. Janau.

UNIVERSITY OF LONDON PRESS, LTD. The London Books of Discovery and Exploration, Book 1 : Heroes of Discovery ; Book 2 : Heroes of Exploration. The Golden Hind Geographies, Book 3 : The Gifts of the Earth—Leonard Brooks and Robert Finch. The British Isles—David L. Linton.

General Biology : Natural History Botany : Zoology

GEORGE ALLEN & UNWIN, LTD. Evolution : the Modern Synthesis—Julian Huxley. Principles of Animal Biology—Lancelot Hogben.

D. APPLETON-CENTURY CO., LTD. Voices from the Grass—Julie Closson Kenly. Wonder Creatures of the Sea—A. Hyatt Verrill.

G. BELL & SONS, LTD. Island Years—F. Fraser Darling.

CAMBRIDGE UNIVERSITY PRESS. Fabrician Types of Insects in the Hunterian Collection, Vol. 2—Robert A. Staig. Organisers and Genes—C. H. Waddington. Evolution by Differentiation—J. C. Willis. A Waterhen's Worlds—Eliot Howard.

JONATHAN CAPE, LTD. Culture and Survival—Guy Chapman. The Advance of the Fungi—E. C. Large.

CHAPMAN & HALL, LTD. Plant Physiology—Bernard S. Meyer and Donald B. Anderson.

ENGLISH UNIVERSITIES PRESS, LTD. Teach Yourself Biology—M. E. Phillips and L. E. Cox.

WILLIAM HEINEMANN, LTD. A Nature Book—Cicely Englefield.

HUTCHINSON & CO., LTD. Animal Neighbours of the Countryside—Joseph Wharton Lippincott. Wildfowling with a Camera—Lorene Squire.

JARROLDS PUBLISHERS (LONDON), LTD. Spring Flowers of the Wild—Edward Step. Summer Flowers of the Wild—Edward Step. The Harvest of the Woods—Edward Step.

H. K. LEWIS & CO., LTD. Insect Pests—W. Clunie Harvey and Harry Hill.

MCGRAW-HILL PUBLISHING CO., LTD. Heredity and Social Problems—L. L. Burlingame. Manual of Aquatic Plants—N. C. Fassett. The Invertebrates : Protozoa through Ctenophora—Libby H. Hyman. Plant Micro-Technique—Donald A. Johansen. Biology in the Making—E. E. Suyder.

MACMILLAN & CO., LTD. Animal Behaviour—J. A. Loeser.

METHUEN & CO., LTD. The Story of the Dog and his Uses to Mankind—Cecil G. Trew.

OXFORD UNIVERSITY PRESS. Embryos and Ancestors—G. R. de Beer. The Orientation of Animals : Kineses, Taxes and Compass Reactions—G. S. Fraenkel and D. L. Gunn. The New Systematics—edited by Julian Huxley. Birds of the Grey Wind—E. A. Armstrong. Quetzal Quest—Victor Hagen and Quail Hawkins. Pompey was a Penguin—Thomas Wyatt Bagshawe.

SIDGWICK & JACKSON, LTD. A General Zoology of the Invertebrates—G. S. Carter.

UNIVERSITY OF LONDON PRESS, LTD. A Second Book of Biology—Mary W. Phillips and Lucy E. Cox. Down Nature's Byways : Adventures with Nomad the Naturalist—Norman F. Ellison. Elementary Biology—Mary W. Phillips and Lucy E. Cox.

H. F. and G. WITHERBY, LTD. The Handbook of British Birds, Vol. 4 : Cormorants to Crane—H. F. Witherby, F. C. R. Jourdain, Norman F. Ticehurst and B. W. Tucker. The Birds of South Africa—Austin Roberts.

Agriculture : Horticulture : Forestry

GEORGE ALLEN & UNWIN, LTD. Talks on Vegetables and Fruits—C. H. Middleton.

D. APPLETON-CENTURY CO., LTD. Gardening for Fun, Health and Money—A. Frederick Collins.

B. T. BATSFORD, LTD. How to Grow Food—Doreen Wallace (Home-Front Handbooks).

ADAM & CHARLES BLACK, LTD. British Garden Flowers—Geoffrey Henslowe.

COUNTRY LIFE, LTD. Gardening for Beginners—E. T. Cook. Greenhouse Culture for Amateurs—Edith Grey Wheelwright. Gardening made Easy—E. T. Cook. The Gardener's Handbook—T. C. Holmes and R. E. Hay. 500 Gardening Hints—500 Gardeners.

J. M. DENT & SONS, LTD. A Garden Note-Book—Constance Spry.

ENGLISH UNIVERSITIES PRESS, LTD. Principles and Practice of Poultry Husbandry—Tom Newman. Grow your own Food Supply—W. E. Shewell-Cooper.

MCGRAW-HILL PUBLISHING CO., LTD. Soilless Culture Simplified—Alex Laurie.

OXFORD UNIVERSITY PRESS. Colonial Forest Administration—the late R. S. Troup. Agriculture in Uganda—edited by J. D. Tothill. An Agricultural Testament—Sir Albert Howard. Vegetable Growing in the Tropics—L. H. Saunders.

Anatomy : Physiology

Oxford University Press. Problems of Nervous Anatomy—J. Boeke. The Growth and Developmental Structure of the Human Body—R. E. Scammon, with the collaboration of Edith Boyd.

Rich & Cowan, Ltd. Slimming for the Million—Eustace Chesser. Sex and its Urge—Eustace Chesser.

Anthropology : Archæology

D. Appleton-Century Co., Ltd. We Called them Indians—Flora Warren Seymour.

B. T. Batsford, Ltd. How to Look at Old Buildings—Edmund Vale (Home-Front Handbooks).

Cambridge University Press. The Cat in Ancient Egypt—N. and B. Langton. The Swazi : an Ethnographic Account of the Natives of the Swaziland Protectorate—Brian Allen Marwick.

Chatto & Windus. Stone Men of Malekula, Vol. 1 : Vao—John Layard.

George G. Harrap & Co., Ltd. The Bible and Archæology—Sir Frederic Kenyon. Prehistory—A. Vayson de Pradenne. Religion in Primitive Society—Wilson D. Wallis.

Hodder & Stoughton, Ltd. The Story of Jericho—John Garstang.

McGraw-Hill Publishing Co., Ltd. The Great Cultural Tradition—Ralph E. Turner.

Methuen & Co., Ltd. More Rock Paintings in South Africa : from the Albany District—Dorothea F. Bleek. The Prehistoric Foundations of Europe : to the Mycenean Age—C. F. C. Hawkes.

Oxford University Press. The Iberians of Spain and their Relations with the Aegean World—Pierson Dixon. Drama of Orokolo : the Social and Ceremonial Life of the Elema—F. E. Williams. The Nuer : a Description of the Modes of Livelihood and Political Institutions of a Nilotic People—E. E. Evans-Pritchard. Perachora : the Sanctuaries of Hera Akraia and Limenia (Excavations of the British School of Archæology at Athens, 1930–1933 : Architecture, Bronzes, Terra-cottas)—Humfry Payne and others. Lachish 2 : The Fosse Temple—Olga Tufnell, C. H. Inge and Lankester Harding. African Political Systems—M. Fortes and E. E. Evans-Pritchard. The Phonetics of the Kikuyu Language—L. E. Armstrong. The Eastern Sudanic Languages, Vol. 1—A. N. Tucker. Bibliography of South African Native Affairs—I. Schapera. The Transformation of Islamic Society : a Study of the Impact of Western Civilization on Moslem Culture in the Near East, Vol. 1 : Islamic Society in the Eighteenth Century—H. A. R. Gibb and Harold Bowen.

C. A. Watts & Co., Ltd. Jocasta's Crime—Lord Raglan (Thinker's Library). A Short History of Sex-Worship—H. Cutner.

Philosophy : Psychology

George Allen & Unwin, Ltd. Freedom and Culture—John Dewey. Theism and Cosmology (The Gifford Lectures on Natural Theology given in the University of Glasgow, 1939)—John Laird. The Idea of the Soul in Western Philosophy and Science—William Ellis. Studies in the Relationship of Islam and Christianity—Lootfy Levonian. Living Religions and a World Faith—William Ernest Hocking. Holy Images—Edwyn Bevan. The Toddler at Home—Mary Chadwick. The Child's Work with Materials—Charlotte Bühler.

D. Appleton-Century Co., Ltd. Social Psychology—Charles Bird.

Cambridge University Press. The Architecture of the Intelligible Universe in the Philosophy of Plotinus—A. H. Armstrong. Aristotle on Friendship—edited by G. Percival.

English Universities Press, Ltd. Teach Yourself Psychology—Arnold Bellwood.

Faber & Faber, Ltd. The Serial Universe Simplified—J. W. Dunne.

Jarrolds Publishers (London), Ltd. Common-Sense and the Adolescent—Ethel Mannin. Common-Sense and the Child—Ethel Mannin. The Meaning of Psycho-Analysis—Martin W. Peck. Motives of Conduct in Children—Alice Hutchinson. The New Psychology and the Teacher—C. Miller.

John Lane The Bodley Head, Ltd. Peculiarities of Behaviour—Wilhelm Stekel (translated from the German by James S. Van Teslaar). Impotence in the Male : the Psychic Disorders of the Sexual Function in the Male—Wilhelm Stekel (authorized English version from the third German edition). The Riddle of Woman : a Study in the Social Psychology of Sex—Joseph Tenenbaum.

McGraw-Hill Publishing Co., Ltd. Experience in Student Teaching—Raleigh Schorling. Psychology in Education—Herbert Sorenson. Principles of Guidance—E. G. Williamson and M. E. Ham. The Education of Exceptional Children—Arch O. Heck. Criminal Behavior—Walter C. Reckless.

Oxford University Press. Plato's Method of Dialectic—Julius Stenzel. An Introduction to Hegel—G. R. G. Mure. Measuring Intelligence of Indian Children—V. V. Kamat. Text-Book of Psychiatry—D. K. Henderson and R. D. Gillespie.

Sir Isaac Pitman & Sons, Ltd. Correcting Nervous Speech Disorders—Mabel Farrington Gifford.

George Routledge & Sons, Ltd. The Rape of the Masses : the Psychology of Totalitarian Propaganda—Serge Tchakotin (translated from the French by E. W. Dickes). The Integration of the Personality—Carl G. Jung. The Place of Value in a World of Facts—Wolfgang Köhler. Philosophy and Language—Friedrich Waismann.

C. A. Watts & Co., Ltd. The Man *versus* the State—Herbert Spencer (Thinker's Library). The World as I See It—Albert Einstein (Thinker's Library). Psychology and War—D. W. Harding. Ideals and Illusions—L. Susan Stebbing. The Human Mind—Alfred Hook.

Bacteriology : Hygiene

H. K. Lewis & Co., Ltd. Elementary Bacteriology and Immunity for Nurses—S. F. Marshall.

Martin Secker & Warburg, Ltd. The Conquest of Bacteria—F. Sherwood Taylor.

Oxford University Press. Industrial Hygiene—edited by Anthony J. Lanza. Mosquito Abatement for Health and Comfort—William Brodbeck Herms and Harold Farnsworthy Gray.

Miscellany

D. Appleton-Century Co., Ltd. Stories of Useful Inventions—S. E. Forman. Science with Simple Things—Raymond F. Yates. Experimenting at Home with the Wonders of Science—Eugene Hodgdon Lord.

W. & R. Chambers, Ltd. Chambers's Technical Dictionary—edited by C. F. Tweney and L. E. C. Hughes.

Chapman & Hall, Ltd. Advanced Readings in Chemical and Technical German—J. T. Fotos and R. N. Shreve.

William Heinemann, Ltd. A Century of Science—F. Sherwood Taylor.

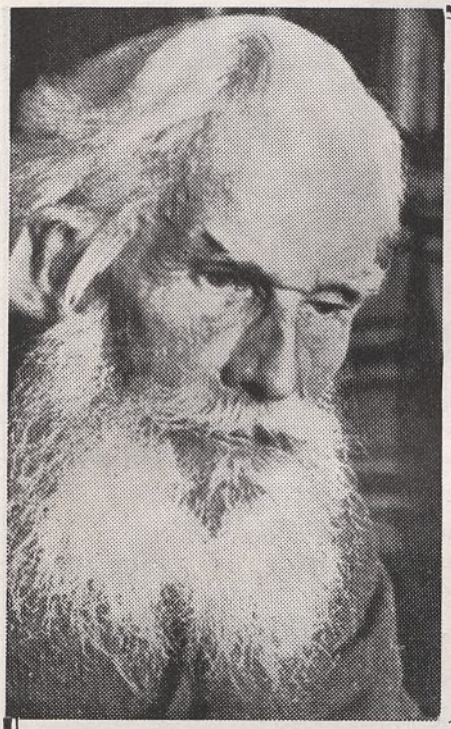
McGraw-Hill Publishing Co., Ltd. Genius in the Making—Herbert Carroll. Writing the Technical Report—J. R. Nelson. The Arts and Man—Raymond S. Stites. Industrial Design—Harold Van Doren.

Macmillan & Co., Ltd. Berkeley Moynihan : Surgeon—Donald Bateman. Religion in Science and Civilization—Sir Richard Gregory. Social Relations of Science—J. G. Crowther. Introductory Applied Science, Part 2—H. B. Brown and S. Jones.

Methuen & Co., Ltd. General Science, Part 2—J. C. Platt, Freda Jones and J. H. Hopkinson.

Oxford University Press. Military Science To-day—Lieut.-Col. Donald Portway (Pageant of Progress Series).

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS.



HAVELOCK ELLIS's AUTOBIOGRAPHY

My Life

✱ "I have been a dreamer and an artist, a great dreamer for that is easy, not a great artist for that is hard, but still always an artist, whether in the minor art of writing, or the greater art of comprehending, or the supreme art of living, wherein it is something to have tried even if one fails. So that if I am often sad—for the art of living is finally the art of loving, in which one becomes a master too late—I am always content."
From the author's Preface.

"An intensely interesting document," says *The Times*, which will be of special interest to scientific readers.
542 pages, 8 plates. 15*s.* net

¶ PSYCHOLOGY OF SEX, the one volume synthesis of his chief work, is still the most authoritative introduction to the subject. Published in 1933, it is now in its fifth large printing.
Prospectus available. 12*s.* 6*d.* net

¶ SEX IN RELATION TO SOCIETY, first issued in 1937, is a completely revised and up-to-date version of the most important volume of the famous *Studies* (VI), now presented for a wider public. *Prospectus available.* 12*s.* 6*d.* net

Recent Scientific Books

W. R. FEARON, M.A., Sc.D., M.B., F.I.C.

Introduction to Biochemistry

✱ This new second edition, greatly enlarged and thoroughly revised throughout, now includes material not hitherto available in English. It claims the attention, not only of students, but all who are interested in the chemical interpretation of the facts of life. *Prospectus available.* 17*s.* 6*d.* net

GEORGES LAKHOVSKY

The Secret of Life

✱ The famous French engineer-physicist here explains his theories concerning cosmic rays and the radiations of living beings, throwing new light on such subjects as instinct in animals, the migration of birds, dowsing, and disease in plants and animals. With remarkable photographs.
10*s.* 6*d.* net

DAVID FORSYTH, M.D., D.Sc., F.R.C.P.

How Life Began

✱ A speculative study in modern biology, in which the author advances some interesting new ideas on heredity and environment, the evolutionary process, the struggle for existence, the diversity and variation of species and the genesis of life on the earth. 5*s.* net

ISABEL EMSLIE HUTTON, M.D.

Mental Disorders in Modern Life

✱ A contribution to mental hygiene propaganda, and virtually a textbook of psychiatry for the non-medical reader. "Her book is sensible, lucid, informative and encouraging. It is the sort of book that will do an immense amount of good."—*Daily Telegraph.* *New cheap edition*, 3*s.* 6*d.* net

DAVID O. WOODBURY

The Glass Giant of Palomar

✱ An engineer of long training and experience describes the inception, building and purpose of the world's greatest telescope, together with a background of astronomy, in non-technical language. Fully illustrated, 18*s.* net

C. E. WHEELER, M.D., B.S., B.Sc.

The Principles and Practice of Homœopathy

✱ The most authoritative presentation for professional and other enquirers, showing that a knowledge of homœopathy is essential for a full understanding of the orthodox curative methods. Full descriptions of some 30 of the principal remedies in the *Materia Medica* are given. *Prospectus available.* 15*s.* net

In preparation

J. E. R. McDONAGH, F.R.C.S.

The Universe Through Medicine

✱ The author has been recognized as one of our most distinguished research workers on the nature and cause of disease. This book, his magnum opus, clarifies and advances the work of nearly 40 years, and its importance will be realized not only in the field of medicine, but in every branch of physics and chemistry affecting vegetable and animal life. He is led to an examination of some fundamental conceptions, metaphysical as well as scientific, which open up new and far-reaching lines of thought. 384 pages. 25*s.* net

☞ The publishers are preparing a special prospectus which they will be glad to send to NATURE readers on application.

