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Food Supplies and Health

THIS paradoxical situation, poverty in the midst of plenty, presents a problem the solution of which has proved beyond the power of individual national policies. A more equitable distribution of foodstuffs and renewed prosperity in the farming industry can only be secured by far-sighted co-operative planning on a world scale.

At the League of Nations Assembly in September, Mr. Bruce, speaking for the Australian Delegation, suggested combining the studies of national health and agricultural economics, in the belief that a practical treatment of the one question may help to solve the other. Delegates from twelve countries asked that an international inquiry into the relation of health to nutrition and their bearing on agricultural problems might be discussed by the present Assembly. On behalf of the Government of the United Kingdom, Lord De La Warr welcomed these proposals and looked forward to fashioning practical schemes which will turn increased powers of production into a blessing instead of a disaster and make possible a healthier and fuller life. The adjustment needed is the extension of consumption and not the restriction of output.

Every country has tried to stave off the ruin of its farmers, and some of the emergency measures adopted in self-defence have cut two ways. Restricted imports at first forced up the prices of home produce, but by reducing consumption in the long run reacted adversely on the farmer. Everyone prefers home produce if able to afford it. The extent to which lowered prices increase consumption has recently been demonstrated by two interesting experiments. By issuing vouchers to the unemployed, who formed one third of the population in a Durham town, the Potato Marketing Board effected a price reduction equivalent to 3*d*. a stone, and the total consumption of potatoes in the district increased by ninety-six per cent. Through another Government-aided scheme, the price of milk to school children was halved and within nine months the consumption was trebled. The price of meat might be lowered if it became customary in Great Britain, as on the Continent and in the United States, to market veal and 'baby beef' in place of old and costly fat-stock.

By judicious controlling of prices, the current of popular demand can be diverted towards the purchase of the right kinds of foods more surely and quickly than by any educational process. The artificial stimulation of the consumption of such foods as potatoes, milk and milk products, fish, eggs, fresh fruit and vegetables, will repay in health the money expended and may eventually pay in cash. It is good to read in a memorandum just issued by the Ministry of Agriculture and Fisheries that the wisdom of having spent millions on subsidising production is now questioned, and the financing of price cuts advocated as an alternative likely to pay a dividend in improved national health with less drain on the taxpayer.

From the point of view of nutrition, subsidies for sugar and wheat are unnecessary. Both these foodstuffs were already consumed in sufficient amounts and cannot be produced economically in Great Britain. For health reasons also, the growing consumption of sugar is to be deprecated. A subsidy might more profitably be devoted to the distribution of basic manures for those soured fields which produce nothing but fine crops of sorrel and daisies.

We look forward to the realisation of Mr. Bruce's ideal, the marriage of health and agriculture. At present there is no unity of action. Municipal sanitarians project ever larger and more expensive schemes for swilling wastefully into the sea the

precious mineral salts and organic matter, which, by the appropriate treatment of sewage, could be conserved and used to restore fertility to exhausted soil.

Foodstuffs are the material of which mankind is built, and cannot be viewed dispassionately as purely commercial commodities. An international committee might consider the bill-of-fare which each country can produce and advise how its deficiencies can best be supplemented in the promotion of health by suitable imports. The effect upon land-locked countries of a reduced import of sea-fish and fish-liver oils is now visible in the prevalence of goitre and rickets in Central Europe. Curtailed importations of citrous fruits, tomatoes, etc., may also prove harmful to health in winter-time.

The extent to which malnutrition exists cannot be assessed in the absence of a proper standard. The figures returned present obvious absurdities; a relatively prosperous borough like Twickenham claiming a malnutrition rate about six times as high as that of Wigan; and Bootle a rate twelve times as high as Liverpool, of which it is an extension. The immediate task is to create a higher standard of life in terms of health and proper food.

The Warburg Institute

Kulturwissenschaftliche Bibliographie zum Nachleben der Antike

Band 1: Die Erscheinungen des Jahres 1931. In Gemeinschaft mit fachgenossen Bearbeitet von Hans Meier, Richard Newald, Edgar Wind. Herausgegeben von der Bibliothek Warburg. (A Bibliography on the Survival of the Classics. First Volume: The Publications of 1931. The Text of the German edition with an English Introduction. Edited by the Warburg Institute.) Pp. xxiii+333. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1934.) 21*s*. net.

FOUNDED at Hamburg by a wealthy Jewish family who had made a fortune in America, and inspired by Prof. Warburg of that stock, the Warburg Institute has within the last two years been transferred to the banks of the Thames, and now takes rank with the numerous benefactions which our more tolerant nation owes to foreign persecutions. It consists of a rich and specialist library, well arranged in part of Thames House on the Embankment, near the new Lambeth bridge. The volume under review is the first issued from the Institute's new headquarters, and is for the first time introduced by a full and interesting English chapter, giving the general object of the Institute and the general scope of this issue. Both the volume and the Institute deserve the notice and the encouragement of readers of NATURE, because, though starting with a literary tradition, they offer promise of providing in England a more adequate library for the study of the history of civilisation (including, and based on, science) than can be found elsewhere. There is in fact no such collection of books anywhere available to the public, though a few private collectors, such as Dr. Merz at Newcastle-on-Tyne, have been inspired by the idea.

This *catalog raisonné* of more than 300 pages purports to be an account of only the books published in the year 1931, though, as the dates are not given after the separate entries, it is impossible to satisfy one's self on that score, and no doubt many are included which had appeared by then, though not exactly in that year. The editors explain in their introduction that their general ideal is that of promoting the study of the history of *Cultur*, and quote Burckhardt as the fountain-head. The notion has, however, been enlarged in one direction and narrowed in another, since Burckhardt's time, in the programme of the Institute, and this the editors attribute to Prof. Warburg himself. The 'culture' studied is not civilisation as a whole, but 'culture' as represented in the West by the tradition of Greece and Rome. But, while thus limited in extent, it became deeper in content by the inclusion of all forms of tradition in western Europe. Thus folk-lore and magic are included, as well as the æsthetic ideals which appealed to Burckhardt and the earlier students of the art of the Renaissance. Warburg refused to separate literary from artistic or religious documents, on the ground that the student who seeks to understand how the Olympian gods were revived in the Renaissance as æsthetic ideals must also study how they survived in the Middle Ages as astrological and magical demons.

The bulk of the volume is in German, and one can only indicate here in the briefest way the riches of its content. The survival of the classical tradition is discussed, first, in a general way—what does survival in this sense mean, and then, under

its separate sections, of religion, mythology, philosophy and the various sciences. A large section is devoted to the artistic tradition, both in the theatre and in the plastic arts. A similar division covers speech and music. Rather more than a third of the whole treats of the classical tradition, as it was displayed in particular epochs and regions. Thus both the Hellenistic West and Hellenistic Judaism are fully dealt with, and one passes through the transformations of Byzantium and the Middle Ages, down to the more fragmentary and slighter treatment accorded to the humanism of the present. On this last section the amount of the material available to the editors and their staff of critics was clearly not sufficient to allow the picture presented to be in any way adequate to the facts. But for all the earlier portions, and for the literary and artistic criticism of classical works of all kinds, published quite recently, the catalogue is a gold-mine. One finds here an account of books often not otherwise known at all in England, and the short summary and criticism appended are always expert, sufficient and enlightening. One short and interesting example (of the hundreds which the book contains) may be given:

"Nogara Bartolomeo. The Laocoon group in the Vatican.

"A summary history of the group since its discovery. Different attempts at restoration are described. . . . Interesting proof arises from Titian's travesty in his 'Apes-Laocoon', that the chief figure had his arm bent towards his head."

In recommending the whole undertaking, one would only repeat the hope that in the development of the work of the Warburg Institute in London, larger and larger attention may be given to the history of science. On art it is already ample and admirable. F. S. MARVIN.

Mechanisation in Industry

Mechanisation in Industry

By Harry Jerome. (Publications of the National Bureau of Economic Research, Inc., No. 27.) Pp. xxxi+484. (New York: National Bureau of Economic Research, Inc., 1935.) 15*s*. net.

THE habit of producing goods whether they are needed or not, of applying power whether it is effective or not, of utilising inventions whether they are useful or not, pervades almost every department of our present civilisation. The untoward consequences of this materialistic habit, as seen for example in employment, have led to increasing attention being given to the social consequences of mechanisation in recent years. We are at last coming to realise that social inefficiency may be too high a price to pay for mechanical efficiency and that, from the point of view of the community as a whole, industrial efficiency must take account of the effects on the worker and the community as well as of the purely mechanical or chemical efficiency of its processes.

Although the social and cultural aspects of mechanisation have received a certain amount of attention, there has as yet been no detailed account of the process of mechanisation in a broad economic setting, interpreting the details in regard to mechanisation as a whole and to related processes of economic life. Some such account Dr. Jerome attempts to give us in the present study, particularly in relation to the nature and significance of current changes in the degree of mechanisation. He emphasises the wide range of consequences which must be traced if we are to measure accurately the effects of a mechanical change, and his careful technique of treatment should supply a further corrective to hasty or ill-founded assumptions regarding the effects of mechanisation.

In the first instance, Dr. Jerome distinguishes between changes which increase the units of output per hour of labour and those which reduce the number of workers required. He also directs attention to the effects which may be produced not merely on labour operating a process but also on auxiliary labour such as that required in maintenance, or on embodied labour such as that required in the production of the machine or the power or other services required for its operation, as well as on indirectly required labour like that engaged in transport, selling or advertising. It is only as the effects in all these directions are visualised that we can compute the true effect of a technical change on the community, and attain such an understanding of current changes that the manner and rapidity with which they occur can be in some degree controlled.

Dr. Jerome suggests that the most important single question about current changes in mechanisation is the rate at which they occur. The evidence presented, drawn from a wide range of manufacturing industries as well as from agriculture, mining, building, transport and handling of

materials, etc., leads him to conclude that a continuing increase in mechanisation at a moderate pace may be expected. Though there are still many possibilities for the extension of mechanisation, there are sufficient obstacles to mechanisation to render uncontrollably rapid mechanisation unlikely. On the contrary, stabilising factors which limit the rate of mechanisation also suggest that the rate of change in mechanisation is relatively stable. Even within the limited range of fluctuations in the rate of mechanisation, the experience of the last ten or fifteen years indicates ill effects which deserve consideration and, moreover, are not beyond reasonable possibility of prediction and control. For example, rapid mechanisation brings a substantial amount of displacement of skill and technological unemployment which, even when the change represents a net gain to society as a whole, may bring serious losses to individual workers, particularly to the older and more highly skilled. Moreover, there is reason to believe that, while advancing mechanisation probably tends to lessen seasonal fluctuations in industry, it may aggravate cyclical fluctuations.

The evidence upon which these conclusions are based is admirably presented, and is supported by statistical data which give the book real value as a work of reference upon the rate of mechanisation of industry. The book is eminently readable, and, while limiting himself closely to the special aspects of mechanisation indicated above, Dr. Jerome indicates a number of directions in which further investigation is required. The challenge to research thus thrown down by problems of obsolescence and plant occupation, the effects of mechanisation upon labour turnover, etc., is not the least of the claims of this book upon the attention of the scientific worker. R. BRIGHTMAN.

Witchcraft and Psychopathology

The Medical Man and the Witch during the Renaissance

By Dr. Gregory Zilboorg. (The Hideyo Noguchi Lectures.) (Publications of the Institute of the History of Medicine, the Johns Hopkins University, Third Series, Vol. 2.) Pp. x+215+5 plates. (Baltimore, Md.: The Johns Hopkins Press; London: Oxford University Press, 1935.) 11*s*. 6*d*. net.

WITCHCRAFT and the witchcraft persecutions were a manifestation of the hysteria endemic among the European populations of the Middle Ages; and after the Renaissance, even when the flame of seventeenth century fanaticism, which made a belief in witchcraft a test of orthodoxy, had died down, sporadic outbursts of popular excitement still showed that the evil had not been completely allayed.

In these three lectures Dr. Zilboorg, skilled psychiatrist and trained sociologist, examines the records of the fifteenth and sixteenth centuries with the purpose of demonstrating why, while other branches of medical sciences at the time of the Renaissance entered upon a period of rapid growth with the introduction of the scientific spirit and scientific method, the true nature of the phenomena of witchcraft and demonic possession was only tardily recognised as due to an abnormal psychic state—and that merely by the few. The study of psychopathology and psychiatry made no advance between the middle of the sixteenth century and the end of the nineteenth century.

In the "Malleus Maleficarum", the guide to theory and practice of the medieval inquisitor and witch-finder, there is, Dr. Zilboorg shows, a complete clinical record of psychic abnormalities known to modern science. He also shows by an analysis of records of the examination of cases of demonic possession and of the writings of such authorities as Paré, Paracelsus and Cornelius Agrippa, that medical men 'shied away' from a province expressly, and often explicitly, debarred from the healing art and consigned to the Church and the Law, either as heretical and criminal—the witch; or as spiritual—the demonically possessed.

Glimmerings of the truth are to be observed among the more advanced masters of medicine, as, for example, in the writings of Paracelsus and Agrippa; but as Dr. Zilboorg shows by copious quotation, the introduction of a scientific attitude of mind and of accurate clinical observation of cases in this field is due to Johann Weyer (1515 or 1516–88), native of Brabant and physician to Wilhelm, Grand Duke of Trier. Weyer was the founder of psychiatry. Unfortunately, Weyer's work became inextricably entangled in the conflicts between heresy and orthodoxy and the Roman and the reformed Churches. Hence, notwithstanding the decay of the active belief in witchcraft, the field of psychopathology continued to be dominated by the theological attitude towards possession for just on three hundred years.

Study of X-Rays

X-Rays in Theory and Experiment

By Prof. Arthur H. Compton and Prof. Samuel K. Allison. Second edition of "X-Rays and Electrons" by Arthur H. Compton. Pp. xiv+828. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1935.) 31*s*. 6*d*. net.

"X-RAYS in Theory and Experiment" was originally conceived as a second edition of Compton's deservedly celebrated "X-Rays and Electrons". That book was published just at the time when the great revolution in physical theory, characterised by the new quantum mechanics, was making itself felt, and the changes which this new outlook produced—changes due not in small part to the work of the authors—have caused instead a second book to be written, twice as large, and containing far more than twice the amount of data and interpretation.

It is, of course, a different kind of book from "X-Rays and Electrons". The first was the product of pioneering and provocative research. The Compton effect was one of those final discoveries that made reconciliation between the wave and quantum aspects of radiation seem altogether impossible, and the impossibility of this reconciliation was underlined and emphasised all through the book. The theoretical physicists could no longer evade the contradiction; they must resolve it; and thus, through the works of de Broglie, Schrödinger, Heisenberg and Dirac we have learnt that both the wave and the quantum form are valid not only for radiation, but also for matter, and in a way that obliges us to consider both as we had never thought of them before. The contradictions earlier raised by Compton now found their solution in wave mechanics in the uncertainty principle, and so the new book takes on a far more finished character than the old. Problems and difficulties still remain, but they are no longer the predominating note. Instead, we have presented in field after field a satisfactory quantum mechanical explanation of the phenomena.

The subject covered by the book is one of those divisions of physics which, growing up naturally, takes its part in the classification of physics based essentially on the size of the energy changes with which it deals. Normal optics is concerned with changes from a fraction of a volt to 100 electron volts, X-rays in the widest sense from 100 to 100,000 volts, but mostly in the tens of thousands, and beyond it, there are nuclear physics and the ultra-physics of cosmic rays, ranging into millions and thousands of millions of volts. From another point of view, the study of X-rays is an extension of the familiar theories of physical optics in an unfamiliar world, where the apparatus is no longer mirrors and lenses, but crystals and electron clouds, and the refractive index is both imaginary and less than one. We have a theory of spectra, of fluorescence, of absorption and dispersion, just as in the optical field, as well as a theory of scattering and diffraction. On the experimental side, things are, of course, very different; all beams are divergent beams limited by slits. The one link is the photographic plate, but apart from that the ionisation chamber and the Wilson chamber take the part of the human eye, while the single and the double crystal spectrograph replace the spectrometer and the interferometer in the analysis of wave-lengths.

One of the particular advantages of the book is the logicality of its arrangement. After the history of X-rays, the theory of their production is discussed, and then of their scattering—by electrons, by atoms, by liquids and by crystals. In the light of this knowledge, particularly of crystal refraction, the fluorescence, the absorption and the spectroscopy of X-rays are treated. One of the most interesting chapters is Chapter iii, dealing with the theory of scattering and incorporating a great deal of Prof. Compton's new work. It is in itself an admirable introduction to the new quantum theory. In the first section, the experimental evidence for light consisting of discrete quanta is derived both from the change of wave-length on scattering and its dependence on angle, and from the velocity and angular distribution of the recoil electrons.

The next section gives the resolution of this dilemma by means of wave mechanics, where we are dealing with the interference of two trains of waves, photonic and electronic. It is possible to go further, and obtain, from the fine structure of the Compton scattered line, the analysis of the distribution of electronic velocity in an atom, complementary to the distribution of electronic density which is derived from the unmodified scattering. The next chapters of the book give a comprehensive account from the physicist's point of view of the scattering of electrons by gases, liquids and crystals.

It should be emphasised that the book is primarily a physical treatise concerned with the principles of the relation of X-rays, electrons and matter, and not with the chemical or crystallo-

graphic question of the structure of the different forms of matter. The accounts of the methods of X-ray crystal analysis would not, and cannot be expected to, be of the nature of a manual of practical crystal analysis, but it will be a great help for chemists and physical chemists if physicists acquire in this way a knowledge of the principal developments in this field. It would be possible, for example, to criticise as inadequate the information offered as to detailed electronic configuration of certain atoms, where values are quoted coming from work which has been superseded. In the same way, in the question of the structure of liquids, not enough account has been taken of the work of Prins, while other results, which are strictly applicable only to a certain class of polar liquids, have been given a too general application.

Particularly useful are the chapters on dispersion and absorption of X-rays—questions which have rarely received such comprehensive treatment in English works. The value of the section on X-ray spectroscopy lies particularly in the space given to the detailed analysis of spectral lines by means of the double crystal spectrometer which has been the particular work of Prof. Allison, and until now has been far too little known. A critical discussion of the value of the electronic charge, whether based on oil-drop or absolute wave-length measurement—which give a difference between 4·77 and 4·80 $\times 10^{-10}$ E.S.U.—is not brought to any definite conclusion: in fact, as yet, this crucial metrical problem has not been solved.

The presentation of the book is excellent. In the figures a new method of rather violent perspective and shading is used to give three-dimensional impression in an effective, though somewhat startling, way. Both in the book and the appendixes there are contained the tables of the latest values of most of the fundamental atomic constants, structure factors, wave-lengths, absorption coefficients, etc. "X-Rays in Theory and Experiment" cannot fail to become a standard work of reference, both for physicists and crystallographers.

J. D. BERNAL.

Experimental Bacteriology

Experimental Bacteriology in its Applications to the Diagnosis, Epidemiology and Immunology of Infectious Diseases

By Prof. Dr. W. Kolle and Prof. Dr. H. Hetsch. Translated from the seventh, completely revised German edition by Dagny Erikson. The English version, incorporating further revision, edited by Prof. John Eyre. Vol. 1. Pp. 592+49 plates. Vol. 2. Pp. 613+62 plates. (London: George Allen and Unwin, Ltd., 1934.) 30*s*. net each.

THE classical German textbook, which enjoyed much popularity under the title "Experimentelle Bakteriologie", has been translated into several languages and now appears for the first time in English. The whole work comprises two large volumes each of more than five hundred pages, and has been edited by Prof. Eyre. It may be stated at once that this has been well done, and that all those interested in bacteriology in its relation to disease, whether from the point of view of student, teacher or investigator, will be grateful to have this German work more easily accessible by reason of its English version.

The first volume follows the conventional course by opening with chapters on general morphology and the biological aspects of pathogenic organisms and on immunity. Serological diagnostic methods appear in due course, and the ground is prepared for the ensuing descriptions of purely bacterial infections such as diphtheria, anthrax, typhoid fever, the streptococcal infections, the anærobes, etc. With the exception of tuberculosis and leprosy, infections of bacterial origin are included in this volume.

The second volume deals with infections with the acid-fast bacteria, spirochætal infections, tropical diseases, the filterable viruses affecting man, and to some extent animals, and the filamentous fungi and yeasts.

Though this subject is vast, there is no suggestion that there has been undue compression of material. Each chapter deals with its subject matter in a quite convincing and, for the most part, thorough way. Each disease is treated from the aspects of causative agent, diagnosis, epidemiology and immunology and, where possible, information gathered from post-mortem material is included. It would, indeed, be difficult to better many of the descriptions, which are liberally reinforced by excellent illustrations, many of them colour plates, which are a very valuable addition to the work. These volumes will make an appeal because the difficult liaison between clinical and laboratory knowledge has been brought about in a natural and convincing way without undue stress on either branch. It is at the same time a work for the student of medicine, for those whose interest lies primarily in tropical medicine and a useful book of reference for the investigator.

The work as a whole is not, however, free from faults, some of which are glaring and could easily have been avoided. It is not surprising to find confusion in such terms as "typhus" and "typhoid" and it would be, perhaps, wiser in an English edition to avoid the use of the term "spotted fever". The word "virus" also connotes nowadays a recognised group of infective agents rather than a general term, and should not be used in connexion with such diseases as syphilis. These faults are not really important. Much more serious, however, is the inescapable conviction that reference to foreign published work, particularly English and American, is to a very great extent absent. It may be that the authors had not ready access to these publications, although it is difficult to believe that the absence of the Kahn test from the discussion on the serological diagnosis of syphilis can be put down to this. It should, beyond question, have found a place alongside the Meinicke and Sachs-Georgi methods. There is also a tendency to refer to the work of investigators throughout the text while omitting it from the list of references. The value of these volumes as a work of reference has to some extent suffered by such omissions.

As a general rule, whilst the authors are progressing along the older and better beaten paths of bacteriology, there is a surety of treatment and a careful discrimination in the selection of available material. The case of the filterable viruses, however, is not so happy. There it is essential to move with the times, and this has not been done. Certain filterable viruses, such as louping ill and Rift Valley fever, have been missed completely. Admittedly, to be quite up to date in a large published work is difficult, so rapid is the progress in this highly important field. In dealing with the question of psittacosis, reference to work so recent as 1934 is found, and a quite useful account of the disease is given. It is a mistake to dismiss the problem of prophylactic measures in the control of yellow fever without mention of the promising results of vaccination. The cultivation of filterable viruses is now an accomplished fact, and several investigators have made convincing claims for its practical importance in smallpox vaccination.

A true indication of the nature of the filterable viruses has not been given in these volumes by reason of omission of more recent work along this line. On this point, reference is made to the experiments of Frosch and Dahmen with foot-and-mouth disease, whereas no mention is made of the very important work of the Maitlands and of Hecke. Nor is it a good reflection of generally accepted opinion to find on page 523 of vol. 2 the statement that the Borrel bodies in fowl-pox are "specific products of reaction of the tissues". These are but a few instances, and no doubt in future editions the treatment of the filterable viruses will follow more closely recent developments and so reach the same high standard which for the most part characterises the rest of the work.

The translation, which must have been an arduous task, has been admirably done.

Les plantes alimentaires chez tous les peuples et à travers les âges :
Histoire, utilisation, culture. Par Prof. D. Bois. Vol. 3 : Plantes à épices, à aromates, à condiments. (Encyclopédie biologique, Vol. 7.) Pp. iii+289. (Paris : Paul Lechevalier, 1934.) 50 francs.

THIS part of the "Encyclopédie biologique" deals primarily with spices but contains, in addition, useful information on a number of economic plants yielding edible products that may not be generally regarded as spices.

The first half of the volume deals with the true spices, and the early pages are devoted to an interesting historical account of the spice trade, the early days of which were so filled with romance. The more important spices such as pepper, nutmeg, cloves, cinnamon, ginger, chillies and vanilla are dealt with in detail, while those of more limited consumption such as turmeric, Guinea grains and star-anise receive more summary treatment. In addition to a description of the spice and the plant yielding it, information is given regarding areas of production, cultural requirements and practice, yields, uses and common names in various languages.

In the section devoted to condiments there are good accounts of mustard, horse-radish and the various representatives of the families Umbelliferæ, Compositæ and Labiatæ that fall under this category. Brief accounts of edible oil- and sugar-yielding plants are given at the end of the volume. Their inclusion in a volume devoted to spices and condiments is perhaps somewhat surprising.

Structure et propriétés des noyaux atomiques :
Rapports et discussions du Septième Conseil de Physique tenu à Bruxelles du 22 au 29 Octobre 1933 sous les auspices de l'Institut International de Physique Solvay. Pp. xxv+365. (Paris : Gauthier-Villars, 1934.) 75 francs.

