NATURE

SATURDAY, SEPTEMBER 29, 1934

No. 3387 Vol. 134

CONTENTS

Editorial and Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET, LONDON, W.C.2
Telephone Number : WHITEHALL 8831
Telegraphic Address : PHUSIS, LESQUARE, LONDON

The Service of Scientific News

IN any fair and reasonable consideration of the place of science in newspapers and popular magazines, or of that of the 'ephemeral' Press in carving a way for scientific advancements, it must be at once apparent that the fundamental problem can be stated in terms of the equilibrium between commercial profits and intellectual requirements. Editors indeed may be unmindful of the interesting news which science can provide daily; reporters may be painfully ignorant of fact and careless of expression; readers may resent uplift or get it in an indigestible form; scientific people may criticise but do little to help; all these things contribute to the complexities of a many-sided riddle which students of science and of public life regard as a major problem of our times, namely, how to keep developments in scientific knowledge and the community at large in effective touch for the common good. But all these things are capable of being set right in the course of time if the appropriate educational methods are adopted.

It may be asked whether all the bother about the place of popular science in the morning newspaper, or of articles of slightly greater erudition in the weekly journal, is worthy of serious attention. We have to remember that we no longer live in an age when science provides mere drawing-room magic for a gaping assembly; we must not allow ourselves to forget that to-day it is as impossible to divorce ourselves from scientific as it is from political interests and responsibilities. Our daily lives depend at every point on the achievements of scientific research, and much of our hope for betterment in the future is closely allied to our progress in the search for knowledge, if only we can at the same time learn how to use that knowledge in the enjoyment of peace and in the service of our fellows as well as of ourselves.

There are three ways in which the ordinary man, which is the title we confer on the person who has not specialised in our own department of culture, can constantly be kept in touch with the world's progress: the Press, the 'wireless' and the cinema, each with its own peculiar technique, but with a common source of material and a common beneficiary. True, each is exploited primarily for profit and accepted largely for its entertainment value; but one cannot doubt that among the minds in control of these three forms of enterprise, there are men and women who are very seriously aware of their responsibilities as educators and as

moulders not so much of opinion as of an intelligent basis of opinion. Of course, the public dislikes being educated, as we all dislike some things that are good for us. If the majority of us actively sought to equip ourselves as competent members of a community based for its material welfare on expanding scientific knowledge, the problem under consideration would vanish, for learning and gain would then become bedfellows. Since the majority of us do nothing of the kind, the minority are exercised to do more.

We well know that in some instances editors pay due attention to the means available for the dissemination of scientific knowledge and to the methods which scientific workers employ; in others the lack is only too painfully obvious. There is clearly room for proper co-ordination in this matter, and pronouncements by those experienced in both realms of enterprise naturally carry special weight. Sir Richard Gregory's presidential address to the Association of Special Libraries and Information Bureaux (Aslib), delivered at the annual conference at Oxford on September 21, is a noteworthy contribution. Speaking on "Science in the Public Press" he examined the treatment meted out to scientific discovery in the Press, discussed publicity from the points of view of the reader and of the worker, considered difficulties which obstruct the presentation in simple and attractive, yet substantially accurate, language of technical material, exposed faults which still mar our educational system and offered definite and considered suggestions. He echoes widely-held opinion when he asks that every daily or weekly newspaper of importance should have on its editorial or reporting staff someone capable of dealing with scientific subjects in a way which bears comparison with the presentation of news and criticism relating to finance, to art, to music or to athletics. Are the phenomena of Nature less worthy of interest than the actions of men, and are their social and economic consequences of smaller concern than our own brief antics on the stage of time? But while Sir Richard Gregory is severe in his comment on this deficiency, he recognises that "very few scientific men have the time or inclination, and indeed not many have the ability, to transform scientific material into such a form as will be understood and appreciated by the plain man". The active prosecution of some branches of science demands the use of a special vocabulary; the translation of this technical phraseology into terms in common use provides an example of the difficulties which face the lay writer and dissuade the 'expert witness' from interrupting his researches to talk about them.

Another fact which the lay mind fails to grasp is that there can be any claim to attention in a scientific narrative other than the quality of the results attained, yet workers themselves know how frequently human character and human weaknesses peep from behind a sober report of achievement. "The human interest in exploration in any field lies in the log book of the journey, the difficulties met, and how they were overcome, until the object of the expedition is attained." Since the best story is that which the explorer himself tells, it follows that scientific investigators are best qualified to offer their own knowledge to the public.

The solution offered by Sir Richard Gregory involves the establishment of an organisation to deal with scientific news in such a way as to make the best of both worlds. The suggestion is not novel; indeed science publicity has been successfully organised in the United States of America since 1921 by a non-profit-making corporation called "Science Service". The attempts made to organise a science news service in Great Britain have received little encouragement from men of science or from newspaper editors. Sir Richard proposes the creation of an agency comparable with those which handle foreign news—a body of experts who would collect material, whether news items, or considered views or 'stories', from scientific bodies and individuals, and then prepare it for circulation to the Press. Thus the ground could be systematically covered, the Press would be relieved of a duty which, in the main, it now performs badly, and the public would be kept informed of everything of interest or moment. The scheme deserves wide support; as a business undertaking, however, it needs more than goodwill, for Sir Richard Gregory considers that several years must elapse before such an enterprise could show a financial profit. The American service enjoys a substantial benefaction, and it would appear that the British public must await the coming of a public-spirited and far-sighted benefactor who is both ready and able to place popular scientific news on the same plane as other news in respect of reliability and the manner of its presentation. Until that happens, the public Press can scarcely claim to provide a symmetrical reflexion of the world's affairs.

Keith Lucas

Keith Lucas. Pp. 131+1 plate. (Cambridge: W. Heffer and Sons, Ltd., 1934.) 5*s.* net.

THE principal object of a biography is to state the achievements of its subject. The kernel of "Keith Lucas" will therefore be found between pages 98 and 108, under the heading "Keith Lucas as a Physiologist". This section of the composite work was written by Prof. E. D. Adrian; needless to say, it is happy in its author.

In Prof. Adrian's view—and no one has a better right to speak—Lucas's outstanding achievement was his demonstration that the all-or-none relation between the response and the stimulus applies to skeletal muscle; its application to medullated nerve being also implicit in his work. Adrian, with characteristic modesty, passes lightly over the reason why this discovery was so important. That reason may perhaps be brought into its true perspective. The whole fascinating framework of which Adrian himself is a master builder, in company with Forbes, Gasser, Erlanger, Matthews and a score of others—that whole edifice is erected on the foundation laid by Lucas. If the metaphor may be changed, the language of the nervous system has been read by that brilliant school of post-War physiologists, but the code in which it was written was deciphered by Lucas in the years around 1912.