HEINEMANN 99 GREAT RUSSELL ST. LONDON WC1

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

NEWS AND VIEWS

Sir Benjamin Baker, F.R.S. (1840–1907)

IT is just fifty years ago this month since the famous Forth Bridge was opened and a hundred years ago since one of its designers, Sir Benjamin Baker, was born. The son of Benjamin Baker of Carlow, Ireland, Sir Benjamin was born in Somersetshire on March 31, 1840, and at the age of sixteen was apprenticed at the Neath Abbey Iron Works, South Wales. At the age of twenty he entered the employ of a civil engineer in London and two years later began his long association with Sir John Fowler (1817–98), who was then engaged on the construction of the first part of the London Underground Railway. Baker first gained recognition by a series of articles in *Engineering* in 1867 on "Long-Span Bridges". This series was followed by others on beams, brickwork and urban railways. In the 'seventies plans had been drawn up by Sir Thomas Bouch for a bridge over the Firth of Forth, but the failure of his Tay Bridge led to a reconsideration of the scheme.

In 1881 the railway companies interested requested their consulting engineers T. E. Harrison, W. H. Barlow and Fowler, with whom Baker collaborated, to report on the feasibility of a bridge over the Forth, and the type of bridge. The report recommended a cantilever bridge with a central supported girder, a type first adequately treated by Baker in his articles of 1867. The great work was begun in 1883 and completed in 1890, Baker then receiving the honour of knighthood. The second great work for which Baker will be remembered is the Aswan Dam on the River Nile, 6,400 ft. in length, carried out in the years 1898–1902 at a cost of £3,250,000. He was consulted regarding many projects both at home and abroad, acted as an arbitrator, and served on many commissions and committees. He was elected fellow of the Royal Society in 1890, and served as president of the Institution of Civil Engineers in 1895. He died unmarried on May 19, 1907, and was buried at the village of Idbury in the Cotswolds. Two years later a memorial window to him was erected in the north aisle of Westminster Abbey.

Substitutes for Imported Fuels

IN the House of Commons, on March 20, Mr. Geoffrey Lloyd, Secretary for Mines, stated that Sir Harold Hartley had been appointed honorary adviser on the development of home-produced fuels. A number of leading representatives of industry, finance, and technical science, under the chairmanship of Sir William Bragg, had been asked to make a rapid survey of the subject in the light of war conditions, and within a month this authoritative body completed its survey. On its recommendations the following six specific problems are being investigated simultaneously: (1) the production of oil from coal by synthetic processes, under the chairmanship of Sir William Jowitt; (2) the products of low-temperature carbonization, under Lord Henley; (3) the liquid products of high-temperature carbonization, under Mr. Davidson Pratt; (4) alternative fuels for internal combustion engines, under Viscount Ridley; (5) the development of the use of colloidal fuel, under Mr. Irvine Geddes; and (6) the more efficient use of fuel generally, under Sir Clement Hindley.

A report has already been received, Mr. Lloyd said, on the recovery of benzole. This indicates that already additional crude benzole is being recovered at the estimated rate of 15,000,000 gallons a year, and that an extension of voluntary effort should secure a further 12,000,000 gallons a year. A survey has also been completed which shows how our production of tar, creosote, and pitch can take the place of imported fuel oil and bitumen to the extent of some 300,000 tons in the current year. Mr. Lloyd stated in conclusion that action already taken on the basis of reports received will result in obtaining in the current year some 32,000,000 gallons of substitutes for imported oil.

Economic Aspects of War

THE economic aspects of war are ably discussed by Mr. G. Crowther in an Oxford Pamphlet on World Affairs (Oxford: Clarendon Press. 3*d*. net), entitled "The Sinews of War", in which he maintains that war is now an industrial proposition, being more influenced by the science of economics than by the art of strategy. The demand of war for the whole of a nation's industry and wealth has given an immense advantage to the rich country. Limiting himself to the question of men and materials, Mr. Crowther compares the resources of man-power and materials available to the Allies and to Germany. In almost every respect the Allies have an overwhelming advantage, and our advantage in man-power will increase the more Germany succeeds in making her raw materials at home. To win the War, however, even with these advantages, economic mobilization is essential. We must keep the seas open to our trade while closing them to the enemy; we must prevent the enemy from over-running our industrial areas or bombing them out of existence before they convert our advantages of man-power and materials into a military superiority. We must also preserve our ability to pay for imports by maintaining and increasing our export trades, and be prepared to reduce to the minimum the amount of man-power and materials consumed for purposes other than war. Finally, we must be energetic and speedy in organizing the transfer both of men and materials into their war-time jobs. In laying down programmes of war production, we must be content with nothing short of the maximum that is physically possible.

Tuberculosis and War

IN a recent paper on this subject (*Paris méd.*, 1, 52; 1940), Dr. E. Rist, of Paris, remarks that war favours the extension and aggravation of tuberculosis not only in belligerent nations but also in neutral countries, owing to the economic disturbance caused by the blockade, the scarcity of indispensable articles due to the destruction of merchant shipping and the hindrances of all kinds offered to the transport of goods by land and sea. During the War of 1914–18, the mortality curve from tuberculosis, which had fallen from 1900 to 1914, rose sharply from 1915 to 1918, and did not decline again until after the conclusion of peace. Among the numerous causes of an increase of endemic tuberculosis in war-time, one of the most serious is the rapid and wholesale evacuation of urban and rural populations to districts which are not sufficiently prepared to receive them, with the result that numerous healthy persons become infected with tuberculosis by those suffering from an active form of the disease.

Another factor leading to increase is the interruption of the most successful method of treatment of pulmonary tuberculosis, consisting in various forms of collapse therapy, especially artificial pneumothorax, caused by evacuation of patients to areas where there are no practitioners familiar with the technique. Other factors found to be responsible for the spread of tuberculosis are overwork, especially among those engaged in war industries of various kinds, under-feeding, as was illustrated in Denmark during 1914–18, and mental worry, the importance of which was emphasized by Laennec long ago. In conclusion, Dr. Rist, while admitting the necessity of an ample supply of tuberculosis experts in the armed forces, emphasizes the importance of restoring to civil practice a large number of them who are employed on quite unsuitable duties.

British Museum (Natural History)

LECTURE tours in the British Museum (Natural History) on Saturdays at 3 p.m., and on the first Sunday in each month at 3 p.m. have been arranged. London museums are re-opening their doors, and although many treasures have had to be moved away to safety from the Natural History Museum, their places have been filled to some extent by special exhibitions and new grouping. Two of the galleries are being used for a special exhibition to show Nature in the service of man. The exhibits illustrate the animals and plants from which our most important textiles are produced; sources of oil, animal, vegetable, and mineral, and some of the industries in which the various oils are needed; materials from which cosmetics and surgical requisites are prepared; the use made of spiders' webs and the origin of domestic breeds of poultry, cattle, pigs, etc. There is a section showing the animals particularly useful in war, such as white mice, canaries, reindeer, and Airedale dogs. Another gallery which has been proving a great attraction during the few weeks of limited opening is the Whale Hall, where a full-size model of a Blue Whale 92 feet long is on view—a treasure certainly, but much too large for evacuation!

Night-Shining Eyes

MOST people are familiar with the greenish gleam which shines from the eyes of a cat when a beam of light is directed upon them at night, and are aware that the glow can be seen only when the observer's line of vision is closely parallel with the beam of light. The phenomenon has been investigated in many animals by E. P. Walker, assistant director of the National Zoological Park of the Smithsonian Institution, and his results are referred to in the current Year Book of the Institution. The apparatus used in the tests was a reflecting head lamp, similar to a hand torch, worn on the forehead and connected with a three-cell battery in his pocket. The best results were obtained with a beam of moderate intensity, the effect of an intense beam being to make the glow less conspicuous or entirely to prevent its appearance. The shining is due to reflection from some surface in the eye, but its colour and character vary with the kind of animal. Colour ranges ran from silvery to blue-green, pale gold, reddish-gold, brown, amber and pink, and while most resembled reflection from a burnished metal surface, those of crocodiles and alligators gave the observer the impression of gazing into "a brilliantly glowing pinkish opening in a dull-surfaced bed of coal".

In the case of glowing eyes, the appearance is as if one looked through the pupil of the eye and saw reflection from the surface of the retina, but where the gleam was metallic in character there was no impression of looking into the interior of the eye. In the latter case, however, a difficulty arose because in most cases the reflection disappeared at a distance closer than from eight to twenty feet, so that the actual reflecting surface could not be determined. In some forty species of mammals and reptiles tests were made with red and blue coloured beams of light, but these made little change in the reflected gleam except to add a corresponding tinge of red or blue, a result which confirms the suggestion of simple reflection without any real animal light. To some degree there is a family resemblance in the character of the gleams, for most rodent eyes shine dully in brown, hazel or amber, although in porcupines the reflection is brilliantly silver. No shine was obtained from the eyes of higher apes or monkeys and no proof of the alleged shining of human eyes, yet, curiously enough, the most brilliant reflections of all were from the eyes of two of the lemurs, the slow loris and the potto.

Ethnological Reconnaissance in New Guinea

MUCH of the Mandated Territory of New Guinea is still uncontrolled, and even unexplored. Notwithstanding the difficulties of the country, the policy of exploration with a view to control is pursued with as little intermission as circumstances allow and has made substantial additions to knowledge in the information collected relating to the culture of previously unvisited or unknown peoples of the interior, notably in the regions adjacent to Mt.

Hagen. A recent report to Sir Walter McNicoll, administrator of the Mandated Territory, by Mr. J. L. Taylor, assistant district officer, records the results of a patrol carried out by him in unexplored country westward from Mt. Hagen to the border of Dutch New Guinea, and northward towards the southern tributaries of the Sepik River during March 9, 1938–June 19, 1939. The area surveyed consisted of some 20,000 square miles, and was found to be for the most part of temperate climate, such as might be suitable for European occupation. The future of the country traversed is said to lie in agriculture and pig-raising.

Large numbers of natives were encountered, most of whom appear to have been friendly, though on more than one occasion the patrol was attacked and suffered some casualties. Among natives to the north-west of Mt. Hagen, who had not previously seen a white man, the members of the patrol were regarded as spirits of the dead returned to earth. One of them, while taking observations from a tree, received the offering of a pig and was asked to ascend to heaven. In another village, the women were kept at a distance in the belief that they would die if they beheld these spirits. Among the more remarkable features in the culture of the peoples encountered, of which some particulars are given in a dispatch from the Canberra correspondent of *The Times* in the issue of March 26, is a system of deep drains or sunken roads, in the form of an elaborate complex of trenches, which serves both for defence and in cultivation as an effective drainage system, or as a protection against the ravages of pigs. Another remarkable culture trait is the use of wigs of human hair, made by professional wig-makers. Each man, it is said, aimed at having at least one wig made of his own hair. The tribes of the area were found to be keen traders, the most important and much sought after commodity being salt prepared from wood burnt after saturation in salt-springs.

Archæological Investigations in Jerusalem

EXCAVATION of the remains of certain of the ancient walls of Jerusalem carried out by Mr. C. N. Johns on behalf of the Department of Antiquities has produced results of considerable archæological interest and historical importance. These results include the establishment of a chronological sequence in the remains of these ancient walls, which carries back to pre-Herodian times—certainly to the Maccabees and possibly even to the days of Nehemiah, although the evidence for the latter is archæologically undated. A further result is the confirmation of a tentative identification, made in the seventies of the last century, of the so-called Tower of David with Phasael, the third of the three towers described by Josephus as erected by Herod the Great. The systematic exploration of the site was made possible by the demolition of the Turkish barracks under the British occupation, and was undertaken by the Department of Antiquities in 1934 through the direct personal interest of Sir Arthur Wauchope, then High Commissioner.

The excavation, as described in a dispatch from the Jerusalem correspondent of *The Times* in the issue of March 23, has laid bare the old wall inside and parallel to the present north and west walls of the Citadel as reconstructed by the Crusaders and Mamelukes. This fragment of the old wall consists of three towers, Phasael and those named respectively by the excavators the Corner Tower and the South Tower, and their connecting curtain walls. The curtain between Phasael and the Corner Tower is of crude chalky stone solidly laid without mortar on the native rock scarp. Stratified remains of pottery suggest that this may go back to Jonathan Maccabæus ; but in fact it incorporates an even earlier and clumsier wall, as previously mentioned, archæologically undated. The Maccabæan wall was partially demolished shortly after its erection, in a battle, presumably during the sieges by one or other of the Antiochus dynasty, of which the relics are seen in iron and bronze javelin heads and stone ballista balls. There is now evidence that after repairs it was reconstructed in the remarkable protective works of Herod, in which the tower Phasael was the strongest and most striking, rising from a cube of solid masonry, measuring 68 ft. on each side, in two stages to a height of 155 ft. In addition to their intrinsic interest, these discoveries will tend to throw light on other problems of the character and appearance of the Holy City at the opening of our era.

Trotula and the Ladies of Salerno

IN a paper read before the Section of the History of Medicine of the Royal Society of Medicine on January 10, Dr. H. P. Bayon stated that several contemporary writers maintained that a fictitious Trottus was the author of "De passionibus mulierum", which was usually ascribed to Trotula of Salerno, a matron mentioned in the text of most manuscript copies and therefore a definite person. Whether she wrote or compiled the chapters "De ornatu mulierum" is not ascertained, but a study of early manuscript texts dealing with cosmetics seems to afford some clue. The gynæcological chapters are notable because of the recommendation of the support of the perinæum in childbirth and the primary suture of the perinæum. The many manuscript copies, printings and literary allusions concur in showing the appreciation which Trotula enjoyed during the twelfth to sixteenth centuries.

The references in the text of Trotula's work to Saracens, many drugs from the East, the avoidance of magical formulæ and hagiology, together with the description of alchemical manipulations, indicate the personal influence of Moslem and Hebrew physicians ; in other Salernitan writings, quotations from the Old Testament are preferred. It is recorded that Costanza of Salerno lectured on medicine during the reign of Giovanna I of Anjou (1326–82) ; she was probably the first woman professor. The decline of the College of Salerno must have occurred after its destruction in the sack of the town in 1194. In academical teaching Salernitan doctrines were replaced by dialectic scholastic medicine, but the

College of Salerno brought to the West a system of professional medical practice which has since prevailed in all parts of the civilized world.

A New Kind of Museum Exhibit

THE New England Museum of Natural History in Boston, Mass., has been the first to turn a trade innovation in lighting to the service of museum galleries. In the particular case described by Bradford Washburn in the *Museums Journal* (**39**, 450; 1940) you gaze at a stoat watching you from the edge of a summer wood. As you look, the lights fade, become momentarily dim, and when the full light shows again the summer scene has gone, snow covers the ground, the trees are bare of leaves, and the stoats have changed into their winter dress of ermine. The case really contains two groups, a summer and a winter one; but the spectator looking at the summer group perceives it, when it is brilliantly lit internally, through a transparent sheet of Belgian 'black' glass. When the internal lights fade and the second group is illuminated, the black glass becomes opaque and acts as a mirror in which only the snow scene is visible, exactly overlapping the summer scene, of which it is a replica in reverse. Many technical difficulties had to be surmounted before the new exhibit was satisfactorily completed; but its dissolving habitat group at once made a great impression. One wonders if the average mortal really needs such bait in order to be induced to look at a representation of Nature: and the result—half his mind is thinking about the trick of the thing; only the other half is giving itself to the study of the Nature group.

Earthquakes Near Great Dams

ACCORDING to *Earthquake Notes* (**11**, No. 3; January 1940), earthquakes of varying intensity have been recorded from the neighbourhood of Boulder Dam since September 1936. During the first four months twelve shocks were felt, but the frequency increased until during April 1937 forty-five were felt. After this time the frequency increased until during the early part of 1939 there were on average two humanly felt earthquakes a month. The Wood-Anderson seismograph on the spot recorded more than five hundred disturbances during 1938. There has been some discussion among U.S. seismologists of plans for the observation of possible earthquakes in the neighbourhood of two other areas which will probably be similarly loaded. The first is the unfinished Grand Coulee Dam in the State of Washington, and the second is the proposed Shasta Dam near the confluence of the Pit and Sacramento Rivers in northern California. In the latter case there is yet time to obtain information of the seismicity of the area before loading. Similar data were not obtained in the case of the Boulder Dam.

Oxygen Administration and Inhalation Apparatus

A FIFTH memorandum in the Emergency Medical Services Series has been issued by the Ministry of Health entitled "Oxygen Administration—Indications, Methods and Types of Apparatus" (H.M. Stationery Office. 2*d*. net). The administration of oxygen is a valuable aid in the treatment of some forms of gas poisoning and lung disease, and in some surgical conditions such as shock and chest wounds. The memorandum incorporates the results of research on the subject, and is intended primarily for the guidance of medical officers in charge of hospitals. It describes the conditions for which oxygen therapy is likely to be effective, methods of oxygen administration, and the more important types of apparatus for the purpose, including a new form of nasal mask.