THE report on the seventh Solvay Conference (1933) at Brussels contains papers by Cockcroft, Chadwick, the Joliots, Dirac, Gamow, Heisenberg, with discussions by a galaxy of notable physicists on the structure of atomic nuclei, neutron, positron, neutrino and the 'materialisation' of gamma rays. The report adopts and recommends the notation $^{4}_{2}He$, $^{226}_{86}Ra$, and so forth, rather than $^{4}He_{2}$, $^{226}Ra_{86}$ . . . , a change which the chemist would approve. In these days of rapid development of atomic physics, it would be a great boon to receive these reports within a few weeks of each conference, and to find them with their edges cut.

Quelques éclaircissements épars sur mes Monumenta Cartographica Africae et Aegypti

Par Prince Youssouf Kamal. Pp. vi+216. (Leiden : E. J. Brill, S.-A., 1935.)

STUDENTS of the history of cartography in general, and of African cartography in particular, are deeply indebted to Prince Youssouf Kamal for the inception and production of his lavishly designed volumes—"Monumenta Cartographica Africae et Aegypti"—which he is presenting to all the important libraries of the world. When completed, this work will prove a valuable storehouse of cartographical material for students, to whom much of it would otherwise be inaccessible. Interpreting his title widely, he includes not only reproductions of original maps, but also reconstructions of the historical geography of various periods, and extracts from contemporary writers containing topographical references. The present volume is largely an explanation of the scheme upon which the "Monumenta" have been designed, and a commentary upon the material already published.

It is not a comprehensive history of cartography ; the author is content rather to discuss, without being didactic, and sometimes discursively, some of the major problems, and to indicate lines of profitable research. Such points are the symbolical character of early maps, the origin of the maps illustrating Ptolemy's Geography—he omits consideration of the probability that the tables of data were largely derived from maps of some kind—the content of medieval *TO* maps, and the work of the Oriental or Arab cartographers. His analysis of the latter reinforces the evidence for their dependence upon classical sources. In discussing his plan for the final volume dealing with the European discoverers of the early modern age, he presents a useful summary of the cartographic evidence for maritime activity along the coasts of north-west Africa prior to the movement associated with the name of Prince Henry. It yet remains to be demonstrated by whom this work was performed, and the relative contributions of Portuguese, Spanish and Italian pioneers. It is evident that this formidable undertaking is the work of a true enthusiast, and a patron of research.

G. R. C.

Fundamentals in Teaching Home Economics

By Ivol Spafford. Pp. xiii+424. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1935.) 13*s*. 6*d*. net.

FEW students of social problems to-day will question the general statement that the strength and sanctity of home life is still one of the most vital elements in the national fabric ; and that the efforts now being made by far-sighted educationists to place the study of home economics on a firm basis, occupying a high and secure position in school curricula, merit every encouragement. This need was well recognised by the inclusion in the recent Congress for Scientific Management of a section for domestic economy ; and in the present excellent and comprehensive work that need is still more clearly and fundamentally emphasised and provided for. The book deals of course with the teaching of home economics in the United States, but its breadth of view and depth of thought are such as to make it international in scope and application.

Home economics is here seen to be a matter of deep interest to everybody, to all indeed who have or hope to have any sort of home life and wish to make the best of it in all its varied intellectual, practical and emotional aspects. It is something vastly greater than a cookery or sewing class for adolescent girls. It makes a stirring appeal to boys and to adults of both sexes. It reaches down to the fundamentals of education in its analysis of the desire to learn, to know the truth, of thinking and self-directed education, of measuring progress in learning, and of the philosophy of education in general. But besides these deeper general aspects of the subject, the book contains a wealth of practical and helpful instruction to the teacher in a very difficult field, based on the author's own wide experience and profound study which, judging from the copious list of references appended to each chapter, must have been of an unusually complete and indefatigable nature.

Sumatra

Its History and People, by Edwin M. Loeb ; The Archaeology and Art of Sumatra, by Robert Heine-Geldern. (Vol. 3 of Wiener Beiträge zur Kulturgeschichte und Linguistik des Institutes für Völkerkunde der Universität Wien.) Pp. ix+350+40 plates. (Wien : Verlag des Institutes für Völkerkunde der Universität, 1935.) 23 Österr. schillings ; 4.40 dollars.

ALTHOUGH both the authors of this volume have a first-hand knowledge of the indigenous peoples of the Dutch East Indies, they do not claim to have attempted more than compilation. The result of their labour is, nevertheless, welcome to English readers, among whom a knowledge of the Dutch language, in which the copious literature dealing with the antiquities, culture and peoples of these islands for the most part has appeared, is either non-existent or far from profound. A reference to the extensive bibliography of the works upon which they have drawn for their material will show how very extensive this literature has come to be. To a great extent, the bar of language has been responsible for the fact that the position of the Javanese in the ethnology of Indonesia and as a link extending from New Guinea to the Malay Peninsula has received less consideration than its importance warrants.

In the section dealing with art and archæology, the author distinguishes no less than ten cultural strata extending in date from palæolithic (here a cultural rather than a chronological term in the strict sense) to the Chinese influence of the end of the fourteenth century A.D. It is to be noted that in the palæolithic he discriminates between a flake culture, which he holds to be probably Veddoid, and a hand-axe culture, which he would assign to the Papuo-Melanesian.

The book is illustrated by excellent photographs.

Diesel Engines and Coastal Shipping

DURING the meeting of the British Association at Norwich, an evening discourse was delivered on September 6 by Dr. S. J. Davies on Diesel engines and coastal shipping.

After referring to the remarks of Sir Frederick Bramwell in 1881 and the comments made by Sir Alfred Ewing in 1931 on Bramwell's suggestion that by 1931 steam engines would be superseded by internal combustion engines, Dr. Davies said that, for transport by road and in the air, the internal combustion engine holds a practical monopoly, but in large power stations the steam installation successfully meets competition. But the contest goes on, improvements in competing types appearing almost daily, while apparently unimportant developments in physics or metallurgy may have far-reaching consequences. The production of a better heat-resisting metal, for example, might change the whole position of the contest. The competition in the marine-engine field has proved one of the most interesting. On passenger liners the contest between the two divisions of steam engines, reciprocating and turbine, had first to be settled. To-day, while the steam turbine shows outstanding advantages for the largest passenger liners, Diesel engines have met with some success on the smaller liners, although the question is still very open. It is in the remaining classes of ocean-going vessels of the mercantile marine that Diesel engines have their greatest application, while in the last few years their importance in coastal work has steadily increased.

The term 'coastal shipping' includes a variety of craft, but for his purpose Dr. Davies confined himself to the three divisions : tugs, fishing vessels and coasters. In comparison with ocean-going vessels, these are limited in size and in the lengths of their voyages. These limitations involved factors quite different from those governing the design of ocean-going ships and their machinery. Ocean-going vessels spend by far the greater proportion of their time under way in travelling steadily at normal engine speeds, the proportion of time at reduced speeds and while manœuvring in harbour being small. In other words, the loads on the engines are for the most part uniform, and the demands made in respect of repairs and overhauls consequently less exacting than in coastal vessels. An ocean-going ship might go for days without the engineers receiving any orders from the bridge, and all running conditions—such as cooling water temperature, injection, adjustments, etc.—can be set and left unchanged.

The coasting vessel, on the other hand, is steaming to bell most of the time ; entering ports and rivers, docking, turning and then steaming on to its next destination through relatively crowded waterways. It is thus essential that the engines of the coaster should continue to work without detail supervision, and that they should withstand without difficulty both the mechanical stresses imposed by rapid changes of load and speed, and also the changes of engine temperature involved. In coasting vessels, the opportunities for carrying out repairs and adjustments are more limited. Then, too, limitation of size involves other conditions. Whereas the ten-thousand ton vessel has a little spray blown over the engine-room hatchway in bad weather, a moderate breeze will cause a small coaster to be drenched with spray, and so the engine must be made waterproof. The coaster too, lying alongside quays, is exposed to dust and grit, and the machinery should be totally enclosed to avoid the wear of working parts from the abrasive action of the grit. It is therefore clear that the machinery works under most exacting conditions, and it is necessary that everything possible should be done to lighten the duties of the engineer and to facilitate the repair or renewal of engine parts.

The Diesel engine for coasters is still in the experimental stage. Many firms are entering the field, and the Diesel engine is justifying itself handsomely in certain applications. Nevertheless, the full benefits of the Diesel engine cannot be realised until a limited number of designs can be standardised. As a result of such standardisation, the first costs of the engines should be lower than at present, spare parts should be readily and cheaply supplied, and the proportion of time the vessel is laid up for overhauls should be reduced. One direction in which the duties of the engineer could be lightened is by removing the navigational control of the machinery from the engine-room to the bridge. The handle of what is normally the engine-room telegraph should be the control handle on the bridge, and the change of speed and reversing the propeller should be fully automatic in response to the movement of this handle.

Investigations into the wear of Diesel engine cylinder liners have demonstrated the bad effect of changes of temperature of the circulating water and in particular of running an engine with cold circulating water. Coastal vessels, with their rapid changes of load and speed, and relatively frequent stops, are especially subject to

these unfavourable conditions, and it would be sound economy on all but the smallest vessels to take steps to reduce their effects. To ensure efficient cooling of the cylinders, cooling, in all but the smallest vessels, should be by fresh water passing round a closed circuit consisting of a small tank well above the engine, feeding into the line near the pump suction, and a tubular cooler placed well down in the ship. Clean lubricating oil is always an economy. This is provided by employing the 'dry sump system' in which the oil from the crank chamber is forced into a storage tank through filters which extract the solid particles. The filtered oil is drawn from the storage tank, and delivered under pressure to the engines.

While matters of design, control and upkeep are common to all classes of vessels, each kind of service brings its own special problems, and the examples quoted should show how these have been solved. Diesel engines for tugs have become of considerable importance in the last seven years. On the Thames, goods are carried in flat-bottomed barges which are towed downwards and upwards with the tide, the current at full ebb and flow being about 3 knots. There are approximately 350 tugs engaged in lighterage on the river, of which already 150 are motor tugs. The Thames Steam Tug and Lighterage Co. has been one of the pioneers in the use of Diesel engines, and one of their vessels has been in use for more than five years. In the *Irande*, the propelling machinery consists of a six-cylinder directly-reversible four-stroke Carels-Ingersoll-Rand engine developing 340 b.h.p. Another vessel of the same company, the *Framfield*, has two six-cylinder four-stroke engines, each driving a dynamo delivering current at 350 volts to a 400 s.h.p. propulsion motor. Control is from the bridge, there being two control handles, one on the port side and the other on the starboard side, so that the steersman can use the one most convenient to him. Mr. F. T. Mayor, the superintending engineer of the company, kindly supplied figures which made a comparison of the working costs of a steam tug and motor tug possible. These figures are very favourable to the motor tug.

As regard fishing vessels, the application of Diesel engines has been very uneven at the various ports. The Cornish fishermen, for example, have applied small engines to practically all their sailing vessels. The Scottish fishermen have gone further and have applied Diesel engines to many vessels of the sizes formerly steam-driven. The larger classes of trawlers, having displacements up to 2,300 tons, have engines of 1,000 h.p. and more. Several such vessels have been built in Great Britain, but mainly for French owners, and are employed in cod-fishing. There is a difference of opinion as to the question of drive in certain classes of fishing vessels. For the largest vessels, directly-reversing engines with direct drive to the propeller are usual; for small vessels, combined speed-reduction and reversing gears give the best service. In view of the large mass of experience already gained at home and abroad with Diesel-engined vessels, reliability in service may now be taken for granted. Other factors must, of course, be taken into account in making a comparison between steam engines and Diesel engines, and since the first costs of the latter are higher than those of the former, Diesel engines must show other advantages to counterbalance their higher capital charges. These compensating advantages follow mainly from two important facts: first, for the same power and output Diesel engines occupy considerably less space than the corresponding steam engines and boilers; secondly, the Diesel engine has a much higher thermal efficiency than the steam engine.

Turning to the third division of coastal vessels, the coasters, Dr. Davies said the primary duty of these is to convey goods, although small numbers of passengers are carried in some of the larger vessels. Among the companies who have recently adopted Diesel engines for coastal work is Messrs. Coast Lines, Ltd. The first of their four motor-ships was launched just two years ago and the fourth in July last. Their M.V. *Pacific Coast* has a dead-weight capacity of 1,755 tons. She is a twin-screw vessel, having two five-cylinder Polar-Diesel two-stroke engines, each developing 628 b.h.p. at 250 r.p.m. The auxiliaries are all electrically driven, current being generated by three oil-driven dynamos.

Such large vessels, however, are exceptional and, in view of the smaller difference between their work and that of ocean-going vessels, the superiority of Diesel engines in their case could be almost taken for granted. In tugs and fishing vessels, too, the matter seems also to be clearly proved. It may be summarised broadly by saying that where the vessel is for the greater part of its time under way, the advantages of the Diesel engine more than balance its higher first cost.

Whether as a result of the application of the Diesel engine or not, there is an undoubted revival of interest in coastal shipping. That this question is being approached more scientifically than hitherto is to be seen in the recent report of the work of the Froude Tank at the National Physical Laboratory. It is interesting to note, too, that the researches carried out have led to results definitely favourable to engines driving propellers at higher speeds of revolution, which is usually the case when Diesel engines are employed. Dr. Davies' lecture throughout was illustrated with slides of the various types of craft and their machinery.

Absolute Units and Electrical Measurements

By Sir Richard Glazebrook, K.C.B., F.R.S.

THE absolute system of electromagnetic units was developed by the British Association Committee on "Practical Standards for Electrical Measurements". Of this Committee Sir Wm. Thomson (Lord Kelvin) and Clerk Maxwell were the leading members and the development of the system is mainly due to them. It may be of interest to have here a brief account of what is meant by an 'absolute system'.

The meaning given to the term 'Absolute Measurement' was clearly explained by the B.A. Committee in the report to the Newcastle meeting in 1863. The Committee states :—

"The word 'absolute' in the present sense is used as opposed to the word 'relative' and by no means implies that the measurement is accurately made or that the unit employed is of perfect construction, but only that the measurement, instead of being a simple comparison with an arbitrary quantity of the same kind as that measured, is made by reference to certain fundamental units of another kind treated as postulates."

"For true absolute measurement the unit of force is defined as the force capable of producing the unit of velocity in the unit of mass when it has acted on it for the unit of time. Hence this force acting through the unit of space performs the absolute unit of work. In these two definitions, time, mass, and space are alone involved and the units in which these are measured, i.e., the second, gramme and metre* will alone in what follows be considered as fundamental units."

The Report then goes on to consider the mechanical, chemical and thermal effects due to electrical action, and since the chemical and thermal effects are measured by reference to a mechanical unit of work, concludes that it is only necessary in developing an absolute system of measurement to attend to the connexion between electrical magnitudes and the mechanical units. We are thus led to the following explanation of an absolute system of measurement.

Electric or magnetic systems exert force and are sources of energy. Force and energy are measured in terms of length, mass and time.

The forces between two quantities of electricity or two magnetic poles, measured in any units whatever, can be shown to be proportional to the product of the charges or of the poles and inversely to the squares of the distance between them. The constants of this proportion form the links required to connect quantities of electricity or of magnetism with the fundamental units. A third constant is required to determine the relation between a quantity of magnetism and an electric current. These three constants, usually denoted by K_0, μ_0 and A, are reduced to two because it can be shown that

$$A^2/\mu_0 K_0 = C^2,$$

where C is the velocity of wave propagation.

In order to form an absolute system of electrical measurement, it is absolutely necessary to know *two* of these constants, which thus form the links connecting electrical and magnetic quantities with the fundamental units of length, mass and time. Such is the basis of the system of measurement conceived by Maxwell and the B.A. Committee in the year 1863.

The committee selected as fundamental units the centimetre, the gram and the second, thus establishing the C.G.S. system. That, of course, was not necessary; the metre, the kilogram and the second might have been taken, but the choice was deliberate and only arrived at after much inquiry*.

To complete the electromagnetic system the Committee had to select the values of the two constants μ_0 and A. It was at liberty to select any values it pleased for these; the selection would determine the units in terms of which quantities of magnetism and currents of electricity were to be measured. Further investigation showed that μ_0/A represents permeability—the ratio of the magnetic induction at a point in space to the magnetising force at that point—and it was a very natural step to assume that this ratio was unity, that is, to select the permeability of space as the unit of permeability, and thus to make $\mu_0/A = 1$ on the C.G.S. system of absolute units.

A further assumption was required as to A, and for this the Committee selected the value unity. It thus formed the C.G.S. absolute system of electrical measurement with the centimetre, gram and second as basis, together with unity as the value of each of the necessary constants μ_0 and A.

* The metre was changed later to the centimetre.

* See B.A. Reports on Electrical Measurements: A Record of the History of "Absolute Units" and of Lord Kelvin's work in connection with these. Reprinted by the Association, 1912 (Cambridge University Press). See also "Dictionary of Applied Physics", vol. 2, page 941, article on units of electrical measurement.

The last assumption, that A is unity, implies that $\mu_0 K_0 C^2$ is unity, and hence that $K_0 = 1/\mu_0 C^2$.

For mechanical purposes the M.K.S. system is excellent and has many advantages, the main one perhaps being that the Joule, 10^7 C.G.S. units of energy, is on that system unity. But in my view the M.K.S. (Resistance) system is not an absolute system of electrical measurement. A material substance—a tube of mercury or a coil of wire—will not of itself serve to connect electrical quantities with length, mass and time. There is a sense perhaps in which the M.K.S.Ω system (Ω the ohm) may be looked on as a kind of hybrid absolute system because the ohm, 10^9 absolute C.G.S. units of resistance as defined by the B.A. Committee, is by that system linked to the units of length, mass and time. Personally I should greatly regret to see the word 'absolute' divorced from its original meaning.

The M.K.S. system can, of course, become 'absolute' for electrical measurements just as the C.G.S. system has done. Three constants will be required: we may call them K_1, μ_1 and A_1. They will be connected by the equation

$$A_1^2/\mu_1 K_1 = C_1^2,$$

where C_1 is measured in metres per second.

On the C.G.S. system, A is an undimensional constant arbitrarily assumed equal to unity; we may agree to make the similar assumption on the M.K.S. system and thus put A_1 = unity. We are also free to assume any value we like for μ_1 which leads to the result that $K_1 = (\mu_1 C_1^2)^{-1}$, and we have then a second quite satisfactory system of 'absolute measurement'. This will usually differ from the C.G.S. system. If, however, we choose for μ_1 the value 10^{-7}, the M.K.S. system leads to practical results identical with those of the C.G.S. system, and the accompanying table gives the relations between the various quantities involved—it might, of course, be extended to include others. M.K.S. system, may be selected as a fourth fundamental quantity required by the M.K.S. system. It must, of course, be remembered that a fifth such quantity is needed and completeness is attained by assuming for the value of A_1 unity, as the B.A. Committee did for A.

At a conference at which I was present recently the question was asked: "What is the need for a 'fourth unit' ?" The reply was to the effect that the 'fourth unit' is needed to complete the dimensional equations. Thus it is not put forward to simplify electromagnetic theory or place it on a firmer basis, but to fill a supposed gap in the dimensional equations.

Dimensions, as the term is used by Maxwell, have reference to the three fundamental quantities of length, mass and time, and he set out with the object of expressing all electrical quantities in terms of these three. This proved to be impossible. Using more modern terms and symbols, the quantities denoted now by A, μ_0 and K_0 are involved and these are connected as explained above by the equation $A^2/\mu_0 K_0 = C^2$.

The dimensions of $\mu_0 K_0/A^2$ are those of the reciprocal of the square of a velocity, but without some further assumptions we can proceed no further. Maxwell tacitly assumed A to be unity and undimensional, leading to the result that $\mu_0 K_0 = 1/C^2$.

Maxwell points out that two assumptions are possible: on the one, the electromagnetic, μ_0 is treated as an undimensional constant of value unity and we have the electromagnetic system, on which, for example, the dimensions of a resistance are those of a velocity, those of a coefficient of induction are a length, etc. For the electrostatic system, K_0 is treated as an undimensional constant of value unity.

There is, however, another solution to the equation $\mu_0 K_0 = 1/C^2$. We may assume μ_0 and K_0 each to have unknown dimensions in length, mass and time, but to be so connected that the dimensions of their product are those of $1/C^2$. The dimensions of a coefficient of induction are then those of $\mu_0 \times L$; those of a resistance are those of

TABLE SHOWING THE RELATION BETWEEN QUANTITIES ON THE C.G.S. ELECTROMAGNETIC SYSTEM AND ON THE PROPOSED M.K.S. SYSTEM

	Length	Mass	Time	Space Permeability μ_0/A	Electromagnetic Coefficient A	Coulomb	Ampere	Volt	Ohm
C.G.S.	1 cm.	1 gramme	1 second	1	1	10^{-1}	10^{-1}	10^8	10^9
M.K.S.	1 metre	1 kilogramme	1 second	10^{-7}	1	1	1	1	1

On Maxwell's theory of the electrical field the permeability of space is assumed to be a quantity having dimensions. The value, therefore, will depend on the system of units employed. The symbol μ_0 is used to denote this quantity. On the C.G.S. system the permeability of space has been selected as the unit of permeability. Hence on this system the value of μ_0 is unity. On the M.K.S. system its value is 10^{-7}, and on the 'rationalized' M.K.S. system the value of μ_0 is $4\pi \times 10^{-7}$.

At the same time the S.U.N. Commission desires to take this opportunity of placing on record its recognition of the fact that there are important electrical theories supported by a number of physicists in accordance with which $\mu_0 K$ is a pure number.

This, then, briefly gives my reason for the desire that 10^{-7}, the value of space permeability* on the

* In cases in which it is desired to use the "rationalized system of units", this will become $4\pi \times 10^{-7}$, while the value of A will be unity.

$\mu_0 L/T$, and both are unknown. But nothing is really gained by taking either of these quantities as a 'fourth unit' and treating it either as a fourth dimension additional to those of length, mass and time, or as a quantity of unknown dimensions in length, mass and time.

The first alternative is an additional complication to electromagnetic theory—it does no doubt simplify certain dimensional equations; the second is secured by the acceptance by the I.E.C. of the statement that 'μ_0 possesses physical dimensions'.

What is necessary to place the M.K.S. system on a secure basis is the realisation of the facts that the two quantities A and μ_0 are essential, and that if the units of the system are to be the practical units of the C.G.S. system, their values (unrationalised) must be 1 and 10^{-7} and (rationalised) 1 and $4\pi \times 10^{-7}$.

It must, of course, be recognised that another solution to the equation $A^2/\mu_0 K_0 = C^2$ is open to us. We may, with Gauss, put $A = C$ and then $\mu_0 K_0$ becomes a numeric.

Adolf von Baeyer, 1835-1917

By Prof. J. R. Partington, M.B.E.

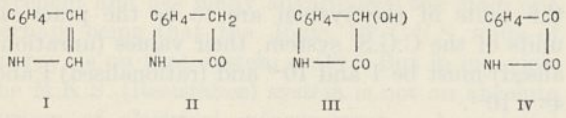
TWO of the outstanding organic chemists of the later nineteenth and early twentieth centuries were Adolf von Baeyer and his pupil Emil Fischer. As the late Prof. W. H. Perkin said, "their influence has been profound, mainly no doubt because of the immense amount of work of fundamental importance which they have left behind, but to a scarcely less degree by reason of their influence as teachers". The discoveries of Baeyer have also had a most important bearing on chemical industry, although he himself was little interested in their commercial exploitation. The side of theoretical organic chemistry which interested him most was the structural aspect, and in this his views, even in his early publications, were remarkably accurate. He modified in many ways the picture as left by Kekulé, and in some parts modern developments have merely filled in the details.

Adolf von Baeyer was born in Berlin on October 31, 1835. His chemical training began, like that of so many others eminent in this science, with Bunsen at Heidelberg. There he worked on cacodyl compounds, already made important in the early history of organic chemistry by the investigations of Bunsen. The latter had little interest in the development of organic chemistry at that time, and Baeyer, who wished to take up this branch of the science, spent two years in a private laboratory of Kekulé at Heidelberg. In 1858 he followed Kekulé to Ghent and began work on derivatives of uric acid. His interest in this was aroused in a curious way. During his journey from Heidelberg he became acquainted with a former pupil of Liebig, who gave him a box of specimens of uric acid derivatives. The further investigation of this class of bodies, carried out by Baeyer and his pupil Emil Fischer, may therefore be said to go back directly to the early work of Liebig at Giessen.