Periods of stagnation exist in the history of most sciences, and electrophysiology is no exception. That department of biological inquiry had formed the work of some of the most acute thinkers of the end of the nineteenth century—Helmhotz, Bernstein, du Bois Raymond and Burdon Sanderson and Einthoven. It appeared to be a road to the understanding of the intimate processes of living matter. Then the road seemed to reach a dead end. Electrophysiology, after the death of Gotch, appeared important only in its applications, such for example as the analysis of the cardiac and other rhythms undertaken by Mines and of cardiac disorders by Mackenzie and Lewis—nor should Waller's name be forgotten in this connexion.

Now electrophysiology has returned to its own, and the recent great expansion of the subject has been rendered possible by the application of modern methods of amplification. Between the two eras of fruitfulness stood Lucas. His methods were perhaps the most advanced of which the older school—the school which as yet lacked amplifiers—was capable. With those methods he rendered possible the discoveries of the new. If I may revert to my former metaphor: Lucas discovered the cipher but the type was too small, for the most part, to be read; amplification has rendered it legible.

To return, however, to "Keith Lucas"—the book. The date of its publication is not without interest: it is now close upon eighteen years since Keith Lucas was killed. In a chapter headed "Ancestry" the late Prof. H. H. Turner speaks of Lucas's grandfather and great-grandfather, respectively, John and Edward Riddle. He says: "The esteem in which the Riddles were held is permanently recorded in the Riddle Medal at the Royal Naval School. It was established in June 1923; and it is specially significant that such an honour should be forthcoming thirty years after the death of the son and nearly forty after that of the father". A similar significance attaches to the publication of the present biography almost two decades after the death of its subject—desirable at any time, it has now become compelling. That is because every advance in electrophysiology has made the value of Lucas's researches more evident.

For the rest, the reader must read the book; it consists of a short explanatory preface by Alys Keith-Lucas and chapters on "Ancestry", "Earliest Years" by the late Prof. Turner, "At Rugby" by Col. F. C. Temple, "Undergraduate Days" and "Return to Cambridge" by the late Sir Walter Fletcher, "New Zealand" by the late George Ll. Hodgkin, "Cambridge 1914–18" by Prof. E. D. Adrian, and "War Time" by (1) G. Mervyn O'Gorman, (2) the late Prof. B. Hopkinson, (3) Major R. H. Mayo. Many who came across Lucas in his lifetime, and perhaps more who know him only by reading the published record of his works, will thank Sir Walter Fletcher, who after the War began to prepare the memoir, and Prof. Adrian, who lately brought it to fruition, for the opportunity of "getting to know about Lucas's English life, his family and his friends". J. B.

Fear and the Anthropologists

The Fear of the Dead in Primitive Religion: Lectures delivered on the William Wyse Foundation at Trinity College, Cambridge. By Sir James George Frazer. Vol. 2. Pp. x+151. (London: Macmillan and Co., Ltd., 1934.) 10*s.* 6*d.* net.

WHEN the anthropology of anthropologists comes to be written, future generations will have to explain why the first quarter of the twentieth century was so fascinated by fear, why that emotion was made to account for everything, for weddings, funerals, for religion itself. They

will doubtless notice that during the same period there was a great increase in nervous disorders in which fear is the chief element, and they may conclude that there is a link between the two phenomena.

Whatever the cause of this vogue of fear, it must certainly lie in the mind of the anthropologist, for it is not in the facts. The savage is rather less liable to phobias than we are. Of course, it is dangerous to generalise from one people to the others, for there are savages and savages; though in the works of anthropologists they appear all very much alike, as Negro faces do to those who have merely passed them in the street. When we get to know them, we find the greatest variety. There are indeed decaying remnants hard pressed by overpowering enemies, by disease, by anxiety for the future, by despair at their own diminishing numbers: they fear much because there is much to fear. There are others, many others, with the wide open spaces and the future spread before them, free from anxiety, free from nerve-racking bustle and uncontrollable desires, who therefore take both life and death far more fearlessly than we can. Their placidity seems often callous to the over-sensitive European, but the truth is they take things as they come. Their attitude is that of the old men of the Omahas: "No one can escape death and no one should fear death, since it cannot be avoided." Death is just a break in the routine of life, and death ceremonies tend to be elaborated because men make the best of their holidays.

When therefore Sir James Frazer in a previous volume began his study of the fear of the dead, he was forced to recognise that many so-called primitives "observe customs which appear to be inconsistent with such a fear, and to indicate rather respect and affection for the souls of the departed". This fact he honestly passed on to his readers, and it was all the more to his credit as the discovery evidently ran contrary to his wishes. We had then reason to hope that in this second instalment he would investigate the conditions under which men are not afraid of the dead, as well as those under which they are; further, that we might be shown what other things besides the dead inspire fear. Then we might discover the springs of fear. Our hope is disappointed. We had reckoned without the lure of fear. The author succumbs to it, and readily finds an excuse for his frailty. "The attitude of primitive man to the spirits of the dead is complex," it is admitted, "and full account should be taken of all these conflicting emotions and tendencies," yet it is legitimate "to single out some one particular element of the compound for special examination". Certainly a psychologist, for example, has the right to single out mind for special examination; he may even single out phobias among mental phenomena; but what hope has he of getting at the bottom of them if he will only observe his patients when they are afraid, and ignore the conditions that make them bold? What earthly hope has he if he will not even consider all cases of fear, but only those prompted by open spaces?

All the resources of Sir James's learning, all the allurements of his style, cannot save from defeat a campaign doomed at the outset by a mistake in the initial direction, which is what matters in science as in warfare. He may draw up his serried battalions of facts; he may throw into the fray case after case of the fear of the dead; he may even press into his service cases where there is not the slightest evidence for fear, but into which fear may be read if you have the faith. If the mourners protest that they cut down a dead man's trees because "the sight of objects which belonged to their relation makes them melancholy", they are informed they have no right to be unafraid, and so afraid they jolly well shall be. If the savage washes after a death it must be through fear. The fact that he washes after a birth, an initiation, a marriage, a royal consecration, a medical treatment, after every kind of ritual, can be excluded under the rules that were made at the outset. All is in vain. In spite of these desperate efforts the author at the end of this second engagement is further than ever from capturing a single key position. Nothing remains but to fight a rear-guard action, and to impose upon the enemy that respect which is due to the old guard fighting gamely to the end. A. M. HOCART.