Alexander Pedler Lecture

THE Alexander Pedler Lecture, which is given annually under the auspices of the British Association, was this year delivered by Prof. Allan Ferguson before the Cardiff Naturalists' Society. The lecture, which was given in the Reardon Smith Lecture Theatre of the National Museum of Wales, Cardiff, on March 14, was entitled "Splashes, and what they Teach". It was chiefly concerned with an explanation of the phenomena attendant on the impact of a drop of liquid on a liquid or solid surface. A high-speed film was shown which illustrated the phenomena, and the results were compared with those of the earlier classical experiments carried out by the late Prof. Worthington.

Old Books on Social Sciences

WE have received a copy of Catalogue 54 published by E. P. Goldschmidt and Co., of 45 Old Bond Street, W.1, containing 307 items of old works dealing with a great variety of subjects. Attention may be directed to the following: Jacques Legrand's "Sophologium", a popular handbook of useful knowledge, possibly printed by Caxton, not later than 1473; Naudé's work on the principles of librarianship and library organization (1627); Beccaria's treatise on crimes and penalties (1766); Sir Edwin Chadwick's "Report on the Sanitary Condition of the Labouring Population of Great Britain" (1842); Patissier's work on factory hygiene and the diseases to which miners, industrial workers and others are exposed (1822); Schreiber's sixteenth century book on practical arithmetic, the first German book on the subject; Jérome de Monteux's treatise on hygiene, which contains chapters on dietetics, the care and nourishment of children, and a section on cosmetics (1559); Bernard Palissy's discourse on the nature of waters, fountains, rains, metals, salts, stones, earths and fire (1580), which entitles him to be regarded as one of the pioneers of modern chemistry and geology; Neander's "Tabacologia" (1626), the most important early work on tobacco; Villafranca's "Methodus refrigerandi" (1550), the earliest work on artificial refrigeration; and the first edition of Linnæus's book on the increase of the habitable earth (1744) bound up with the second edition of his oration on travelling in one's own country (1743).

Hydro-Electric Development in India

IN NATURE of January 6, p. 23, under this heading, it was stated that an irrigation scheme involving the generation of large quantities of electric power between the Punjab and the State of Bilaspur "is under construction". We are informed by the secretary of the Central Board of Irrigation that "the project referred to, namely the Bhakra Dam Project in the Punjab, is not 'under construction' but simply 'under consideration' at present".

Exhibition of Chinese Art at Leeds

AN exhibition of Chinese art was opened in the Temple Newsham Mansion, Leeds, on March 23 by Dr. Thomas Bodkin, Barber professor of Fine Arts and director of the Barber Institute in the University of Birmingham. The exhibition consists of more than 200 specimens of pottery, paintings and bronzes, exhibited by the courtesy of Messrs. John Sparks of London, and on the initiative of the curator of Temple Newsham, Mr. Philip Hendy. Although the exhibition is, so far as possible, comprehensive in a chronological sense, the periods which will appeal most to students of the earlier phases of Chinese culture, covering the Shang-Yin (? 1766–1122 B.C.) and Chou (? 1122–249 B.C.) Dynasties and the Warring States, are represented by some notable exhibits forming a group of seven very rare bronzes. Three belong to the Shan-Yin Dynasty—two beaker-shaped vessels with a finely engraved design, and a sacrificial cup. There are also three vessels of the Chou Dynasty; and a dagger with a handle in the form of a mule's head is of the period of the Warring States (481–221 B.C.). Special interest is attached to these bronzes, all coming from burials. Among the most important of the pottery exhibits is the figure of a Lohan or Buddhist priest, seated with arms folded in the sleeves of his cloak, which stands about four feet high.

A Big Sunspot

A BIG sunspot has crossed the solar disk during the past week; appearing at the east limb on March 20, reaching the central meridian on March 26·3 and due to pass around the west limb of the disk on April 1. The area of the spot on March 23 was 1,000 millionths of the sun's hemisphere—an area well above the lower limit of size for naked-eye visibility. On March 23, a bright chromospheric eruption of considerable intensity was observed directly over the spot. A great magnetic storm began on March 23 and was in progress during the night of March 24–25, when the aurora was also seen in spite of bright moonlight. Widespread interference with both radio and cable communications was reported.

The Night Sky in April

DURING the month, night shortens by nearly two hours in the latitude of London. The moon is new on April 7 at 20·3h. and full on April 22 at 4·6h. On the latter date, a penumbral eclipse of the moon occurs, having been preceded on April 7 by an annular eclipse of the sun invisible in Great Britain, but to be seen in the southern parts of the United States of America. The penumbral lunar eclipse on April 22 begins at 2h. 27m., reaches a maximum phase (0·89) at 4h. 26m., and ends at 6h. 25m. In the nature of things, a penumbral lunar eclipse is not a spectacular phenomenon, but a difference in brightness between the east and west parts of the moon's disk should be discernible in a naked-eye scrutiny. In the evening skies after sunset, the brilliant planet Venus dominates the other planets still above the horizon—Mars, which is visible for about three hours after sunset, and Saturn, drawing nearer to the sun's position until it is in conjunction on April 24. Jupiter is now too close to the sun for observation, being in conjunction on April 11. It may be noted that also on April 11 at 0h. Venus is in conjunction with Mars; while at 19h. the moon, then nearly four days old, will be in conjunction with both these planets. The Lyrid meteors are due during April 19–22, the radiant point being near 104 Herculis. [All times are given in Universal Time; add 1 hour to convert to Summer Time.]

Announcements

SIR HAROLD CARPENTER, F.R.S., professor of metallurgy in the Royal School of Mines, London, has been awarded the Honda prize of the Japan Metallurgy Society. He is the first foreigner to receive the award, which consists of a gold cup and £300.

PROF. A. V. HILL, M.P., F.R.S., has been appointed as assistant air attaché in Washington for special scientific liaison duties. The appointment is temporary, and has been accepted without remuneration.

THE Messel Medal of the Society of Chemical Industry has been awarded to Lord Samuel. This medal, one of the two principal awards in the hands of the Society, is given in alternate years for "meritorious distinction in Science, Literature, Industry or Public Affairs, and who is prominently concerned with the Welfare of the Society". The presentation will be made at the annual meeting of the Society to be held in London on July 9, when Lord Samuel will deliver an address.

THE Kitasato Institute for Infectious Diseases, founded at Tokyo, by Baron Kitasato, who discovered the bacillus of bubonic plague and who died in 1931, celebrated the twenty-fifth anniversary of its foundation on November 5.

ACCORDING to Dr. C. Louis Leipoldt, medical secretary of the Medical Association of South Africa, in Southern Rhodesia where there are 188 registered medical practitioners, 116 are available for service in the present national emergency.

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.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 516. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Human Genera and Species

PROF. OSMAN HILL'S suggestion[1] that the classification of the Hominidæ is in urgent need of revision is likely to meet with general agreement. It is doubtful, however, if the particular proposals which he puts forward will do more than deliver the question from its present confusion—a confusion which at least has the merit of attributing a glamorous if unreal diversity to human ancestry—into another confusion at least as great. This is certain to occur if the principles of zoological classification are as he defines them. The differences which he suggests indicate generic distinctions ("differences in external or internal structure") cannot be regarded as essentially different from those which he believes to indicate specific distinctions ("differences in bodily proportions . . . differences in bodily form", etc.). For, quite apart from the verbal and logistic difficulty of deciding what is a difference in "structure" and what is a difference in "form", there is strong reason for supposing that pronounced differences in the one or the other or both aspects of the body or its organs are often simply due to differences in growth-rates. For example, some monkeys have a vermiform appendix, others lack this structure. Osman Hill's criteria suggest that differences of this kind are necessarily a sign of generic distinction. The difference, however, is entirely dependent on a different pattern and rate of growth in the cæcal region of the large intestine, that is, on a process which in this case leads to an extreme difference in bodily proportions. These, however, Osman Hill regards as indicative of specific and not generic distinction. It would therefore seem that no real difference separates his criteria for defining genera and species. In any event it is difficult to see how they could be applied to fragments of fossil human skulls.

It is because systematists have never succeeded in devising any standards of general application that zoological classification remains the somewhat uneven structure that it is. In spite of all attempts at suppression, the personal factor still enters largely into decisions that this or that group of animals constitutes a species of a genus. Some systematists are 'lumpers', others 'splitters', and however much it may be regretted as indicative of a lack of objectivity, Tate Regan's remark[2] that a species is something which a competent systematist recognizes as such still holds. But this does not mean that arbitrary conventions are not devised and used which allow of fairly equal generic and fairly equal specific subdivision within a given group of organisms. It was in the belief that this was so that I suggested in 1931[3] that there was no reason to regard Java man (Pithecanthropus) and Pekin man (Sinanthropus) as generically distinct. This view was reaffirmed last year by Le Gros Clark[4] and has just been re-stated by von Koenigswald[5] and Weidenreich.

Any rigid set of principles of systematic classification based, as Osman Hill's are, on a supposed application of principles derived from other fields of biology, usually defeats itself. One has to be particularly careful about such principles in the study of human origins because, as I have suggested elsewhere[6], the importance attached to this question, and the consequent and inevitable derivation of views on primate phylogeny from primate classification, make it essential that the genera within a single family, or the species within a single genus, should be at least approximately equivalent in their taxonomic differentiation, if the theoretical condition is to be fulfilled that the sub-groups of a given genus or family can be regarded as more closely related to each other by descent than they are to the members of other genera and families. This necessity applies to the whole field of palæontology. In a recent review of the problem, Arkell and Moy-Thomas[7] point out that every new genus and species of fossil should fit as nearly as possible into a uniform scale of classificatory values, and that classification should not be complicated by the introduction of preconceived, and usually arbitrary, views about phylogeny.

In the classification of the Hominidæ it is clear (*a*) that a difference which in one case serves as part of the basis for generic differentiation should be given equal consideration in another, and (*b*) that any common characters which bind the species of Homo into a single genus should not occur in any other genus of the Hominidæ. These are purely empirical and, to that extent, arbitrary criteria. But they are essential criteria if there is to be any order in the classification of the Hominidæ, and if views on human phylogeny are to be soundly based. The main difficulty that usually lies in the way of their application to the classification of any new human fossil skull is the desire to make too much of a good thing by magnifying its significance. This was certainly done, either consciously or unconsciously, in the case of the Pekin skull, and the only new fact which Weidenreich's recent announcement implies is that he has at last looked objectively at all the evidence which should have been taken into account at the start of his labours—for in my opinion[3] his conclusion was obvious from the moment Davidson Black published the measurements of the first two Sinanthropus skulls in 1930 and 1931[8], even though he, too, insisted on the distinctive generic separateness of the type. But in this, Black's successor in the excavations of Choukoutien has behaved no differently from almost every other discoverer of a fossil human skull, for the tendency to make too much of such a discovery appears to be irresistible.

An excellent example is provided by the recently described Swanscombe skull, which an impartial committee of experts set up by the Royal Anthropological Institute agreed, after exhaustive examination, differed in no significant way from modern human skulls[9]. In what amounts to a minority report, however, Marston[10], its discoverer, dissociates himself from this view and claims that the skull is much more primitive than this, even more primitive than the Neanderthal group !

If these controversies are to be avoided, it must be accepted by physical anthropologists that the species concept as used in systematics is artificial (however much meaning the term 'species' may have in another context, for example, ecological, as signifying a genuine biological unit), and that in consequence it is necessary to define the amount and kind of differentiation which, in the family Hominidæ, should determine either specific or generic status. At the present time there does not seem to be any more reason than there was ten years ago[3] for separating generically from one another in classification such archaic types as Sinanthropus, Pithecanthropus, Neanderthal and Rhodesian man. The only classification which still appears to be justified to-day is the separation of this group from a group comprising modern man, types belonging to the Upper Palæolithic, and such temporally aberrant types as the Swanscombe skull. The facts demand such a classification—whatever be its phylogenetic significance.

S. ZUCKERMAN.

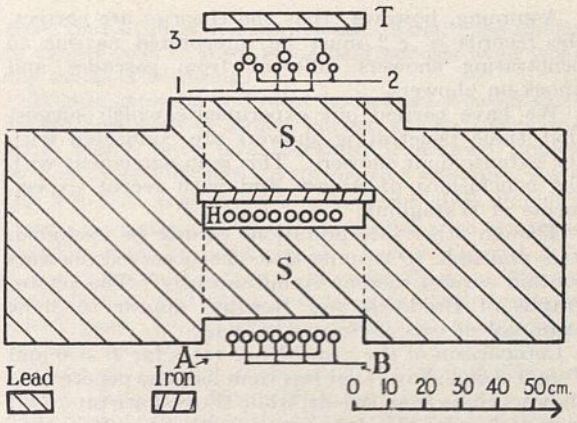
Department of Human Anatomy,
Oxford.
March 2.

[1] Osman Hill, W. E., NATURE, **145**, 260 (1940).
[2] Regan, C. Tate, Rep. Brit. Assoc. Southampton, 1925 (1926).
[3] Zuckerman, S., *Eugenics Rev.*, **24**, 1931 (1931).
[4] Le Gros Clark, W. E., *Modern Quarterly*, **2**, 115 (1939); also Presidential Address to Section H, Brit. Assoc. Advance Sci. (1939).
[5] Von Koenigswald, G. H. R., and Weidenreich, F., NATURE, **144**, 926 (1939).
[6] Zuckerman, S., "Functional Affinities of Man, Monkeys and Apes" (London: Kegan Paul, 1933).
[7] Arkell, W. J., and Moy-Thomas, J. A., in "The New Systematics". Edited by J. S. Huxley. (Oxford University Press, 1940).
[8] Black, D., *Bull. Geol. Soc. China*, **9**, 7 and 97 (1930).
[9] *J. Roy. Anthrop. Inst.*, **68**, 17 (1938).
[10] Marston, A. T., *J. Roy. Anthrop. Inst.*, **67**, 339 (1937).

Penetrating Cosmic Ray Showers

IT is now recognized that the majority of cosmic ray showers at sea-level consist of electron cascades (see, for example, Jánossy[1] and Lovell[2]). The present investigation gives evidence for the existence of a very small number of penetrating showers remaining after the cascades have been removed by suitable absorbers. The frequency of these penetrating showers, however, amounts only to a few per cent of all showers at sea-level. They therefore could not be detected in the experiments referred to above, or in the similar experiments of Schmeiser and Bothe[3].

The experimental arrangement is shown in the accompanying diagram. The counters shown joined with lines are connected in parallel, giving five-fold coincidences 1-2-3-*A*-*B*. Each five-fold coincidence registered corresponds to a shower containing more than one particle near the top counters as well as near the bottom counters. The eight counters *H* are placed in the middle of the absorber *S* in order to obtain evidence on the number of rays in the shower. These counters control small neon indicators in such



a way that whenever a five-fold coincidence 1-2-3-*A*-*B* occurs, the lamps indicate the number n of the counters *H* which are discharged simultaneously with the coincidence. The neon flashes were recorded photographically. Some of the experimental results are collected in the table below.

Absorbers (cm. Pb)		Records containing n flashes (rate per 100 hour)		
T	*S*	$n = 0$ or 1	$n = \geq 2$	$n = 0-8$
0	50	11 ± 2·5	8 ± 2	19 ± 3
Various thicknesses 1·8 — 10·0 cm.	50	32·5 ± 2·2	15·6 ± 1·6	48 ± 3

Since the bottom counters are effectively surrounded by 50 cm. of lead, each shower giving rise to a coincidence necessarily contained particles penetrating at least 50 cm. of lead whatever the direction of the shower particles.

It can be calculated that a cascade shower which penetrates 50 cm. of lead must have an initial energy of at least 10^{19} ev. If electrons or photons of this energy were sufficiently frequent to account for our observations, they would have to transfer an enormous amount of energy into ionization on their way through a lead absorber. This ionization can be shown to be larger than the total ionization produced by the whole cosmic ray beam, and would therefore be incompatible with the known rate of ionization. If, therefore, the Bethe-Heitler theory is valid for very high energies, the showers cannot be cascades.

A meson may produce two independent secondaries, one near the top and another near the bottom counters, and so give rise to a five-fold coincidence. In general, such a 'double knock-on' will give rise to a record $n = 0$ or 1, according as to whether the primary meson is, or is not, recorded by one of the counters *H*. In fact, the observed number of records $n = 0$ or 1 is in good agreement with the estimated rate of double knock-on processes. Only a small fraction of the double knock-on showers should produce independent secondaries near the counters *H* and so give rise to records with $n \geq 2$. The observed rate of records $n \geq 2$ is, however, more than 50 per cent of those with $n = 0$ or 1. We conclude, therefore, that the records with $n \geq 2$ are *not* due to multiple knock-on showers. This conclusion would be invalidated if the cross-section for head-on collisions of mesons with electrons for energies above 5×10^{10} ev. should prove to be essentially larger than that calculated by Bhabha[4] or Massey and Corben[5].