In 1860 Baeyer returned to Berlin as a teacher of organic chemistry in a small technical school. In this poorly paid and modest position he remained for twelve years, during which period he had in his laboratory such men as Graebe, Liebermann and Victor Meyer. The work on uric acid derivatives was continued, and in this period Baeyer also put forward the suggestion (in 1870) that the formation of sugar in plants is due to the reduction of carbonic acid, HO.CO.OH, in the green leaves and under the influence of light, to formaldehyde, H.COH, which then undergoes polymerisation to grape sugar, $C_6H_{12}O_6$. The study of a very important class of reactions called condensations began in 1866 with an investigation of the action of acids on acetone, and was developed in various directions, including the condensation of hydrocarbons with phenols and aldehydes. One outcome of this work was the use of phthalic anhydride, which led to the discovery of the phthaleins, many of which are dyestuffs, such as fluorescein, eosin and the rhodamines.

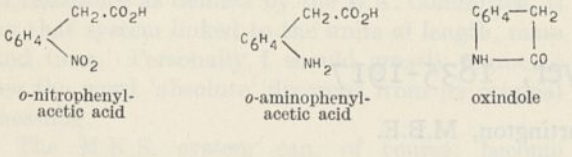
After a period from 1870 until 1875 at Strassburg, where Emil Fischer was his pupil, Baeyer succeeded Liebig at Munich. For more than twenty years, Liebig's activities at Munich had been confined to lecturing and studying the applications of chemistry to agriculture and medicine. There was no laboratory, and Baeyer's first task was to plan large new laboratories which were completed in 1877. In these he continued the investigation of indigo which he had begun in 1865, preparing several derivatives. He found that isatin (IV), a red substance discovered by Laurent in 1840 and produced by oxidising indigo with nitric acid, on reduction yields first dioxindole (III) and then

oxindole (II), which on distillation with zinc dust is reduced to the parent substance, indole (I):

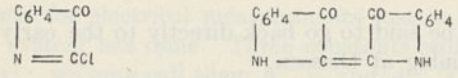


I II III IV

In 1870 Baeyer and Emmerling had found that isatin chloride when heated with phosphorus and hydriodic acid yields indigo, and thus when isatin was synthesised from *o*-nitrophenylacetic acid in 1870, this was also a synthesis of indigo:



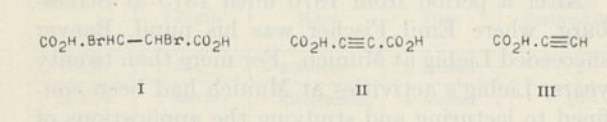
o-nitrophenylacetic acid — *o*-aminophenylacetic acid — oxindole



isatin chloride — indigo

Several other methods of synthesising indigo were worked out in the period until 1885, and naturally the German dyestuff firms became interested in the matter. They spent great sums of money on research, but all the processes tried at first proved too expensive, and since Baeyer declined to take an active part in helping to solve the commercial difficulties, some ill-feeling developed on the side of the firms, which led Baeyer to terminate his researches on indigo altogether in 1885.

Baeyer then turned to the investigation of a series of interesting but dangerous compounds, the polyacetylenes. From dibromosuccinic acid (I) he obtained acetylene carboxylic acid (II), from which by removal of carbon dioxide he prepared propargylic acid (III). From this the compounds diacetylene carboxylic acid (IV), diacetylene (V) and finally tetracetylene dicarboxylic acid (VI) were obtained. The latter was very explosive.

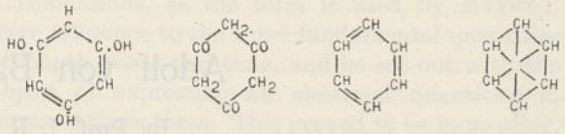


I II III

IV V VI

The properties of these compounds led Baeyer to consider the nature of the triple bond and the stability of rings of carbon atoms, the result being announced in the 'strain theory', in which stability is related to the strain to which the valencies of carbon atoms, normally directed from the centre of the tetrahedron model towards the corners, must be subjected in the formation of closed rings. Although this theory has been to some extent modified by later work, the idea of a resistance to bending exhibited by carbon valencies has been fully substantiated.

In the period between 1884 and 1893 Baeyer published a mass of important work of very varied kind, including the proof that phloroglucinol can function either as trihydroxybenzene (I) or triketohexamethylene (II), a case of what was called tautomeric change, many examples of which Baeyer brought to light.



I II III IV

He also worked on partially reduced benzene rings, and made out the profound change in 'aromatic' properties which occurs when a ring is saturated with hydrogen atoms. This work led him to abandon the Kekulé formula for benzene (III) and to adopt the centric formula (IV), in which six valencies of the carbon atoms in the ring, instead of being linked in three double bonds, appear as six valencies directed towards the centre of the hexagon. This formula had been proposed by H. E. Armstrong.

Baeyer's work on the terpenes from 1893 until 1899 was important, although the theory was fully clarified only by Wagner and later workers. An oxidising agent used in this work was Caro's acid, which Baeyer and Villiger in 1900 showed was permonosulphuric acid, $HO.O.SO_2.OH$. This led to the study of organic peroxides, such as the benzoyl compound, $C_6H_5.CO.O.OH$, and the two ethyl compounds $C_2H_5.O.OH$ (unstable) and $C_2H_5.O.O.C_2H_5$ (stable), the second of which, on reduction, yielded two molecules of alcohol, hence pointing to the formula HO.OH for hydrogen peroxide.

At the age of sixty-six years, in collaboration with Villiger, Baeyer published a long and important series of researches on oxonium compounds, having become convinced of the truth of Collie and Tickle's interpretation of the salts of dimethylpyrone as containing basic oxygen, a view which he at first opposed. His last research, published in 1915, two years before his death, was on the pyrones and contains the first description of the oxonium colouring matters, which have such an important relation to natural pigments.

Baeyer's work covers a wide range, and it is practically all of fundamental importance.

Obituary

Dr. H. W. Dudley, O.B.E., F.R.S.

ON October 3, nearly three weeks after a serious operation, Harold Ward Dudley died in a London nursing home. His death was a peculiarly tragic one, for until a month before it occurred his friends had no reason but to expect that there lay ahead many fruitful and happy years for him. That this was not to be is a most serious loss to biochemistry, creates a deplorable gap in the ranks of a wide circle of acquaintances, and is a cause of unfathomable grief to his family and to his intimate friends.

The eldest son of Florence and the late Rev. Joshua Dudley, he was born at Derby on October 30, 1887, and educated at Truro College, King Edward VI Grammar School, Morpeth, and the University of Leeds, where he specialised in chemistry. That his career was so uniformly successful was due to a combination of rare gifts with happy associations.

It was Dudley's good fortune while at Leeds to come under the influence of that inspiring trainer of biochemists, the late Prof. Julius B. Cohen, and further, after taking the degree of M.Sc. by a thesis on optical activity in menthyl esters, to obtain an 1851 Exhibition research scholarship. In the choice of Emil Fischer's laboratory as the place in which to work during the tenure of this scholarship he was again well advised, and there, under the immediate guidance of Prof. Wilhelm Traube, he carried out an investigation on the then topical subject of the purines, for which he received the Berlin Ph.D. in 1912.

There followed what was perhaps the most important step in Dudley's career when, on his return from Berlin, he became an assistant in the Herter Laboratory, New York; there he not only carried out important work under the guidance of another former Leeds student, H. D. Dakin, but what was more, formed a friendship which he treasured throughout the remainder of his life. It is needless to enumerate their publications, for their work is well known to biochemists and others whom it concerns, but one might mention 'glyoxalase', which they discovered, and 'protein racemisation' which they investigated, both of which are known to every student of biochemistry, as an indication of the fundamental nature of their researches.

Returning to Leeds in 1914, Dudley was for about a year lecturer in biochemistry, but soon the insistent voice of war called for the application of his high gifts in the service of his country, and he did not hesitate to respond. On the formation of an anti-gas research department under the leadership of Lieut.-Colonel E. H. Starling, at the Royal Army Medical College at Millbank, Dudley began work with the rank of Lieut. R.E. early in 1916, and was soon assisting in the evolution of the small box respirator, and in many other ways giving his fertile mind to problems of chemical warfare. Having by 1918 acquired a large experience of the subject, he was sent, with the rank of Major, in charge of a responsible anti-gas mission to the United States. He fulfilled these duties with characteristic care and thoroughness, and made many and varied new friends. He was awarded the O.B.E. for these war services.

After the War he returned, not without relief, to biochemistry, as head of the Department of Biochemistry of the Medical Research Committee (since Council), and worked at the Lister Institute until, in 1919, the Council obtained possession of its premises at Mount Vernon. There he worked until September 5 last, and formed a happy and fruitful association with the director, Sir Henry Dale, and with many other of his colleagues.

It was during these years that Dudley's best and most mature work was done. His work on the active principles of the posterior lobe of the pituitary body, although it fell short of his own expectations and high standards of achievement, was none the less a masterpiece of technique and a monument of patience. Then, after the discovery of insulin, by Banting and Best, he and Sir Henry Dale went to Toronto and established important contacts there on behalf of the Medical Research Council. Afterwards his fine flair for chemical methods was illustrated by the introduction by him of the picrate method for the extraction of insulin, and for its ready purification. After other important work on the subject of the preparation of insulin, he was entrusted with the preparation of the first international standard of that substance. The work, carried out in collaboration with others, on spermine, histamine and acetyl choline as tissue constituents also represented fundamental contributions to biochemistry, and are illustrations of his wide knowledge and abundant resource in investigation. He was elected a fellow of the Royal Society in 1930.

Dudley's last research probably represented his most valuable contribution to knowledge, since it culminated in the discovery of the active alkaloid of ergot, called ergometrine. The last paper on this subject from his pen appeared in the *Proceedings of the Royal Society* on the day of his death. Although search had often been made for the constituent of ergot to which the contractions of the puerperal uterus which its administration occasions were due, it was shown by Moir that none of the hitherto known constituents of ergot was clinically responsible for this action. Dudley succeeded, in collaboration with Moir, who carried out the clinical tests, in isolating this new alkaloid, which, thanks to him, is now "by far the most readily accessible alkaloid of ergot", and is already on the market.

The list of Dudley's great services to biochemistry would be incomplete without reference to his work for the Biochemical Society: he acted as secretary

in 1922–24, and then became, jointly with Prof. Arthur Harden, an editor of the *Biochemical Journal*. In the performance of this arduous duty, which he continued for six years, it is true, as Boswell said of Johnson, that "That part of his labour which consisted in emendation and improvement of the productions of other contributors, like those employed in levelling ground, can be perceived only by those who had an opportunity of comparing the original with the altered copy". Certain it is that over this duty, and other editorial work as assistant editor of "British Chemical Abstracts", which he performed with equal care and thoroughness, he often worked far into the night, and over many of his week-ends. In 1921 he married Mary Nettleship, who, after prolonged illness, which was a source of the deepest sorrow to him, died as recently as last April. She was a great help to him in his editorial work, and those who heard her sing will long remember her beautiful voice.

Dudley was a keen fly fisher and of musical and artistic tastes. Though of a retiring disposition, he was always ready to place his wide knowledge at the service of others. He had a wide circle of friends and was a member of the Savage Club. Had he wished, he could have had many intimate friends, for his was a personality of rare charm. Those who were honoured with his close friendship will always treasure in their hearts the memory of his unselfish character, affectionate sympathy and characteristic placid wit, his patience in adversity and his intuitive penetration of all humbug. Our sympathy goes out especially to his mother, who had such good reason to be proud of him. C. A. L. E.

Prof. Rhoda Erdmann

THE death of Prof. Rhoda Erdmann, of Berlin, has deprived the scientific world of a distinguished research worker and a most notable personality.

Dr. Erdmann began her scientific career as a protozoologist. Shortly before the War, she went to the United States, where she collaborated with Woodruff in protozoological studies which are now classical. When the United States entered the War, Dr. Erdmann, as a German subject, became the victim of war-time hysteria. She happened to be investigating an organism pathogenic to mice only, when a serious epidemic broke out in a neighbouring military camp. She was accused of having secretly infected the troops with the organism she was studying, and was arrested and imprisoned in New York. Her scientific and medical friends in the United States rallied to her aid and eventually she was acquitted of the fantastic charge.

After the War, Dr. Erdmann returned to Germany and began to work with tissue culture, mainly on problems connected with tumour growth. She was appointed a professor of the University of Berlin and placed in charge of the new Institut für Experimentelle Zellforschung at the Charité. She developed the institute until it became one of the principal centres for tissue culture research in Europe. At the same time she set herself to organise experimental cytology throughout the world. The *Archiv für Experimentelle Zellforschung* was founded in 1925 at her instigation, and was edited by her until her death. She also conceived the idea of an international society of experimental cytology which should hold a triennial congress and of which the *Archiv* should be the official organ. This scheme she successfully accomplished, and thanks to her tireless efforts as general secretary three congresses have now been held, the third being at Cambridge in 1933.

The change of government in Germany involved Dr. Erdmann in much hardship and difficulty, and in 1933 the institute to which she had devoted so much labour and care was closed, and she was pensioned. This was a great grief to her as she lived for her scientific work. She was accordingly delighted when in December 1934 the German Government decided to open another institute for experimental cytology under her directorship. Her health, which had troubled her for many years, was failing rapidly, but with undaunted courage and enterprise she began the task of creating her institute anew in a set of empty rooms in a private house. This task she was not destined to complete, and on August 23 she died at the age of sixty-four years.

Perhaps the quality which most endeared Dr. Erdmann to her friends was her gallant spirit. Oppressed by burdens of mind and body which many would have found overwhelming, she never lost heart but continued to work and plan for the future with the energy which characterised all she did. To those of us who knew her well, her death is a personal loss.

H. B. F.

DR. HYNEK VYSOKÝ, professor of classical archæology in the Charles University, Prague, died at Rychnov, his birthplace in north-east Bohemia, on August 27, at the age of seventy-four years. He was educated at Prague and Berlin, and afterwards studied in Italy, Greece and Turkey. He wrote a number of Czech and German works on Greek archæology and mythology, and compiled most of the material dealing with archæology in Otto's (Czech) "Encyclopædia".

WE regret to announce the following deaths :

Prof. Carl Barus, emeritus professor of physics in Brown University, Providence, R.I., known for his work on interferometry and acoustic pressures, on September 20, aged seventy-nine years.

Mr. F. Escombe, who collaborated with Mr. H. T. Brown in noteworthy investigations on photosynthesis, on October 12, aged sixty-three years.

Major-General A. W. Greely, known for his geographical work in the Arctic, aged ninety-one years.

Dr. Walter Hough, head curator of the Department of Anthropology in the U.S. National Museum, on September 20, aged seventy-six years.

Mr. Joseph A. Johnson, president of the American Institute of Electrical Engineers in 1934, on October 5, aged fifty-three years.

News and Views

The E.R.A. Laboratory at Perivale

ON October 22, the Duke of Kent opened the new laboratory of the British Electrical and Allied Research Association which has been built at Perivale, Middlesex. Referring to the importance of research, he said that, in a mechanical era such as ours, it is one of the most important features of productive industry. The Association is supported by the Department of Scientific and Industrial Research, the Institution of Electrical Engineers, the British Broadcasting Corporation and many other bodies, including electric supply undertakings in the dominions and colonies. Electrical manufacturing firms are now well-equipped with laboratories for conducting research into problems bringing immediate profit to themselves, and they spend in this way hundreds of thousands of pounds a year. The Research Association conducts researches of general interest, which are of benefit to the user of electricity (the public), the user of electrical plant and apparatus (the electricity supply undertakings and the public) and to the manufacturer who uses electrical materials. The research work is carried out under the guidance of its council and seventy-five technical committees consisting of 450 leading experts in all branches of the industry who give their services voluntarily. The research work as a whole is supervised by the director, who is assisted by a staff of forty-seven technical experts and thirty-two clerical workers. Most of the work is done in existing establishments, the National Physical Laboratory, universities, manufacturers' laboratories, etc., but where special facilities are required it is carried out by the technical staff.

THE Association's new laboratory has a total floor space of about 14,000 square feet; but there is room for increasing the staff without further extension of the premises, and the site is capable of further development. The power frequency and heavy current laboratory contains a trench specially constructed for tests on cables laid horizontally. The standardising laboratory, physics laboratory, and generator room are also on this floor. In the east wing are situated laboratories which are specially equipped for researches on heavy current circuit breakers. The west side contains the radio and telephone laboratories, high-voltage laboratory, chemical laboratory, workshop and main store. The plant comprises a 230 volt–450 ampere hour battery which is charged automatically during the night by a mercury arc rectifier, and its output voltage is controlled by an automatic voltage regulator. Over each investigator's bench there is a small switchboard from which any of the numerous A.C. or D.C. circuits can be obtained. The high-tension laboratory is equipped for tests up to 80,000 volts. The heating plant is operated automatically, and burns a cheap grade of coal. The laboratory has been designed with a view to economy and efficiency. The night and week-end temperature is automatically maintained at a somewhat lower value than the thermostatically controlled temperature of the working period.

Bridging the Gap: Metropolitan-Vickers Laboratories

BETWEEN the abstract idea of an invention, or new scientific knowledge, to demonstrated utility, there is generally a wide gap, and to bridge this gap much work has to be done in special research laboratories. At the end of the War, Metropolitan-Vickers was one of the first large industrial organisations to realise the great part which scientific research would play in the development of industry. The building of the research laboratories, which now have a floor area of more than 40,000 square feet, was commenced in 1920. A rule has been made that all materials and products which enter the company's works as 'raw materials' must be subjected to test by the Research Department. As this Department is in close touch with the works and factories which develop the raw materials, these tests have been a great help to suppliers in improving their products.

THE Research Department is organised into a series of sections which form one co-operative whole, and this enables each problem to be investigated rapidly in the most efficient way. The four main buildings may be roughly described as the chemical, mechanical, high-tension and physical laboratories. Photographs of some of the apparatus used in making tests is shown in the pamphlet. Many of the machines used are unique; some of them incorporate the latest methods devised by scientific workers, and there are few machines in Great Britain which rival them in size. We were much impressed by the photograph of the M.V. 500 kw. wireless valve, installed at Rugby and continuously evacuated by M.V. oil condensation pumps and a single rotary pump. In the library section, current scientific, technical and economic literature is scrutinised and translations are constantly being made from many languages.

The Mitten Crab in English Rivers

IN the review of Peters and Panning's "Monograph of the Mitten Crab" published in NATURE of June 9, 1934, an account was given of the invasion of European rivers by this Chinese species, and the probability of its spreading to English rivers was pointed out. This seems now to have come to pass. About a fortnight ago, a living specimen was found on one of the screens guarding the pipes through which water is pumped from the Thames into the condensers at Lots Road Power Station in Chelsea. It is a full-grown male, the carapace measuring 63 mm. in length, by 68 mm. in breadth. The exact way in which the species has reached Great Britain is

a matter for conjecture, but the possibilities of transport from the estuaries of Holland or North Germany are obvious. Some highly coloured forecasts have appeared in the daily Press regarding the damage likely to be caused if the crab becomes established in English rivers and estuaries. It can safely be said, however, that there is little ground for apprehension. On the Continent, the banks of rivers have been undermined in places by the burrows of the crabs, but the most serious damage has been caused to fresh-water fishes. In Great Britain, where fresh-water fish have for the most part only a sporting value, the new addition to the fauna may justify some anxiety on the part of anglers in the eastern counties. There is fortunately no reason for anticipating that the crab will introduce into Europe the lung disease, paragonimiasis, of which it is one of the vectors in the Far East.

Association of British Chemical Manufacturers

THE nineteenth annual report of the Association of British Chemical Manufacturers, submitted to the annual meeting on October 10, records an increase in membership from 109 to 118, while the number of affiliated associations is now 13. Reference is made to the participation of the Association in the Brussels International and Universal Exhibition, the British Chemical Exhibit at which has been organised by the Association at the request of the Department of Overseas Trade. The safety activities of the Association have been continued, and the Association has submitted a list of solvents in general use as a basis for the investigation, which has now been commenced by a special committee under the Medical Research Council, on their physiological effects in relation to industrial risks. The investigation on tests for the detection of low concentrations of toxic gases that are likely to be encountered in industry, to which the Association has contributed half the cost, is nearing completion. Methods of detection and estimation, usually with test papers, have been worked out and standardised for a number of gases by the Chemical Defence Research Department, and a printing method has been discovered which will give consistent results and yield permanent stains. The Association is also supporting financially work on the testing of respirators for industrial use to ensure that they give adequate protection, which is being carried out by the Chemical Research Department. The Association has taken over from the Chemical and Allied Employers' Federation the regular collection and investigation of accident statistics as part of its normal safety activities. Other matters on which action has been taken during the year relate to the Provisional Poisons List and Poisons Rules and the report of the Poisons Board, trade marks, Government patents and the transport of chemicals by road.

IN moving the adoption of the report at the annual meeting, Mr. T. Wallace, who deputised as chairman in the absence of Dr. F. H. Carr, through illness, referred particularly to the manner in which the Government left the chemical section of the Polish Treaty to be worked out between the Association and the Polish Union of Chemical Industries. The importance of industrial reorganisation was stressed, particularly the necessity for further co-operation in regard to research, production and marketing. Commenting on the position of the fine chemical industry, Mr. Wallace said that since the report was written a supplementary memorandum has been submitted to the Key Industries Committee of the Board of Trade, detailing reasons why the manufacturers considered the progressive development of the industry would be better assured by a continuance of the key industry duties than by a transfer to the Import Duties Act.

Roman Yorkshire

As progress is made in the excavation of the Roman villa at Rudston, six miles west of Bridlington in Yorkshire, it affords a more extended view of settled life under what has been termed the 'signal-station' system, which archæological discovery in this area has revealed as a characteristic feature in the organisation of this section of Roman Britain. The site has now been under investigation for three seasons by a local committee in conjunction with the Roman Antiquities Committee of the Yorkshire Archæological Society, the excavation being in charge of Messrs. A. M. Woodward and K. A. Steer. Both coins and types of pottery point to an occupation of considerable duration, the former ranging from Domitian to Valens, and the latter including late first century, Samian, third century types from the Yorkshire pottery at Throlam and 'signal-station' types of the end of the fourth century. A system of pre-Roman ditches below the foundations may go back so far as the Bronze Age. An interesting building to the west of the residential block, discovered in 1934, which measures not less than 50 ft. by 22 ft., is now seen, according to a report of the latest results of excavation (*The Times*, Oct. 22), to have been used for a variety of purposes connected with the needs of the villa. *Tesserae* of sandstone not of local origin, and many chippings of chalk and tile, confirm the view suggested by earlier discoveries of chalk *tesserae* and red and blue tiles that it was a workshop for making and repairing mosaic flooring. Further, remains of no less than six ovens point to other uses not yet completely apparent. An early suggestion that they were part of the equipment for the manufacture of wool or for tanning has now been abandoned in favour of the view that they were for drying or roasting grain preparatory to grinding.

The College of Science, Benares Hindu University

FEW countries are, in proportion to their literate population, so well equipped with modern laboratories as India. The reproach can no longer be levelled at Indian university education that it is purely literary. We need only cite as examples the fine laboratories to be found at the University College of Science, Calcutta, the Presidency College, Madras, and the Royal Institute of Science, Bombay. From the time of its foundation in 1911, the Hindu University at

Benares has paid particular attention to the teaching of science, both pure and applied. The science departments with a staff of seventy provide accommodation for about one thousand students, and these departments have now been constituted a separate College of Science within the University. This College, of which Prof. K. K. Mathur has been appointed the first Principal, was formally opened on September 12 by the veteran Vice-Chancellor and founder of the University, Pandit M. M. Malaviya. In his opening address, the Vice-Chancellor emphasised the need in the present economic position of India for increased facilities for the study of science in all its branches. The Hindu University has already played a prominent part in the industrial development of the United Provinces, and we are sure that the foresight of the Vice-Chancellor and executive body of the University in establishing this new college will lead to an expansion of its activities.

New German renderings of 'Foreign' Words

IN NATURE of September 28, p. 495, we published a short notice of the second edition of "Theoretische Physik" by Dr. Georg Joos. Our reviewer commented very favourably upon the book, but animadverted upon the addition of a glossary of "foreign" words (*Erlaüterung einiger Fremdwörter*), "in which *Absorption* (*Verschluckung*), *Elastizität* (*Dehnbarkeit*), *Kapillarität* (*Haarröhrchenkraft*) and such-like non-Prussian words are translated into the new German, although these 'foreign' words appear in the articles in Gehler's 'Physikalisches Wörterbuch' of more than a hundred years ago". We have now received an indignant letter from Dr. Joos, containing the following explanation of this glossary. "Many English readers, who according to the reporter are to be impressed comically through these things, will know that the graduates of the 'Oberrealschule' have studied neither Latin nor Greek and that for them an explanation of these words is very desirable", adding, "According to the wording of the report the reader must think that it is my intention to seriously substitute 'Verschluckung' for 'Absorption' or 'Segelstange' for 'Antenne' ". As regards the last sentence our reviewer suggested nothing about Dr. Joos' intentions, but stated the bare fact that the glossary had been added to the book, leaving his English readers free (if we may use the word without offence) to draw any conclusions they wished. Many will, no doubt, share his and our surprise that words which have been in regular use in the German language for four generations and more, a period sufficient, we should have thought, to guarantee their incorporation, should be regarded and named as foreign.