New Form of Graphical Representation

Funktionentafeln: mit Formeln und Kurven (*Tables of Functions: with Formulæ and Curves*). Von Prof. Dr. Eugen Jahnke und Prof. Dr. Fritze Emde. Zweite neubearbeitete Auflage (Second revised edition). Pp. xviii+330. (Leipzig und Berlin: B. G. Teubner, 1933.) 16 gold marks.

THE second edition of this book differs from the first in many respects. The number of pages has been increased from 188 to 348, and the explanatory matter is now in both German and English. There are now nineteen sections. The first contains a table of powers and a diagram of the surface $z = x^y$, with two auxiliary diagrams for computing its ordinates. The second section contains tables and graphs for performing various

operations with complex numbers, including finding their reciprocals and square roots. Then follows a section on cubic equations, treated in a manner which will surprise the student whose knowledge of the subject has been gained only from the usual textbooks. The next two sections deal with certain equations containing trigonometrical functions.

The sixth section contains the first example of the most striking feature of the new edition, namely, the graphical representation of functions of complex variables. The function $e^{1/z}$ is shown in two ways. The upper half of p. 39 contains two sets of curves (in this case circles) superposed on squared paper, from which one can read off the modulus and amplitude of the function corresponding to the x and y of the complex variable. Below this is sketched a surface, called the 'relief'. Corresponding to any pair of values of x and y, which define a point in a horizontal plane, a vertical ordinate is drawn to represent the modulus of the function. On the surface thus formed are drawn two sets of curves, the contour lines (loci of constant modulus) and the lines of the greatest slope (loci of constant amplitude). Thus the diagram on the upper half of the page is the orthogonal projection of the contour lines and lines of greatest slope of the 'relief'. The value of this novel mode of representing a function of a complex variable is very great, and we hope that writers of textbooks will adopt it. For example, it shows at a glance the peculiarity of an essential singularity, as a point where both the modulus and amplitude are completely indeterminate. Later sections contain several other reliefs. Those of elliptic functions and of Riemann's zeta-function are particularly remarkable, and it would be interesting to have plaster models.

We have no space to describe the remaining sections in detail. The other functions tabulated include not only the well-known Bessel, Legendre, theta, and error functions, but also Planck's radiation function and source functions of the conduction of heat.

There are a few minor points which call for criticism. The list of "useful books for the computer" does not contain Barlow's Tables. The "Index of Tables of the Elementary Functions" does not contain the British Association Tables (though these are mentioned in the preface), but it does contain certain tables of which a reviewer said "the percentage of errors is about a hundred times as great as might be expected in a table on which reasonable care had been exercised".

The book as a whole is very good, and the price is not so high as that of other recent German publications. H. T. H. PIAGGIO.

Methods in Cytology

Cytological Technique. By Dr. John R. Baker. (Methuen's Monographs on Biological Subjects.) Pp. xi+131. (London: Methuen and Co., Ltd., 1933.) 3*s*. 6*d*. net.

FOR some time now a small handbook of cytological technique containing the salient facts brought out in recent editions of the "Microtomist's Vademecum" has been a possibility. In some ways, Dr. Baker's book fills this gap. What really seems to be wanted, however, is a little book on cytological technique with good illustrations of tissues and cells prepared by a skilled cytologist, with, side by side, illustrations of the same types of tissues and cells in which the method has worked unsuccessfully. It is very common nowadays to find that published papers have been written by persons who have not mastered such techniques as Da Fano or Weigl.

Dr. Baker has attempted to give the student some insight into the reactions of the various commoner fixing substances, used singly, which they never are. The student is encouraged to use such a tissue as the liver, pieces being punched out with a cork borer. In Dr. S. G. Scott's time, about twenty-five years ago at Oxford, the senior histology students were put to this sort of work, only the liver was cut into squares with a scalpel—a much better way. It is nevertheless a depressing fact that one could be good at stabbing a liver with a cork borer, and bad at making cytological preparations.

The only way to get a correct impression of a man's cytological technique is to see some of his preparations, and the reviewer has not had the pleasure of seeing any of Dr. John Baker's slides, and so does not know just how seriously to take some of Dr. Baker's opinions on technique. Dr. Baker is not always impressed, so we gather, by Gustav Mann, Bolles Lee, Champy, Altmann, Benda and the reviewer. Some of Dr. Baker's criticisms, captious as they are, may be justifiable, but why put them in a junior student's textbook? Dr. Baker finds Champy's fluid inferior to Altmann's (which he dilutes), and he looks upon Champy's fluid as a modified Altmann. The reviewer rather regards it as a modified Flemming, the addition of the bichromate of potassium producing a more robust stain with hæmatoxylin or acid fuchsin. Champy's fluid is not likely to be ousted by any form of Altmann's mixture. Benda's intricate method, so little used nowadays, but such a wonderful one when it can be got to work, presents no difficulty to Dr. Baker.

While Dr. Baker has added nothing to current fixing and staining technique, he has written a readable and useful book which the reviewer recommends. J. BRONTË GATENBY.

Structure of Matter

Handbuch der Radiologie. Herausgegeben von Prof. Dr. Erich Marx. Band 6: *Quantenmechanik der Materie und Strahlung.* Zweite Auflage der "Theorien der Radiologie". Teil 1: *Atome und Elektronen.* Pp. x+466. 43 gold marks. Teil 2: *Moleküle.* Pp. viii+604. 56 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933, 1934.)

THE opening chapter of this work is a masterly and highly condensed statement of corpuscular and wave-theory by M. von Laue (Berlin). After dealing with de Broglie waves and leading on to the Schrödinger equation, he gives a short account of the mathematical theorems necessary for a more elaborate treatment of wave-mechanics and Dirac's theory of the electron. The reading of this section of the book requires considerable mathematical skill but has the advantage that it covers all the essentials in a minimum of space.

The second chapter gives a fairly complete survey of experimental researches and theories concerning excitation and ionisation of atoms and is by Hanle and Larché (Jena), who have themselves published valuable papers on the subject. The section dealing with the excitation and ionisation of atoms in solid bodies is particularly welcome as no other account of the same scope is available. It is regrettable that the authors follow Döpel on p. 194 in using the term 'neutron' for a neutral hydrogen atom, the more so as in the fourth chapter (on nuclear structure and quantum mechanics) the term is used in its accepted modern sense as introduced by Chadwick.

F. Bloch discusses in Chap. iii the electron theory of metals in considerable detail. He shows that it enables us to understand quantitatively or qualitatively the most important properties of metals, but he also points out its inability to deal with the interaction of the conduction electrons, which is probably the reason why the phenomenon of supra-conductivity has not yet been explained.