Assuming, however, that the theories are correct, the records $n \geq 2$ must be interpreted as due to penetrating showers different from cascades and knock-on showers.

We have carried out experiments which suggest that these penetrating showers are connected with the extensive air showers. This is in agreement with the conclusions of Auger[6] and with recent experiments of Wataghin[7].

Though other interpretations cannot be excluded, it is plausible to assume that the observed showers contain several mesons simultaneously. The photographs of Braddick and Hensby[7] appear to show examples of two associated mesons.

Comparison of the coincidence rates for $T = 0$ and $T \geq 1{\cdot}8$ cm. shows that less than half the penetrating showers come from the air, while the rest are produced in the absorber T. It seems possible, therefore, that some of the observed showers are due to creation of mesons in the absorber T.

L. JÁNOSSY.
P. INGLEBY.

Physical Laboratories,
University,
Manchester.

[1] Jánossy, L., *Proc. Camb. Phil. Soc.*, **24**, 614 (1938).
[2] Lovell, A. C. B., *Proc. Roy. Soc.*, A, **172**, 568 (1939).
[3] Schmeiser, K., and Bothe, W., *Ann. Phys.*, **32**, 161 (1938).
[4] Bhabha, H. J., *Proc. Roy. Soc.*, A, **164**, 257 (1938).
[5] Massey, H. S. W., and Corben, H. C., *Proc. Camb. Phil. Soc.*, **35**, 463 (1939).
[6] Auger, P., Maze, R., and Grivet-Meyer, T., *C.R.*, **206**, 1723 (1938).
[7] Wataghin, G., Souza Santos, M. de., and Pompena, P. A., *Phys. Rev.*, **57**, 61 (1940).
[8] Braddick, H. J. J., and Hensby, G. S., NATURE, **144**, 1012 (1939).

Origin of Visual After-Images

IT is sometimes disputed whether visual after-images are due to retinal or central processes. Their retinal origin appears to be capable of demonstration as follows. If one eye is pressed with the finger or a spring balance near the outer canthus for about thirty seconds, it will become temporarily blind. This effect, known to Thomas Young, Helmholtz and Donders, is attributed to retinal anoxæmia. The pressure should be about 250 gm., applied over an area of 1 sq. cm. The easiest method is to press on top of the lids, keeping them sufficiently far apart to permit vision. A brown mist will spread over the visual field, and finally all objects will disappear. The image of a bright light, such as a 60-watt bulb, at a distance of 1 m. or 2 m. should now be thrown on a fixed region of the retina in the blind eye.

The easiest method is to fixate the light with the other eye; the natural convergence of the two eyes will cause the other to remain stationary though the pressure will prevent the image from falling exactly on the fovea. Such fixation is maintained for two minutes; the normal eye may be closed for a second from time to time, to make sure that the other eye is still completely blind. If, finally, the head is turned away from the light and pressure removed an after-image of the light will, of course, be seen with the normal eye on any suitable surface, being dark on a bright background and bright on a dark one.

If the normal eye be closed and the other opened ten seconds or so after pressure has been released, its vision will be found restored, and *an after-image positive or negative, will be seen against a suitable background, though the stimulation from the primary image has never reached the lower and higher visual centres at all.*

The image will usually be eccentrically placed in the visual field, through lack of normal fixation, and may be blurred or multiple owing to eye-movements. It may also be feebler at first owing to incomplete recovery of vision in the pressed eye. Under suitable conditions, however, its similarity to the image in the other eye leaves no doubt that both originate in the same way. This confirms the view that the positive after-image seen on a dark ground is due to retinal after-discharge, and the negative image on a bright ground to local reduction of retinal sensitivity. Since these effects occur despite anoxæmia, their photochemical origin is confirmed. The same result is obtained if the unpressed eye has been closed throughout, but fixation of the blind eye is then very difficult and there is no normal image for comparison. It is not denied that central processes may exert an inhibitory influence on these after-images.

Induced anoxæmia of the retina thus provides a useful method of blocking impulses between the retina and the visual centres and of isolating the contributions of different parts of the system to the sensory process.

K. J. W. CRAIK.

Psychological Laboratory,
University, Cambridge.
Feb. 27.

Metabolism of Tumours

IN a recent review[1] of the 1939 report of the British Empire Cancer Campaign, Dr. E. Boyland criticizes as "rather misleading" the following statement from the report of this Laboratory: "There appear at the present time to be two main points in which the metabolism of cancer differs from that of most normal tissues. Firstly the ability of cancer cells to form lactic acid persists even when the tissue is respiring, secondly cancer tissue has a respiratory quotient indicating that the oxidation of carbohydrate is abnormal".

This statement, far from being misleading, seems to me to be clear and correct: tumour tissue differs from most normal tissues in these two respects. In an earlier report[2] we had stated our view at length: following our findings[3] that kidney medulla has a powerful aerobic glycolysis not only in Ringer solution but also, contrary to György *et al.*[4], in serum, we said[2]: "In these somewhat rare cases, therefore, aerobic fermentation is certainly not associated with growth, still less with malignancy. Aerobic glycolysis is not specific for tumours, though practically all tumours have strong aerobic glycolysis". Later we studied cartilage[5] which we found[6] to have a similar type of metabolism. These are clearer examples than retina, since these tissues are probably no more damaged than in other tissue-slice experiments. Bone marrow glycolyses aerobically in Ringer's solution[7], though the preparation used by Fujita[2] had low aerobic glycolysis in serum.

Some of Dr. Boyland's other examples are less satisfactory. Liver[9,10], smooth muscle[10], diaphragm[11] and normal lymph glands[12,13,10] have all been reported with insignificant aerobic glycolysis compared with that of tumours. In fact, the transformation of normal liver into a hepatoma is a striking example[14,15]

of the development from normal liver metabolism of "The type of metabolic activity characteristic of malignant tissue generally, that is, active glycolysis with a relatively high value for the aerobic glycolysis"[15]. This important result does not seem to favour the view that cancer tissue arises in general from normal tissue with a cancer-like metabolism.

Normal skin glycolyses aerobically and undergoes relatively little alteration of metabolism when it becomes papillomatous[16], but when muscle is replaced by malignant sarcoma a great increase of glycolysis occurs[16]. In observations of which details are not yet published, Berenblum, Chain and Heatley[17] found with isolated epithelium of skin and of Shope papilloma little difference of metabolism or of *R.Q.*, the latter being low in both. Thus their results on skin epithelium appear to resemble those of Bywaters[5] on synovial membrane. If we exclude retina, of which the *R.Q.* is controversial, these two examples represent the present exceptions among normal tissues to both our generalizations. Although both are tissues of low metabolic activity, it is likely that similar characteristics will be found in more active tissues as the search proceeds. It is clear that neither of our generalizations, nor both in combination, is in the strictest sense specific for tumours. Nevertheless, the association in tumour metabolism of relatively high aerobic and anaerobic glycolysis with the lowered *R.Q.* is such a constant one that to dismiss it is to discard as unimportant the most characteristic of established biochemical peculiarities of tumour tissue.

F. DICKENS.

Cancer Research Laboratory,
North of England Council of the
British Empire Cancer Campaign,
Newcastle-upon-Tyne.
Feb. 23.

[1] NATURE, **145**, 246 (1940).
[2] *Ann. Rep. Brit. Emp. Cancer Campaign*, **13**, 158 (1936).
[3] Dickens, F., and Weil-Malherbe, H., *Biochem. J.*, **30**, 659 (1936).
[4] György, P., Keller, W., and Brehme, T., *Biochem. Z.*, **200**, 356 (1928).
[5] Bywaters, E. G. L., *J. Path. and Bact.*, **44**, 247 (1937).
[6] Dickens, F., and Weil-Malherbe, H., NATURE, **138**, 125 (1936).
[7] Orr, J. W., and Stickland, L. H., *Biochem. J.*, **32**, 567 (1938).
[8] Fujita, A., *Biochem. Z.*, **197**, 175 (1928).
[9] Elliott, K. A. C., Greig, M. E., and Benoy, M. P., *Biochem. J.*, **31**, 1003 (1937).
[10] Rosenthal, O., and Lasnitzki, A., *Biochem. Z.*, **196**, 340 (1928).
[11] Meyerhof, O., Chemische Vorgänge im Muskel, Berlin, 1930, p. 55 and own unpub. results (in serum).
[12] Victor, J., and Winterstein, M. R., *Amer. J. Cancer*, **22**, 561 (1934).
[13] Victor, J., and Potter, J. S., *Amer. J. Cancer*, **32**, 554 (1938) (p. 558, correction).
[14] Nakatani, M., *et al.*, *Gann*, **32**, 240 (1938).
[15] Orr, J. W., and Stickland, L. H., *Ann. Rep. Brit. Emp. Cancer Campaign*, **16**, 161 (1938); and *Chem. and Ind.*, **58**, 1088 (1939).
[16] Crabtree, H. G., *Biochem. J.*, **22**, 1289 (1928).
[17] *Ann. Rep. Brit. Emp. Cancer Campaign*, **16**, 215 (1939).

THE above letter contains two conflicting statements.

(1) "Aerobic glycolysis is not specific for tumours, though practically all tumours have strong aerobic glycolysis." This from Dr. Dickens's report of 1936 seems to be a fair and true statement of the position and not consistent with the following statement from the 1939 report, which I consider "rather misleading".

(2) "There appear at the present time to be two main points in which the metabolism of cancer differs from that of most normal tissues. Firstly the ability of cancer cells to form lactic acid persists even when the tissue is respiring."

Benign growths and most body tissues (with some exceptions, such as kidney cortex, spleen, ovary and lung) which have been carefully examined appear to have some aerobic glycolysis (for example, testis $Q_L^{O_2}$ 2·8–5·5, liver 0·9–4·3, uterus 3·0–6·9). Some of these non-malignant tissues, in addition to the three mentioned by Dr. Dickens, also have a lowered *R.Q.* A few malignant tumours, particularly some human carcinomata[1] and some spontaneous carcinomata in mice[2], have lower aerobic glycolysis than many 'normal' tissues.

There can be no doubt that the British Empire Cancer Campaign has in this, as in so many other problems connected with cancer, given most valuable help by securing the thorough investigation of the question in several different laboratories.

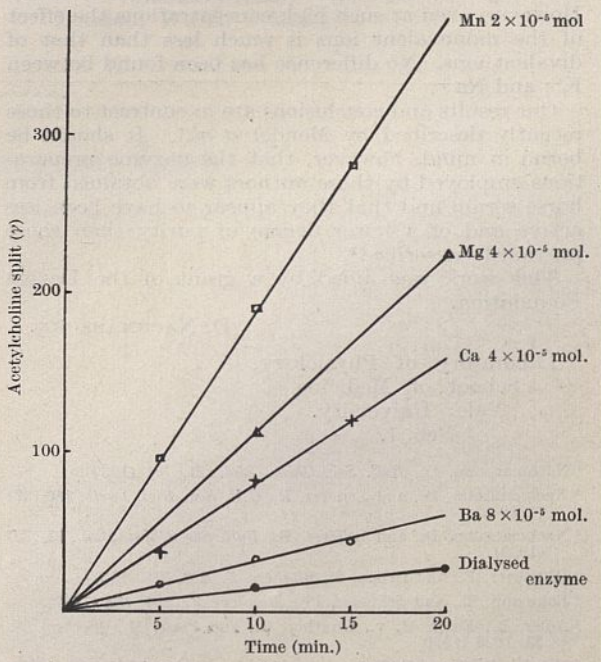
E. BOYLAND.

Chester Beatty Research Institute,
The Royal Cancer Hospital (Free),
London, S.W.3.
Feb. 29.

[1] Dickens, F., and Patey, D. H., *Lancet*, **2**, 1229 (1930).
[2] Murphy, J. B., and Hawkins, J. A., *J. Gen. Physiol.*, **8**, 115 (1925).

Action of Ions on Choline Esterase

THE physiological significance of choline esterase suggested by its high concentration at muscle end plates and at synapses of the central nervous system[1] makes it desirable to investigate the properties of the enzyme. The electric organ of Torpedo, which is considered as an accumulation of muscle end plates, has by far the highest content of choline esterase ever found in a tissue of fluid. An organ of 100–200 gm. weight splits about 200–400 gm. acetylcholine in 60 min., which is a hydrolytic power of the



ACTION OF DIVALENT IONS ON CHOLINE ESTERASE

same order of magnitude as calculated for end plates. The organ has therefore been used as material for the preparation of active enzyme solutions[2].

Evidence obtained previously from these preparations indicated that the enzyme contains —SH groups essential for its activity[3]. The present investigations show that the enzyme is only active in the presence of divalent cations. After dialysis the enzyme practically completely loses its activity. A few γ of divalent ions reactivate it. The order of activation by the ions is as follows: Ba++, Ca++, Mg++, Mn++ (see accompanying figure). Mn++ in a concentration of 0·00002 mol. (1·1 γ per c.c.) increased the amount of acetylcholine split in 60 min. from 0·08 to 1·13 mgm.

Meyerhof's co-workers described a strong effect of Mn++ on the action of cozymase[4] and cocarboxylase[5]. Mg++ was also active but to a smaller extent. v. Euler and his associates[6] observed that *iso*-citric dehydrogenase does not act unless Mn++ or Mg++ are present. In all three enzyme systems concentrations of the ions and relationships between the strength of Mn++ and Mg++ were similar to those described here.

The reactivation by cations occurs at a point different from that at which the reactivation by reduction of S–S groups takes place. The maximal effect of glutathione plus Mg++ is equal to the sum of the effects of each alone (see accompanying table).

SUM OF EFFECTS OF Mg++ AND GLUTATHIONE. MGM. ACETYLCHOLINE SPLIT IN 60 MIN.

	Values obtained	Calculated values
Dialysed enzyme	0·45	0·45
+ GSH 0·0003 mol.	2·20	+ 1·75
+ GSH 0·001 mol.	2·30	
+ Mg++ 0·002 mol.	1·85	+ 1·40
+ Mg++ 0·002 mol. + GSH 0·0003 mol.	3·67	3·60

Monovalent ions (Na,K) also reactivate the enzyme, but only at very high concentrations (0·1 mol.). However, even at such high concentrations the effect of the monovalent ions is much less than that of divalent ions. No difference has been found between K+ and Na+.

Our results and conclusions are in contrast to those recently described by Mendel *et al.*[7]. It should be borne in mind, however, that the enzyme preparations employed by those authors were obtained from horse serum and that they appear to have been less active and of a lower degree of purity than those previously described[2].

This work was aided by a grant of the Dazian Foundation.

D. NACHMANSOHN.

Laboratory of Physiology,
School of Medicine,
Yale University.
Feb. 7.

[1] Nachmansohn, D., *Bull. Soc. Chim. Biol.*, **21**, 761 (1939).

[2] Nachmansohn, D., and Lederer, E., *C.R. Soc. Biol. Paris*, **130**, 321 (1939).

[3] Nachmansohn, D., and Lederer, E., *Bull. Soc. Chim. Biol.*, **21**, 797 (1939).

[4] Ohlmeyer, P., and Ochoa, S., *Biochem. Z.*, **293**, 338 (1937).

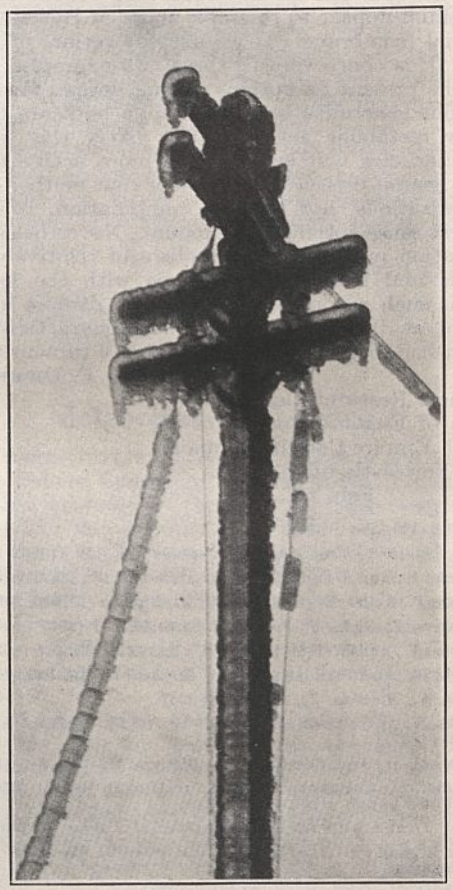
[5] Lohmann, K., and Schuster, Ph., *Biochem. Z.*, **294**, 183 (1937).