OUR reviewer adds: "We note that graduates of the Oberrealschule have studied neither Latin nor Greek, but then they did not do so at the time of the first edition, which did not contain the glossary; in fact, they never did. Most students in England and other countries are equally unfamiliar with Latin and Greek, but have no difficulty over 'elasticity' and 'capillarity', while Germans unfamiliar with French have, we believe, no difficulty over '*General*' and '*Soldat*'. Dr. Joos does not seem to realise that, if there is any force in his contention, most German students will not know what his book is about, since both '*Theoretische*' and '*Physik*' are Greek words not explained in the *Erläuterung*. For that matter, *Electricität* (may we suggest *Bernsteinreibungskraft?*) is not in the glossary, although *Kapazität* (*Fassungsvermögen*) is: *Alkali* (a Semitic word which occurs in the book combined with a Latin word as *Alkalispektren*—shall we suggest *Pflanzenaschenerdelichterscheinung?*) is missing, although *Kondensator* (*Verdichter*) is included. We hope in the next edition to see the glossary either omitted or properly completed. We in England find so much in the present-day activities in German universities to move us to tears that Dr. Joos really must allow us a faint smile when we come across something harmlessly amusing from that quarter, and permit us to be our own judges of what is 'comical' ".

International Exhibition of Nature Photography

THERE was a large assembly of naturalists and Nature photographers at the opening on October 16 of the *Country Life* International Exhibition of Nature Photography at the British Museum (Natural History), Cromwell Road, South Kensington. The Earl of Onslow, president of the Society for the Protection of the Fauna of the Empire, referred to the great value of Nature photography and cinematography as "a very powerful incentive towards the preservation of wild life in all its forms", and to the fact that the Exhibition contains a large number of subjects that have never been seen before. He went on to remark that "there is a very grave danger at present hanging over us and that is that unless wild animals, big-game and birds of all kinds are carefully preserved a great number of species will become extinct and they will be a downright loss to the world in general. We could do without poison snakes but most other animals are a very valuable asset not only from the natural history point of view, but from the scientific point of view and from the point of view that they tend to preserve the balance of Nature." The audience, which included, among many others well known for their interest in wild life, the Duke of Sutherland and Lord Desborough, afterwards inspected the Exhibition. More than thirteen hundred photographs are displayed on screens in the Whale Hall, one wall being devoted entirely to the work of pioneer photographers, which includes the late J. H. Symonds' picture "Goldfinches fighting on Teazle", "Marsh Harrier" by the late Col. H. Moore, and no fewer than seventeen fine studies by Mr. C. J. King. The Exhibition will be open—admission free—until November 30. A souvenir volume (5*s*.), containing reproductions of 120 pictures from the Exhibition, has been published.

Edwin Klebs

IN a centennial note published in the *New England Journal of Medicine* of July 11, Dr. Leona Baumgartner, of Cornell University Medical College, New York, claims that Edwin Klebs, who was born

on February 6, 1834, and died in 1913, was not only one of the pioneers of bacteriology, but also made important contributions to other fields of medicine. In addition to being the first to describe the causal organism of diphtheria in 1875, he described acromegaly in 1884, two years before Pierre Marie; inoculated primates with syphilis fifteen years before Metchnikoff; isolated colonies of bacteria on solid media in the form of Sturgen's glue nine years before Koch; was the first to produce tuberculosis experimentally in animals by the injection of milk from infected cows, thereby establishing the bovine origin of the disease; and described the typhoid bacillus before Eberth. Klebs pursued his medical education in his native town of Königsberg under Rathke, Helmholtz, Burdach and Werther, and later in Würzburg under Virchow, Kölliker, Leydig and Scanzoni. He led a wandering life, being successively professor at Berne, Würzburg, Prague, Zurich and the Rush Medical College, Chicago. His contributions to pathological anatomy and physiology included the first experimental production of valvular disease of the heart and the recognition of bacterial infection in the production of the subsequent endocarditis, the description of hæmorrhagic pancreatitis as a rapidly fatal disease, the introduction of the paraffin embedding method and his textbooks on pathological anatomy (1869–76) and general pathology (1887–89). Klebs also took an active part in the foundation of three important medical journals, namely, the *Correspondenz-Blatt für Schweizer Aerzte* (1871), which some years ago was renamed *Schweizer medizinische Wochenschrift*, the *Archiv für experimentelle Pathologie und Pharmakologie* (1873) and the *Prager Medizinische Wochenschrift* (1876).

Work of the Government Chemist

THE report of the Government Chemist on the work of the Government Laboratory for the year ending March 31, 1935 (London: H.M. Stationery Office, 9*d*. net), outlines the work carried out in the Government Laboratories for the Admiralty, Ministry of Agriculture and Fisheries, the Air Ministry, Crown Agents for the Colonies, Board of Customs and Excise, Ministry of Health, Home Office, Post Office and other Government departments. The total number of samples examined during the year was 522,788, as compared with 503,592 in the previous year. There was an increase of 26,594 in the number of samples examined in the laboratory at Clement's Inn Passage, and decreases at the Custom House laboratory and at the chemical stations of 232 and 7,166 respectively, the latter being due to the closing of the Manchester chemical station and the transfer of the examination of samples of tea to tea inspectors of Customs and Excise. The principal increases occurred in the number of samples of hydrocarbon oils, beers, wine, spirits, cocoa and chocolate, samples for duty under the Import Duties Act, 1932, Safeguarding of Industries Act, 1921, tobacco and silk exportations, samples of sugar composite goods and British sugar, and in samples taken under the national marking schemes.

THE hydrocarbon oils duty has involved the examination of nearly 17,000 samples for assessment of duty on importation or drawback of duty on exportation, the increase being due to the duty of 1*d*. per gallon charged on oils other than light oils. Many of the samples had to be examined for other dutiable substances, such as alcohols, esters and chemicals listed by the Board of Trade under Part I of the Safeguarding of Industries Act. The growing use of duty-free spirits and industrial methylated spirits in industry involves an increase in the consultative work of the Laboratory, apart from the examination of samples to ascertain whether the conditions of use laid down by the Commissioners of Customs and Excise have been fulfilled. The number of samples of cocoa, chocolate and wine submitted for examination increased by 1,400; samples of beer increased by 1,609, of silk and rayon by 1,866, while the Laboratory was also called upon to deal with the testing of animal and vegetable fibres and hairs of all kinds under the Import Duties Act. The number of samples of tobacco and snuff examined has also increased, and improved methods for the analysis of tobacco have been studied. Much work has been carried out on the revision of existing methods and the investigation of new methods of detection and determination of substances.

Petroleum and Tar Oils as Insecticides

AN important paper by Dr. Hubert Martin on the standardisation of petroleum and tar oils and preparations as insecticides appears in the *Annals of Applied Biology* (**22**, 334). In recent years, a great deal of attention has been devoted by research workers and by the appropriate Government departments to the standardisation and specification of the sprays and dusts employed for the control of insect pests and diseases infesting agricultural and horticultural crops. An important body of knowledge on the chemical constitution and physical properties of these materials is scattered through the literature of the subject, and is so extensive as to be available only to relatively few. Of the many insecticides now in use, the petroleum and tar distillate oils occupy a very important position, and their use, already widespread, is expanding. Dr. Martin gives an extended and critical review of the published information of the chemical and physical factors defining these products, and in addition incorporates much original work of his own.

DR. MARTIN sets out in a concise and ordered way how the chemical and physical criteria can be correlated with insecticidal and phytocidal properties, and finally builds up from his own analyses specifications which he considers are available for judging the suitability of these oils, and preparations made from them, for their various uses as insecticides. In addition, the analytical methods available are considered, and the most suitable set out with supporting evidence in considerable detail. This paper is an important step towards the realisation of the hope, that a reasonable standard of efficiency and safety in use

and of uniformity of quality may be attained for these important products. It is published with the object of ascertaining how the various specifications will work out in practice, and thus it is advisable that interested manufacturers, horticultural advisers, and large users will give it the attention it deserves. The Council of the Association of Applied Biologists has consented to the paper being reprinted for sale, the price being 2*s*. post free; it is obtainable from the author (Research Station, Long Ashton, Bristol).

International Congress of Mining, Metallurgy and Applied Geology

THE seventh International Congress of Mining, Metallurgy and Applied Geology was opened at the Sorbonne, Paris, on October 20, and will continue until October 26. The President of the Republic, M. Lebrun, was present at the inaugural session. Sir Robert Hadfield, the delegate of the Iron and Steel Institute, presented to M. Lebrun a copy of the picture in the Bodleian Library, Oxford, depicting Roger Bacon presenting a book to the Chancellor of the University of Paris. Sir Robert also presented a miniature knife of steel made by Michael Faraday during the years 1819–24 while he was residing at the Royal Institution. The steel contains 0·74 per cent platinum. The weight of the blade is one-hundredth of an ounce, and that of the complete knife, one-twentieth of an ounce. Sir Robert suggested that the knife should be handed either to Dr. Leon Guillet, head of the Ecole Centrale des Arts et Manufactures, or to the Ecole des Mines.

Pasteur Institute of India, Kasauli

IN the thirty-third annual report for 1933 of the Kasauli Pasteur Institute, the Director, Lieut.-Col. Shortt, gives an account of the work of the Institute for 1933. The total number of patients attending the Institute and its various centres was 19,524, an increase of 4,406 as compared with the previous year. Such a large number of patients indicates the widespread threat of rabies in India. The vaccine used was carbolised 5 per cent Paris sheep vaccine, and three out of every four cases with face bites received antirabic serum in addition, as this appears to improve the results obtained. Deducting some 2,000 cases that did not complete the treatment, and 1,446 cases whom it was considered did not require treatment, there were 1,356 Europeans and 14,582 natives treated. There were no deaths among the Europeans, and 83 deaths among the natives, a combined percentage death-rate of only 0·52.

Australian Statistics

THE Official Year Book of the Commonwealth of Australia for 1934 (Commonwealth Bureau of Census and Statistics. 5*s*.) gives as usual an exhaustive summary of all aspects of Australian life and activity. The call of economy still hampers the editor in carrying out all his projects, but he has achieved great success in presenting information in forms that are useful to economists and others. Many details of the census of 1933 are incorporated. An appendix gives a summary of the chief events in connexion with the financial crisis that began in Australia in 1929.

Craftsmanship in Scientific Instruments

THE Physical Society announces that the seventh annual craftsmanship and draughtsmanship competition will be held as usual in conjunction with its annual exhibition of scientific instruments and apparatus in January next. Competitors must be in the regular employ of a firm or institution which will be exhibiting or has exhibited at least once during the previous three years, and has been invited by the organising committee to enter its employees for the competition.

Chinese Medical Association

THE third general meeting of the Chinese Medical Association, the official medical association of China, will be held on November 1–8. This association is the successor to the China Medical Missionary Association organised in 1886. The 1935 meeting will be held at the Canton Hospital, Canton, China, because it was here that Dr. Peter Parker introduced Western medicine into China one hundred years ago. He was also the world's first regularly appointed medical missionary. A centennial "History of the Hospital" is now in the press (Kelly and Walsh, Shanghai). Besides the regular scientific sessions of the conference, November 2 will be devoted to the centenary celebrations. The new Canton Hospital will be formally opened, and the foundation stone will be laid for the new medical school building. The money for the latter has been obtained by a special grant from the Central Executive of the National Government of China.

New Secretary of the Institution of Naval Architects

MR. G. V. BOYS has been appointed secretary of the Institution of Naval Architects, in succession to Mr. R. W. Dana, who will retire at the close of this year, after thirty-four years of service as secretary. Mr. Boys, who is a son of Sir Charles Vernon Boys, is a graduate of Trinity College, Cambridge (Mathematical Tripos, Pt. 1, and Mechanical Science Tripos). He is an associate-member of the Institutions of Mechanical and Electrical Engineers, and was for some years a demonstrator in mathematics and mechanics at the Imperial College of Science and Technology; previous to this he was one of the founders of the University of Cambridge Engineering Society. For the past fourteen years he has been on the staff of Messrs. Kennedy and Donkin (consulting engineers).

Royal College of Physicians

THE annual Harveian Oration was delivered on October 18 at the Royal College of Physicians by Sir Henry Dale, director of the National Institute for Medical Research, whose subject was "Some Epochs in Medical Research". The substance of the lecture is printed on p. 690 of this issue. The president of the Royal College of Physicians, Lord

Dawson of Penn, afterwards presented the Baly Gold Medal to Dr. F. H. A. Marshall and the Bisset-Hawkins Gold Medal to Sir George Newman, lately Chief Medical Officer of the Ministry of Health. The Baly Medal is awarded annually for distinction achieved in the science of physiology. The Bisset-Hawkins Medal is awarded triennially for "such work in advancing sanitary science or in promoting public health as in the opinion of the College deserves special recognition".

Care of Cripples and Invalids

A JOINT conference of the Invalid Children's Aid Association and the Central Council for the Care of Cripples will be held on November 7–8 at the Drapers' Hall, Throgmorton Street, London, E.C. The opening address will be given by the Minister of Health, Sir Kingsley Wood. The subjects for discussion will be: (1) infectious diseases and their after-effects; immunisation and other preventive measures; (2) the problem of physical handicap in modern life; (3) the after-effects of accidents; rehabilitation. Visits will also be paid to various homes and hospitals. The Conference fee, including the report of the proceedings, is 7*s*. 6*d*., and should be sent to Miss Wynne (Invalid Children's Aid Association) or Miss Nangle (Central Council for the Care of Cripples), Carnegie House, 117 Piccadilly, W.1, from whom further information may be obtained.

Announcements

SIR ALBERT HOWARD, formerly director of the Institute of Plant Industry, Indore, will deliver a lecture entitled "The Manufacture of Humus by the Indore Process", before the Royal Society of Arts on November 13 at 8 p.m.

PROF. HERMANN LEVY will deliver the Sidney Ball lecture in the University of Oxford on October 29 at 5 p.m. He will take as his subject "The New Aspects of Industrial Combination" and the lecture will be given in the Examination Schools, Oxford.

THE Masters Memorial Lectures of the Royal Horticultural Society will be delivered in the lecture room of the Society's new hall in Greycoat Street, Westminster, on November 5 and November 26, at 3.30 p.m., by Sir William Wright Smith, on "Problems connected with the Classification of Plants". Sir Arthur Hill and Sir Daniel Hall have consented to take the chair on these occasions.

PROF. GREGORIO MARAÑÓN, president of the Spanish Academy of Medicine, has recently been elected president of the Hispano-Belgian scientific *entente* committee.

DR. FRITZ LENZ, professor of racial hygiene, University of Berlin, has been awarded the Josef Schneider medal by the medical faculty of the University of Würzburg.

A COMMITTEE has been formed for the erection of a monument at La Ciotat, by the sculptor Paul Gondard of Marseilles, to the brothers Louis and Auguste Lumière, who were the first to exhibit cinematograph films in September 1895.

ON the occasion of the fiftieth anniversary of the first inoculation for rabies on July 20, a bust of Pasteur was unveiled at Havana in a square to which his name had been given, on the initiative of the academy of Sciences of Havana, in conjunction with the Franco-American Committee of Paris.

PROF. WILHELM HABERLING, of the Düsseldorf Academy of Medicine and joint editor of *Mitteilungen zur Geschichte der Medizin, der Naturwissenschaften und der Technik*, has recently been awarded the Sudhoff medal by the German Society of the History of Medicine for his eminent services to the study of the history of medicine.

VICTOR COUSIN in 1848 described at length a MS. of the Abbey of Corbie now in the Municipal Library of Amiens, which contained a number of treatises by Roger Bacon, written while he was teaching in the University of Paris. Under the title "Opera Hactenus Inedita Rogeri Baconi", the Oxford University Press is publishing shortly the last—the thirteenth—of a series of fasciculi, completing the publication of these treatises, which represent the teaching of the Faculty of Arts in the first half of the thirteenth century. The editors are Mr. Robert Steele and the Rev. Père F. M. Delorme.

THE Royal Commission for the Exhibition of 1851 has re-issued its list of whole-time awards for scientific research, other than professorships, offered by public and private bodies in Great Britain and Northern Ireland. The list does not include awards of value less than £150 a year, neither does it include awards offered by universities and scientific societies exclusively for the benefit of their own members. The list, which brings together in convenient form a good deal of useful information, can be obtained from the Secretary of the Commission, 1 Lowther Gardens, Exhibition Road, London, S.W.7, price 6*d*.

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

A senior assistant to the principal (also to teach mechanical engineering) in the Barrow-in-Furness Technical College—The Director of Education, Town Hall, Barrow-in-Furness (Nov. 4).

An assistant (III) at the Fuel Research Station, East Greenwich and a junior scientific officer at the Chemical Research Laboratory, Teddington—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Nov. 5).

A senior lecturer in mathematics, and lecturers in mechanical and civil engineering in the Lester School and Institute, Shanghai—The Lester Trust, c/o Messrs. Viney, Price and Goodyear, Empire House, St. Martin's-le-Grand, London, E.C.1 (Nov. 30).

A lecturer in mechanical and civil engineering in the Rotherham College of Technology and Art—The Director of Education, Education Offices, Rotherham.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He 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.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 686.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A New Type of Skeletal Movement

FIGS. 1 and 2 reproduce photographs of a model demonstrating a type of skeletal movement which depends upon automatic adjustments of hydrostatic pressure acting upon an elastic body wall. Neither muscular nor nervous mechanism is demanded. These skeletal movements, according to investigations I have made recently, appear to have characterised some of the Cambrian Cystoidea—the earliest and most primitive of all the Echinodermata. The automatic adjustments of body wall and skeleton, it is suggested, were brought about by varying ciliary activity during the rise and fall of the tide.

The model consists of a football bladder, representing the elastic body wall of the animal. Upon this are fixed a double row of oblong thin blocks of rubber representing a portion of the food grooves. Fig. 1 shows the body collapsed and the grooves closed. Air blown into the bladder (Fig. 2) increases the tension on the elastic wall. This causes a pull on fibres attached to the blocks and to the body wall. The blocks, working on the hinge of attachment to the wall, are pulled over and the groove opens.

The place of air as a means of inflation was taken, in the lifetime of the Cystid, by water introduced into the body through the stone canal (here the neck of the bladder). Cilia in the stone canal drove a water current through it and so increased the hydrostatic

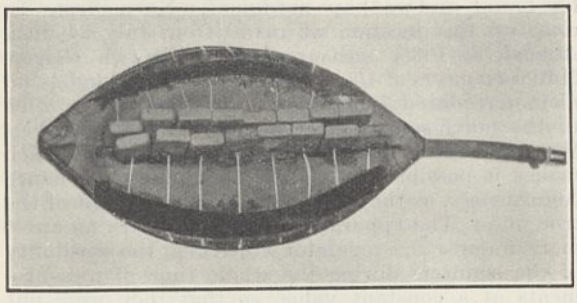


FIG. 1.

pressure. A change of conditions (suggested below) caused the ciliary movement to cease. The elastic tension of the body wall would reverse the current, force water out through the stone canal, with consequent collapse of the form and closure of the groove again.

The suggested mechanism fits in with what is known of the state of preservation of the fossils and the conditions under which the beds containing them were deposited. *Stromatocystis* found in the Lower and Middle Cambrian affords a good example. The Lower Cambrian beds of Newfoundland, in which

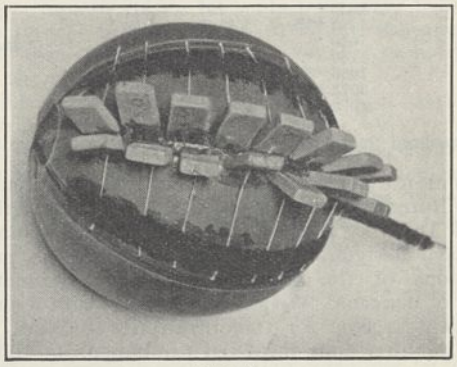


FIG. 2.

forms were discovered by Schuchert, have, as that author has shown, rain pits and all the other evidences of shallow water deposition. All the specimens of *Stromatocystis* both from Newfoundland and Bohemia (Middle Cambrian) which I have examined show the body collapsed and the groove closed. Related forms from deeper waters show an open groove and a firmer skeleton. Comparison of these various forms suggests that the collapsible skeleton and groove of *Stromatocystis* was adapted to intertidal conditions. When the tide came in, freshly aerated water would be brought in, which would stimulate the cilia of the stone canal. The animal would swell, rise above the surface of the sand, the groove would open and the animal begin to feed. After the tide had retreated, the water immediately around the animal's body would become saturated with carbon dioxide, the cilia would cease motion and the animal would collapse into the wet sand which would preserve it from desiccation.

Gray[1] has described a somewhat similar phase in the feeding periods of *Mytilus*, and it is because of this work that I am venturing these views, which do much to clear up many difficult points in Cystid structure.

W. K. SPENCER.

Ipswich.
Sept. 25.

[1] "Ciliary Mechanisms".

Infra-Red Spectrum of Hexadeuterobenzene and the Structure of Benzene

In our letter in NATURE of June 22 (p. 1033), we referred *inter alia* to our measurements of the Raman and infra-red spectra of C_6D_6, but did not give the infra-red results, as a collective publication of this and other spectra was projected. In the August number of the *Journal of Chemical Physics* (p. 446), Barnes and Brattain have now reported some infra-red measurements[1], and we therefore cite our own data for comparison. The principal frequencies (cm.$^{-1}$) are in Table 1, but we omit the record here of the numerous very weak bands, obviously combination tones, which form an almost continuous background to the spectrum. Intensities are roughly indicated by asterisks. Our complete map of the spectrum shows much less background than appears in Barnes and Brattain's graph, but except for this and the deviations in the extreme frequencies, the agreement is good so far as the ranges overlap.

Table 1.

Assignment	C_6H_6	C_6D_6		Assignment
	Literature	B. and B.	This note	
$A2u$	669 **	—	671 *	
	1030 ***	797	817 ****	
	1483 ***	1147	1150 *	
$E\bar{u}$	1620 *	1321	1334 **	$E\bar{u}$
	1780 **	1439	1448 **	
	1950 **	1608	1610 *	
	3073 **	2294	2246 ***	
	4070 *	—	2985 *	

[The unassigned frequencies are assumed to be combination tones.]

In our previous note we showed that an analysis of the Raman frequencies of C_6H_6 and C_6D_6 with the aid of Teller's product theorem[1] permitted an unequivocal assignment of frequencies to the proper vibrations of the plane hexagonally symmetrical model of benzene. We shall now show that a similar statement is true for the infra-red spectrum. The model requires four infra-red fundamentals divisible into two symmetry classes as shown in Fig. 1. Class $A2u$ consists of one hydrogen vibration perpendicular to the ring; class $E\bar{u}$ contains three degenerate vibrations in the plane of the ring. The product theorem gives, for the (H/D)-quotient of the products of frequencies of like symmetry, $\tau(A2u) = 1{\cdot}36$, $\tau(E\bar{u}) = 1{\cdot}93$, and these figures, together with consideration of the intensities of the bands, lead to the assignment indicated in Table 1. The work is incomplete as it is unsatisfactory to have to identify the $A2u$ benzene frequency by exclusion: search for the corresponding C_6D_6 frequency (at ν 491) requires a modification of apparatus, to effect which will take some time.

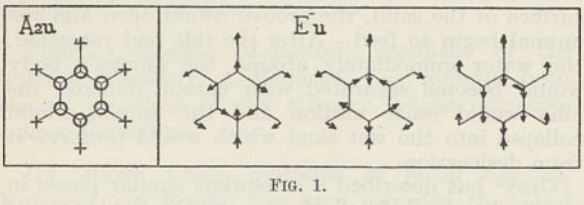


FIG. 1.

The reason which led many physicists to reject the plane hexagonally symmetrical benzene model was the appearance of coincident frequencies in the Raman and infra-red spectra: it was assumed that these were coincidences of principle and not of accident, and the conclusion then followed inescapably by Placzek's theory that no centre of symmetry was present. An immediate result of our work is *that certainly all but one, and very probably all the coincidences, are accidental.* They are shown (with the very generous allowance of 40 wave-numbers) in Table 2. Of the four in C_6H_6, three disappear in C_6D_6. One new one appears, but it was not present in C_6H_6. Only one (marked *) remains common, and apart from the poor agreement of frequencies, it occurs in a region where (as Dr. Placzek pointed out to us) accidental coincidences would be expected owing to the relatively weak coupling of individual C–H stretching vibrations. Thus no good reason remains for rejecting the benzene model which chemists prefer.