By far the largest chapter of the book is the last, which deals with nuclear structure and quantum mechanics. Prof. Beck of Prague is the author. He points out that—thanks largely to the work done at the Cavendish Laboratory—there is now an abundance of empirical material available, which it has not yet been possible to include in a single theory. It is true that new relationships have been discovered by applying quantum-mechanical methods to various individual problems, and to explain some of the experimental phenomena, but other questions have arisen in nuclear physics which seem to make it necessary once again to undertake a radical revision of our fundamental physical concepts. A complete theoretical treatment does not merely entail the discovery of a model, but must also have as its objective the formulation of physical laws themselves. The author's account embodies the results of very recent work, as is seen from the table on p. 386 where twenty-two nuclear reactions are enumerated; they include the production of neutrons and also their use for disintegrating nitrogen. There are two other tables, one dealing with the uranium-radium series of elements and the other giving a list of the elements with their atomic members, isotopes, relative amounts of associated isotopes, mass, mass defect (in electron-volts), nuclear spin, magnetic moment. The latter table occupies eight pages. The bearing of nuclear properties on optical spectra is discussed, also hyperfine structure, passage of penetrating radiation through matter, theory of radioactive processes and certain difficulties in Dirac's theory.

In the second part of vol. 6, the high standard of the first part is maintained throughout. We have here five sub-sections dealing with molecules in their various aspects. The first section is by R. de L. Kronig (Groningen), who gives a quantum-mechanical treatment of band spectra and molecular structure. Two particularly interesting paragraphs are devoted to predissociation, and change of intensity and nuclear moment of momentum. P. Debye (Leipzig) and H. Sack (Brussels) contribute an important section on the theory of the electrical properties of molecules. A brief résumé is given of the older work, the formulæ of Clausius-Mosotti and Lorenz-Lorentz being successively derived. The theory of molecular dipoles and its application to chemical structure is discussed, and the section closes with a mathematical treatment of the electrical asymmetry of molecules.

A. Placzek (Copenhagen) accomplishes very successfully the difficult task of giving in some fifty pages a comprehensive account of the quantum-mechanical theory of Rayleigh scattering and the Raman effect. The molecular theory of magnetism is worked out in detail by F. Bloch (Rome) in the fourth section, and the last section on quantum theory and homopolar chemical bonds is contributed by W. Heitler (Bristol).

It is superfluous to attempt to express adequately the great merit of this volume of Marx's series of handbooks. The names of the various authors are a sufficient guarantee of the high standard attained. It is to be noted that the various sections of either of these parts of vol. 6 may be purchased separately (there are nine sections in all) at a price which for all the sections taken together works out at almost the same as that of the complete set. No physics library or research institute can afford to be without these volumes. H. L. B.

Short Reviews

Vergleichende Länderkunde. Von Alfred Hettner. Band 1: *Die Erde, Land und Meer, Bau und Hauptformen des Festlandes.* Pp. viii+221. 7 gold marks. Band 2: *Die Landoberfläche.* Pp. viii+172. 6.40 gold marks. (Leipzig und Berlin: B. G. Teubner, 1933, 1934.)

THE fundamental conception upon which this work is based is that the individuality of a geographical region extends throughout the entire realm of Nature, and is not limited to any single factor, climatic, geological, biological, human or political. It follows, therefore, that the treatment of every branch of the science of geography should be comparative rather than purely descriptive. This method has been adopted by the author and in this treatise he aims at a synthesis of the relationship between cause and effect throughout the geographical habitat.

A knowledge of the earth's origin, internal structure, etc., is a necessary basis for a complete understanding of its surface forms. Part I of the first volume is, therefore, devoted to the cosmical and related aspects of the earth, and concludes with a useful and comprehensive appendix dealing with mathematical geography and cartography. The second half of the volume gives a clear account of the general form of the earth's surface, the distribution of land and sea, the sub-divisions of the continental areas, the materials of the crust and the internal forces such as earthquakes, volcanoes and earth movements which influence the surface topography. This section concludes with a simple account of the structure of the different continents.

Vol. 2 is devoted to comparative physiography and commences with a general account of the surface agents of denudation. This is followed by a detailed discussion of the main geographical cycles under varying tectonic, structural and climatic conditions. Throughout this discussion, the comparative aspect is well preserved.

The book is profusely illustrated with maps and photographs and, although the author states that it was not written as a textbook, it is in effect an excellent and moderately advanced textbook of comparative physical geography.

Dynamics of Earthquake Resistant Structures. By Jacob J. Creskoff. Pp. xi+127. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 15*s.* net.

ALTHOUGH it might appear that such a subject has little direct application in Great Britain, it will be found that the problem treated in this work is one of vibration in structures and, as such, is worthy of close consideration. The object of the book is to provide design procedure and data for buildings which are to be erected on ground subjected to earthquake activity. The opening chapters deal with seismography, illustrating the earthquake history of the United States and presenting a résumé of seismography in general.

After a short account of the simple beam theory and the empirical formulæ adopted for the reinforced beam, the fundamental principles of free and forced vibration of beams are considered, followed by an examination of the resulting moments and stresses due to these dynamic effects. The application of these principles to buildings is introduced by short notes on the geology of building sites. The end conditions, as determined by the character of the foundations, are also discussed, and the appropriate coefficients for use in the frequency formula suggested. Finally, the complete design procedure is presented in an ordered arrangement so that the reader may be guided carefully through each phase of the calculations.

Two examples of aseismic design are given, one for a building 540 ft. in height, the other for one of 144 ft. The work of computation is given in detail and is easy to follow. The book contains numerous and valuable references, and is written in the brief manner of a handbook, so that it is suitable for direct application to design.

Elements of Hydraulic Power Generation. By Arthur M. Greene, Jr. Pp. iii+58. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 6*s.* net.

THIS slender manual of almost breast pocket size sets out very briefly the elementary principles and calculations essential to the design and construction of hydraulic power plant. Stated to be intended to supplement in the hydraulic power field the author's "Elements of Power Generation", it affords in admirably compact form an insight into the nature and capabilities of the apparatus used in hydraulic power development, and accordingly it should be particularly useful to the student, draughtsman and young engineer. Detail drawings and photographic illustrations are given of various modern installations, such as the Conowingo, Niagara Falls and other notable developments. An unusual feature of the book is that it is produced as if typewritten, with the technical terms and important matter underlined instead of being italicised. The illustrations are clear and the type legible.