[6] Adler, E., Euler, H. v., Gunther, G., and Plass, M., *Biochem. J.*, **33**, 1028 (1939).

[7] Mendel, B., Mundell, D., and Strelitz, F., NATURE, **144**, 479 (1939).

Ice Formation in Worcestershire

ON January 27, when the great snowstorm was developing, the Evesham district experienced a relatively light fall and this changed at night to 'supercooled' rain. Sunday, January 28, found us awaking to a strange 'creaking' of trees in the wind due, I found, to an armour of thick ice. Most of the ice was on top—my aerial had ¾ in. above, ¼ in. below. Wider exploration presented an amazing experience. Roads, walls, trees, hedges—everything was coated with inches of crystal clear ice. Branches and twigs were encased in ice many times their own diameter, and many were, like the telegraph wires in the accompanying illustration, either broken down or



snapping as I passed. Slight rain was still falling and freezing instantly. There seems no doubt that rain had been falling all night in a 'supercooled' state, contact with objects initiating solidification, generally complete before the water could run underneath. People were chiselling their way into cars left outside, and ice on one near Broadway Tower was 6 in. thick.

I saw wood-pigeons, encased in ice as they roosted, hobbling through the grass. Presumably with the receipt of latent heat they had realized nothing untoward until attempting to fly. Roads themselves were sheets of ice—6 in. thick on Broadway Hill—and being used as skating rinks.

Quantitatively—ice 4 in. thick on twigs common, 'blades' of grass 4 in. thick; I measured one telegraph pole guy 18 in. in circumference; one branch weighed

before and after thawing gave ratio 64 to 1, and on one fine grass blade the ice weighed 197 times the grass.

The whole appearance of the countryside was fantastic and grotesque, and it would be interesting to know if any previous similar occurrence is on record.

A. A. NEWBOLD.

The Haven, Greenhill,
Evesham.

Optical Anisotropy of Cellulosic Sheets

THE following observations on the optical anisotropy of cellulose ester sheets may supplement the findings of Drummond[1].

Whether the 'slow ray' in the plane of the sheet is normal to, or coincident with, the direction of stress depends on the hydroxyl content of the ester, and, to a lesser extent, on the solvent content of the sheet when stress is applied.

Increasing hydroxyl content favours the same direction as that of the stress, whereas, as surmised by Drummond, introduction of acyl groups favours the normal direction. Thus, with cellulose acetates, the acetyl contents of which are greater than 43 per cent, the slow ray direction may be normal to the direction of stress; similar behaviour is also shown by cellulose nitrate sheets.

Within a certain range of hydroxyl contents, in acetate and in nitrate sheets the amount of solvent or imbibed liquid when tension is applied may influence the position of the slow ray. In general, the slow ray lies normal to the direction of stress if tension is applied to a sheet which contains a large proportion of solvent, whereas removal of the latter favours its location in the direction of the applied stress.

The extrapolation of birefringence values of cellulose ester sheets to zero acetyl content by Drummond finds some justification from measurements made on uniaxial cellulose acetate sheets, where the increase in negative birefringence is approximately linear with a decrease from 44·8 to 27·0 per cent acetyl. This is more strictly the case in the triacetate region, provided a solvent is selected which gives relatively flexible sheets, and that esters of similar chain-length are employed. As might be anticipated, increase of chain-length increases the negative birefringence.

A detailed discussion of these results will be published elsewhere.

It may be opportune to emphasize here that this method of sheet birefringence determination[2] in its more accurate form is restricted to sheets of relatively low values of birefringence such as those which lie beyond the sensitivity of immersion methods. The method is essentially an approximation in two respects, first, in the assumption of identity of path of the two components in transmission through the sheet, and secondly, in the inherent approximation of the graphical extrapolation.

JOHN SPENCE.

Research Laboratories,
Eastman Kodak Company,
Rochester, N.Y. Feb. 15.

[1] Drummond, D. G., NATURE, **145**, 67 (1940).
[2] Spence, J., *J. Phys. Chem.*, **43**, 865 (1939).

Structure of Cellulose Acetate

RECENTLY I have examined several samples of cast plasticized secondary cellulose acetate sheet material under the microscope. With crossed nicols a uniform yellow polarization colour was shown, indicating a considerable amount of orientation. Taking the casting flow-lines, parallel to the 'selvedge' edge, as the direction of the *c* axis, the samples showed oblique extinction. This phenomenon is consistent with the view that the cellulose acetate unit, and also the parent cellulose, is monoclinic rather than orthorhombic.

C. A. REDFARN.

Quality House, Quality Court,
Chancery Lane,
London, W.C.2. March 6.

Points from Foregoing Letters

L. Jánossy and P. Ingleby have carried out counter experiments which give evidence for the occurrence of penetrating showers distinctly different from cascades or knock-on showers. Parts of the showers may possibly be accounted for by assuming the creation of mesons in lead.

Mechanical pressure on the eye causes temporary blindness through retinal anoxæmia. K. J. W. Craik finds that after-images of a light exposed to the eye in this condition can be seen on releasing the pressure. This appears to demonstrate their retinal origin, since the stimulation from the primary image has never reached the visual centres in the brain.

In a reply by F. Dickens to a recent comment by Boyland, it is pointed out that although the association of a lowered respiratory quotient with a strong aerobic glycolysis is no longer considered as strictly specific to tumour metabolism, the occurrence among normal tissues of this combination is exceptional enough for it to remain the most characteristic of the known biochemical features of cancer. Dr. Boyland replies that, in his opinion, as this combination does recur in some cases, it is undesirable to say that tumours differ from non-malignant tissues in these properties.

Using enzyme preparations obtained from the electric organ of Torpedo, D. Nachmansohn finds that choline esterase is only active in the presence of divalent cations. Monovalent cations will reactivate the enzyme, but only at very high concentrations.

J. Spence points out, in regard to the anisotropy of cellulose sheets, that the hydroxyl content of the cellulose ester and the solvent content of the sheet influence the orientation of the slow ray in the plane of the stressed sheet. Uniaxial cellulose acetate sheets show, within limits, a linear increase in negative birefringence with increasing hydroxyl content.

RESEARCH ITEMS

Pleistocene and Prehistory in Europe and China

EXTENSIVE research by Wen-Chung Pei in the Chinese Pleistocene and comparison with corresponding results of European geologists and archæologists is summarized in "An Attempted Correlation of Quaternary Geology, Palæontology and Prehistory in Europe and China" (Institute of Archæology, University of London. Occasional Paper No. 2, 1939. Pp. 16+2 tables. 2*s*. 6*d*.). The object of the investigation was to arrive at the age of Sinanthropus, which is here assigned to the Lower Pleistocene in spite of the lithic industry, which exhibits a few features that in Europe do not appear until later. From the point of view of human evolution Sinanthropus would be contemporary with the European Eoanthropus and *Homo Heidelbergensis*. While the European Quaternary covers four main periods of cold climate, in China four physiographic cycles may be observed in which phases of erosion alternated with phases of sedimentation. From the geological point of view, Europe and China have two series of Pleistocene deposits in common, the older covering the period from late Pliocene to early Pleistocene, the younger characterized by the frequent occurrence of loessic material. These two series can be correlated in Europe and in China stratigraphically, lithologically and faunistically; but it is impossible to go further and into detail. It is premature, therefore, to base a correlation on geological evidence only. A purely palæontological basis, notwithstanding difficulties, is more satisfactory. The early Saumenian corresponds to Villafranchian, Choukoutien (Sinanthropus level) to Cromerian, Choukoutien III to early middle Pleistocene, Sjara-Osso-gol (Ordos) to Neanderthal, and Choukoutien Upper Cave to European Upper Palæolithic. Prehistory helps little, owing to differences of workmanship, but subject to this proviso, Choukoutien loc. 13 is contemporary with Abbevillian, Choukoutien loc. 15 with early Acheulean, early Clactonian and Tayacian, Ordos with middle and late Acheulean, Micoque, early and middle Levalloisian and Mousterian, and Choukoutien Upper Cave with upper Palæolithic—Aurignacian, Solutrean and Magdalenian.

Insulin Hypoglycæmia and the Central Nervous System

ERNST GELLHORN reported his investigations on the effects on the central nervous system of insulin hypoglycæmia before the recent meeting of the American Association. There is a close interrelationship between its effects and those of cerebral anoxia, in that the two states are mutually synergistic, and in both there is depressed cortical but augmented autonomic excitability. The resultant increased activity of the sympathetic system tends to restore the blood-sugar level, and at the same time to render the medullary centres less excitable, in this case by a direct action upon them of circulating adrenalin. Such reactions tend to restore the animal to its resting state, but may, under slightly different conditions, aggravate the effects of the changes. Thus, prolonged anoxia may prevent hypoglycæmic convulsions, but may also prevent the eventual restoration of a normal blood-sugar level by depressing the mobilization of the hepatic stores of glycogen.

Inheritance of Bobbed Hair

S. E. STODDARD (*J. Hered.*, **130**, 543–545; 1940) reports a pedigree in man showing the inheritance as an autosomal dominant of a short fore-lock. The hairs of the fore-lock on the head of the affected individuals grow to five or six inches and then fall out, being replaced by new hairs which again reach 5½ inches and then fall out. This self-bobbing characteristic is to be called 'catatrichy'.

The Oldest Vertebrate Egg

FOSSIL reptilian eggs have been recorded from Cretaceous and Jurassic deposits, but they are rare, and the most striking discovery hitherto was the nest of dinosaur eggs found in the Desert of Gobi by Dr. Roy Chapman Andrews and his fellow-explorers. All earlier records are, however, much antedated by the discovery of an egg, 59 mm. long, at Rattlesnake Canyon, Archer Co., Texas, in rocks which lie close to the boundary between Carboniferous and Permian. Prof. Alfred S. Romer and Llewellyn I. Price describe the shell, almost 1 mm. thick, as ornamented with small rounded tubercles, and in section showing lamellæ, typical of amniote egg-shells (*Amer. J. Sci.*, **237**, 826; 1939). The interior, as examined by X-ray photographs, showed no indication of embryonic development. Although it is impossible to say to what reptile the egg must be assigned, the most abundant of the four common reptiles of the Red-beds of Texas is the pelycosaur Ophiacodon (Theropleura), and the "chances are perhaps somewhat in its favor as the possible progenitor".

Growth Hormones in Seed Dressings

H. E. Croxall and L. Ogilvie (*J. Pom. and Hort. Sci.*, **17**, 362; 1940) have shown that the application to pea and bean seeds of dry fungicidal dressings containing growth-promoting substances may be of considerable value. The vegetative growth of several different varieties of pea plants was stimulated by such treatments, but there was no difference in time of flowering. The dressings used consisted of talc, a proprietary mercurial dressing, and cuprous oxide, containing 5–20 parts per million of naphthalene acetic acid, mixed naphthylidene acetic acids and indolyl butyric acid. The rate of emergence of pea seeds sown in sterile soil in the greenhouse was accelerated, and the dry weight of the seedlings after three weeks growth was increased, by treating the seeds with the above dressings. In certain conditions, the development of some varieties of peas was checked by mercurial and cuprous oxide dressings. This check was partly or entirely overcome by the incorporation of growth substances. In field trials in summer, mercurial and cuprous oxide dressings alone reduced the crop when the soil was dry for a long period, but dressings containing growth substances gave yields up to 80 per cent greater than those from untreated seeds. In greenhouse soil contaminated with damping-off fungi, a higher percentage emergence from several varieties of peas, and one of dwarf beans, was obtained by treating the seeds with hormone-containing dressings than by the use of the same dressings without hormones. There was considerable difference in the response of different varieties to the dressings used.

Two Distinct Diaphorases

COENZYME-SPECIFIC dehydrogenases catalysing the oxidation of tissue metabolites such as lactic acid may require the presence of coenzyme I (diphosphopyridine nucleotide) or coenzyme II (triphosphopyridine nucleotide). Reduced coenzymes I and II do not by themselves react with oxygen, and a further link has been made by the demonstration of the presence in animal tissues of a 'coenzyme oxidase', named by Euler 'diaphorase' and by Dewan and Green 'coenzyme factor', which catalyses the oxidation of these reduced coenzymes I and II. Also, cytochromes *-a* and *-b* are rapidly reduced by the diaphorase – coenzyme system and re-oxidized by cytochrome oxidase and oxygen. The complete system for lactate is thus :

Lactate —→ Coenzyme —→ Cytochromes *-a* and *-b* —→ Oxygen
dehydrogenase diaphorase cytochrome oxidase

(arrows show the direction of hydrogen transfer). Straub, Corran and Green showed that diaphorase is identical with a flavoprotein isolated from heart muscle containing flavin-adenine-dinucleotide as prosthetic group. E. P. Abraham and E. Adler (*Biochem. J.*, **34**, 119 ; 1940) have now confirmed that there are two distinct diaphorases having activities with respect to coenzyme I and coenzyme II. Thus diaphorase from heart has only diaphorase I activity, and that from acetone-dried adrenal possesses also diaphorase II activity, and the ratio of the activities of diaphorase II and diaphorase I varies widely for different tissues.

Evaluation of *e*, *m* and *h*

AN important paper on the evaluation of the electronic charge and mass and the quantum of action was read by C. G. Darwin at a meeting of the Physical Society on February 9, and is appearing in the March issue of that Society's *Proceedings*. This subject has recently been discussed by Dunnington in *Reviews of Modern Physics* and by Du Mond in the *Physical Review*. The aim in each case is to derive the best possible values of *e*, *m* and *h* by combining all the different experimental data. By considering the logarithms of the quantities concerned rather than the quantities themselves, Darwin develops a method which is simpler than Dunnington's and might well be adopted in any future revision of the constants. Du Mond takes much the same point of view, but where his method is approximate, Darwin's is exact. Darwin agrees with the other two investigators in concluding that there is a discrepancy between the direct determination of h/e and the other experimental methods. There has probably been some unknown systematic error in the determinations of the limit of the X-ray continuous spectrum, unless, as is far less likely, there are systematic errors in several of the other experiments which happen to give concordant fallacious values. The final results are : $e = 4{\cdot}8025 \times 10^{-10}$, $e/mc = 1{\cdot}7591 \times 10^{7}$ and $h = 6{\cdot}6243 \times 10^{-27}$, the probable error being about one in ten thousand in each case. With these values the fine-structure constant $hc/2\pi e^2$ is 137·03, with probable error about 0·03.

The Study of Atmospherics

T. H. Laby, J. J. McNeill, F. G. Nicholls and A. F. B. Nickson (*Proc. Roy. Soc.*, A, **174**, 145) have carried out a series of investigations of atmospherics, using an aperiodic aerial connected through an amplifier to a self-recording cathode-ray oscillograph. The results confirm those of previous workers that the electric field changes due to a lightning discharge include a slow field change due to the leader stroke, a rapid return stroke, and a final slow non-oscillating change. The disturbance is often followed by waves reflected from the ionosphere. In some cases a damped oscillating discharge was observed, and reasons are given for regarding this as a feature of the discharge rather than a result of successive reflections. A mean value of the peak power in an atmospheric is 5×10^5 kw., and of the total energy radiated 200 kw. sec. This is small compared with the total energy of a thundercloud.

An Auto-collimating Spectrohelioscope

M. A. ELLISON has described very fully a home-made spectrohelioscope (*J. Brit. Astro. Assoc.*, **50**, 3 ; 1940). The instrument took Mr. Ellison 2½ years to construct. A clear explanation with numerous diagrams is provided, and those who are interested in the subject should study the paper carefully. It is satisfactory to know that the performance of the instrument has come up to expectations, and most of the chromospheric details in $H\alpha$ light visible in the Hale instruments are shown. The performance is particularly good with limb prominences.

Spectrum of Nova Aquilæ (1918)

A DETAILED examination of the spectrum of Nova Aquilæ has been made by Arthur B. Wyse (*Pub. Lick Observatory*, **14**, Pt. 3) and is a valuable contribution to data already published by a number of other workers on this interesting nova. Nova Aquilæ is the only nova of which the pre-nova stage spectrum is known. As a star of about mag. 10·5, its spectrum appears as approximately of Class *A* on the Harvard plates taken about thirty years before the outburst. With a rapid rise in brightness commencing on June 7, 1918, it reached a maximum brilliance of mag. — 1·1 by June 9·9. (It is the brightest nova since Nova Ophiuchi in 1604.) At the present time it is a star of about mag. 10·8. Another interesting feature of this nova was the subsequent appearance of an expanding luminous disk discovered by Barnard three and a half months after the outburst on June 7. Later measurements made by Aitken gave a rate of angular expansion of about 2″ a year. Combining with this value the measured Doppler shifts representing radial motion, a distance of about 360 parsecs or 1,200 light years is derived. The absolute luminosity of the nova at maximum was of the order 300,000 times that of the sun. The spectrograms which form the basis of the present work were taken at the Lick Observatory, but because of the rapid changes in spectrum during the active stages of the nova, spectrograms from a number of other observatories (Mt. Wilson, Cape of Good Hope, Cambridge, etc.) form a valuable link in the daily journal of the spectrum which Dr. Wyse has prepared. Reference must be made to the text for details of the changing absorption and emission spectra. There were three absorption spectra recognized in the order of appearance, I, II and III, on June 8, 10 and 11 respectively. This order also represents the relative magnitudes of the Doppler displacements of the spectral lines towards the violet. The chief points of interest in the emission spectrum include the oscillatory change in the profiles of the bands during the few weeks following the outburst, and also the peculiar distribution of light in the various emission bands in the spectrum of the expanding nebulous envelope.