Table 2.

C_6H_6		C_6D_6	
Raman	Infra-red	Raman	Infra-red
607		583	
	669		(671)
849		666	
	1030		817
993		944	
	1483		1334
1176		867	
	(1620)		(1150)
1585, 1606		1552	
	(1780)		(1448)
3049		2265	
	(1950)		1610
3064		2292	
	3073		2246

[Combination tones are enclosed in parentheses. Fundamentals which correspond to the same proper vibrations in C_6H_6 and C_6D_6 are placed on a level. 'Coincidences' are marked ——.]

W. R. ANGUS.
C. R. BAILEY.
University College, C. K. INGOLD.
London. A. H. LECKIE.
Sept. 28. C. G. RAISIN.
J. W. THOMPSON.
C. L. WILSON.

[1] This will be discussed in a forthcoming publication by G. Placzek and E. Teller.

Diurnal Variation of Cosmic Ray Intensity and Nova Herculis

LAST year several articles were published describing measurements made with the intention of deciding whether the outburst of the Nova Herculis had an influence upon the intensity of cosmic radiation. The results obtained with the coincidence method are not in perfect agreement with each other: Kolhörster[1] has found, and we[2] have not found, a Nova effect. To clear up the question we made, from July 24 until August 5, 1935, measurements with two Geiger-Müller counters of 100 cm. effective length, and 4 cm. diameter, placed 7 cm. apart with their axes parallel to the north-south direction, one above the other. We used the Barnóthy coincidence method which makes it possible to neglect the number of chance coincidences, as they are less than 0·4 per cent of the true ones. The apparatus is provided with an automatic impulse size regulator which kept the sensibility of the counters during the whole time of measurements at a constant value, so that they were not influenced by any changes occurring in the inside temperature or in the supplying voltage. In 349 hours we registered 1·53 million coincidences; their distribution during the three periods of the day is shown in the accompanying table.

We infer from the foregoing that the intensity between 8^h and 16^h is with $1{\cdot}37 \pm 0{\cdot}17$ per cent more than during the other two periods. It may be of

interest to compare our results with those of Kolhörster[1] as the 'field' of our apparatus was similar to his. Kolhörster found for the same hours an intensity surplus of $1{\cdot}76 \pm 0{\cdot}28$ per cent, and interpreted it, with reservation, as an effect of the Nova Herculis. The two results, between the limit of error, can be said to be equal, notwithstanding the fact that

Interval (*M.E.T.*)	Intensity in coincidences per minute	Increase
8^h —16^h	$73{\cdot}78 \pm 0{\cdot}10$	$1{\cdot}37 \pm 0{\cdot}17$ per cent
16^h —24^h	$72{\cdot}78 \pm 0{\cdot}07$	
0^h — 8^h		

in our case, contrary to Kolhörster's, the Nova was not at that time in the 'field' of the apparatus. When the Nova, with an average magnitude of 7 in August, was in the 'field' of the apparatus, we found the intensity $1{\cdot}84 \pm 0{\cdot}13$ per cent less than the average during other hours of the day (Fig. 1).

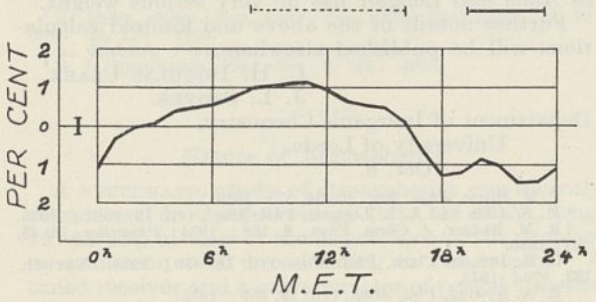


FIG. 1. Percentage variation of cosmic radiation with M.E.T. The points do not represent the original hourly values, but to smooth the curve the fourth means are plotted. Above the graph the time is marked when the Nova passed through the 'field' of our apparatus (July 1935, full line) and through Kolhörster's (Dec. 1934, dotted line).

It seems to be evident that the supposition expressed in an earlier paper[3] is justified, and that the intensity surplus observed by Kolhörster is really nothing else but the daily intensity variation of the cosmic radiation. The real cause of this daily variation, and the reason why it is larger with counter-tube methods than with ionisation chamber methods, cannot yet be satisfactorily explained. We believe, however, that it is not caused by the influence of the sun, but it may be the consequence of the daily variation of the earth's magnetic field intensity, perhaps diminished by the daily variation of the outer temperature. To support this opinion we may say that we have found a correlation coefficient of $-0{\cdot}73$ between hourly means of the cosmic ray intensity and horizontal intensity of the earth's magnetic field[4], and again a coefficient of $-0{\cdot}67$ between daily averages of cosmic ray intensity and outer temperature.

The experimental part of this work was kindly aided by the Hungarian Council for Natural Sciences.

J. BARNÓTHY.
M. FORRÓ.

Institute of Experimental Physics,
University,
Budapest.
Sept. 6.

[1] W. Kolhörster, *Z. Phys*, **93**, 429; 1935.
[2] J. Barnóthy and M. Forró, NATURE, **135**, 618; 1935.
[3] J. Barnóthy and M. Forró, *Z. Phys.*, **94**, 773; 1935.
[4] The magnetic data were taken from Landolt-Börnstein Erg. Bd. 3; they represent the mean values of the intensity for July and August in the period 1921–1930.

Positive and Negative Ions in the Primary Cosmic Radiation

THE observed east–west asymmetry of the cosmic radiation, and its increase with increasing altitude, has been interpreted in terms of an unbalanced primary radiation which is positively charged. It has been suggested by Compton and Bethe that the radiation probably consists of protons, the rest of the primary radiation consisting of equal numbers of positrons and electrons.

The existence of such an unbalanced positively charged radiation would mean that there would be a preponderance of ions of one sign in interstellar space, and, as has been pointed out by Swann[1], this would give rise to enormous differences of potentials between points separated by distances which are relatively small according to astronomical standards. That such differences of potential do not exist is guaranteed by the observed state of rest of the interstellar ionised calcium clouds as shown by Ross Gunn[2]. These considerations suggest strongly that equal numbers of positive and negative charges exist in the cosmic ray beam.

Swann[1] has shown further that any attempt to consider the emission of a greater number of ions of one sign than the other from stars or other heavenly bodies results in a condition in which the particles become bound to their respective stars as a sort of space charge.

Similarly, it would appear that if the earth had been bombarded, since its formation, by a primary cosmic radiation in which positively charged particles predominated, it would have gradually acquired a high positive potential. Finally it would, therefore, tend to repel those ions which were positively charged, while attracting those whose charges were negative. This would result in a gradual reduction of the earth's potential until equal numbers of positive and negative charges would be incident on the earth. It is apparent, therefore, that equal numbers of positive and negative ions must be falling on the earth at any instant, and it must be concluded that the azimuthal asymmetry must be explained in some different way other than in terms of an unbalanced positive component.

Ross Gunn has suggested that the positive and negative ions travel through space with equal velocities, and that the asymmetry is due to the differences between the penetrating power of the positive and negative ions, and to the different spirals, which, on account of their different rest masses, these particles describe in the earth's magnetic field.

H. J. WALKE.

Radiation Laboratory,
University of California,
Berkeley.
Sept. 5.

[1] Swann, *Phys. Rev.*, **44**, 124; 1933.
[2] Ross Gunn, *Phys. Rev.*, **45**, 900; 1934.

Slow Neutrons

FOR some months past we have been investigating the influence of the temperature of hydrogen containing material on the activity of silver irradiated by slow neutrons. In our experiments we have cooled down paraffin wax to the temperature of liquid air. Under these conditions, no increase of activity of silver has been observed. Moon and

Tillman[1] and also Fermi[2] have shown that the activity of silver increases to about 10–30 per cent when paraffin wax is cooled through the same range of temperatures as in our experiments. The only difference in the experimental conditions consisted in the fact that Tillman and Moon used a layer of cooled paraffin wax 1·7 cm. thick while in our experiments the thickness of this layer was about 10 cm. The discrepancy of the results may be explained by the assumption that the process of slowing down neutrons is accompanied by the absorption. In fact, if cooled paraffin wax absorbs slow neutrons more strongly than the paraffin at room temperature, then the decrease of the number of neutrons reaching the target in the case of a thick layer of cooled paraffin wax may counterbalance the increase of activity of neutrons.

We repeated our experiments under the former conditions and also measured the temperature effect using different thicknesses of paraffin cylinders containing the silver target. Neutrons before reaching these cylinders were strongly retarded. Experiments were made with three cylinders, 0·8 cm., 1 cm. and 1·7 cm. thick respectively. In all three cases, in cooled paraffin wax an increase of activity of silver was observed which diminished with the increase of thickness of paraffin. The increases amounted to 45, 24 and 13 per cent respectively. There was no increase of activity when the thickness of the paraffin layer was about 10 cm. The range of thicknesses investigated was greater than the mean free path of slow neutrons (0·5 cm.). At smaller thicknesses, a decrease of the influence of temperature should be again observed.

Our experiments prove the existence of the temperature effect and demonstrate the absorption of slow neutrons by paraffin. The absorption becomes stronger as the paraffin is cooled, that is, increases with the decrease of velocities of thermal neutrons.

The effective cross-section of neutrons calculated from our data, assuming the absorption by protons in paraffin wax, is about 10^{-24} cm. sq. The existence of the absorption of slow neutrons explains very well the fall of activity with great retarding thicknesses of water in the well-known experiments of Westcott and Bjerge[3]. The results of Lea's[4] experiments also may be explained in the same way, if under the conditions of his experiments the slow neutrons were present in sufficient number.

P. LUKIRSKY.
T. ZAREWA.

Physical Institute,
University,
Leningrad.
July 16.

[1] Moon and Tillman, NATURE, **135**, 904; 1935.
[2] Fermi, *La Ricerca Scientifica*, VI, **1**, 11-12.
[3] Westcott and Bjerge, *Proc. Camb. Phil. Soc.*, **31**, 145; 1935.
[4] Lea, NATURE, **133**, 24; 1934.

Suggested Improvements of Morse's Rule

MORSE's empirical relation[1] between r_e and ω_e for di-atoms has recently formed the subject of considerable discussion. It has been amended by three authors, (*A*) Allen and Longair[2], who introduce the 'reduced mass' μ, (*B*) Badger[3], who utilises the bond-constant k_0 derived from a pendulum-type formula, and (*C*) one of us (C. H. D. C.)[4], who uses the group number n. It is noteworthy that each of these modifications introduces period constants, varying discontinuously between different molecular periods. The amendments assume interest in view of the preliminary theoretical attack on the problem from the point of view of wave-mechanics by Newing[5], whose general conclusion is: "We shall expect a law of the type that has been suggested by Badger and by Clark". Further analysis is promised.

The modifications may be tested in their capacity to reproduce experimental values of r_e (in A.) from known ω_e (in cm.$^{-1}$). The following average ($\pm$ per cent) errors are found for 31 electronic levels of di-atoms of the *KK* period: (*A*) 2·7, (*B*) 1·7, (*C*) 1·2, as against the unmodified formula: 5·3. The *C* formula ($\omega_e r_e^3 \sqrt{n} = 9{\cdot}70 \times 10^{-21}$ cm.^{2}) is therefore the best for this period.

Allen and Longair[2] have stated that the *C* formula will be inapplicable to isotopic molecules, where the r_e's may be closely alike whilst the ω_e's are different. The only case cited in the *KK* period is of $B^{10}O$ and $B^{11}O$, where in the ground states the *C* formula gives errors of $-1{\cdot}1$ and $-0{\cdot}2$ per cent, respectively. Since both these numbers are within the average error ($\pm 1{\cdot}2$ per cent), it would appear that in practice the objection of Allen and Longair has no very serious weight.

Further details of the above and kindred calculations will be published elsewhere.

C. H. DOUGLAS CLARK.
J. L. STOVES.

Department of Inorganic Chemistry,
University of Leeds.
Oct. 9.

[1] P. M. Morse, *Phys. Rev.*, (ii) **34**, 57; 1929.
[2] H. S. Allen and A. L. Longair, *Phil. Mag.*, (vii) **19**, 1032; 1935.
[3] R. M. Badger, *J. Chem. Phys.*, **2**, 128; 1934; *Phys. Rev.*, (ii) **48**, 284; 1935.
[4] C. H. Douglas Clark, *Phil. Mag.*, (vii) **18**, 459; 1934. NATURE, **133**, 873; 1934.
[5] R. A. Newing, *Phil. Mag.*, (vii) **19**, 759; 1935.

Viscosity of Air and the Electronic Charge

THE greatest uncertainty in determining the electronic charge e by the oil drop method of Millikan is introduced by the uncertainty in the assumed value of the coefficient of viscosity of air, η. The value adopted by Millikan in 1917

$$\eta_{23^\circ} = (1822{\cdot}6 \pm 1{\cdot}2) \times 10^{-7}$$

is probably too low, and its accuracy overestimated, as is pointed out by Shiba[1].

Considering the fundamental importance of the constant e, I have undertaken a new determination of η, using the rotating cylinder method also employed by Millikan and his co-workers[2,3]: An inner cylinder of electron metal, suspended vertically by a fine phosphor-bronze wire between two guard cylinders of equal diameter is deviated from its equilibrium position through an angle φ by a concentric outer cylinder, rotating with constant velocity, η being calculated from the equation

$$\eta = \frac{I\,(b^2 - a^2).\varphi\, t}{2\, a^2\, b^2\, l\ \ T^2}\ ,\quad \text{where}$$

a = the radius of the inner cylinder = 2·81767 cm. at 20°;
b = the radius of the outer cylinder = 3·26628 cm. at 20° or = 3·18328 cm. at 20° (two different cylinders);
l = the length of the inner cylinder = 9·9981 cm. at 20°;
t = the time of revolution of the outer cylinder (20 – 150 sec.);
T = the period of oscillation of the suspended system (53 – 128 sec., using different suspensions);

I = the moment of inertia of the suspended system about the line of suspension = 423·22 gm.cm².

The mean value of 51 determinations of η for dry air at temperatures between 18·9° and 20·9° is

$\eta_{20°} = (1820{\cdot}0 \pm 3{\cdot}0) \times 10^{-7}$ corresponding to
$\eta_{23°} = (1834{\cdot}8 \pm 3{\cdot}0) \times 10^{-7}$.

From this we get

$$e = \left(\frac{1834{\cdot}8}{1822{\cdot}6}\right)^{3/2} \times 4{\cdot}770 \times 10^{-10} = (4{\cdot}818 \pm 0{\cdot}012) \times 10^{-10} \text{ E.S.U.},$$

the uncertainty stated being due only to the viscosity, other sources of error not being considered here.

I am, therefore, of the opinion that the discrepancy between the 'oil drop value' of e and the 'X-ray value' can be explained by the error in η.

A more detailed report will be published elsewhere.

GUNNAR KELLSTRÖM.

Physics Laboratory,
University, Uppsala.
Sept. 11.

[1] K. Shiba, *Scient. Pap. Inst. Phys. Chem. Res., Tokyo*, **19**, 97; 1932. 21, 128; 1933.
[2] L. Gilchrist, *Phys. Rev.*, **1**, 124; 1913.
[3] E. L. Harrington, *Phys. Rev.*, **8**, 738; 1916.

Nature of Atmospherics

A SYSTEMATIC study of atmospherics was recently commenced in this laboratory (lat. 11° 25′ N., long. 79° 44′ E.), in view of the importance of the problem in connexion with broadcasting in the tropics. A tuned receiver and a galvanometer of period 1 second were used to record photographically the atmospherics. The results obtained during the months of October and November 1934 (a period during which the atmospheric activity was extremely severe) are of much interest, in connexion with the discrepancies observed between the results for the average duration of atmospherics as recorded by several investigators.

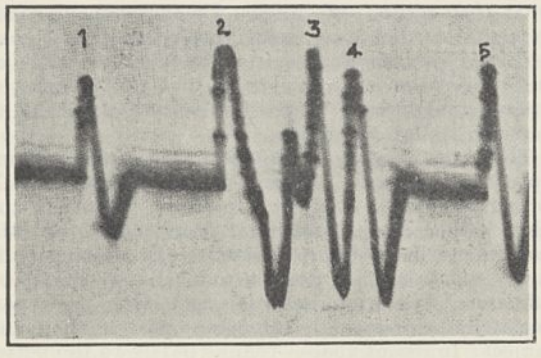


FIG. 1.

In the accompanying illustration (Fig. 1), which is an enlargement of a section of one of the records, certain thickenings are observed along the trace of the galvanometer motion. The number of thickenings or dots, which indicate the number of separate impulses received by the galvanometer in any given interval, can be arranged into groups taking into consideration the rate at which they succeed each other. The curves show that the number of components in groups 1–5 are 4, 12, 8, 10 and 6 respectively. The total duration of each 'atmospheric' is about ½ second. The number of components as indicated by the dots range from 4 to 12. These separate impulses may be due to the separate strokes ranging in number from 1 to 12, constituting a lightning discharge, observed by Schonland and Collens[1].

These individual strokes themselves may be composite, but their nature cannot be recorded or indicated by instruments of periods 0·1–1 sec. The peaks in the records of Munro and Webster[2] may be taken to correspond to the thickenings or the dots in the curves reproduced here.

The dots indicate what may be called the *gross structure* of the atmospheric. In addition to this, there is also evidence of a *fine structure* as revealed by the cathode ray oscillograph records of Watt and Appleton[3]. The durations as observed by them are of the order of milli-seconds, and in many cases the main structure of the atmospheric was supplemented by ripples superposed on the growth and decay slopes. The variations observed during these small intervals may be referred to as the *fine structure* of the components of an atmospheric and are probably due to lightning discharges succeeding each other at intervals of the order of milli-seconds.

The records reproduced here throw light on the discrepancies between the observations of lightning flashes reported by Schonland and Collens, Boys[4] and Halliday[5] on one hand, and Munro and Webster[2] on the other. The former authors record about 10–12 component flashes, whereas the latter have observed up to fifty. Although this difference may be explained according to Munro and Webster[2] on the supposition that a multitude of small flashes occur within the cloud and hence could not be recorded by the camera, there is another explanation which is in agreement with all the observations.

Taking into account the results outlined above, the close agreement between the number of components of an atmospheric as recorded by instruments of relatively long periods (0·1–1 sec.) and the number of lightning flashes recorded by moving lens cameras, and also the complex nature of these components revealed by the work of Watt and Appleton[3], it appears reasonable to suppose that the fifty flashes observed by Munro and Webster are not in the same temporal relation with one another. These can be divided into 10 or 12 groups, each group being separated from the previous one by periods of the order of 0·1 second. Each group may consist of 4 or 5 flashes (occurring either inside the cloud or outside visibly) succeeding each other at intervals of the order of milli-seconds and giving rise to what has been described as the fine structure.

This view is supported by the recent work of Appleton and Chapman[6] on lightning flashes, and is in agreement with the facts revealed by the cathode ray oscillograph and by instruments of much larger periods and with all the observations on lightning flashes recorded so far, as well as with the audible effects produced in a wireless receiver.

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Sept. 4.

[1] *Proc. Roy. Soc.*, A, **143**, 654; 1933.
[2] NATURE, **134**, 880; 1934.
[3] *Proc. Roy. Soc.*, A, **103**, 84–102; 1923.
[4] NATURE, **131**, 765; 1933.
[5] *Phil. Mag.*, **15**, 409; 1933.
[6] NATURE, **134**, 968; 1934.

Influence of Substituents on Organic Reactions: a Quantitative Relationship

FLÜRSCHEIM[1] made the classical observation that substituent atoms or groups influence the dissociation of carboxylic acids and amines in a manner related to their effect on further substitution in benzene derivatives containing them. This has led, directly or indirectly, to much further work which has established that this type of qualitative relationship applies to the velocities of a wide variety of reactions and to a number of dissociations. The results have been extensively discussed either in terms of Flürscheim's Theory of Valency or in terms of the electronic theory which has incorporated the essential elements of the earlier conception. But these discussions have been concerned with sequences of groups or other qualitative considerations.

In more limited fields such relationships have been found to be quantitative. For example, H. B. Watson and his collaborators[2] have found quantitative relationships between the dipole moments of substituents and their influence from the *m*-position on the velocities of side-chain reactions and also on dissociations. Hammett and Pfluger[3] found a linear relationship between the logarithms of the velocity constants for the reaction of a series of methyl esters with trimethylamine ($R.CO.OMe + NMe_3 \rightarrow R.COO' + NMe_4^+$) on one hand and the logarithms of the dissociation constants of the corresponding carboxylic acids on the other*.

It now appears that this last quantitative relationship is more general. Plotting the logarithms of the dissociation constants of a number of *m*- or *p*-substituted benzoic acids as a reference series and, against them, the logarithms of the velocity constants of a number of side-chain reactions involving substances containing the same *m*- or *p*-substituents, one obtains a series of linear relationships. For example, a straight line is obtained for the alkaline hydrolysis of the various substituted ethyl benzoates, another for the substituted benzamides and others for the solvent hydrolysis of the benzyl chlorides, the acid catalysed hydrolysis of the potassium arylsulphates, the alkaline hydrolysis of the ethyl cinnamates and so on. The logarithms of dissociation constants other than those of the substituted benzoic acids (for example, those of the phenylacetic acids) can be similarly related to the same reference series. The choice of this is quite arbitrary and the relationships of course hold between the different phenomena as well as between them and the reference series. The significance of individual deviations from the straight lines constitutes a separate problem but the deviations do not vitiate the generalisation. This has been applied here to *m*- and *p*-substituted derivatives only, but this does not represent the limit of its applicability although the curves for other types of compound will not generally be co-linear with those for the *m*-*p*-series. Reactions which have required special consideration in terms of electronic theory will, in general, show more complex relationships to those of the linear group.

The applicability and significance of these relationships are discussed in a more detailed communication which is being submitted for publication, but a few general points may be noted here.

The slopes of the curves measure the relative sensitivities of the different phenomena to variations of structure of the type considered, but in interpreting this in detail the slight variation of slope with temperature must be allowed for.

According to the transition state method as used by Evans and Polanyi[4], the velocity constant of a reaction is determined by the equilibrium between the initial and transition states. Log k (velocity) is directly related to the free energy change in this process as log K (equilibrium) is to the total free energy change in dissociation, and the linear relationships described above may be stated as follows in terms of the transition state conception:

The influence of substituents on the free energy change associated with the equilibrium between the initial and transition states, in a reaction considered in respect of velocity, is directly proportional to their influence on the free energy change between the initial and final states in a corresponding acid dissociation.

The interpretation of this in terms of the Arrhenius Equation seems to require a parallelism between the variations in the α and in the E terms.

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Sept. 29.

* Since this letter was passed for press, a further paper by Hammett (*Chem. Rev.*, **17**, 125; 1935) has been received, which extends greatly the application of the linear relationship to the reactions of pairs of closely related substances.

[1] *J. Chem. Soc.*, **95**, 725; 1909.
[2] *J. Chem. Soc.*, 893; 1933. *Chemistry and Industry*, **54**, 735; 1935.
[3] *J. Amer. Chem. Soc.*, **55**, 4079; 1933.
[4] *Trans. Faraday Soc.*, **21**, 875; 1935. Compare also Wynne-Jones and Eyring, *J. Chem. Phys.*, **3**, 492; 1935.

Spectrum Analysis

IN response to Mr. Twyman's appeal[1], may I express the hope that the term "spectrum analysis" will continue to be used "to denote the analysis of substances by means of their spectra"? The term is a technical one with an established meaning which a student has to learn, and it would introduce a very bad principle to change such terms whenever opportunities arise for them to be misunderstood by those who have not taken the trouble to find out what they mean. We might, for example, be asked to abandon the term 'solar time', because a post-relativity physicist takes it to be the time kept by an observer on the sun; or to give up speaking of 'stellar magnitudes' now that we have learnt to measure stellar volumes.

There are strong historical reasons for confining 'spectrum analysis' to its original meaning. It formerly included every spectroscopic operation, and when other than analytical applications of the instrument became predominant, the more general term 'spectroscopy' was introduced (I think by Schuster), 'spectrum analysis' remaining as a particular and decreasingly important part of the wider subject. In recent years—thanks partly to the better understanding of spectra and their variations which has come from physical theory—there has been, as Mr. Twyman well knows, a remarkable revival of spectrum analysis, while the term-analysis of spectra, on the other hand, has proceeded so far as to be well on the decline. It would therefore not only be inappropriate to rob a rejuvenated subject of its name in favour of a declining one, but it would tend also to hinder reference by modern workers to such ancient classics on spectrum analysis as those of Lockyer, Roscoe, Schellen and others, which record practical experience now largely forgotten and well worth attention by practitioners of a revived art.