Line Coordinate Charts for Vapor Pressure-Temperature Data. Prepared by Frank E. E. Germann and Odon S. Knight. *Boiling Points of Ring Compounds.* 36 in. × 12 in. *Boiling Points for Chain Compounds.* 36 in. × 12 in. (Boulder, Colorado: Prof. Frank E. E. Germann, Department of Chemistry, University of Colorado, 1933.) 1 dollar each.

THESE charts, the origin and use of which are fully explained in *Industrial and Engineering Chemistry* (26, 467; 1934), enable the boiling points of a large number of compounds at varying atmospheric pressures to be read off very simply and with sufficient accuracy for all practical purposes. The idea is ingenious and the charts are well executed. They should prove very useful in laboratories.

Transport and Storage of Food

THE annual report of the Food Investigation Board* reviews the work carried out in 1933, which was initiated and inspired by Sir William Bate Hardy, whose death on January 23, 1934, robbed the Board of its Director of Food Investigation at a time when the results of his researches were being more and more applied on the commercial scale in the preservation of foodstuffs. The report refers also to the death of Sir Walter Morley Fletcher and to the resignation through ill-health of Prof. J. J. R. Macleod; the tenure of Sir Joseph G. Broodbank as chairman of the Board had been extended, and Sir J. Alfred Ewing had been re-appointed, and Prof. T. P. Hilditch appointed, members of the Board.

As in previous years, the report is divided into sections dealing respectively with the work carried out at the Low Temperature Research Station, the Torry Research Station and the Ditton Laboratory, as well as at the National Physical Laboratory and the Imperial College of Science and Technology. The researches in progress are briefly described by the actual workers concerned. Some have already been published in detail in the scientific Press, others have not yet been completed. In notices in NATURE of earlier reports of the Board, some of the results obtained by the different research workers have been described in considerable detail. On the present occasion, it appears that it might be more profitable to consider some of the broader aspects of the Board's work, and to review the progress made during the past seventeen years, during which Sir William Hardy had been first chairman of the Board and later director of food investigation, in which position he has been succeeded by the Acting Director, Mr. E. Barnard.

At the recent meeting of the British Association in Aberdeen, Sir Frank Smith delivered the Hardy Memorial Lecture on September 8, taking as his subject the transport and storage of food and the influence of Sir William Hardy's work upon food supplies, especially in Great Britain. In this connexion, reference may be made to the aims of the Food Investigation Board, with its annual expenditure of about £45,000, which are not always fully understood. The Board's object is, and always has been, the improvement of the nation's food-supply, of which a considerable part is derived from overseas. However, while the source of a particular foodstuff is not the primary consideration, preference is accorded first to home-grown produce, then to that of the Dominions and other oversea parts of the Empire and finally to foreign produce. It follows that much of the work which finds a place in the Board's programme is intended to find its application abroad. Great importance is attached to increasing our knowledge of the fundamental properties of foodstuffs, since it is from such work that large advances in the technique of storing and transporting food must be looked for. The principle of gas-storage, for example, was established as the result of a purely scientific inquiry into the phenomenon of dormancy in seeds. The results of such work are, of course, of universal application; moreover, it is impossible to predict in what direction they will find application. For example, the results of work on the oxidative changes in the fat of beef and mutton have been applied in the storage of butter, of bacon and of vegetable oils. Much fundamental work required for the needs of our own people cannot be carried out here because the experimental material is unobtainable, so that it is the Board's task to promote this where it can best be done. An obvious example is the physiology of tropical and semi-tropical fruits.

The principal foodstuffs on which researches have been carried out are meat, bacon, fish and fruit and vegetables. Seventy years ago, no one in Great Britain had tasted lamb from New Zealand, since it could not be transported and remain fit for food. In 1932, Great Britain imported 7 million pounds' worth of lamb from New Zealand, and this was only about a tenth of the total meat imports. The possibility of importing meat in an edible condition is due to the use of cold as preserving agent. But the satisfactory use of refrigeration depends on a number of factors apart from the maintenance of the requisite degree of cold. Thus cleanliness in handling the carcases is of the utmost importance. The time of hanging before and after refrigeration must also be considered. Hence it is necessary to know exactly what happens in muscle (meat) from the time the animal is killed to the time the meat reaches the consumer, the behaviour of the constituents of the muscle during autolysis, and during freezing and thawing, and the effect of the growth of micro-organisms upon them, before it is possible to specify the correct conditions of storage and transport, with which the refrigerating engineer must comply. When Sir William Hardy started his work on food preservation, he found that the science of refrigeration had grown at a rapid rate, but on the biological side advance had been slow. He initiated a large expansion in the biological research on foodstuffs, the results of which have already borne fruit in commercial practice.

* Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1933. Pp. ix+248. (London: H.M. Stationery Office, 1934.) 4s. net.

One of the disadvantages of freezing, especially of beef, is the occurrence of drip when the meat is thawed, due to the formation of ice crystals between the muscle fibres which break them up, and so prevent the reabsorption of the water when the meat is thawed. With very quick freezing, the ice is formed within the fibres and the size of the crystals is diminished, with the result that the drip is less when the meat is thawed. However, the requisite rate of freezing is so high that it is unattainable in pieces of meat thicker than about $2\frac{1}{2}$ in. Once frozen, moreover, the meat must be kept at a lower and therefore more expensive level of temperature than usual, namely, not higher than − 20° C. For short periods of storage, chilling, that is, storage at − 1° C., is a satisfactory method of preserving meat, provided that the carcases are relatively clean bacteriologically. Beef from South America can be kept chilled for so long as five weeks, but up to the present it has not been found feasible to import chilled beef from Australia and New Zealand.

Recently, however, it was demonstrated on a semi-commercial scale at the Low Temperature Research Station that beef can be held in perfect condition in the chilled state for so long as 60–70 days in an atmosphere containing 10–20 per cent of carbon dioxide. This doubling of the life of the meat is due to inhibition of the growth of micro-organisms. The laboratory experiments have been fully verified by large-scale experiments at sea and, last year, a consignment of chilled beef in good condition reached Great Britain from New Zealand. The process of gas-storage will also probably be of value to the importers of chilled beef from South America since it seems likely that the use of carbon dioxide will enable the temperature of carriage to be slightly raised and so prevent the formation of any ice in the meat, as occurs under present conditions. It is not possible to raise the concentration of carbon dioxide above 20 per cent since higher concentrations affect the bloom of the meat. Bacon and pork, however, can be stored successfully for considerable periods in high concentrations of carbon dioxide.