INTERNATIONAL HEALTH INVESTIGATIONS

THE report to the Council of the League of Nations on the work of the thirty-first session of the Health Committee, November 20–24, 1939 (Special Supplement to Monthly Summary of the League of Nations, January, 1940), emphasizes the important duties of the Health Organisation under war-time conditions, particularly in view of the threats to health from movement of populations and evacuation.

The Committee agreed that the permanent health services should not be interrupted, particularly the Epidemiological Intelligence Service, the Singapore Bureau and the biological standardization work, the utility of which is universally acknowledged. It is also desirable to continue studies on which a considerable amount of work has already been carried out, such as the inquiry into the radiological treatment of cancer of the cervix uteri, the preparation for the unification of the various national pharmacopœias, the studies undertaken by the Malaria Commission on malaria immunity, and the biology of certain strains of Plasmodium, the co-ordination of investigations into nutrition in the East, and the analysis of the annual statistics of rabies. The Committee also considers that national committees and national institutes should be urged to continue their work on nutrition, physical fitness and housing, for which the Health Section will ensure the necessary liaison and co-ordination. It was considered that comparatively new studies, such as museums of hygiene, clothing and the preparation of an international list of diseases, must be relegated to the background for the present, and it was agreed that the impending Pan-African Health Conference should be deferred until the end of the War. The Anti-malarial Drug Conference and the Rabies Conference have been similarly deferred.

In view of the repercussions the present War is likely to have on public health, the Health Committee considers that attention should be devoted to such questions as the importation of diseases into regions hitherto free, the possible contamination of drinking water, and lower standards of living and hygiene. The Emergency Sub-Committee and the Health Section have accordingly been authorized to take such action as circumstances require, including a stocktaking of the armoury of preventive and curative weapons made possible by modern epidemiology, chemotherapy and serotherapy. The Health Section proposes to define the principles which should be followed in the control of those epidemic diseases which are regarded as the most important in present circumstances, for example, immunization against diphtheria and scarlet fever. Other questions to which the Health Organization is prepared to give attention are the medico-social problems arising out of the evacuation of threatened populations from war zones, including questions of environmental hygiene among evacuated persons living in the reception areas and individual standards of hygiene, as well as problems of food supply requiring the application of the rules of modern dietetics in the use of foodstuffs and in collective and individual dietaries. In view of the considerably increased volume of work anticipated, the Committee directed the Secretary-General's attention to the desirability of making at least some temporary increase in the staff.

The introduction of international biological standards by the Copenhagen and Hampstead Institutes has continued normally, and the number of institutes using these standards has increased. The Health Committee once more directed attention to the recommendation adopted by the Permanent Commission on Biological Standardisation in 1928 regarding nomenclature to be used in the designation of blood groups.

The report of the Housing Committee, which met at Geneva during June 26–July 1, 1939, to discuss the hygiene of the planning of space, the abatement of smoke, dust and toxic gases, water supply, sewage treatment, and the collection and treatment of domestic refuse, is being communicated to Governments, health administrations and the institutions concerned.

RECENT AMERICAN WORK ON PLANT VIRUSES

THE meeting of the American Association for the Advancement of Science, which was held at Columbus, Ohio, in December, was the occasion for the presentation of several interesting papers which make fundamental contributions to our knowledge of plant virus diseases. The first categorical indication of structure of the virus particle can be obtained from a comparison of the work of John W. Gowen, of Iowa State College, with earlier findings. His work on X-ray inactivation and size of various organisms, including insects, bacteria and viruses, shows that functional correlation of these two factors "must be between the size of some vital substances within the cell rather than the cell as a whole". The 'reproductive' part of a virus particle has a molecular weight of 15,000,000, which compares with about 7,000,000 suggested by other workers for the whole virus particle. The portion of a virus susceptible to inactivation by X-rays is apparently denser than the rest of the particle.

Vernon L. Frampton, of Cornell University, showed that the protein of tobacco mosaic virus is thixotropic; it forms a colloidal sol, but can change to the fluid state if it is agitated. The report consisted of motion pictures which recorded the birefringence of the sol as observed through polaroid plates. Thixotropic gels show neither Brownian movement, diffusion nor osmotic phenomena, and it is pointed

out that any attempt to determine molecular weight of the protein by any of these means would yield abnormally large values.

In the sphere of host-virus relations, Ernest L. Spencer, of the Rockefeller Institute for Medical Research, demonstrated that the rate of virus multiplication is closely bound with the nitrogen metabolism of the host. Tobacco plants growing in pure culture, and supplied with a relatively large amount of nitrogen, allowed the virus to attain about five times the concentration found in normally fed plants. The effect was not due to an increased growth-rate of the plant, and it was also demonstrated with older seedlings. James M. Wallace, of Riverside, California, dealt with the development of resistance to the curly top virus of Turkish tobacco. He showed that plants recover from an attack by the virus, a certain time after inoculation. Such plants, when re-inoculated, do not again develop severe symptoms. Transmission from a recovered to a healthy plant by means of insect vectors induced severe symptoms in the healthy plants, but grafting merely transferred the mild symptoms typical of the recovered plants. Resistance, therefore, appears to be due to some interaction which is set up between host and virus.

INDIAN SCIENCE CONGRESS ASSOCIATION*

MADRAS MEETING

ASPECTS OF THE MYXOPHYCEÆ

Prof. Y. Bhâradwâja, presiding over the Section of Botany, considered the peculiar group of algæ known as the Myxophyceæ. These algæ present many problems, both economic and botanical, and in spite of the extensive literature there is scarcely any authoritative statement that can be made concerning any aspect of their study at the present time. Owing to the peculiar properties of their cells, many of them are able to exist under high-temperature conditions and are largely tropical in their distribution, so that India is a particularly suitable centre for their study. With the active investigations that are being carried out by Prof. Bhâradwâja and other algologists at Madras, Lahore and Benares, it is hoped that much light will be thrown upon their peculiar features.

A special interest of this group for India is the way in which the Myxophyceæ at times undergo extreme development and give rise to the condition known as 'water-bloom'. On death and decay, such masses of algæ give disagreeable tastes and odours to the water and may render it unfit for drinking purposes, in fact there are records from many parts of the world of serious effects produced upon man and animals by drinking such water. In India, water-blooms are of common occurrence in ponds, pools and tanks, the water of which is used for consumption by humans and domesticated animals; though no serious effects have so far resulted in India, it is obviously a subject requiring investigation. Such points as the conditions favouring the development of the blooms, the contributing organisms, methods of control, and the manner in which the organisms persist all require workers in India.

Prof. Bhâradwâja also directed attention to the problems played by Myxophyceæ in soil ecology. These algæ occur in considerable numbers in the soil flora and some of them, notably Nostoc and Anabæna, are capable of nitrogen-fixation. In the Indian rice fields, the same crop is grown year after year without addition of manure, and it has been discussed whether the abundant development of these algæ during inundation may be a factor of any importance. Fritsch and De came to the conclusion that their part in this connexion was probably relatively insignificant, but the problem needs further study.

*Continued from page 471.

The Myxophyceæ are also in need of closer study and revision from the botanical point of view. In many cases the generic distinctions are unsatisfactory, as they are not applied logically and allow of too much intergrading. Their cytology has received considerable attention lately and most workers are now agreed that the central body may be regarded as a nucleus.

Systematic study of the group involves such problems as their relation to the isolated group of the Chamæsiphonales and also to the Bacteria, especially such types as the sulphur bacteria.

Prof. Bhâradwâja's address points out the wide scope for workers in this field, and his survey of the present position of knowledge of the group will be a valuable basis for anyone attracted to further the study of the Myxophyceæ.

AIR-BREATHING FISHES

The presidential address to the Section of Zoology was delivered by Prof. B. K. Das.

In a comprehensive survey of present knowledge of the phenomenon of 'air-breathing' in fishes, Prof. Das developed the theory of structural adaptation in response to environmental change. "The habit of swallowing air," he says, "being long continued, becomes deeply engrained in the constitution of the species, generations after generations, and is gradually improved and eventually leads to structural modifications, usually in the form of reservoirs adapted to lodge the inhaled air. These reservoirs are of very different forms and quite independently evolved, in each and every species of fish. . . ."

Six main types were described of progressive adaptations, which are to be seen in modern air-breathing fishes, namely, modifications of the buccopharynx; pharyngeal 'lung'; opercular chambers; opercular 'lung'; specialized parts of the alimentary canal (stomach and intestine); and the air-bladder. These accessory respiratory organs are regarded as the physiological forerunners of the true lungs of the terrestrial vertebrates, evolved in consequence of a lack of oxygen in the water.

The views of Carter and Beadle are supported and quoted verbatim: ". . . A power of breathing air must have been a necessary preliminary to the possibility of migration to land. It appears probable

that the development or the preservation of aerial respiration in fishes of the tropical fresh waters was a response to the shortage of oxygen in the water, and that it occurred while the fish was still purely aquatic. The fish was then ready for the later changes which completed the migration. The stimulus for these was probably provided by the droughts to which any animal living in such waters must have been subjected. That this has been the course of the later stages of the migration on to the land is generally accepted, but it does not seem to have been so generally realized that the first stage in the process of migration was the evolution of adaptations to aerial respiration, first instigated by the lack of oxygen in the shallow tropical fresh waters in which the fish lived."

This presidential address in its printed form, with its extensive bibliography and liberal quotations from the work of other investigators, is to be welcomed as a helpful handbook of reference to a subject of general biological interest.

Ecology and Control of Insects

Dr. Hem Singh Pruthi, in his presidential address to the Section of Entomology, discussed the general principles of insect ecology and, in particular, the application of such knowledge to insect control. As he pointed out, if we know the conditions of environment of an insect pest and the influence of changes thereof on its population, it may be possible to predict the outbreak of the pest in advance or to evolve methods which would keep the injurious species under control. Of the various physical factors of environment, temperature is undoubtedly the most important single agency. In order to illustrate the influence of this factor and to indicate how such information can be utilized by applied entomologists, examples are given of Zwolfer's critical work on the nun moth, *Lymantra monacha*, of Bodenheimer's studies on the Mediterranean fruit-fly and of several other works.

Next in importance to heat, the fundamental necessity of insects, as of other animals, is the moisture content of their environment. Too low or too high humidity is injurious to their existence. On the basis of such information, the Imperial Agricultural Research Institute has shown that good and well-spread rains do not reduce the spotted boll worms of cotton directly, but indirectly by raising the atmospheric humidity, which is inimical to the bollworm and conducive to the multiplication of its parasite *Microbracon lefroyi*. Afzal Husain and Haroon Khan's work on the ecology of pink bollworm of cotton in the Punjab illustrates the combined effect of temperature and humidity on insect prevalence. They found that temperatures between about 18° C. and 26° C., with a relative humidity of more than 70 per cent, are most suitable for egg production and oviposition. Those parts of the Punjab where temperature and humidity conditions approach the above figures during July–October, which is the active period of the pest, are badly infested with the bollworm, while in canal colonies and the western Punjab, where the conditions are different, the pink bollworm does not occur as a pest.

Insects are not only exposed to climatic factors but also to biotic factors such as parasites, predators, competitors, types of surrounding vegetation, etc. The importance of natural enemies in reducing the population of insect pests is well known and is being exploited by workers on biological control of pests. The basic principle underlying this method is the differential behaviour of a pest and its parasite under the same ecological conditions. This is illustrated by Shelford's work on the aphid, *Toxoptera graminum* and its parasite, *Lysiphlebus tritici*, and by the researches of several other workers. Even small differences in the rates of development of the host and parasite may cause the extinction of one or the other.

The control of malaria-transmitting mosquitoes by ecological methods has had undoubted success in certain areas and has possibilities of more general application. The fact that most of the vector Anophelines do not breed in sewage-polluted waters is exploited by turning industrial wastes, etc., into clean breeding waters. On the same principle the filling of pools and streams with cut vegetation, termed 'herbage package', which not only acts as mechanical obstruction but also pollutes the water, and brings about other changes, has been made use of as an anti-malarial method. Strickland recently showed that streams shaded by forests, in Assam, breed only non-vector harmless mosquitoes, and when these shades are cleared the malaria-carrying species at once appears and begins to breed. Therefore, shading of streams by growing low hedges of lantana, etc., is being extensively practised in India, Malaya and other countries. These observations also emphasize the necessity of preserving original shade and adding more trees to natural jungle as an anti-malaria measure.

Dr. Pruthi's address, it may be added, is well documented with a bibliography of the literature bearing upon the subjects under discussion.

Anthropological and Archæological Studies in India

The presidential address to the Section of Anthropology was delivered by Rao Bahadur K. N. Dikshit, who discussed "The Scope of Prehistoric and Anthropological Work in India".

It is to be hoped that the association between archæology and anthropology which has been exemplified in this session of the Indian Science Congress will be a more abiding one, and will react to the mutual advantage of both the sciences, and that all universities and research institutions, which have provided facilities for work in one, will always extend them to the other branch of humanistic studies. In this vast country there is unlimited scope for these studies, and the danger from the extension of cultivation and rural expansion in a more sophisticated mode of life is equally felt by both. It is, therefore, all the more necessary that the future research programme should be speeded up and properly co-ordinated.

So far as expenditure is concerned, although archæology looms somewhat large among the scientific departments of the Government of India, an infinitesimal amount is available for expenditure on work of a scientific character. The personnel ought to be strengthened with a view to the extension of scientific activities in prehistoric archæology and anthropology. Many of the museums are doing good work in the educational sphere, but there is scarcely any scope for the acquisition of scientific knowledge regarding man and very few research facilities.

Sir Leonard Woolley has directed attention to the want of sufficient contact between the Archæological Department and the anthropologist. He has

suggested the possibility of unravelling the problems of the past by significant survivals among existing peoples, as, for example, the ancient burial customs in South India. A common plan pursued by workers in the field should, he holds, result in a more intelligent collection of anthropological material, and the task of the archæologist would be made simpler if the museums of India were to collect and preserve, not only ancient pottery and handiwork, but also that produced up to to-day by the primitive peoples of India. The idea of a central ethnological museum in New Delhi unfortunately has been allowed to lapse, and India is still without either an anthropological, ethnological or archæological central museum.

Turning to the field of prehistoric archæology, it is now more than seventy years ago that the first human artefacts associated with the bones of extinct mammals were found in the cliffs of the Nerbada and the Godaveri. It is unfortunate that further investigations were not carried on in the light of new discoveries in every part of the world. The attention of the Government and the universities should be directed towards the necessity of the systematic conduct of such work under trained prehistorians. It is unfortunate that the systematic survey of the Yale-Cambridge expedition under Dr. H. de Terra has not been continued.

The most interesting and well-developed phase of the prehistoric civilization of India undoubtedly is that represented by Harappa and Mohenjo-daro. It is unfortunate that there is no prospect of further work in this field to discover tribes with earlier and later cultures. Further systematic work at Dambbuthi would be rewarded with rich results unravelling an earlier civilization than Mohenjo-daro, whereas bridging the gap between Mohenjo-daro and later civilizations will occupy generations of workers.

The problem of Aryan invasion has as yet received no light from excavation in Sind and the Punjab, while the proper study of the sequence of metallurgical knowledge has yet to be established, and the place of the copper culture of the Gangetic valley and the iron industry of, for example, Bellary in the south has yet to be determined. Further research alone will show what the exact relation between the stone and metal ages of North and South India must have been.

In South India, the scope for work is greater owing to the abundance of material suitable for the manufacture of tools for palæolithic and neolithic man; while in every district one or other phase of pre- and protohistory is present in examples which must be systematically studied before many of them meet destruction at the hand of man. Among such subjects of research are the rock-shelters and the rock-paintings and carvings which lead up to the culminating splendours of Ajanta and Bagh.

One of the greatest difficulties facing the physical anthropologist in India is that of obtaining material for determining the racial characteristics of the ancient people of their country. The dearth of students in this highly interesting branch of knowledge is very keenly felt. In anthropometry, much interesting work has been done in the various provinces and among the different castes or tribes; but it is no exaggeration to say that barely the fringe of the problem has been touched. For the anthropologist there can be no more interesting country than India to study, although he would probably be overwhelmed by the immensity of the task and the diversity of the material before him. When in India every stage of the entire progress of the human race from the humblest beginnings to the greatest spiritual elevation can be studied with greater ease and facility than in any other country, is it too much to expect that the proud possessors of this wonderful heritage will not neglect their patrimony and will not leave entirely to others the task of studying themselves, their racial composition and age-long cultures?