I am loth even in appearance to temper these remarks by discussing Mr. Twyman's suggested alternatives, but since he intends temporarily to adopt one of them, I am tempted to do so. Spectroscopic (or spectrographic, which, as Prof. Curtis would probably agree, better describes modern practice) analysis seems preferable to spectro-chemical analysis for the following reason. There are three experimental 'hall-marks' of an atom—atomic weight(s), spectrum, chemical properties—and, correspondingly, three methods of analysis, which might be called 'mass-analysis' (by Dr. Aston's instrument, for example), 'spectrographic analysis' and 'chemical analysis'. 'Spectro-chemical analysis' would then indicate an analysis jointly by spectrographic and chemical methods—a not uncommon process, I believe, as in cases where the qualitative analysis is spectrographic, and the quantitative, chemical. It would be a pity to give the name 'spectro-chemical analysis' to a process in which chemical methods are not used.

I repeat my opinion, however, that the proper course to take would be to call spectrum analysis by its own name, and let the penalties of misunderstanding fall on those who are ignorant of physical nomenclature rather than on those who conscientiously learn it.

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[1] NATURE, **136**, 609, Oct. 12, 1935.

Antagonistic Effect of Potassium Iodide in Baldness due to Thallium Acetate

THALLIUM salts administered per os or subcutaneously in the body disturb the equilibrium of mineral metabolism[1], bring about lesions in the central and peripheral nervous system[2], cause disturbances in the endocrine system[3], have a deleterious effect upon the heart[4], bring about disturbances in the digestive tract[5] and kidneys[6] and have unfavourable effects upon development and growth of animals[7]. Further, the daily administration of thallium for a longer period of time brings about in animals, especially in young ones, under-development of skin[8], atrophy of hair follicles, hyperplasy and hypertrophy of sebaceous glands[9], degenerative changes of hair[10], and alopecy[11].

In our experiments we used six groups of rats. The first three groups received daily, per os, 3, 4 and 6 mgm. of thallium acetate per 1,000 gm. weight, respectively. The other three groups received the same quantity of thallium acetate per os, and in addition, each animal received daily, subcutaneously, 0·75 c.c. of a two per cent solution of potassium iodide. After 12–16 days, the rats which received only thallium acetate started losing their hair and at the end of the experiment (35 days) all the surviving animals had lost most of their hair, and some of them, especially those which were getting higher doses, became entirely bald. On the other hand, the rats which received thallium acetate per os and potassium iodide subcutaneously retained completely their hair coating. Also, the mortality in the groups with potassium iodide was smaller, which indicates that potassium iodide reduces the toxicity of thallium acetate.

The object of further experiments being carried out by us is to determine whether other salts of iodine, such as sodium iodide, lithium iodide, calcium iodide and magnesium iodide, prevent partly or entirely the loss of hair caused by thallium and reduce the deleterious action of thallium upon organisms.

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[1] Klopstock, *Med. Klin.*, 345; 1924.
[2] Dixon, *Proc. Roy. Soc. Med.*, **20**, 79; 1927.
[3] Buschke und Peiser, *Med. Klin.*, **18**, 23; 1922.
[4] Buschke und Jacobsohn, *Dtsch. med. Wschr.*, 859; 1922.
[5] Seitz, *Klin. Wschr.*, **1**, 157; 1930.
[6] Schneider, Ref. *Zbl. Hautkrkh.*, 35, 124.
[7] Buschke und Peiser, *Klin. Wschr.*, **1**, 44, 2182; 1922.
[8] Bernhardt, Ref. *Zbl. Hautkrkh.*, **14**, 42.
[9] Mamoli, Ref. *Zbl. Hautkrkh.*, **18**, 39.
[10] Leigheb, Ref. *Zbl. Hautkrkh.*, **29**, 523.
[11] Fiocco, Ref. *Zbl. Hautkrkh.*, **18**, 790.

A 'Dope' for Embedding Wax

ATTENTION has been directed by Higgs[1] to the effect of small quantities of petroleum ceresins in causing paraffin wax to cool in a microcrystalline state. It seemed possible that this effect might be valuable in the technique of cutting paraffin sections. During this summer we have been using, for the routine sectioning of early amphibian embryos, a paraffin wax mixture, without addition of beeswax but containing 0·5 per cent of petroleum ceresin which was supplied by Messrs. Shell-Mex and B. P., Ltd. The results have been all that could be desired, the wax cooling with a very fine texture even when the embedding dish was allowed to cool in the air without being immersed in water. It is necessary to use a mixture having a melting point, before the addition of ceresin, slightly lower than is normally appropriate. The electrostatic properties of the wax appear to be unaltered. The 'dope' may be particularly useful in embedding large objects, in which ordinary wax tends to cool too slowly in the centre of the block.

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[1] Higgs, P. G., *J. Inst. Petroleum Tech.*, **21**, 1; 1935. See also NATURE, **135**, 113; 1935.

Corophium curvispinum, G. O. Sars, var. *devium*, Wundsch, in England

WHILE passing through Tewkesbury on June 30, 1935 I found thirteen specimens of *Corophium curvispinum* var. *devium*, inhabiting tubes made upon submerged plants in shallow water near the left bank of the River Avon about two hundred yards below King John's Bridge. From the associated flora and fauna I believe this water to be permanently fresh, though I took no measurements of salinity. Prof. Wundsch has kindly confirmed my identification.

The species *C. curvispinum* was described and figured by Sars[1] from the Caspian Sea in 1895. In 1912, Wundsch[2] described *C. devium* as a new species from fresh water in the Müggelsee, near Berlin. Later

Behning[3], having seen specimens from other localities, reduced *C. devium* to a freshwater variety of *C. curvispinum*, an alteration to which Wundsch[4] agreed. In both these papers Wundsch gives figures adequate for identification.

Wundsch[5] gave a map of the known distribution of the variety in 1919, and Wolski[6] in 1930 gave a list of localities without adding much to the range known in 1919. It inhabits the lower and middle courses of rivers running into the Caspian Sea (Volga and its tributaries), the Black Sea (Danube, Dnieper and Don) and North Sea and Baltic (Niemen to Elbe): also two lakes in the Caucasus near the Caspian Sea. It has not yet been found west of the Elbe.

Wundsch[4] stated that in 1915 this variety was spreading rapidly in Germany, moving through canals and rivers from east to west and usually downstream.

It is unlikely to have been introduced from its European localities with living fish, since no example of such importation of stock to the Severn or Avon is known to the secretaries of the Bristol Naturalists, the Fishmongers Company or the Severn Fishery Board. But ships from the Baltic and the Black Sea reach Bristol Docks, and might carry specimens in the fouling on the hull. Nothing is known of the resistance of this variety to sea-water travel.

It would be of interest to ascertain the present distribution of this variety in England, and in Europe west of the Elbe. It might thus be made clear how it reached Tewkesbury, and how rapidly it is able to spread in our rivers.

Its usual localities are the lowland fresh-water reaches of sluggish rivers. It lives in tubes made of mud upon weed or piles. Specimens of *Corophium* found burrowing in mud are almost certain to be the common species *C. volutator*.

I shall be pleased to identify any specimens of *Corophium* sent me. The general aspect of species of this genus is clearly shown in the drawings of Sars[7].

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[1] G. O. Sars, *Bull. Acad. Sci. St. Pétersb.*, Ser. 5, **3**, 302; 1895.
[2] H. H. Wundsch, *Zool. Anz.*, **39**, 729; 1912.
[3] A. Behning, *Zool. Jb.*, **37**, 385; 1914.
[4] H. H. Wundsch, *S. B. Ges. Naturf. Fr. Berl.*, Nr. 3, 56; 1915.
[5] H. H. Wundsch, *Arch. Hydrobiol. Plankt.*, **12**, 693; 1919.
[6] T. Wolski, *Frag. faun. Mus. Zool. polon.*, **1**, 152; 1930.
[7] G. O. Sars, "Crust. Norway", **1**. Amphipoda, 1894.

Points from Foregoing Letters

A MODEL consisting of a football bladder and rubber blocks, to illustrate how early forms of sea-urchins (of Cambrian age) may have behaved under tidal conditions, has been constructed by Dr. W. K. Spencer. The model opens and closes automatically under the influence of changes in hydrostatic pressure, acting upon the elastic body-wall.

To elucidate the 'shape' of the benzene molecule, the principal lines of the infra-red spectrum of benzene containing heavy hydrogen, C_6D_6, are compared with those of ordinary benzene, C_6H_6, by a group of investigators from University College, London. The authors conclude that, as in the case of the Raman spectra, the apparently coincident frequencies are accidental, and consequently there is no longer any reason for physicists to reject the regular hexagon model accepted by chemists for the benzene molecule.

An increase in the intensity of cosmic rays was observed by Kolhörster during the outburst of Nova Herculis, between 8 h. and 16 h., when that star was in the 'field' of his apparatus, and he therefore suggested that cosmic rays originate in novæ. Drs. J. Barnóthy and M. Forró now find an increase in the intensity of cosmic rays between 8 h. and 16 h. as a normal diurnal variation, which they tentatively ascribe to changes in the earth's magnetic field and in the outer temperature.

It has been suggested that there are more positive than negative particles in cosmic 'rays'. H. J. Walke enumerates several objections to this view. He prefers Ross Gunn's explanation of the east-west asymmetry of the cosmic rays, namely, that it is due to differences in the penetrating power of positive and negative particles and in the spiral paths which they describe under the influence of the earth's magnetic field.

Moon and Tillman have found that the radio-activity induced in silver by neutrons slowed down by passage through a thin layer of paraffin wax is increased when the wax is cooled by liquid air. Prof. P. Lukirsky and T. Zarewa, using a thicker layer of paraffin, failed to observe this temperature effect; but now, using thinner layers, they confirm it. With thicker layers, the increase in the activity of the neutrons, caused by lowering the temperature, is apparently counterbalanced by loss due to absorption.

C. H. Douglas Clark and J. L. Stoves claim that the modification to Morse's relation between the equilibrium internuclear distance r_e and the vibration frequency ω_e of 'di-atoms', suggested by one of them (C. H. D. C.), gives better approximations to the actual experimental values than either Allen and Longair or Badger's suggestions.

The charge of an electron calculated from X-ray wave-lengths determinations comes to $4{\cdot}80 \times 10^{-10}$ E.S.U., whilst the usually accepted value obtained from the rate of fall of electrified droplets is $4{\cdot}77 \times 10^{-10}$ E.S.U. Dr. Gunnar Kellström has re-determined the viscosity of dry air and finds a value different from that used by Millikan when he calculated the electronic charge by the falling droplets method. The recalculated electronic charge agrees with that deduced from X-ray wave-length determinations.

Records of atmospherics obtained with a galvanometer (of period 1 second) by N. S. Subba Rao indicate that lightning flashes have, in addition to the 'fine' structure revealed by the cathode ray oscillograph, also a 'gross' structure, due to the fact that the flashes occur in groups of 4–12. The duration of such a group is about $\frac{1}{2}$ sec. Each member of the group may be due to 1–12 separate strokes as observed by Schonland and Collens, and these strokes may themselves be composite. This complex nature of the electric discharge may account for the divergence in the observations of lightning flashes reported by various investigators.

Experiments upon rats, carried out by O. V. Hykeš and F. A. Diakov, indicate that potassium iodide reduces the toxicity of thallium acetate, and in particular prevents the loss of hair caused by thallium poisoning.

Research Items

Flint-mining at Grime's Graves, Norfolk

SINCE 1921 Mr. A. Leslie Armstrong has been engaged in exploring Grime's Graves, the famous East Anglian prehistoric flint mining site. A report on the results of the excavations, which are still in progress, was presented by Mr. Armstrong to Section H (Anthropology) at the Norwich meeting of the British Association on September 6. A gradual evolution in mining methods, in the tools used, and in the form of the mine shafts has now been demonstrated. Three well-defined phases are recognisable: (1) The primitive phase, in which the shafts are devoid of galleries, and picks made from the long bones of animals are used exclusively; (2) the intermediate phase, in which the shafts are in the form of open workings, but are devoid of galleries, and deer antler picks appear for the first time, increasing until they exceed the earlier bone form in number; (3) the late phase, of deep shafts with mined galleries, in which celts with pointed butts appear and the picks are of deer antler. Trenching and trial excavation have defined the area in which mining was carried on and have also revealed the circumstances which caused the mining to be confined within these limits. There is evidence of occupation in bronze-iron age times, but all mining had ceased before this date.

Wild Cat in Scotland

A SUMMARY of the position of the Scottish wild cat at the present time has recently been given by G. Dent (*J. Soc. Pres. Fauna of the Empire*, N.S., Pt. 26, **48**, Sept. 1935). In the years just before the War, the species was confined to a limited area in the counties of Ross and Sutherland. The author thinks it unlikely that any survived to the south of Loch Ness. The advent of the War gave the wild cat a chance of multiplying and spreading. By 1919 it had crossed Loch Ness and become well-established in Inverness-shire and parts of Perthshire; individuals were trapped on estates where none had been seen for fifty years or more. They have penetrated into parts of Stirlingshire; and have reached so far south as Callander, Gleneagles and Loch Lomond-side; westwards they have appeared in eastern Argyllshire. The author is of opinion that the wild cat will maintain its hold in many parts of the newly-won territory.

South African Fishes

AMONG many interesting papers published in the *Records of the Albany Museum* (**4**, Part 2, 1935), Mr. J. L. B. Smith describes some new and little-known fishes from South Africa. A large number of specimens of *Myliobatis cervus* n.sp., 'Pyl-Stert' (Krysna) were obtained. This species is very like *M. aquila*, and the females can only be distinguished by the shape of the snout. The female of *M. cervus* appears to seek the shallow banks of the river, where the young are born. One large specimen after capture gave birth to seven young. These 'rays' are evidently preyed upon by various species of 'sharks'. On one occasion a large *aquila* was observed to take refuge in a few inches of water on the edge of a bank in the river, violently beating the water with its pectorals in order to scare off a large 'shark' which lay close in, with part of its body out of the water. The *aquila* was secured, an adult female, and three young were born after capture. On another occasion, a large female *aquila* was caught on a line and, being too large for the boat, was tied to the bows. Several young were born, and drifted down with the tide, one being swallowed by a large 'shark'. In the summer months at Krysna a cold current, of temperature 50° F., frequently sets inshore, numbing innumerable fish. It is shown that an *Iso natalensis* (Atherinidæ) does not seem to be inconvenienced by this cold water, and the presence of *Chaetodon marleyi*, a species of a genus usually found farther north, in the river, is a sure sign that the onset is imminent; when the cold water actually enters the river dead specimens are usually thrown ashore.

Digestive Tract of *Emyda vittata*

A. NARAYANA RAO (*J. Mysore Univ.*, **7**, 1933–34) describes the digestive tract of the mud-turtle, *Emyda vittata*, which lives near the water-margins of the tanks and burrows in soft earth. The œsophagus is differentiated into two regions, an anterior lined with stratified epithelium and with few mucous cells, and a posterior with numerous mucous cells. In the stomach are two kinds of glands—tubular glands lined by cubical cells and mucous glands, but there are no oxyntic cells. There is no pyloric sphincter between the stomach and intestine. The pre-rectal region of the intestine possesses a longitudinal typhlosole which reduces the cavity of the intestine to a semilunar slit. The author states that the turtle feeds on animal dung and other matter poor in nutriment, and the typhlosole presents a larger surface for absorption and also retards the rate of passage of the food. He directs attention to the appearance of the typhlosole in this turtle as an archaic character. Spaces lined by cells, and with a rich supply of blood-capillaries, occur between the circular and longitudinal layers of muscle in the wall of the rectum. "The animals when kept under water are seen to take in large quantities of water and the presence of blood vessels in the vicinity of these spaces . . . points to the existence of intestinal respiration."

Maturity of Fruit

THE term 'maturity' as applied to fruit denotes, for practical purposes, a condition where maximum value as an article of human food has been attained. Physical and chemical changes which accompany the process of maturation have been studied by Dr. J. C. Hinton, of Long Ashton Research Station, Bristol, who publishes a series of three papers on this subject in the Station's annual report for 1934 (pp. 29–108). The first paper, which is really the fourth of an extensive series, traces the changes in catalase and oxidase content. It shows that the former increases for a time, whilst the latter decreases steadily during storage. An ingenious hardness tester has been used to obtain the results reported in the second paper. Apples soften steadily during storage; but the rate depends upon the time of picking. The rate of loss in weight during storage is

also correlated with time of picking, and it is further suggested that apples growing in grass-covered orchards, or on trees which have been bark-ringed, or where fruit thinning has been prosecuted, ripen slower than in orchards with clean cultivation. Changes in nitrogen, acid-hydrolysable material, total sugars, and sucrose in relation to reducing sugars, are discussed in the third paper.

A Disease of Young Walnut Trees

DR. JOYCE B. HAMOND, of the East Malling Research Station, Kent, has published the results of her work on "The Morphology, Physiology and Mode of Parasitism of a species of *Chalaropsis* infecting Nursery Walnut Trees" (*J. Pom. and Hort. Sci.*, **18**, 81, June 1935). Walnuts are propagated at East Malling by grafting scions upon seedlings of *Juglans nigra*. The method is usually successful, but in the spring of 1930, a large number of grafts failed, as a result of attack by a fungus. This parasite is now known to be *Chalaropsis thielavioides*. It produces macrospores and endospores, appears under four strains on different hosts, attacks lupins and causes a rot upon carrots. Infected grafts show discoloration of the scion, with a mass of black, sooty spores along the plane of union. Weak solutions of formalin are used to paint the cut made upon the stock during grafting, and to spray the walls and shelves of the propagating house. These precautions control the disease effectively in practice.

Origin of Potash-Rich Rocks

RUTH DOGGETT TERZAGHI has recently discussed the origin of 'orthoclase-rich rocks', which term she applies to those of which the composition lies in the orthoclase field of the felspar equilibrium diagram (*Amer. J. Sci.*, April 1935). Reference is made to Vogt's suggestion that when water is present in relatively large quantities in the liquid phase, potash and plagioclase felspar may be in equilibrium with a liquid having a higher ratio of *Or* to (*Ab*+*An*) than if the melt is 'dry'. It is also shown that high pressure may be expected to displace equilibrium in the same sense. More important, however, is the recognition that some of the potash-rich rocks which appear to be of igneous origin may have been produced by metasomatic processes, such as the felspathisation of quartzite. It is also pointed out that, during hydrothermal alteration and weathering of igneous rocks, the potash/soda ratio may undergo a considerable increase which is not always accompanied by easily diagnosed changes in the appearance of the rock. Attention has been more recently directed to relevant work by Fenner on the action of hot waters on the Yellowstone lavas (*Amer. J. Sci.*, Aug. 1935). In this investigation, Fenner conclusively proved that obsidian is greatly enriched in potash by a process of adularisation accompanied by devitrification of the ground-mass (*Trans. Amer. Geophys. Union*, Fifteenth Annual Meeting, 1934, pp. 241–243).

Light of the Night Sky

LORD RAYLEIGH and H. Spencer Jones have analysed measurements made on the light of the night sky at Terling in Essex, Canberra and the Cape over a period of more than eight years (*Proc. Roy. Soc.*, A, **151**, 22, August, 1935). The measurements were made in spectral regions in the blue, in the red, and around the green auroral line. Periodic yearly and half-yearly variations were detected at all the stations, the former apparently depending on latitude in a complicated way. The auroral component shows a long-period variation common to the three stations and clearly connected with the sunspot cycle, while the slow variation in the blue and red regions is much less clearly defined. There is rather feeble evidence of a connexion between the irregular variation of the auroral green light and magnetic disturbance. The absolute intensities of the light at the three stations are comparable, but seem to be higher at Terling and lowest at the Cape.

A New Discharge Tube Vapour Lamp

AT the opening meeting of the Illuminating Engineering Society, on October 8, a novel 'super high pressure' mercury vapour lamp was shown. It was developed in the physics laboratories attached to the Philips' factories, the aim in view being to increase the light-giving power of ordinary h.p. mercury vapour lamps. It consists of a quartz tube with thick walls having an internal diameter of $\frac{3}{64}$ in. and an external diameter of $\frac{1}{4}$ in. The electrode at each end of the tube consists of a simple tungsten wire sealed into the quartz; an interposed layer of a special grade of glass being necessary as the coefficients of thermal expansion for tungsten and quartz are so different that they prevent hermetical sealing. To facilitate the emission of electrons, the electrode tips are coated with a deposit of alkaline earth oxides and project from a small drop of mercury which condenses at each end. The lamp is placed inside a jacket containing running water. It needs no special stabilising apparatus as it is fed through an auto-transformer. The spectrum of the light produced is continuous, but the mercury lines stand out and are broadened. The luminous efficiency is about 50 lumens (4 candles) per watt. One of the most important advantages of the lamp is that the luminous part is less than $\frac{3}{64}$ in. and so the brightness is very high—about one quarter of the brightness of the sun. This makes it valuable when a concentrated beam is necessary as, for example, in cinema projectors, lighthouses and in all kinds of projectors. The source is almost a point and absorbs 1,500 watts per inch length of discharge. As a source of ultra-violet light, it seems likely to be of use in medical applications, and the absence of thermal inertia is of great value in cinematograph projection.

Chemistry of Antiquities

J. R. PARTINGTON (*Chemistry and Industry*, **54**, 884; 1935) has summarised the results of chemical interest arising from the recent excavations in the Bucheum, near Armant, carried out by direction of Sir Robert Mond and published as the forty-first memoir of the Egypt Exploration Society by Mond and Oliver H. Myers. The article deals with the process of mummification which was probably used for the sacred bulls, with a description of two curious instruments employed in the process. It also gives a table of analyses of metal objects found on the site, some of the bronzes containing large amounts of lead. Some additional information on textiles is also given. The remains probably date from about 357 B.C. to about A.D. 295, and the results are particularly interesting to the historian of chemistry, since it was in this period that the beginnings of chemistry are supposed to have had their origin in Egypt. The article directs attention to this aspect.

Man and the Universe*

THE WIDER PROBLEMS OF ASTRONOMY

WHEN the theory of relativity was enlarged so as to cover the facts of astronomy, it became necessary to discard the symmetry between space and time which had hitherto prevailed. Thus time regained a real objective existence, although only on the astronomical scale, and with reference to astronomical phenomena. De Sitter attacked the problem from the other end, and reached the same conclusion. He began by postulating symmetry between space and time, and found that for such symmetry to prevail, the universe must be totally devoid of matter. As the actual universe certainly contains matter, it is clear that de Sitter's postulate must be discarded. In other words, space and time must be intrinsically different in their natures—which is of course precisely what the plain man has believed throughout. This gives us every justification for reverting to our old intuitional belief that past, present and future have real objective meaning, and are not mere hallucinations of our individual minds —in brief, we are free to believe that time is real.

In 1926 de Broglie and Schrödinger introduced the new quantum mechanics. The universe was no longer regarded as a collection of particles, but as a collection of waves—particles no longer appeared in the picture at all. The new picture was not a mere amplification of the old—it ignored the old altogether and started anew on a clean canvas; and the new picture was strikingly successful. From this time on, there was not one single picture of Nature of which both waves and particles were constituents; there were two distinct pictures—one containing only waves, and the other containing only particles.

This and other occurrences have gradually made it clear that the material world consists of something which cannot adequately be described as either waves or particles. It is obviously something which cannot be grasped in its entirety by the human imagination, so that the best we can do is to represent it by pictures, each of which contains a partial, but only a partial, approximation to the whole truth. The mathematician has a specification of the constituent parts of the universe which he believes to be fairly complete. Looked at with care, and it will be seen that the universe consists of particles. Now let the mathematician go through the process which he will describe technically as "changing the variables", and look again. It is a specification of precisely the same universe, but it is present in an altered form, and we see now that it represents a series of waves—the particles have disappeared from the picture.

In general, it is true that we live in a mathematical universe, so that if we want the ultimate truth about this universe, or anything in it, we must go to the mathematician. When we regard the material world as made up of particles, we can obtain agreement with observation only by supposing that the motion of these particles is not fully determinate. The motion of any one single particle does not appear to obey any definite determinate laws, although the motion of a great number of particles is found to obey a quite definite statistical law. Indeed, it is from such statistical laws that the apparent uniformity of Nature proceeds. If, then, we confine ourselves to the particle-picture, we inevitably conclude that Nature in the last resort is not strictly determinate—somewhere there is an opening for new features to appear in the universe, although we do not know from whence they proceed or what causes them.