Researches on the freezing and smoking of fish were described in the report for 1932 (see NATURE, **132**, 736; 1933). Hitherto the resources of the Torry Research Station have been almost wholly engaged in dealing with white fish, but a start has now been made with work on the herring. Modern taste requires a mild salt-cured fish, both for the home market and also perhaps for markets overseas. It has been found that fish with the authentic rich cured flavour can be produced with a much smaller concentration of salt in it than in hard-cured fish, namely, 5 instead of 15 per cent, a level at which only some 10 per cent of the water has been extracted. These cured herrings can be cooked without previous steeping in water and are almost as soft as fresh herrings. However, these mild-cured fish will not keep unless chilled or frozen: the combination of salting and chilling appears to possess distinct commercial possibilities. It has also been found that herrings rapidly frozen in cold brine and stored at a low temperature will retain their quality for several months, and that kippers made from such herrings are barely distinguishable from those made from the freshest fish. It may be possible therefore to replace herrings imported during the late winter and spring for kippering by home-caught fish which has been brine-frozen and cold-stored earlier in the year. Here it may be mentioned that a new wing of the Torry Research Station containing seven cold chambers in which the temperature can be maintained at 0° to −23° C. was opened by Lady Smith on September 10.

Turning now to fruit, the report points out that little more can be done with imported fruit than to maintain the survey of wastage which is carried out from the Covent Garden Laboratory. The keeping quality of a fruit depends not only on the variety, but also on the stock, soil, climate, cultivation and maturity at the time of picking. The results of storage trials carried out with English varieties grown under English conditions are not applicable to varieties grown overseas under conditions which are generally different to a significant degree: it follows that each area of production must undertake such work for itself, since it cannot be done elsewhere. Most of the work on the cold-storage of fruit is of direct value to the home producer, but only of indirect value to the oversea producer; and this is even more true in the case of gas-storage.

Different varieties of English apples show a remarkable individuality in response to atmospheres containing different proportions of oxygen and carbon dioxide: only a few are suited by an atmosphere containing 10 per cent carbon dioxide with a corresponding diminution in the amount of oxygen, an atmosphere, that is, that can be obtained by regulated ventilation. Other varieties require atmospheres which raise problems in the construction of efficient gas-tight stores. In this connexion, it must be pointed out that research in biological engineering forms an important part of the work of the Food Investigation Board. In the experimental hold at the Ditton Laboratory, it has been possible to compare the efficiency of the different systems of refrigeration in current use, to evaluate such practically important biological constants as the thermal capacity of a stack of apples, the rates at which it generates heat and carbon dioxide, together with the rate

of evaporation from it, and to study also the transfer of heat from fruit to air and from air to pipes. Such work is of direct value to British shipping in the transport of foodstuffs and to home producers who may wish to store their produce.

The effect of carbon dioxide in the atmosphere is not only to depress the post-climacteric respiratory activity of the fruit, but also to delay markedly the occurrence of the climacteric itself. (The climacteric is the sudden critical change in the life of the fruit when respiratory activity is doubled, and flavour and aroma are developed, the fruit attaining maturity shortly afterwards.) Apples, bananas, peaches and pears produce a substance which stimulates the onset of the climacteric in other fruit which have not yet reached this stage, but oranges and grapes do not. With the progress of senescence of apples in air, there is a steady rise in the amount of alcohol and acetaldehyde present: in an atmosphere containing little oxygen, the accumulation of these substances is slowed, so that the life of the fruit is correspondingly extended. A relationship has been found in apples between the incidence of the climacteric, the time at which the fruit is placed in cold-storage and the occurrence of low temperature breakdown. The incidence of the latter was by far the greatest in fruit transferred to cold store at the peak of the climacteric rise in respiratory activity: unfortunately, there is no practical means as yet whereby growers can detect when their fruit enters the climacteric.

These are a few of the directions, indicated by Sir Frank Smith in his lecture at Aberdeen, in which our knowledge of the properties of foodstuffs is advancing. Such knowledge can only be of inestimable benefit to mankind, and will be for ever associated with the name of the late Sir William Hardy.

Mathematical Aspects of the Propagation of Light*

By PROF. H. M. MACDONALD, O.B.E., F.R.S.

FARADAY, like Fresnel, appears to have thought of light in terms of geometrical relations, while Maxwell sought to construct a mechanical model the motions of which will resemble those which constitute light.

Starting from Faraday's ideas, the problem of the propagation of a magnetic disturbance in free space can be approached in a direct manner. There are three vectors involved—the electric current at a point in the space, the magnetic force at the point, and the electric force at the point. The relation between the electric current and the magnetic force is given by Ampère's law, and the relation between the magnetic force and the electric force is given by Faraday's law. It should be noted that Ampère's law was established initially for steady electric currents; its extension to the case where the electric currents are varying is a result of Faraday's work. Assuming, with Faraday, that the phenomena of light and of electricity have a common origin, Fresnel's law of transversality, that the vectors which specify the disturbance are perpendicular to the direction of propagation, will hold for the propagation of an electric or a magnetic disturbance as well as for light.

These three laws are sufficient to determine the circumstances of the propagation of a magnetic disturbance in free space. It follows that for plane waves the direction of the vector j, the time rate of increase of which is the electric current, at a point coincides with the direction of the electric force E at the point, and the relation between E and j is $E = 4\pi V^2 j$, where V is the velocity of propagation of a magnetic disturbance in free space. Further, if the changes which constitute the disturbance satisfy the laws of dynamics, the potential energy per unit of volume is $\frac{1}{2} Ej$—that is, $E^2/8\pi V^2$ in electromagnetic units—and, if E_1 is the same electric force in electrostatic units, the potential energy is $E_1^2/8\pi$; therefore $E = VE_1$, that is, the velocity of propagation is the velocity by which an electric force expressed in electrostatic units must be multiplied to convert it into electromagnetic units; or since the product of an electric charge and the electric force on it, being a mechanical force, is the same in both systems of units, the velocity of propagation is the velocity by which an electric charge expressed in electromagnetic units must be multiplied to convert it into electrostatic units.

The Lagrangian function of the changes which belong to the propagation of an electric or magnetic disturbance in free space is the difference of a kinetic energy function and a potential energy function. The potential energy function is the function given above—the kinetic energy function depends on the electromagnetic momentum and the electric current at a point; the contribution from an element in the neighbourhood of a point cannot be expressed in terms of one vector: it depends on the electric currents throughout space. On this theory, the rate of transfer of energy from a source emitting waves of one frequency is steady, and not oscillatory as on an elastic solid theory.