Crop Production in India

The presidential address to the Section of Agriculture was delivered by Prof. Jai Chand Luthra, who took as his subject "Some Problems of Crop Production in India". Prof. Luthra began by reviewing the condition of Indian agriculture up to the time when the Government took steps to organize some aspects of it on scientific lines, that is about the beginning of the present century. He stressed the fact that India's farm produce is meant primarily for local consumption, and agriculture must therefore remain India's basic industry; there is, however, a demand for the establishment of secondary industries, such as those processing grain for breakfast food.

In the nineteenth century agriculture suffered a setback, of which the chief cause was the indifference of the farmer to the quality of seed. This neglect is of comparatively recent date, for at one time India was famous for the fine quality of its cotton. The merit and the constitutional structure of seed is of fundamental importance in crop husbandry. In India there is no legal safeguard of germination percentage, and pressing need is felt for a Seeds Act. Prof. Luthra reviewed some factors bearing on seed quality. Experiments at Lyallpur have shown that a predominance of yellow in the seed of berseem is an indication of maturity and of good germination; and the proportion of yellow seed bears an inverse relation to the number of cuttings taken from the crop left to seed. A similar correlation of colour to viability has been observed in seeds of shaftal (*Trifolium resupinatum*) and of lucerne.

Selection and breeding have done a great deal for Indian agriculture, but have brought about peculiar difficulties. One of the most important crops of the Punjab and the United Provinces is gram (*Cicer arietinum*). When the two best gram selections, evolved after twenty-five years work, were introduced into cultivation, blight disease was confined to the northern part of the Punjab. For the last four years, gram in other parts of the province has been stricken so severely by blight that one popular selection has been affected up to at least 50 per cent. The growers get alarmed when they find crops damaged by unaccustomed diseases, and it is no wonder if the growers remark that agricultural departments create the diseases. However, in Burma the serious wilt of gram has been overcome by the discovery of a resistant type that now occupies the entire area under that crop.

The wealth of India lies in its innumerable villages; as Tagore has said, "In the keeping of the village lies the cradle of the race". For effecting real improvement in agriculture, it is necessary to take stock of the economic conditions of the farmer. The village is working under many disabilities. There is everywhere an earnest desire that the farmer should raise his standard of living, but so long as he is unable to increase his earning power this will remain a wish. Some measures are necessary for affording relief to the growers of food crops. In the Punjab

the average size of a cultivated holding is scarcely 10 acres, and as many as six or seven persons live on it. Considerable labour is therefore being wasted on an unremunerative occupation.

NUTRITIVE VALUE OF RICE

Dr. W. R. Aykroyd devoted his presidential address to the Section of Physiology to the subject of rice. Rice is the staple food of the majority of the population in the provinces of Assam, Bengal, Bihar, Orissa and Madras. The diet of many other peoples in the East is also based on rice; in fact, it is stated that rice is the staple food of about half the human race. Yet, by modern standards, the rice-eater's diet falls short of such standards in almost every important constituent. In India he consumes in addition to his staple cereal, which supplies 80–90 per cent of the total calories, only very small quantities of other foods such as pulses, vegetables, fruits and meat; milk and milk products are taken in negligible quantities or not at all.

Rice, compared with most cereals, has a low protein content, although the proteins are of high biological value. It is poor in fat and carotene, calcium and iron; the amount of phosphorus present is fairly high. Milling reduces all the above constituents; in many parts of India, however, rice is prepared for consumption by hand-pounding, when the losses are less. Hand-pounded rice retains 50–75 per cent of the pericarp, the germ being usually completely removed. Raw rice when milled loses about three-quarters of its vitamin B_1 and two thirds of its nicotinic acid; these losses are considerably reduced if the rice is parboiled first. Parboiling is the steaming or boiling of unhusked rice after soaking; this splits the woody husk and renders its subsequent removal easier. After parboiling, the rice is pounded or milled in the same way as raw rice; during the steaming some of the vitamin B_1 and nicotinic acid diffuses through the grain and cannot be removed by subsequent milling. This fact is of great importance and, since most of the rice-eaters in India consume parboiled in preference to raw rice, explains the relative rarity of typical beriberi in most parts of the country. Washing the rice results in further losses of essential foodstuffs. The losses are of the following order: calories, 15 per cent; protein, 10 per cent; iron, 75 per cent; calcium and phosphorus, 50 per cent; vitamin B_1 and nicotinic acid, 40–50 per cent.

Dr. Aykroyd finally considered how rice diets can be improved. He is of the opinion that the development of strains of high nutritive value is unlikely to improve rice diets, since rice will always be deficient in certain food factors. He considers the easiest way of raising the nutritive value to be by minimizing the losses brought about by milling, washing and cooking. On the other hand, the introduction of high-yielding strains will reduce the pressure on the land and enable the production of supplementary foods to be increased. When parboiled rice is consumed, there is little difference in nutritive value between hand-pounded and machine-milled, although the former is to be preferred. Highly milled raw rice is a danger to public health, and its use should be discouraged. Dr. Aykroyd suggested that milling beyond a certain degree should be prohibited; a suitable standard might be not less than 1·5 μgm. of vitamin B_1 per gm. Once-polished raw rice has a vitamin B_1 content of this order; use of such a rice would prevent the appearance of beriberi.

Rice must, however, be supplemented by other foodstuffs. Dr. Aykroyd suggested that ragi, a millet, should substitute rice in part, and that the intake of pulses and green leafy vegetables should be increased; the latter supply vitamin A and calcium. Milk is the best supplement to rice diets; if fresh milk is not available, milk reconstituted from skimmed milk powder may be recommended. Milk supplies calcium, or this element can be provided in the form of calcium lactate; such a supplement (about one gram daily) definitely improves the state of nutrition of children on a rice diet. Vitamin A can be provided in green leafy vegetables, milk-fat, fish liver oil or red palm oil. Dr. Aykroyd suggested that it might be possible to blend the latter with common Indian vegetable oils to produce a palatable product with a vitamin A activity corresponding to that of good butter. Finally, he emphasized that the development of an efficient fishing industry would provide India with a valuable supplement to poor rice diets.

PSYCHOLOGY AND EDUCATIONAL RESEARCH

In his presidential address to the Section of Psychology, Dr. D. D. Shendarkar said that although psychology is a comparatively young science, yet it has already found application in many fields, of which education is of vital importance. Results of investigations into such educational problems as scholastic and intelligence tests, examinations, and learning processes, are evidence of the value of psychological methods and knowledge to the efficiency of the teacher. Education is becoming more scientific in method. The suggestion, though, of practical problems and the testing of the experimental results in actual practice must rest with the teacher. Unfortunately, the psychology taught in training colleges for teachers is often too theoretical, and the young teacher does not see the connexion between the science and the problems of the class-room.

There is an urgent need for a central institute of education where training in research methods could be obtained, and where modern research sources in educational topics would be available for reference. Such a body would serve both as a training and consultative body as well as a centre for research. Although learning is the central problem in education, yet research into the learning processes is inadequate, largely because experiments in learning have been studied in psychological laboratories, and the materials employed have too often been of an artificial nature. Research into testing for intelligence has yielded practical results, and now intelligence tests are used in selection for admission to different types of schools, for vocational guidance, and for diagnosing feeblemindedness and backwardness. The problem of admission to different types of higher secondary schools is in reality one of discovering the type of education most suited to the capacities and interests of the pupils, so that they may be classified according to mental ability rather than according to scholastic attainments. Little, however, is known of the abilities required for the various vocations.

Psychology has made considerable development in regard to children's problems and child guidance, and it attempts to diagnose and treat the underlying causes of the various symptoms instead of dealing with the symptom alone. The utilitarian study of psychology has not, however, kept pace with its academic study; what India needs at the present juncture is that the knowledge available should be applied.

SEVENTY YEARS AGO

NATURE, vol. 1, March 31, 1870

The Size of Atoms

"THE idea of an atom has been so constantly associated with incredible assumptions of infinite strength, absolute rigidity, mystical ations at a distance, and indivisibility, that chemists and many other reasonable naturalists of modern times, losing all patience with it, have dismissed it to the realms of metaphysics, and made it smaller than 'anything we can conceive'." "W.T." then goes on to review the experimental evidence for giving tangible sizes to atoms. He refers to Cauchy's mathematical work, and to investigations on the contact electricity of metals on capillary attraction as shown by soap bubble investigations, on the kinetic theory of gases, and sums up as follows :

"The four lines of argument which I have now indicated, lead all to substantially the same estimate of the dimensions of molecular structure. Jointly they establish with what we cannot but regard as a very high degree of probability the conclusion that in any ordinary liquid, transparent solid, or seemingly opaque solid, the mean distance between the centres of contiguous molecules is less than the hundred-millionth, and greater than the two thousand-millionth of a centimetre.

"To form some conception of the degree of coarse-grainedness indicated by this conclusion, imagine a raindrop, or a globe of glass as large as a pea, to be magnified up to the size of the earth, each constituent molecule being magnified in the same proportion. The magnified structure would be coarser grained than a heap of small shot, but probably less coarse grained than a heap of cricket-balls."

Bacterial Warfare

PROF. TYNDALL will have much to answer for in the results that may be expected from the spread of his "dust and disease" theory. It is stated by the *Athenæum* that a new idea has been broached in a recent lecture by Mr. Bloxam, the lecturer on chemistry to the department of artillery studies. He suggests that the committee on explosives, abandoning gun cotton, should collect the germs of small-pox and similar malignant diseases, in cotton or other dust-collecting substances, and load shells with them. We should then hear of an enemy dislodged from his position by a volley of typhus, or a few rounds of Asiatic cholera. We shall expect to receive the particulars of a new "Sale of Poisons" Act, imposing the strictest regulations on the sale by chemists of packets of "cholera germs" or "small-pox seed". Probably none will be allowed to be sold without bearing the stamp of the Royal Institution, certifying that they have been examined by the microscope and are warranted to be the genuine article.

A COURSE of lectures for women in the science and practice of music, by Mr. Sullivan, will be delivered at South Kensington, under the patronage of the Science and Art Department, shortly after the close of Prof. Oliver's course on botany.

IN speaking of the extinction of species and the struggle for existence, Mr. Darwin uses language which may be literally applied—applied without even verbal modification—to the phenomenon of languages. [From an article by Dean Farrar.]

UNIVERSITY EVENTS

LONDON.—The title of reader in physics in the University has been conferred on Dr. F. C. Chalklin, in respect of the post held by him at University College.

The degree of D.Sc. has been conferred on Mr. Hugh Davson (University College), Mr. J. L. D'Silva (King's College), Dr. W. H. Newton (University College), Prof. Gilbert Stead (Guy's Hospital Medical School), Mr. Albert Wassermann (University College), and that of D.Sc. (Engineering) on Mr. R. H. Barfield (Imperial College).

MANCHESTER.—Dr. C. W. Wardlaw, officer-in-charge of the Low Temperature Research Station, Imperial College of Tropical Agriculture, Trinidad, has been appointed Barker professor of cryptogamic botany in succession to Prof. W. H. Lang, who retires at the end of the present session.

READING.—Dr. Barbara Colson, formerly research assistant in botany in the University of Manchester, has been appointed lecturer in botany.

FORTHCOMING EVENTS

Saturday, March 30

ROYAL PHOTOGRAPHIC SOCIETY, at 3 p.m.—H. Mills Cartwright : "Colour Photogravure by the Masking Method".

Tuesday, April 2

ROYAL HORTICULTURAL SOCIETY, at 3 p.m.—Prof. F. E. Weiss : "Graft Hybrids and Chimæras" (Masters Memorial Lectures. Succeeding lecture on April 16).

Thursday, April 4

CHEMICAL SOCIETY, at 2.30 p.m.—Annual General Meeting. At 3 p.m.—Sir Robert Robinson : "Some Biological Aspects of Organic Chemistry, (a) Recent Progress in Chemotherapy, (b) Structural Relations in the Sterol Group" (Presidential Address). At 5 p.m.—Prof. E. K. Rideal : "The Sörensen Memorial Lecture".

Friday, April 5

INSTITUTION OF CHEMICAL ENGINEERS (Eighteenth Annual Corporate Meeting, at the Hotel Victoria), at 11.45 a.m.—F. Heron Rogers : "Oil" (Presidential Address).

BRITISH PSYCHOLOGICAL SOCIETY (Extended General Meeting), April 5–6.

April 5.—Discussion on the Problems of Evacuated Children (Speakers : E. M. Bartlett, A. H. Bowley, C. Preston Rawson).

April 6.—Discussion on Propaganda (Rex Knight : "The Technique of Propaganda" ; F. M. Austin : "Propaganda and Suggestion").

April 6.—Discussion on So-called War Neuroses (Speakers : Millais Culpin, T. A. Ross, Edward Glover).

APPOINTMENTS VACANT

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

ASSISTANT LECTURER IN MECHANICAL ENGINEERING at the Bradford Technical College—The Director of Education, Town Hall, Bradford (April 6).

GRADUATE TEACHER OF MECHANICAL ENGINEERING SUBJECTS in the Smethwick Municipal College—The Chief Education Officer, Education Offices, 215 High Street, Smethwick (April 8).

CHEMIST IN THE WATERWORKS DEPARTMENT—The Secretary, Waterworks Offices, Town Hall, Manchester 2 (April 15).

PROFESSOR OF CHEMISTRY—The Principal, Heriot-Watt College, Edinburgh (April 16).

HEAD OF THE MATRICULATION DEPARTMENT—The Director of Education, The Polytechnic, 309 Regent Street, W.1 (April 16).

TEMPORARY LECTURER in charge of the Department of Physics—The Registrar, University College, Leicester (April 17).

AN ASSISTANT MASTER to teach Geography, Mathematics, Elementary Science and Woodwork at the Rosario English School, Argentine—The British Council, 3 Hanover Street, W.1 (quoting 'Rosario') (April 17).

PRINCIPAL OF THE CEYLON UNIVERSITY COLLEGE—The Director of Recruitment (Colonial Service), Colonial Office, 29 Queen Anne's Gate, S.W.1 (April 30).

TEMPORARY FULL-TIME TEACHER OF ENGINEERING SUBJECTS—The Principal, Technical Institute, Ladywell, Dover.

ASSISTANT ENGINEER for the Drainage and Irrigation Department, Malaya—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9114).