The wave picture, on the other hand, seems at first sight to tell us that Nature is strictly deterministic. The waves spread like ripples on the surface of water. Now such ripples follow a predetermined course, and from a knowledge of the ripples at any one instant, the mathematician can calculate what the motion of these ripples will be, and so what the configuration of the surface will be at any future instant. The determinism which we find in the waves is not one of motions or configurations of parts of the universe, but merely of our knowledge of these motions and configurations. If we acquire new knowledge of the universe, as for example by performing an experiment on any small part of the universe, this accession of new knowledge changes the total of our knowledge, and so changes the waves which represent this small part of the universe in the wave-picture.

The meaning of the determinism which is implied in the wave-picture now becomes clear. If we gain no new knowledge, our old knowledge remains our whole stock-in-trade for estimating the future course of events, whereas if we gain new knowledge we can estimate the future with greater precision. Thus the wave-picture does not proclaim that the course of Nature follows undeviating and unchangeable laws, but merely that our knowledge of Nature can only be altered by the acquisition of new knowledge. This is the only kind of determinism that we find in the wave-picture, and we see that it tells us nothing at all as to the actual course of Nature.

Both the particle- and the wave-pictures have been made to agree completely with Nature, but the particle-picture only by introducing a great number of restrictions and laws which appear to have only an artificial and even arbitrary basis. The wave-picture agrees with Nature almost automatically without any such artificialities; it is simple and complete in itself, and seems to fit the observed phenomena exactly. Thus we seem justified in regarding the wave-picture as our best representation of ultimate reality, while the particle-picture is only an artificial model, which is useful as a concession to the limitations of the human mind. Waves do not depict the electron, but what we know about the electron. They depict something inside our minds, not something outside. Thus the wave-mechanics give no countenance to the supposition that the electron has an objective existence independently of our knowledge of it—rather it suggests that our knowledge of the universe (or a bit of it) is fundamental, and that the electron is a clumsy creation of our own, resulting from our efforts to locate our universe in space and time. The apparent indeterminacy of the particle-picture becomes meaningless,

* Substance of the Sir Halley Stewart Trust Lecture delivered by Sir James Jeans, F.R.S., at the Memorial Hall, Farringdon Street, London, on October 22.

while the determinacy of the wave-picture has nothing to do with the course of objective Nature.

In brief, science is unable to give any decision—even to produce any evidence—in the long debated question of determinacy. We still may or may not be automata; science cannot prove that we are not, but it gives us no reason for thinking that we are.

Reviewing the history of science as a whole, we see scientific knowledge continually compelling man to lower his estimate of his own importance and position in the universe, until the beginning of the present century. It is perhaps still too early to form any judgment of more recent events, both because they are still so near at hand, and also because there is not yet complete agreement about them amongst scientific workers themselves. But it seems that the tide has begun to turn. In the light of recent knowledge gained from the theory of relativity and quanta, we seem entitled to take a more hopeful view of our position than Victorian science had been willing to concede. Man had formed a view of his position, influenced largely, no doubt, by his vanity and self-importance, but based on the whole of his practical everyday experience of life: he believed he was free to choose between the higher and the lower, between good and evil, between progress and decadence. Victorian science seemed to challenge all these beliefs: to it there seemed to be neither higher nor lower, neither progress nor decadence. The machine merely ran on automatically, and of its own inertia, as if it had been set to run on the first morning of the Creation and would continue so to run, following out its predestined course, to the end of time. We now begin to suspect that this challenge was a mistaken one. The universe is more like the untutored man's common-sense view of it than had seemed possible a generation ago, and we may not have been mistaken in thinking that humanity is free to choose between good and evil, to choose its direction of development and, within limits, to carve out its own future.

Epochs in Medical Research*

HARVEY'S "De Motu Cordis", though based on knowledge long available, as well as on new observation and experiment, found a world unready to accept its great discovery. Character and courage, in alliance with scientific genius, were needed to break through the mists of hallowed error, and to walk boldly into the light of a new epoch.

More important to medical progress than a discovery of such profound and lasting significance was the creation and display for all time of the method of discovery by experiment. In preaching this new principle of advancing knowledge, Harvey moved with the great spirits of his age. Though Harvey was a physician, most of his directly clinical observations seem to have been lost, with the political destruction of his papers during the Civil War. As an experimental biologist, he had contact with some who were to be among the original fellows of the Royal Society, founded five years after Harvey's death, with the aims which Harvey had so insistently advocated. After Harvey's discovery of the circulation, a solution of the next main problem of nascent physiology, the meaning of respiration, was dependent on progress in the new science of chemistry, and involved the discovery of oxygen. This, which was nearly attained by Boyle and his associates in the early years of the Royal Society, became obscured by the phlogistic theory for more than a century, until Lavoisier finally revealed the nature of combustion and respiration, and made possible the reunion of physiology with medicine.

To-day, as in the past, there are new domains opening to physiology which can only be explored by men trained in other disciplines than that of medicine. The result, as in the past, will be ultimately to infuse new life into medicine itself, provided that clinical medicine, in the hands of those whose first aim is to increase knowledge, remains and increasingly becomes an experimental science, as Harvey saw it.

Harvey's other and much longer book, "De Generatione Animalium", not only gives us further evidence of his genius as an observer, but also shows into what vague and fruitless speculations even he could wander, when he forsook his own precepts. In his suggestions, however, as to the meaning of supposed cases of spontaneous generation, he appears to have been far ahead of the prevailing ideas of his time.

It is fitting, in commemorating Harvey as the founder of experimental medicine, to consider certain recent phases of active development in that field.

We date the epoch of medical bacteriology from Pasteur and Koch. It left the causation of many important infections unsolved, and we witness to-day what may be the beginning of a new epoch as important for medicine, in the study of infective viruses beyond the range of detection by ordinary microscopy. Influenza is a recent addition to the list. In the dimensions of some of the most finely particulate viruses we seem to approach a borderland between organisation and colloidal dispersion, and perhaps to encounter a new order of vital phenomena.

The most general characteristic of the present epoch in medical research seems to be the growing dominance of chemical ideas and the success of chemical methods. Many hormones and vitamins, of which but a few years ago the very existence was merely a matter of indirect presumption, have been isolated, chemically identified, and even prepared by artificial synthesis. In immunology, embryology and in the physiology of muscular activity and nervous transmission, the methods and conceptions of exact chemistry are finding a rapidly growing application.

All aspects of medicine—diagnosis, treatment, prevention—are profoundly affected by this development. Are we at the beginning of a great new epoch, of a major advance? Or will physiology and biochemistry early find themselves halted and baffled by a complexity which their methods have revealed? We must be content to go forward in the faith of William Harvey, that "Nature herself is to be addressed; the paths she shows us are to be boldly trodden; for thus, and whilst we consult our proper senses, from lower advancing to higher levels, shall we penetrate at length into the heart of her mystery".

* Substance of the Harveian Oration delivered by Sir Henry Dale, C.B.E., F.R.S., before the Royal College of Physicians on October 18.

Nutrition and Catering

THE report of the Nutrition Committee of the British Medical Association, issued in November 1933, and reviewed in NATURE of January 13, 1934 (133, 53), was designed to determine the minimum weekly expenditure on foodstuffs which would maintain in health and working capacity families of various sizes. A supplementary pamphlet is now issued to be of practical help to the housewife*.

The translation of food schedules into appetising meals was first undertaken by teachers of domestic science who attended the summer school of the Board of Education in London in 1934. The B.M.A. specimen diet No. 16 for a man, wife and three children was the chosen model. Improvements were introduced to make more variety without increasing cost. Menus for the principal meals for three weeks have been planned, and the dishes for each day illustrated in colour. Shopping lists of food quantities and recipes are included, and a table of food values. Owing to local and seasonal variations in prices the total cost is not here estimated, but in the original report the average price was assessed at 5*s*. 5½*d*. per man weekly.

The American Medical Association has for many years concerned itself with teaching the public the principles of hygiene, including proper nutrition. We welcome this evidence that the B.M.A. is awakening to the fact that the fight against malnutrition is at the present time the most important problem in preventive medicine. The manner in which the information is presented in this pamphlet is simple and attractive, and beyond criticism, but the nature of the diet recommended is not so faultless. The principles of the newer knowledge of nutrition have not been applied; there is close adherence to the obsolete standards of the pre-vitamin era with the focus too exclusively on calories and an unnecessarily high total protein ratio. The supply of vitamins and minerals is sub-optimal. The proportion of fat, and therefore of fat-soluble vitamins, is admittedly low.

The sum allowed weekly for fresh fruits and vegetables has been cut down from the 2*s*. 6*d*. allowed in the first report to a scanty 1*s*. 11*d*. for a family of five; the amount of vitamin C is further reduced by pickling some vegetables. No advisory note is inserted that *wholemeal* flour and bread provide for the same money better value than white cereal products in respect to quality of protein, vitamins and mineral salts. If, as is probable, white bread, etc., are used, 60 per cent of the total calories are derived from over-refined foodstuffs lacking vitamins and deficient in mineral salts, and leading inevitably to malnutrition. Where money is short the best slogan is that advocated by Prof. Sherman, 'no calories without vitamins'.

The health value of this diet would be greatly improved by an increase of butter or milk and of green vegetables; by a decrease in sugar; by replacing white cereals, sago, etc., by whole cereals; by decreasing the total cereals and increasing the amount of potatoes. As a basis for planning healthy and inexpensive diets Dr. Mikkel Hindhede's book on health by correct and simple diet, reviewed in NATURE of June 22, 1935 (135, 1016), might with advantage be consulted.

* "Family Meals and Catering." Pp. 27 + 3 plates. (London: British Medical Association, 1935.) 6*d*.

Universities and Business Training

AT the discussion on "The Universities and Business" arranged by the Department of Industrial Co-operation, Section F (Economic Science and Statistics), at the British Association meeting at Norwich on September 5, Dr. J. A. Bowie discussed the need for more intimate co-operation and suggested that British university schools of business were supplying a negligible percentage of the men required for administrative positions in industry and commerce. Dr. Bowie estimated that over the whole of British industry there were about one million suitable appointments for the business graduate. If the British schools of business were supplying the administrative grade of employee at the same rate as the replenishment in the closed professions, they should be producing about 40,000 graduates annually instead of the actual 200–300.

It was not suggested that such graduates were entitled at once to a responsible managerial post, but the importance of finding them a progressive post leading to such positions was stressed. Dr. Bowie urged that the main reason for the low output of graduates from the university schools of business in Great Britain lay in lack of close working association between education and business. He considered that academic ideas had influenced too largely the commercial courses in Great Britain, which should be modelled on those of the medical school rather than the arts course.

University education for business should aim at giving the student a knowledge of the facts and principles relating to the nature and functions of business and our economic institutions; the capacity for disciplined thinking, for logical analysis and reasoning with respect to the problem of business and of modern society; facility in oral and written expression; an acquaintance with the operating tools of management such as general and cost accounting; and personal effectiveness including the capacity for job analysis and co-operation. At present Dr. Bowie considered that insufficient attention was paid to the development of facility in oral and written expression, the operating tools of management, and the development of personal effectiveness. The employer attached primary importance to the possession of desirable traits of personality and

character and to the capacity to co-operate effectively with others in the attainment of common ends, and the university should supplement its scholarship test by stimulating the development of such personal qualities, by inculcating right attitudes towards life and work and emphasising the need for disciplined habits of thought.

Dr. Bowie suggested further that the determination of the ideal curriculum for business training awaited the result of an inquiry which had yet to be made, and that industry in its turn should pay more attention to the training of its recruits and to definite schemes of promotion. The tendency for the universities to become too exclusively recruiting and training grounds for the professions was socially undesirable and economically disastrous.

Dr. Bowie's address provoked a lively discussion, particularly with reference to the curriculum of the university schools of business, and the place of economics in such training. Opinion was strongly expressed that it would be disastrous to confuse the academic study of economics and research in this field with preparation for a business career, and that the two were best kept distinct. Dr. Bowie himself suggested that economics was probably best studied at a final stage of a business training rather than as a basic subject for such training.

The whole value of such courses of training for business was challenged in the discussion and opinion was expressed that, provided the recruit entered business with a trained mind, it did not greatly matter whether that training had been given in a science or in an arts course. Business could always utilise the trained mind. Against this view it was pointed out that the transfer of knowledge and training was not high and such a policy might involve serious waste. A plea was made that something in the nature of refresher courses in business subjects on the lines of the post-graduate courses now arranged annually in a number of technical colleges and universities might be useful, and it is possible that the university schools of business may render some of their most important services to industry in the provision of such courses for those actually engaged in responsible administrative work. Somewhat surprisingly, despite Dr. Bowie's remarks, no reference was made to the tendency for administrative work itself to be regarded as a profession or at least to be influenced increasingly by professional ideals.

Educational Topics and Events

ABERDEEN.—Dr. William Hamilton Fyfe, principal and vice-chancellor, Queen's University, Kingston, Ontario since 1930, has been appointed principal of the University of Aberdeen, in succession to the Very Rev. Sir George Adam Smith, whose resignation will take effect on October 31. Dr. Hamilton Fyfe was, in 1919–30, headmaster of Christ's Hospital.

CAMBRIDGE.—D. H. Valentine, of St. John's College, has been appointed to the Frank Smart University studentship in botany.

At Girton College the Founders' Memorial Lecture will be given by Sir Frank Dyson on Saturday, October 26, at the College. The title of the lecture will be "The Discovery of the Solar System".

At Christ's College the following members of the College have been elected honorary fellows: Prof. Arthur Hutchinson, Master of Pembroke College and emeritus professor of mineralogy; Prof. J. Graham Kerr, M.P., emeritus professor of zoology, University of Glasgow, formerly fellow of the College; Prof. G. H. F. Nuttall, emeritus professor of biology and director of the Molteno Institute of Parasitology, formerly fellow of the College; Dr. A. W. Rogers, lately director of the Geological Survey, Union of South Africa, president of the Royal Society of South Africa.

With the withdrawal of the opposition, the offer of £10,000 to the University by Sir John Siddeley for the promotion of aeronautical research has been accepted by the Regent House. The *non-placet* was withdrawn in a fly-sheet in which the signatories explained that their attitude, when the offer was originally made in July, was that the money should be used only for work of a fundamental and non-military character. Prof. Melvill Jones, it is stated, gave in effect the assurance required, for he said that all work done in his department was published in the ordinary way and that Sir John's gift was unconditional. The supporters of the *non-placet* add that, since the promotion of human knowledge and welfare is the special responsibility of the University, "it should not even appear to be associated with work that has the destruction of civilization as its object". The suggestion is also made that the "University should define its position on the whole question of military, commercial and secret research, and that an early opportunity should be given for a discussion of this question".

OXFORD.—Dr. J. G. Priestley has been appointed deputy for the professor of physiology during the vacancy caused by Sir Charles Sherrington's retirement.

Dr. F. G. Hobson has been appointed Litchfield lecturer in medicine and Mr. H. A. B. Whitelocke Litchfield lecturer in surgery.

Dr. J. Marschak, All Souls' College, formerly of the Universities of Heidelberg and Kiel, has been appointed director of the new Institute of Statistics for five years from October 1.

Dr. L. H. D. Buxton has been appointed reader in physical anthropology for seven years from October 1.

FEDERAL aid for schools in the poorer regions of the United States is being urgently demanded on the ground that the existing system of school finance, based on the small school district, has, in many localities, completely broken down. "Our American school system is fighting for its very existence," said a member of Congress recently when introducing a Bill for establishing such a measure of federal participation in public instruction as would ensure a reasonable standard of education for every boy and girl in the Union. In support of his contention, he cited statistics showing that salaries of teachers amounting to more than 57 million dollars are in arrears, and that outstanding salary warrants non-cashable or subject to heavy discounts amount to nearly 50 millions. The resources available in the different States for the maintenance of schools differ very widely, and the years of industrial depression have strengthened the hands of the politicians who hold that the Federal Government should now take more responsibility for education.

Science News a Century Ago

Maury's Work on Navigation

MATTHEW FONTAINE MAURY (1806–73), the distinguished American meteorologist and hydrographer, wrote the first of his books, his work on "Navigation", while serving as master of the United States sloop *Falmouth*, to which he was appointed in 1831. It was during his voyage from New York to the Pacific that he conceived the idea of his celebrated wind and current charts.

Writing to his brother from Philadelphia about his book, Maury said, "Without wishing to excite your expectations, I will let you into the secret of my plans, which I wish you to preserve as a secret, in order that if I should not succeed in what I undertake, my friends and family may not feel the effects of disappointment. You must bear in mind that this is the first nautical work of science that has ever come from the pen of a naval officer; and upon its merits I intend to base a claim for promotion. Such a case has no precedent. Therefore you must look upon it as an experiment, in which I may or may not be successful. If I succeed, I shall be put over the heads of many who are now above me. . . . I wish to impress upon you that I am not sanguine of success, but am resolved to try every honourable means to accomplish the object, and to take the most favourable time for it. The book, I hope, will be out in about six weeks. . . ."

When Maury's book appeared, it was favourably noticed by the highest nautical authorities in Great Britain, and it became the textbook of the United States Navy.

Lindsay's Electric Lighting Experiments

ON October 30, 1835, a letter from James Bowman Lindsay on his electric light appeared in the *Dundee Advertiser*. "As a notice of my electric light," the letter ran, "has been extensively circulated, some persons may be anxious to know its present state, and my views respecting it. The apparatus that I have at present is merely a small model. It has already cost a great deal of labour, and will yet cost a good deal more before my room is sufficiently lighted. . . . I am writing this letter by means of it at 6 in. or 8 in. distant; and, at the present moment, can read a book at the distance of 1½ feet. From the same apparatus I can get two or three lights, each of which is fit for reading with. . . . Brilliant illumination will be obtained by a light incapable of combustion; and, on its introduction to spinning mills, conflagrations there will be unheard of. . . . Exposed to the open air, it will blaze with undiminished lustre amidst tempests of wind and rain; and, being capable of surpassing all lights in splendour, it will be used in lighthouses and for telegraphs. The present generation may yet have it burning in their houses and enlightening their streets. Nor are these predictions the offshoots of an exuberant fancy or disordered imagination. They are the anticipated results of laborious research and of countless experiments. Electricity, moreover, is destined for mightier feats than even universal illumination."

On January 15, 1836, Lindsay gave a lecture in the Thistle Hall, Dundee, on his experiments, and publicly exhibited his electric light.

Societies and Academies

PARIS

Academy of Sciences, September 16 (*C.R.*, 201, 510–512). JEAN LEGRAND: New data for the study of periodicity. Study of the periodic relations between rainfall, mean tide-level, and sunspots.

September 23 (*C.R.*, 201, 513–532). CHARLES RICHET: Notice on the work of the late Léon Fredericq. I. VINOGRADOV: The summations of H. Weyl. VLADIMIR KOSTITZIN: The intoxication of a medium by the catabolic products of a population. LÉOPOLD ESCANDE: Remarks on the perturbations maintained in resonance at the lower end of a water main. MAURICE ROBERT and JULES FOGLIA: The measurement of the flux in coils with iron core, and the realisation of a direct reading Henrymeter for any self-induction. GABRIEL VALENSI: The oxidisability of nickel. The results of experiments on the rate of oxidation of nickel foil are given graphically. The data can be expressed by the Arrhenius formula, $n = 11{\cdot}46^{-11210/T}\sqrt{t}$, in which n is the grams of oxygen fixed per cm.^{2}, T is the absolute temperature and t the time in hours. JEAN TIMMERMANS and GUSTAVE POPPE: The mutual solubility of heavy water and organic liquids. JACQUES DE LAPPARENT: The place of montmorillonite in the category of phyllitous silicates. RENÉ SOUÈGES: The embryogeny of the Verbenaceæ. The first terms of the development of the albumen in *Verbena officinalis*. JEAN MARIE LE GOFF: The differential biological reaction of cobalt compounds and of certain complex cobalt compounds (cobalt-ammines).

CAPE TOWN

Royal Society of South Africa, August 21. J. A. PRINGLE: Observations on certain wood-boring Coleoptera occurring in South Africa. C. VAN RIET LOWE: The Smithfield 'N' culture. Attention is directed to the wide range of artefacts employed by those who practised this variation of the main Smithfield culture. Sites and assemblages of artefacts are described, and it is suggested that this peculiar variation of the parent culture owes its characteristics to a changed environment—necessitating a change in employments and in consequence a new variety of tools—brought about by a migration and probably influenced by other cultures. A description is given of the diffusion of the culture, and the five marked, yet intimately related, variations of the common parent are linked up and explained.

SYDNEY

Royal Society of New South Wales, September 4. F. P. DWYER and J. W. HOGARTH: Oxidation of cobalt amalgam. Cobalt amalgam prepared by electrolysis is shown to have the composition, Co_2Hg_3. Although rapidly oxidised in the air to a mixture of Co and CoO, in the ratio of 3 : 1, it is perfectly stable in dry air, oxygen-free water, and inert gases. Cobalt suboxide, Co_4O, is suggested as an intermediate in the oxidation of the amalgam. The oxidation product readily reduces nitrites and nitrates in neutral solution to ammonia, and, on being freed from oxide by ammonium salts, gives a pyrophoric form of cobalt.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Saturday, October 26

BRITISH PSYCHOLOGICAL SOCIETY, at 3.—(in the Physiology Theatre, University College, Gower Street, W.C.1).—Dr. B. P. Wiesner: "Psychophysiological Studies of Animal Drives".

F. B. Kirkman: "Field Experiments with Birds".

Sunday, October 27

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. H. Smith: "Parasites".*

Monday, October 28

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—E. Barclay: "North American Deer".*

UNIVERSITY OF LEEDS, at 5.15.—Prof. S. Sugden: "Artificial Radioactivities".*

UNIVERSITY COLLEGE, LONDON, at 6.30.—Dr. R. R. Marett: "Magic and Religion".*

Tuesday, October 29

ROYAL INSTITUTION, at 5.15.—Sir James Jeans: "Physical Astronomy" (succeeding lectures on November 5, 12 and 19).

WARBURG INSTITUTE, at 5.30.—Anatole de Monzie: "L'Idée Encyclopédique".*

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Prof. E. V. Appleton.*

Thursday, October 31

UNIVERSITY OF LONDON, at 5.—(at the Royal Society of Medicine, 1 Wimpole Street, W.1).—Sir St. Clair Thomson: "The Defences of the Air Passages" (Semon Lecture).*

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Prof. E. Mellanby.*

Friday, November 1

CHADWICK PUBLIC LECTURE, at 5.30.—(at the Royal Society of Tropical Medicine and Hygiene, Manson House, 26 Portland Place, W.1).—Dr. C. Killick Millard: "The Vaccination Question To-day".*

UNIVERSITY OF DURHAM PHILOSOPHICAL SOCIETY, at 6.30.—(at Armstrong College, Newcastle-upon-Tyne). Dr. E. L. Hirst: "The Chemical Nature of Vitamins".*

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 7.—Eng.-Comr. C. J. Hawkes: "Heavy-Oil Engines for Ship Propulsion" (Andrew Laing Lecture).

ROYAL INSTITUTION, at 9.—Clifford C. Paterson: "The Liberation of the Electron: its Industrial Consequences".

Official Publications Received

Great Britain and Ireland

Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences. No. 524: The Cytology of Trisomic Mutations in a Wild Species of Œnothera. By Prof. R. Ruggles Gates and H. K. Nandi. Pp. 227–254+plates 22–24. (London: Harrison and Sons Ltd.)

List of Whole-Time Awards for Scientific Research, other than Professorships, offered by Public and Private Bodies in Great Britain and Northern Ireland. Pp. 31. (London: Royal Commission for the Exhibition of 1851.) 6*d*.

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 29th October 1935. Pp. 38. Newcastle-upon-Tyne: (Natural History Society of Northumberland.)

Principles and Practice of Field Experimentation. By Dr. J. Wishart and Dr. H. G. Sanders. Pp. 100. (London: Empire Cotton Growing Corporation.) 3*s*.

Papers from the Geological Department, Glasgow University. Vol. 17 (Octavo Papers of 1934–1935). (Glasgow University Publications, 36.) 10 papers. (Glasgow: Jackson, Son and Co., Ltd.) [1210

Oxford University Exploration Club. Seventh Annual Report, 1934–1935. Pp. 23+2 plates. (Oxford: M. J. Dunbar, Sec., Trinity College.)

Ministry of Agriculture and Fisheries: Fisheries—England and Wales. Salmon and Freshwater Fisheries: Report for the Year 1934. Pp. 37+4 plates. (London: H.M. Stationery Office.) 1*s*. net.

Universities Bureau of the British Empire. Report of the Executive Council, together with the Accounts of the Bureau for the Year 1st August 1934 to 31st July 1935. Pp. 20. (London: Universities Bureau of the British Empire.)