Consistently with the foregoing, the effect of

* From the presidential address entitled "Theories of Light" to Section A (Mathematical and Physical Sciences) of the British Association, delivered at Aberdeen on September 7.

material media, so far as electric and magnetic phenomena are concerned, can be represented by a distribution of electric currents and of magnetic currents throughout the space occupied by the material media. These electric current and magnetic current distributions can be supposed to be due to electric charges and to magnetic particles which are in motion, and it follows from the electrodynamical equations, when these current distributions are taken account of, that the current distributions can be represented by a distribution of electric and magnetic oscillators throughout the space occupied by the material media.

Further, the magnetic field due to a distribution of electric and magnetic currents inside a closed surface at any point outside this closed surface can be expressed in terms of the components of the electric and magnetic forces tangential to the surface—that is, any distribution of electric and magnetic currents inside a closed surface produces the same magnetic field at points outside the surface as a distribution of electric and magnetic currents on the surface which is determined by the components of the magnetic and electric forces tangential to the surface at points on it, but a knowledge of the magnetic field external to a closed surface does not determine the distribution of electric and magnetic currents inside the surface which is producing the magnetic field.

When the states of motion belonging to the electric and magnetic current distributions in the material medium are steady states of motion, the material medium is in a state of relative equilibrium ; but, when an electric or magnetic disturbance is being propagated in the material medium, these steady states of motion will be disturbed and, under certain conditions, the effect of the disturbance will be to set up small oscillations about the steady states of motion. A material can be regarded as being perfectly transparent for a disturbance the only effect of which is to set up small oscillations about the steady states of motion. A condition for this is that none of the frequencies involved in the disturbance is equal to or nearly equal to any of the natural frequencies belonging to the steady states of motion.

Fresnel's relations between the amplitudes of the incident, the transmitted, and the reflected waves when a train of waves is incident on the surface separating two transparent media follow on this hypothesis, and also Fresnel's results for the propagation of waves in crystalline media. It should be noticed that on this hypothesis the electric and magnetic forces at a point in a material medium which appear in the equations are not the total electric and magnetic forces at the point, but the parts of them which are due to the disturbance.

Faraday's results for the rotation of the plane of polarisation by an imposed magnetic field when light is being propagated in a non-magnetic transparent medium follow immediately from the above hypothesis without making any additional assumptions.

Further, on the same hypothesis there will be ranges of frequencies for which a material medium is transparent, the extent of such a range will depend on the intensity of the disturbances, and between any two consecutive ranges there will be a range of frequencies for which the medium is not transparent, and the mathematical treatment of the effect of disturbances involving these frequencies will require additional hypotheses.

The theory advanced above is not a mechanical theory of light in the sense that it is possible to construct a machine the motions of which will resemble the motions involved in the propagation of light. The form of the electrokinetic energy function raises the question whether all the time rates of change involved in the propagation of a magnetic disturbance can be represented by moving points, and whether every time rate of change associated with physical phenomena involves change of position in space. It may be necessary to contemplate time rates of change which do not involve change of position in space although they satisfy the laws of dynamics. In this connexion it is of interest to observe that a result of Faraday's laws is that, when there are electric currents in a system of circuits which are in motion, the kinetic energy function does not contain terms which involve the product of an electric current and a velocity, a result which Maxwell verified experimentally.

A possible hypothesis is that physical phenomena are due to the interaction of time rates of change which satisfy the laws of dynamics, and the Lagrangian function in that case would be a homogeneous quadratic function of all the time rates of change. In actual cases only some of the changes are being observed, and the Lagrangian function which is obtained from the experimental evidence is a modified Lagrangian function where the unobserved changes are supposed to be eliminated. In certain cases, this function will be expressed as the difference of a kinetic energy and a potential energy function ; an important case is that where the unobserved changes appear in the original Lagrangian function as velocities only and there are no product terms which involve a velocity belonging to the observed and a velocity belonging to the unobserved changes. There are also cases where the modified function is of this form approximately.

Third International Locust Conference

THE investigations on the locust problem in Africa and Western Asia, organised since 1929 by the Economic Advisory Council, have developed from the beginning on an international scale, for it was considered as hopeless to study the locust problem on a narrow territorial basis. This point of view proved acceptable to other Governments, and in 1931 the First International Locust Conference was called in Rome, where representatives of three countries (Great Britain, France and Italy) accepted a common policy for the investigation of the problem, and designated the Imperial Institute of Entomology in London as the international centre for anti-locust research. The second Conference took place in 1932 in Paris, where nine countries were represented, and further arrangements were made to ensure better co-operation in the study of the problem.

Between 1932 and 1934 great progress has been made in the investigations. Vast areas in Africa and in India have been explored by special entomologists of the British, French and Indian locust research organisations. The information, which has been steadily accumulating at the Imperial Institute of Entomology, made it possible to reconstruct the course of the present locust outbreak, to disentangle the records relating to different species of locusts, and to throw much light on the problem. The Third International Conference held in London on September 11–18 had, therefore, two aims. One was to summarise the results already attained in the study of the locust problem, and another, to elaborate a programme of further work on an international scale.

The Conference was attended by the delegates and experts of thirteen countries. A noteworthy feature was the presence of practically all the specialists actually engaged in locust investigations in Africa and India, which made the discussions very fruitful and devoid of unnecessary general statements. The programme of the Conference was carefully prepared in advance, and all the papers submitted to it were printed beforehand, to avoid the waste of time involved in reading them at the Conference. Owing to these arrangements, it became possible for the Conference to work through its full programme, and to discuss in detail outstanding points of the locust problem.

The main work of the Conference was definitely based on the fact, recently established by French and British investigators, that invasions of each locust species arise from the relatively restricted, so-called outbreak centres. It is only in these centres that the transformation from the solitary phase into the gregarious phase is possible, owing to the peculiar ecological conditions. Therefore, the location of the outbreak centres for each species should constitute the basis of a comprehensive policy for the prevention of locust invasions. A number of outbreak centres have already been discovered and studied, but many more remain unknown. The Conference, therefore, paid special attention to the preparation of a list of suspected areas which must be investigated without delay by the respective Governments. The methods to be employed in the field investigations and in ecological studies in the outbreak centres have been discussed in detail, in order to standardise them and thus to make the results comparable. Particular attention was paid to the methods of studying locust populations in different habitats, to the microclimatic work and to the standardisation of biometric methods for the study of phase transformation. A similar discussion on methods of work was arranged with reference to the study of locust migrations. In this study, close co-operation must be established between entomologists and meteorologists, since the causes of the migration and its directions are most probably climatic. The Conference accordingly recommended that meteorologists should be attached to locust research organisations, and a series of suggestions was elaborated as to the types of meteorological charts most likely to be of assistance in the study of migrations.