ASSISTANT TOWN ENGINEER for the Kumasi Public Health Board, Gold Coast—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/8332).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 19: The Chemical Constituents of Lichens found in Ireland—*Lecanora gangaleoides*, Part 2. By Dr. T. J. Nolan and Dr. J. Keane. Pp. 199–210. 1*s*. Vol. 22 (N.S.), No. 20: Further Experiments on Transpiration into a Saturated Atmosphere. By Prof. Henry H. Dixon and J. S. Barlee. Pp. 211–222+plate 5. 1*s*. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [292

West India Royal Commission, 1938–39. Recommendations. (Cmd. 6174.) Pp. 30. (London: H.M. Stationery Office.) 6*d*. net. [292

Statement of Policy on Colonial Development and Welfare. (Cmd. 6175.) Pp. 8. (London: H.M. Stationery Office.) 2*d*. net. [292

Liverpool Observatory and Tidal Institute. Annual Report, 1939. Pp. 14. (Liverpool: Liverpool Observatory.) [13

Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences. No. 569, Vol. 230: Studies on the Reproduction of the Dogfish. By Dr. H. Metten. Pp. 217–238+plate 20. 5*s*. No. 570, Vol. 230: Studies of the Post-Glacial History of British Vegetation. 3: Fenland Pollen Diagrams; 4: Post-Glacial Changes of Relative Land- and Sea-Level in the English Fenland. By Dr. H. Godwin. Pp. 239–304+plate 21. 10*s*. 6*d*. (London: Cambridge University Press.) [63

Ministry of Health. Memorandum on Cerebro-Spinal Fever. (Memo. 234 Med.) Pp. 10. (London: H.M. Stationery Office.) 2*d*. net. [73

The Physical Society. Reports on Progress in Physics. Vol. 6. General Editor: J. H. Awbery. Pp. v+434. (London: Physical Society.) 22*s*. 6*d*. net. [73

International Tin Research and Development Council. Fourth General Report 1939. (Publication No. 95.) Pp. 24. (Greenford: International Tin Research and Development Council.) [83

Metropolitan Water Board. Thirty-third Annual Report on the Results of the Bacteriological, Chemical and Biological Examination of the London Waters for the Twelve Months ended 31st December 1938. By Lt.-Col. E. F. W. Mackenzie. Pp. 118. (London: P. S. King and Son, Ltd.) 10*s*. 6*d*. [123

Other Countries

U.S. Department of Agriculture. Technical Bulletin No. 715: Keys to the Parasites of the Hessian Fly based on Remains left in the Host Puparium. By C. C. Hill and J. S. Pinckney. Pp. 24. (Washington, D.C.: Government Printing Office.) 10 cents. [292

Sveriges Geologiska Undersökning. Ser. C, No. 424: Geology and Ores of the Målanäs District, Västerbotten, Sweden. By Sven Gavelin. Pp. 221+38 plates. 5.00 kr. Ser. C, No. 425: Hydrogeographische Beobachtungen an einigen Seen in südwest-Schweden. Von Bengt Coliini. Pp. 37. 1.00 kr. Ser. C, No. 426: Urbergsgeologische Undersökningar inom norrbottens Län. Av Olof H. Ödman. Pp. 100+16 plates. 3.00 kr. Ser. C, No. 427: Some Graphs on the Calculation of Geological Age. By Frans E. Wickman. Pp. 8+1 plate. 0.50 kr. Ser. C, No. 428: Lönnfallet, Southernmost Part of the Export Field at Grängesberg. By Ragnar Loosström. Pp. 30+3 plates. 2.00 kr. Ser. C, No. 429: Kvartärgeologiska iakttagelser inom östra Storsjöområdet i Jämtland. Av Per Thorslund. Pp. 15. 0.50 kr. Ser. C, No. 430: Some Post-Silurian Dykes in Scania and Problems Suggested by Them. By Sven Hjelmquist. Pp. 32 (8 plates). 1.00 kr. (Stockholm: P. A. Norstedt and Söner.) [13

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1938. Pp. iv+60. (Calcutta: Government of India Press.) [53

A Manual of the Liverworts of West Virginia. By Nelle Ammons. (Reprinted from *The American Midland Naturalist*, Vol. 23, No. 1.) Pp. 164 (26 plates). (Notre Dame, Ind.: University Press.) [53

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 91: The Effect of Spacing and Time of Sowing on Yield and Yield Components of Wheat Varieties. By H. Fairfield Smith. Pp. 24. (Melbourne: Government Printer.) [53

Imperial College of Tropical Agriculture. Report of the Governing Body and the Principal's Report to December 31, 1939. Pp. 32. (Trinidad and London: Imperial College of Tropical Agriculture.) [53

University of Sydney Publications in Geography. No. 3: Rain Run-off Dispersion and Soil Conservation. By Macdonald Holmes and W. H. Maze. Pp. 32. (Sydney: University of Sydney.) 2*s*. 6*d*. [63

The International Relief Union: its Origin, Aims, Means and Future. By Camille Gorgé. Pp. 52. (Geneva: International Relief Union.) [63

Association de Géodésie de l'Union Géodésique et Géophysique Internationale. Bibliographie géodésique internationale, Tome 2: Années 1931, 1932, 1933, 1934. Publié sous la direction de Georges Perrier par A. Carrier et P. Tardi. Pp. A64+423. (Paris: Association de Géodésie.) 200 francs. [63

The Geological, Mining and Metallurgical Society of India. Bulletin No. 3: The Uses and Applications of Sheet and Waste Mica. By Ramani Ranjan Chowdhury. Pp. 20. (Calcutta: Geological, Mining and Metallurgical Society of India.) 2 rupees. [63

Panjab University Botanical Publications. Ferns of Mussoorie. By Pran Nath Mehra. Pp. vi+30+1 plate. (Lahore: University of the Panjab.) 1 rupee. [63

Department of Agriculture: Straits Settlements and Federated Malay States. Reports of the Field Branch for the Year 1938. Pp. ii+162. (Kuala Lumpur: Department of Agriculture.) [63

Herbertia. Vol. 6, Dedicated to the Union of South Africa. Edited by Hamilton P. Traub. Pp. 252. (Orlando, Fla.: American Amaryllis Society.) 3.25 dollars. [63

National Geographic Society Contributed Technical Papers. Mexican Archaeology Series, Vol. 1, No. 1: An Initial Series from Tres Zapotes, Vera Cruz, Mexico. By M. W. Stirling. Pp. 16. (Washington, D.C.: National Geographic Society.) [63

Institut des Parcs Nationaux du Congo Belge. Exploration du Parc National Albert: Mission G. F. de Witte (1933–1935). Fasc. 1: Introduction. Par G. F. de Witte. Pp. 40+33 plates. 120 francs. Fasc. 2: Myriopodes. Par C. Attems. Pp. 22. 21 francs. Fasc. 3: Oligochäten. Von W. Michaelsen. Pp. 16. 12 francs. Fasc. 4: Parasitic Nematoda. By J. H. Schuurmans Stekhoven, Jr. Pp. 40. 16 francs. Fasc. 5: Carabidae, par L. Burgeon; Carabidae (Scaritini), von M. Bänninger. Pp. 21+1 plate. 16 francs. Fasc. 6: Lucanidae. Par L. Burgeon. Pp. 6+1 plate. 28 francs. Fasc. 7: Scarabaeidae S. Fam. Cetoniinae. Par L. Burgeon. Pp. 16+1 plate. 61 francs. Fasc. 8: Brenthidae und Lycidae. Von R. Kleine. Pp. 18. 19 francs. Fasc. 9: Oiseaux. Par H. Schouteden. Pp. 197+12 plates. 150 francs. Fasc. 10: Mammifères. Par S. Frechkop. Pp. 103+20 plates. 150 francs. Fasc. 11: Vespides solitaires et sociaux. Par L. Bequaert. Pp. 10. 10 francs. Fasc. 12: Onitini (Coleoptera Lamellicornia Fam. Scarabaeidae). Par A. Janssens. Pp. 18+1 plate. 25 francs. Fasc. 13: Haliplidae und Dytiscidae. Von L. Gschwendtner. Pp. 22. 27 francs. Fasc. 14: Pterophoridae, Tortricina and Tineina. By E. Meyrick. Pp. 28+3 plates. 45 francs. Fasc. 15: Passalidae. Par C. Moreira. Pp. 10+2 plates. 30 francs. Fasc. 16: Tardigraden. Von R. J. H. Teunissen. Pp. 21. 19 francs. Fasc. 17: Dermaptera. By W. D. Hincks. Pp. 16. 13 francs. Fasc. 18: Blattids. By R. Hanitsch. Pp. 26. 25 francs. Fasc. 19: Gyrinidae. Von G. Ochs. Pp. 22. 16 francs. Fasc. 20: Geometridae (Lep. Het.). Par H. Debauche. Pp. 56+6 plates. 75 francs. Fasc. 21: Scarabaeini (Coleoptera Lamellicornia Fam. Scarabaeidae). Par A. Janssens. Pp. 76+3 plates. 70 francs. Fasc. 22: Nématodes libres terrestres. Par J. H. Schuurmans Stekhoven et R. J. H. Teunissen. Pp. 229+13 plates. 275 francs. Fasc. 23: Curculionidae (S. Fam. Apionidae). Par L. Burgeon. Pp. 21. 16 francs. Fasc. 24: Poissons. Par M. Poll. Pp. 81+11 plates. 108 francs. Fasc. 25: Oniticellini (Coleoptera Lamellicornia Fam. Scarabaeidae). Par A. Janssens. Pp. 22+1 plate. 16 francs. Fasc. 26: Histeridae. Par L. Burgeon. Pp. 18. 20 francs. Fasc. 27: Arthropoda, Hexapoda—1. Orthoptera: Mantidae, par M. Beier; 2. Gryllidae, par L. Chopard; 3. Coleoptera: Cicindelidae, par W. Horn; 4. Rutelinae, par F. Ohaus; 5. Heteroceridae, par R. Mamitza; 6. Prioninae, par A. Lameere; Arachnoidea: 7. Opiliones, par C. Fr. Roewer. Pp. 29. 25 francs. Fasc. 28: Curculionidae. Par A. Hustache. Pp. 50. n.p. Fasc. 29: Coprini (Coleoptera Lamellicornia Fam. Scarabaeidae). Par A. Janssens. Pp. 104+4 plates. n.p. (Bruxelles: Institut des Parcs Nationaux du Congo Belge.) [73

Institut des Parcs Nationaux du Congo Belge. Exploration du Parc National Albert: Mission H. Damas (1935–1936). Fasc. 1: Recherches hydrobiologiques dans les Lacs Kivu, Édouard et Ndalaga. Par H. Damas. Pp. 128+9 plates. 135 francs. Fasc. 2: Spongilliden. Von W. Arndt. Pp. 26. 20 francs. Fasc. 3: Copépodes Harpacticoïdes. Par P. A. Chappius. Pp. 19. 20 francs. Fasc. 4: Moerisia Alberti nov. sp. (Hydropolype dulcicole). Par E. Leloup. Pp. 7. 9 francs. Fasc. 5: Rotifères. Par P. de Beauchamp. Pp. 11. 12 francs. Fasc. 6: Poissons. Par M. Poll avec la collaboration de H. Damas. Pp. 73+9 plates. 130 francs. Fasc. 7: Cladocera. Von V. Brehm. Pp. 12. n.p. (Bruxelles: Institut des Parcs Nationaux du Congo Belge.) [73

Institut des Parcs Nationaux du Congo Belge. Exploration du Parc National Albert: Mission P. Schumacher (1933–1936). Fasc. 2: Anthropometrische Aufnahmen bei den Kivu-Pygmäen. Von P. Schumacher. Pp. 69+26 plates. 154 francs. (Bruxelles: Institut des Parcs Nationaux du Congo Belge.) [73

Institut des Parcs Nationaux du Congo Belge. Contribution à l'étude de la morphologie du vulcan Nyamuragira. Par R. Hoier. Pp. 20+16 plates. 79 francs. (Bruxelles: Institut des Parcs Nationaux du Congo Belge.) [73

Department of Agriculture, Canada. Annual Report of the Forest Insect Survey, Division of Entomology, Science Service, 1939. Pp. 37. (Ottawa: King's Printer.) [73

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 818: Geology and Water Resources of the Mud Lake Region, Idaho, including the Island Park Area. By Harold T. Stearns, Lester L. Bryan and Lynn Crandall. Pp. v+125+13 plates. 75 cents. Water-Supply Paper 828: Surface Water Supply of the United States, 1937. Part 8: Western Gulf of Mexico Basins. Pp. vii+437+1 plate. 50 cents. Water-Supply Paper 835: Surface Water Supply of Hawaii, July 1, 1936, to June 30, 1937. Pp. iv+112. 20 cents. (Washington, D.C.: Government Printing Office.) [83

Punjab Irrigation Research Institute. Report for the Year ending April 1938. Pp. vii+156+84 plates. Research Publication, Vol. 2, No. 23: An Investigation of the Inter-Relation of Silt Indices and Discharge Elements for some Regime Channels in the Punjab. By Dr. N. K Bose and Dr. J. K. Malhotra. Pp. vi+70+11 plates. (Lahore: Punjab Irrigation Research Institute.) 1.10 rupees; 2*s*. 5*d*. [123

OFFICIAL ANNOUNCEMENTS

BRIGHTON SUMMER SCHOOL IN ANIMAL BIOLOGY

2nd to 15th AUGUST, 1940

The course is intended as an introduction to Biology, and as a refresher course for teachers of the subject. Laboratory and field work. Director: Prof. L. E. S. Eastham, M.A., M.Sc., Professor of Zoology in the University of Sheffield, assisted by specialists. Prospectus of F. H. Toyne, Education Officer, 54 Old Steine, Brighton.

MURDOCH TRUST

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

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

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

CITY OF COVENTRY—WATER DEPARTMENT

APPOINTMENT OF WORKS CHEMIST

Applications are invited from suitably qualified persons, not exceeding 40 years of age, for the post of Works Chemist at the proposed River Avon waterworks, at a salary of £260 per annum, rising, subject to satisfactory service, by annual increments of £10, to a maximum of £300 per annum.

The new treatment works will consist of sedimentation tanks, pressure filters and chlorine and ammonia plant, and the chemist appointed must be capable of making all necessary routine analyses of the raw and treated waters and of directing the operation of the treatment plant. Previous experience in this work will affect appointment. He will also be required to survey and report on the drainage area above the new intake and to undertake general chemical work in the Department.

The post is designated under the Local Government and Other Officers' Superannuation Act, 1922, as amended in regard to annuities to widows by the Coventry Corporation Act, 1936.

The person appointed will be required to pass a medical examination, to contribute on the approved scale to the Staff Widows' and Orphans' Pension Fund, and to devote the whole of his time to the duties of the appointment.

Applications, endorsed "Works Chemist," stating age, qualifications, present occupation and experience, and accompanied by copies of not more than three recent testimonials, must reach the undersigned not later than Wednesday, April 24, 1940.

Canvassing, either directly or indirectly, will be a disqualification.

NORMAN J. PUGH,
Assoc.M.Inst.C.E., M.Inst.W.E.,
Water Engineer and Manager.

Water Department,
Council House,
COVENTRY.
March 21, 1940.

BRADFORD EDUCATION COMMITTEE
TECHNICAL COLLEGE, BRADFORD

Applications are invited for appointment as Assistant Lecturer in Mechanical Engineering. Applicants should possess a good Honours degree and have had a good general training in Mechanical Engineering, with preferably some experience in Electrical Engineering.

Salary according to the Burnham Award, which, in the case of graduates, is up to £528 per annum. Commencing salary according to qualifications and experience.

Further particulars of the appointment and forms of application may be obtained from the Director of Education, Town Hall, Bradford, and completed forms should be returned to the Principal of the College not later than April 6, 1940.

THOS. BOYCE,
Director of Education.

March 19, 1940.

HERIOT-WATT COLLEGE, EDINBURGH

PROFESSORSHIP OF CHEMISTRY

The Governors invite applications from British Subjects for the PROFESSORSHIP of CHEMISTRY, which will shortly become vacant owing to the retirement of Professor T. Slater Price, O.B.E., D.Sc., F.I.C., F.R.S. The Professor is Head of the Chemistry Department, which includes Day and Evening courses of study. The person appointed will be required to take up his duties on September 1, 1940. Teaching experience and works experience in some branch of Industrial Chemistry or Pharmacy is desirable. Salary £1,000 by £50 to £1,200. Particulars may be obtained from the Principal at the College, to whom applications should be sent by April 16.

J. CAMERON SMAIL,
Principal.

UNIVERSITY COLLEGE, LEICESTER

Applications are invited for the post of Temporary Lecturer in Charge of the Department of Physics for the duration of the War. Salary £500 per annum. Duties to commence as soon as possible. Applications must be sent not later than April 17 to the Registrar, from whom further particulars may be obtained.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM
The Laboratory, Plymouth

The following animals can always be supplied, either living or preserved, by the best methods:

Sycon; Clava; Obelia; Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Pleurobrachia (preserved); Leptoplana; Lineus, Amphiporus, Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus, Salpa (preserved), Scyllium, Raia, etc.

For prices and more detailed lists apply to:
Biological Laboratory, Plymouth. THE DIRECTOR.

Information

The address of the Editorial and Publishing Offices of "NATURE" is

MACMILLAN & CO., LTD.,
St. Martin's Street, London, W.C.2.

Telephone Number: Whitehall 8831
Telegrams: Phusis, Lesquare, London.

The annual subscription rates (payable in advance) are: British Isles, £2 12s. 0d., post free; Abroad, £2 17s. 0d., post paid. Volumes begin in January and July of each year, but subscriptions may commence with any issue. Payment from abroad should be made by International Money Order or by Cheque payable at a London Bank, and Cheques, Money Orders and Postal Orders should be made payable to Macmillan & Co., Ltd.

All editorial communications, books for review, etc., should be addressed to the Editors, at the above address.

Advertisements only should be addressed to T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4. Telephone Number: City 4211.

Free Copies of "NATURE".

Each of the signatories of a letter published in the Correspondence columns will be sent, free of charge, on publication, 1 copy of the issue of "NATURE" containing the letter.

If more than 1 copy is desired, written application must be made to the Manager of "NATURE", stating the number of copies that is required. Not more than 6 free copies in all can be presented in connexion with any letter published.

This offer of free copies does not refer to articles and similar contributions to "NATURE".

If any contribution includes illustrations, the blocks used for their reproduction may be obtained by the author, after publication, at half the cost price. Application for the blocks should be made to the Manager of "NATURE".

Proofs will not usually be sent to authors living outside Great Britain. Orders for reprints should, therefore, accompany MSS. All communications regarding reprints should be sent direct to the printers:

FISHER, KNIGHT & CO., LTD.,
Gainsborough Press, St. Albans, Herts.

Printed in Great Britain by Fisher, Knight & Co., Ltd., The Gainsborough Press. St. Albans, and published by Macmillan & Co., Limited, at St. Martin's Street, London, W.C.2, and The Macmillan Co., 60-62 Fifth Avenue, New York—Saturday, March 30, 1940.