Other Countries

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 37, Part 3: Chemical Studies on *Rhizopus japonicus*. By Hoshik Lim. Pp. 165–209. (Tokyo: Maruzen Co., Ltd.)

Bulletin of the American Museum of Natural History. Vol. 68, Article 6: Gazetteer and Maps showing Stations visited by Emil Kæmpfer in Eastern Brazil and Paraguay. By Elsie M. B. Naumburg. Pp. 451–469+plates 6–27. (New York: American Museum of Natural History.)

U.S. Department of the Interior: Geological Survey. Bulletin 864-B: The Willow Creek—Kashwitna District, Alaska. By S. R. Capps and Ralph Tuck. (Mineral Resources of Alaska, 1933.) Pp. ii+95–113+1 plate. 5 cents. Professional Paper 177: The Gold Hill Mining District, Utah. By T. B. Nolan. Pp. viii+172+15 plates. 1.25 dollars. Water-Supply Paper 657: Water Utilization in the Snake River Basin. By W. G. Hoyt. Pp. x+379+26 plates. 1 dollar. Water-Supply Paper 741: Surface Water Supply of the United States, 1933. Part 1: North Atlantic Slope Basins. Pp. x+390. 30 cents. Water-Supply Paper 752: Surface Water Supply of the United States, 1933. Part 12: North Pacific Slope Basins. A: Pacific Slope Basins in Washington and Upper Columbia River Basins. Pp. vi+182. 15 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the California Academy of Sciences, Fourth Series. The Templeton Crocker Expedition of the California Academy of Sciences, 1932. Vol. 21, No. 22: The Vascular Plants from San Nicolas Island, California. By John Thomas Howell. Pp 277–284. Vol. 21, No. 23: The Roccellaceæ, with Notes on Specimens collected during the Expedition of 1905–06 to the Galapagos Islands. By Otto Vernon Darbishire. Pp. 285–294+plates 16–17. Vol. 21, No. 24: New Species of Grasses from the Galapagos and the Revillagigedo Islands. By Albert Spear Hitchcock. Pp. 295–300. Vol. 21, No. 25: The Recent Pectinidæ. By Leo George Hertlein. Pp. 301–328+plates 18–19. Vol. 21, No. 26: New Flowering Plants from the Galapagos Islands. By John Thomas Howell. Pp. 329–336. (San Francisco, Calif.: California Academy of Sciences.) [1110

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 138: Tuberculosis of Buffaloes in Egypt with some Tuberculin-test Experiments. By Prof. Dr. M. Carpano. Translated into English by Dr. Zaki Mohamed. Pp. 19+8 plates. 3 P.T. Bulletin No. 153: Anthrax Infection in Birds. By Prof. Dr. M. Carpano. Translated from the Italian by Elliot J. Moreno. Pp. 18+4 plates. 3 P.T. (Cairo: Government Press.)

Ministry of Public Works, Egypt: Physical Department. Meteorological Report for the Year 1932. Pp. xiv+221. (Cairo: Government Press.) 40 P.T.

What is Nippon Kokutai: Introduction to Nipponese National Principles. By Chigaku Tanaka. No. 1. Pp. ii+16. (Tokyo: The Shishio Bunko.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 58: Certain Aspects of Investigations on Black-end Disease of Bananas in Australia. By Shirley Hoetti. Pp. 22+1 plate. Bulletin No. 92: The Apple-Growing Soils of Tasmania. Part 1: A General Investigation of the Soils, by C. G. Stephens; Part 2: A Soil Survey of part of the Huonville District, by J. K. Taylor and C. G. Stephens. Pp. 55+1 plate. (Melbourne: Government Printer.)

Carnegie Institution of Washington. Publication No. 464: Researches on Waring's Problem. By L. E. Dickson. Pp. v+257. (Washington, D.C.: Carnegie Institution.)

Union of South Africa: Department of Mines. Geological Series, Bulletin No. 5: The Nickel-Copper Occurrence in the Bushveld Igneous Complex West of the Pilandsbergen—a Preliminary Report. By C. M. Schwellnus. Pp. 36. (Pretoria: Government Printer.) 6*d*.

Indian Forest Records (New Series). Vol. 1, No. 3: Neue Brenthiden und Lyciden aus Indien. Von R. Kleine. Pp. ii+73–78. 6 annas; 8*d*. Vol. 1, No. 4: Immature Stages of Indian Coleoptera (17) (Eucnemidæ). By J. C. M. Gardner. Pp. 79–93+2 plates. 4 annas; 5*d*. (Delhi: Manager of Publications.)

Bulletin of the American Museum of Natural History. Vol. 68, Art. 7: The Courtship of Gould's Manakin (*Manacus vitellinus vitellinus*) on Barro Colorado Island, Canal Zone. By Frank M. Chapman. Pp. 471–525. (New York: American Museum of Natural History.)

Catalogues

Dulau's Botanical Catalogue: Herbals, Floras, Monographs, Gardens and Gardening, Wild Flowers, etc. No. 239.) Pp. 52. (London: Dulau and Co., Ltd.)

Books and Periodicals on Zoology and Botany: including Publications of the British Museum and Works on and by Linnæus. (New Series, No. 41.) Pp. 58. (London: Wheldon and Wesley, Ltd.)

Livogen: Concentrate of Vitamin B complex with Liquid Extract of Liver B.D.H. and Hæmoglobin. Pp. 14. (London: British Drug Houses, Ltd.)

Recent Scientific and Technical Books

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

Mathematics: Mechanics: Physics

Copson, E. T. An Introduction to the Theory of Functions of a Complex Variable. Demy 8vo. Pp. v +448. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 25*s.* net.*

Crosland, L. Higher School Geometry. Imp. 16mo. Pp. xiv +322 +xx. (London: Macmillan and Co., Ltd., 1935.) 6*s.**

Eck, Bruno. Einführung in die technische Strömungslehre. Band 1: Theoretische Grundlagen. Roy. 8vo. Pp. vi +134. (Berlin: Julius Springer, 1935.) 6.60 gold marks.

Eddington, Sir Arthur. The Nature of the Physical World. (Everyman's Library, No. 922.) Gl. 8vo. Pp. xii +345. (London and Toronto: J. M. Dent and Sons, Ltd., 1935.) 2*s.* net.*

Forsyth, A. R. Intrinsic Geometry of Ideal Space. Sup. Roy. 8vo. Vol. 1. Pp. xxvi +553. Vol. 2. Pp. xiv +655. (London: Macmillan and Co., Ltd., 1935.) 2 vols., £6 6*s.* net.*

Geiger, H., und **Scheel, Karl,** Herausgegeben von. Handbuch der Physik. Zweite Auflage. Band 24, Teil 2: Aufbau der zusammenhängenden Materie. Redigiert von A. Smekal. Sup. Roy. 8vo. Pp. xiv +1203. (Berlin: Julius Springer, 1933.) 129 gold marks.*

Hall, H. S., and **Stevens, F. H.** A Shorter School Geometry. Section 6. Cr. 8vo. Pp. iii +241–304 +ii. (London: Macmillan and Co., Ltd., 1935.) 1*s.* 3*d.*

l'Institut Henri Poincaré, Annales de. Vol. 5, Fasc. 2: Les noyaux atomiques, par G. Gamow; Les valeurs extrêmes des distributions statistiques, par E. J. Gumbel; Sur les lois de probabilités et la corrélation, par A. Guldberg. Imp. 8vo. Pp. 89–176. (Paris: Institut Henri Poincaré; Les Presses universitaires de France, 1935.) 40 francs.*

Kells, Lyman M., and others. Plane and Spherical Trigonometry. 2 vols. Med. 8vo. Vol. 1. Pp. 283. Vol. 2. Pp. 122. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 15*s.* net.

Kuppuswami Aiyangar, N. The Teaching of Mathematics in the New Education. Roy. 8vo. Pp. vii +420 +v. (Trivandrum: The Author, Training College, 1935.) 5 rupees.

Mendenhall, C. E., Eve, A. S., and **Keys, D. A.** College Physics. Med. 8vo. Pp. xi +592. (Boston and London: D. C. Heath and Co., 1935.) 3.76 dollars.*

Miller, Dayton Clarence. Anecdotal History of the Science of Sound to the beginning of the 20th Century. Demy 8vo. Pp. xii +114 +16 plates. (New York: The Macmillan Co., 1935.) 10*s.* 6*d.* net.*

Miller, Norman. A First Course in Differential Equations. Demy 8vo. Pp. v +148. (London: Oxford University Press, 1935.) 7*s.* 6*d.* net.*

Neugebauer, O., Herausgegeben und bearbeitet von. Mathematische Keilschrift-Texte. (Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik, Abteilung A: Quellen, Band 3.) Teil 1: Texte. Sup. Roy. 8vo. Pp. xii +516. Teil 2: Register, Glossar, Nachtrage, Tafeln. Sup. Roy. 4to. Pp. iii +64 +69 plates. (Berlin: Julius Springer, 1935.) 128 gold marks.*

Pauling, Linus, and **Wilson, Jun., E. Bright.** Introduction to Quantum Mechanics: with Applications to Chemistry. Med. 8vo. Pp. xiii +468. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 30*s.* net.*

Ritchie-Scott, A. A Complete School Algebra. Cr. 8vo. Pp. 711. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1935.) 7*s.* 6*d.*; with Answers, 8*s.* 6*d.*

Sponer, Hertha. Molekülspektren und ihre Anwendung auf chemische Probleme. (Struktur und Eigenschaften der Materie, Band 15.) Band 1: Tabellen. 8vo. Pp. 154. (Berlin: Julius Springer, 1935.) 16 gold marks.

Teichmann, H. Einführung in die Quantenphysik. (Mathematisch-physikalische Bibliothek, Reihe 2, Band 13.) Pott 8vo. Pp. 93. (Leipzig und Berlin: B. G. Teubner, 1935.) 2.80 gold marks.

Van Uven, M. J. Mathematical Treatment of the Results of Agricultural and other Experiments. Sup. Roy. 8vo. Pp. vi +310. (Groningen and Batavia: P. Noordhoff N.V., 1935.) 9.50 f.*

Whittaker, J. M. Interpolatory Function Theory. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 33.) Demy 8vo. Pp. vi +107. (Cambridge: At the University Press, 1935.) 6*s.* 6*d.* net.*

Engineering

Barnard, William N., Ellenwood, F. C., and **Hirschfield, C. F.** Heat Power Engineering. Part 2: Steam Generating Apparatus and Prime Movers, Fuels, Combustions and Heat Transmission. Third edition of second part of Hirschfield and Barnard's "Elements of Heat-Power Engineering". Roy. 8vo. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 27*s.* 6*d.* net.

Blyth, Lieut.-Col. J. D. Practical Performance Prediction of Aircraft. (Aeronautical Engineering Series.) Med. 8vo. Pp. 92. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 5*s.* net.

Boston, Orlan William. Engineering Shop Practice. Vol. 2. Med. 8vo. Pp. x +485. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 25*s.* net.*

Bradshaw, C. S. Steam Turbines. Demy 8vo. Pp. 45. (London: Draughtsman Publishing Co., Ltd., 1935.) 2*s.* net.*

Chapple, H. J. Barton. Popular Television: Up-to-date Principles and Practice explained in Simple Language. Cr. 8vo. Pp. xiii +112. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 2*s.* 6*d.* net.*

Collins, A. Frederick. How to Understand Electricity. Demy 8vo. Pp. 326. (Philadelphia and London: J. B. Lippincott and Co., 1935.) 10*s.* 6*d.* net.

Cook, Arthur L. Elements of Electrical Engineering: a Textbook of Principles and Practice. Third edition, thoroughly revised, rewritten and reset. Med. 8vo. Pp. x +603. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 20*s.* net.*

Crook, W. E., Edited by. Wireless Telegraphy: Notes for Students, covering the Air Licence for W/T Operators. Demy 8vo. Pp. 196. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 7*s.* 6*d.* net.

Gay, Charles Merrick, and **Fawcett, Charles De van.** Mechanical and Electrical Equipment for Buildings. Med. 8vo. Pp. viii +429. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 25*s.* net.*

Hellins, H. H. The Lay-out of Small Water Mains. Demy 8vo. Pp. 45. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 7*s.* 6*d.* net.

Hunter, Summers, Jun. Reciprocating Marine Steam Engine Development during the Past Fifty Years. (London: E. and F. N. Spon, Ltd., 1935.) 2*s.* 6*d.* net.

Keller, K. O. Marine Heavy Oil Engine Development during the Past Fifty Years. (London: E. and F. N. Spon, Ltd., 1935.) 2*s.* 6*d.* net.

Lovell, Alfred. Generating Stations: Economic Elements of Electrical Design. Second edition. Med. 8vo. Pp. 451. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 27*s.* net.

McPherson, T. Marine Boiler Development during the Past Fifty Years. (London: E. and F. N. Spon, Ltd., 1935.) 2*s.* 6*d.* net.

Martin, Major Arthur J. The Work of the Sanitary Engineer: a Handbook for Engineers, Students and others concerned with Public Health. Demy 8vo. Pp. xvi +472 +15 plates. (London: Macdonald and Evans, 1935.) 16*s.* net.*

Maskery, William. Practical Electric Cable Jointing: the Plumber-Jointer and his Craft. Cr. 8vo. Pp. 128 +3 plates. (London: The Technical Press, Ltd., 1935.) 5*s.* net.

Orchard, Frederick Charles. Mercury Arc Rectifier Practice. Demy 8vo. Pp. xi +224 +23 plates. (London: Chapman and Hall, Ltd., 1935.) 15*s.* net.*

Reyner, J. H. Modern Radio Communication. Vol. 2. Cr. 8vo. Pp. 176. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 7*s.* 6*d.* net.

Singleton-Green, J. Concrete Engineering. Vol. 2: Properties of Concrete. Cr. 8vo. Pp. 271. (London: Charles Griffin and Co., Ltd., 1935.) 8*s.* net.

Swallow, M. G. S. Recent Progress in Electrical and General Engineering. (London: E. and F. N. Spon, Ltd., 1935.) 2*s.* 6*d.* net.

Tangerman, E. J., Edited by. Power Operator's Guide: 1001 Practical Helps. Med. 8vo. Pp. 576. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 24*s.* net.

Terman, Frederick Emmons. Measurements in Radio Engineering. Med. 8vo. Pp. 410. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 24*s.* net.

Turner, H. Cobden, and **Banner, E. H. W.** Electrical Measurements in Principle and Practice. Demy 8vo. Pp. xiv +354. (London: Chapman and Hall, Ltd., 1935.) 15*s.* net.*

Walker, R. J. Marine Steam Turbine Development during the Past Fifty Years. Roy. 8vo. (London: E. and F. N. Spon, Ltd., 1935.) 2*s.* 6*d.* net.

Warnock, F. V. Strength of Materials: a Textbook. Demy 8vo. Pp. 282. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 10*s.* 6*d.* net.

Whitehead, J. B. Impregnated Paper Insulation: the Inherent Electrical Properties. (National Research Council Committee on Electrical Insulation, Monograph No. 4.) Med. 8vo. Pp. xiii +221. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 20*s.* net.*

Young, C. R. Elementary Structural Problems in Steel and Timber. Second edition. Med. 8vo. Pp. xiii +315. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 20*s.* net.*

Chemistry: Chemical Industry

Bhatnagar, S. S., and **Mathur, K.N.** Physical Principles and Applications of Magnetochemistry. Med. 8vo. Pp. xiv +375. (London: Macmillan and Co., Ltd., 1935.) 21*s.* net.*

Creighton, H. Jermain. Principles and Applications of Electrochemistry. 2 vols. Med. 8vo. Vol. 1: Principles. Third edition, revised and enlarged. Pp. xviii +502. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 20*s.* net.*

Dole, Malcolm. Principles of Experimental and Theoretical Electrochemistry. (International Chemical Series.) Demy 8vo. Pp. xiii +549. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 30*s.* net.*

Gibbs, R. H. A Middle School Chemistry. Cr. 8vo. Pp. vii +358. (London: Edward Arnold and Co., 1935.) 4*s.*.*

Gmelins Handbuch der anorganischen Chemie. Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 4: Stickstoff. Lieferung 2. Sup. Roy. 8vo. Pp. 283–506. (Berlin: Verlag Chemie, G.m.b.H., 1935.) 35 gold marks.*

Henderson, William Edwards, and **Fernelius, W. Conrad.** A Course in Inorganic Preparations. Demy 8vo. Pp. 188. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 15*s.* net.

Holderness, A., and **Lambert, John.** The Essentials of Qualitative Analysis. Demy 8vo. Pp. vii +72. (London: William Heinemann, Ltd., 1935.) 1*s.* 6*d.*

Holleman, A. F. Lehrbuch der organischen Chemie. (Lehrbuch der Chemie, Organischer Teil.) Zwanzigste, umgearbeitete und vermehrte Auflage, von Friedrich Richter. Med. 8vo. Pp. xii +546. (Berlin und Leipzig: Walter de Gruyter und Co., 1935.) 14 gold marks.*

Krczil, F. Adsorptionstechnik. (Technische Fortschrittsberichte: Fortschritte der chem. Technologie in Einzeldarstellungen, herausgegeben von B. Rassow, Band 34.) Pp. 140. (Dresden und Leipzig: Theodor Steinkopff, 1935.) 8.50 gold marks.

Lucas, A. Forensic Chemistry and Scientific Criminal Investigation. Third edition. Demy 8vo. Pp. 376. (London: Edward Arnold and Co., 1935.) 18*s.* net.*

Manfield, G. W. Modern Science. Book 2: Chemistry. Cr. 8vo. Pp. xii +156. (London: Macmillan and Co., Ltd., 1935.) 2*s.* 3*d.*

Marshall, C. E. Colloids in Agriculture. Cr. 8vo. Pp. viii +184. (London: Edward Arnold and Co., 1935.) 5*s.* net.*

Mines Department: Safety in Mines Research Board. Paper No. 93: The Ignition of Firedamp by Compression. By (the late) H. B. Dixon and J. Harwood. Roy. 8vo. Pp. 23. (London: H.M. Stationery Office, 1935.) 6*d.* net.*

Oppenheimer, Carl. Die Fermente und ihre Wirkungen. Supplement, Lieferung 1 (Band 1: Specieller Teil: Hauptteil 7–15.) Imp. 8vo. Pp. 160. (Den Haag: W. Junk, 1935.) 28*s.*.*

Ostwald, Wolfgang. Metastrukturen der Materie. (Sonderausgabe aus dem Kolloid-Beiheften, herausgegeben von Wo. Ostwald.) Roy. 8vo. Pp. ii +16. (Dresden und Leipzig: Theodor Steinkopff, 1935.) 0.80 gold mark.*

Read, John. A Text-Book of Organic Chemistry: Historical, Structural and Economic. (Bell's Natural Science Series.) Second edition. Cr. 8vo. Pp. xiv +703. (London: G. Bell and Sons, Ltd., 1935.) 12*s.* 6*d.* net.*

Schuster, F. Stadtgas-Entgiftung. (Chemie und Technik der Gegenwart, herausgegeben von H. Carlsohn, Band 14.) Pp. viii +167. (Leipzig: S. Hirzel, 1935.) 7.60 gold marks.

Staudinger, H. Tabellen zu den Vorlesungen über allgemeine und anorganische Chemie. Zweite Auflage, unter Mitarbeit von G. Rienäcker. 8vo. Pp. 168. (Karlsruhe i.B.: G. Braun, 1935.) 4.80 gold marks.

Stone, H. W., and **Dunn, M. S.** Experiments in General Chemistry. Second edition. Demy 4to. Pp. 285. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 9*s.* net.

Sutton, Francis. A Systematic Handbook of Volumetric Analysis: or the Quantitative Determination of Chemical Substances by Measure, applied to Liquids, Solids and Gases. Twelfth edition, revised throughout, with numerous additions, by A. D. Mitchell. Demy 8vo. Pp. xvi +631. (London: J. and A. Churchill, Ltd., 1935.) 35*s.*.*

Taylor, F. Sherwood. Tables for Qualitative Analysis. 14 cards, 10 in. × 7 in. (London: William Heinemann, Ltd., 1935.) 1*s.* 3*d.*.*

Vanino, L. Die Leuchtfarben: ihre Herstellung, Eigenschaften und Verwendung. (Enke's Bibliothek für Chemie und Technik, Band 22.) Zweite erweiterte Auflage. 8vo. Pp. 168. (Stuttgart: Ferdinand Enke, 1935.) 12 gold marks.

Waters, William A. Physical Aspects of Organic Chemistry. Demy 8vo. Pp. xv +501. (London: George Routledge and Sons, Ltd., 1935.) 25*s.* net.*

Weiser, Harry Boyer. Inorganic Colloid Chemistry. Vol. 2: The Hydrous Oxides and Hydroxides. Med. 8vo. Pp. vii +429. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 23*s.* 6*d.* net.*

Winton, Andrew L., and **Winton, Kate Barber.** The Structure and Composition of Foods. Vol. 2: Vegetables, Legumes, Fruits. Med. 8vo. Pp. xiv +904. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 75*s.* net.*

Geology: Mineralogy

Geological Survey and Museum. British Regional Geology: The South of Scotland. By J. Pringle. Roy. 8vo. Pp. iv +97 +7 plates. 1*s.* 6*d.* net. British Regional

Geology: The Grampian Highlands. By H. H. Read. Roy. 8vo. Pp. vi +81 +11 plates. 1*s.* 6*d.* net. British Regional Geology: Scotland—The Tertiary Volcanic Districts. By J. E. Richey. Roy. 8vo. Pp. vii +115 +9 plates. 1*s.* 6*d.* net. British Regional Geology: Northern Ireland. By T. Eastwood. Roy. 8vo. Pp. v +76 +8 plates. 1*s.* 6*d.* net. British Regional Geology: The Welsh Borderland. By R. W. Pocock and T. H. Whitehead. Roy. 8vo. Pp. v +84 +11 plates. 1*s.* 6*d.* net. (London: H.M. Stationery Office, 1935.)*

Harker, Alfred. Petrology for Students: an Introduction to the Study of Rocks under the Microscope. Seventh edition, revised. (Cambridge Geological Series.) Cr. 8vo. Pp. vii +300. (Cambridge: At the University Press, 1935.) 8*s.* 6*d.* net.*

Miller, William J. An Introduction to Physical Geology: with Special Reference to North America. Third edition. Med. 8vo. Pp. xii +465. (London: Chapman and Hall, Ltd., 1935.) 15*s.* net.*

Stach, Erich. Lehrbuch der Kohlenpetrographie. Sup. Roy. 8vo. Pp. vii +293. (Berlin: Gebrüder Borntraeger, 1935.) 18 gold marks.*

Weyberg, Zygmunt. Świat kryształów. (Z Dziedziny Nauki i Techniki, Tom 8.) Demy 8vo. Pp. x +298 +6 plates. (Warszawa: "Mathesis Polskiej", 1935.) 12 zl.*

General Biology: Natural History

Botany: Zoology

Ayre, A. M. Wild Flowers of Newfoundland: mainly Orchis, Willow, Buttercup, Mustard, Rose. Part 3. Oblong Fcap. 8vo. Pp. vi +231. (St. John's, Newfoundland: A. M. Ayre; Ashford, Kent: L. Reeve and Co., Ltd., 1935.) 4*s.**

Berridge, W. S. All about Reptiles and Batrachians. Demy 8vo. Pp. 271. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1935.) 7*s.* 6*d.* net.

Bland, H. M. Birds in an Eton Garden. Demy 8vo. Pp. 138. (London and Toronto: J. M. Dent and Sons, Ltd., 1935.) 7*s.* 6*d.* net.

Borradaile, L. A., and **Potts, F. A.** The Invertebrata: a Manual for the Use of Students. With Chapters by L. E. S. Eastham and J. T. Saunders. Second edition. Demy 8vo. Pp. xv +725. (Cambridge: At the University Press, 1935.) 25*s.* net.*

Bose, Sir Jagadis Chunder, Edited by. Transactions of the Bose Research Institute, Calcutta. Vol. 9, 1933–1934: Biological and Physical Researches. Med. 8vo. Pp. vi + 210. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 18*s.* net.*

British Museum (Natural History). Instructions for Collectors, No. 4: Insects. Eighth edition. Demy 8vo. Pp. 16. (London: British Museum (Natural History), 1935.) 3*d.**

British Museum (Natural History). Great Barrier Reef Expedition, 1928–29. Scientific Reports, Vol. 3, No. 10: Ecological Surveys of Coral Reefs. By S. M. Manton. Roy. 4to. Pp. 273–312 +16 plates. (London: British Museum (Natural History), 1935.) 10*s.**

Chisholm, Alec H. Bird Wonders of Australia. Cr. 8vo. Pp. xiv +299 +33 plates. (Sydney and London: Angus and Robertson, Ltd., 1935.) 6*s.* net.*

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