An interesting discussion took place on the problem of fundamental research. It was pointed out that out of the field investigations there arises a number of problems in locust biology and physiology which can be solved only in well-equipped research laboratories. The Conference recommended, therefore, that Governments should provide financial assistance to university and other laboratories for research on specific problems of immediate value in locust investigations. This means that research laboratories would be offered opportunities for carrying out scientific work of general interest, provided it is done on an object of practical interest, namely, locusts. Since researches of this kind may be undertaken in various institutions, the Conference recommended that the laboratories undertaking research on locusts should communicate with the Imperial Institute of Entomology in order to avoid overlapping.

The practical problems of locust destruction did not come within the scope of the Conference, but the relatively recent method of destroying locusts by arsenical dusting from aeroplanes was discussed in some detail. The experimental results obtained so far are considered encouraging and a hope was expressed that they will be continued. At the same time, the Conference pointed out the

necessity of investigating the physiological action of poisons on locusts, in order to find possible substitutes for arsenical compounds, which have certain disadvantages.

Apart from the very fruitful discussions during the meetings, the Conference provided a unique opportunity for entomologists of various countries engaged in locust research for the personal exchange of experiences and ideas. These informal discussions occupied all the intervals between meetings, and their value for those working of necessity for years in the wilds of Africa must be very great.

The Conference demonstrated very fully that the international investigations on the locust problem are following the only possible way to its solution. The value of international co-operation in this work has now become so obvious, that it was decided to make the next Conference still more comprehensive. Accordingly, it was suggested that the Egyptian Government, which has invited the Fourth Conference to meet at Cairo in 1936, should be asked to extend the invitation to all the countries of the world suffering from locust invasions. The Fourth Conference will, therefore, mark a new period in the international attack on the locust problem. B. P. UVAROV.

Two Types of Diamond

SIR ROBERT ROBERTSON'S recently published résumé of his researches on the two types of diamond* is one of the most fascinating detective stories of modern science. It has the advantage that though the circumstances of the crime are laid bare step by step, the real criminal escapes, to be dealt with, we hope, in the sequel.

The diamond has been studied for longer than any other natural stone, and its unique character had always been taken for granted. But it has been left for Sir Robert Robertson to discover that there are two types of diamond fundamentally different in many important respects.

The original observation was that one of the diamonds he had obtained from Prof. W. T. Gordon differed from all the others by not possessing the characteristic infra-red absorption of diamond at 8 μ. Abnormalities in the absorption of diamond had been noted before, in one case by Miller so far back as 1862, but their significance had not been realised. Sir Robert, however, with his collaborators, Dr. J. J. Fox and Dr. A. E. Martin, proceeded to examine many of the physical properties of diamonds and showed that the absence of the 8 μ band was completely correlated to striking differences in a number of physical properties, while in many other properties no differences whatever could be observed.

The characteristic differences are shown in the accompanying table taken from the paper. In electron diffraction, Raman spectrum, triboluminescence, dielectric constant, refractive index, colour and specific gravity, no differences were observable. There is no doubt that structurally both types of diamond are substantially alike. The observed differences are, on one hand, those affecting reaction with radiation, that is to say, electronic; and on the other, refer to the perfection of the crystal texture, crystals of Type 2 showing by their lamination and small primary extinction of X-rays that they are of a more marked mosaic pattern than those of Type 1. The two types of difference would appear to be closely correlated, but at first sight in a most unexpected way, because from the electronic point of view crystals of Type 2 would seem more perfect than those of Type 1, while from the textural point of view the reverse would appear the case. On the whole, however, the rarer type of diamond, Type 2, seems to be the normal type, as its properties agree more closely with prediction. The 8 μ band should be an inactive one and no compound containing only carbon single valency bonds should have ultra-violet absorption higher than *c.* 2200 A. The presence of an 8 μ absorption and complete absorption at 3000 A. in Type 1 diamonds suggests strongly the effects of an abnormality similar to that produced by strain or impurity.

	Type 1.	Type 2.
Occurrence . . .	The common type	Rarer.
Form	Derivatives of cubic system	Derivatives of cubic system, but with fine parallel laminations.
Isotropy	Considerable anisotropy between crossed nicols	Nearly isotropic.
Infra-red absorption-persisting at −170° C.	At 3, 4·1, 4·8 and 8 μ	At 3, 4·1 and 4·8μ No band at 8 μ.
Ultra-violet absorption	Not complete until 3000 λ; sequences of bands near this W.L. increasing in intensity down to − 170° C.	Not complete until 2250 λ. Faint absorption and diffuse bands near this W.L., disappearing at − 100° C.
Photo-electric conductivity . .	Small with even high voltages	Present with small voltages or none.
X-ray pattern . .	Normal. Ratio of intensity of 111/222 usually small	Normal. Ratio of intensity of 111/222 usually large.

The Type 2 diamonds in any event show properties of the greatest physical significance. The most fascinating are the photoelectric properties not shown in Type 1 owing to the heavy absorption in the activating region. Here the work of Gudden and Pohl has been confirmed and extended.

There are three types of reaction of diamonds of Type 2 to light of different wave-lengths. For

* "Two Types of Diamond." By Sir Robert Robertson, Dr. J. J. Fox and Dr. A. E. Martin. *Phil. Trans.*, A, **232**, 463; 1934.

wave-lengths 2000–2400 A. (optimum 2300 A.) a normal photoelectric response is produced, but the diamond after illumination at this wave-length is left in a peculiar condition—photo-electrically activated. For a time after exposure a current is given even in the dark, but this decays with time to a constant value. Even after some days, however, much larger currents can still be obtained by illuminating with red light (optimum 5850 A.) and this current lasts as long as the light is maintained. Light of intermediate wave-length, 2400–5000 A., however, though itself producing a simple photoelectric effect on an inactivated diamond, destroys in one already activated both the dark current and the capacity for restimulation return to their ground state when disturbed by light of intermediate wave-length—deactivation.

In the general problem of the differences of the two types of diamond, Sir Robert is able to put forward a partial solution. Correlations can be found between the inactive 8 μ band and the ultra-violet band system observed in diamonds of Type 1 at low temperatures. This leads to the hypothesis that the strain to which these diamonds are subjected (shown by their strain bands between crossed nicols) allows atomic and electronic frequencies, otherwise forbidden, to be effective in absorption. How this occurs is not clear; but then we know practically nothing of the atomic conditions produced by strain in crystals.

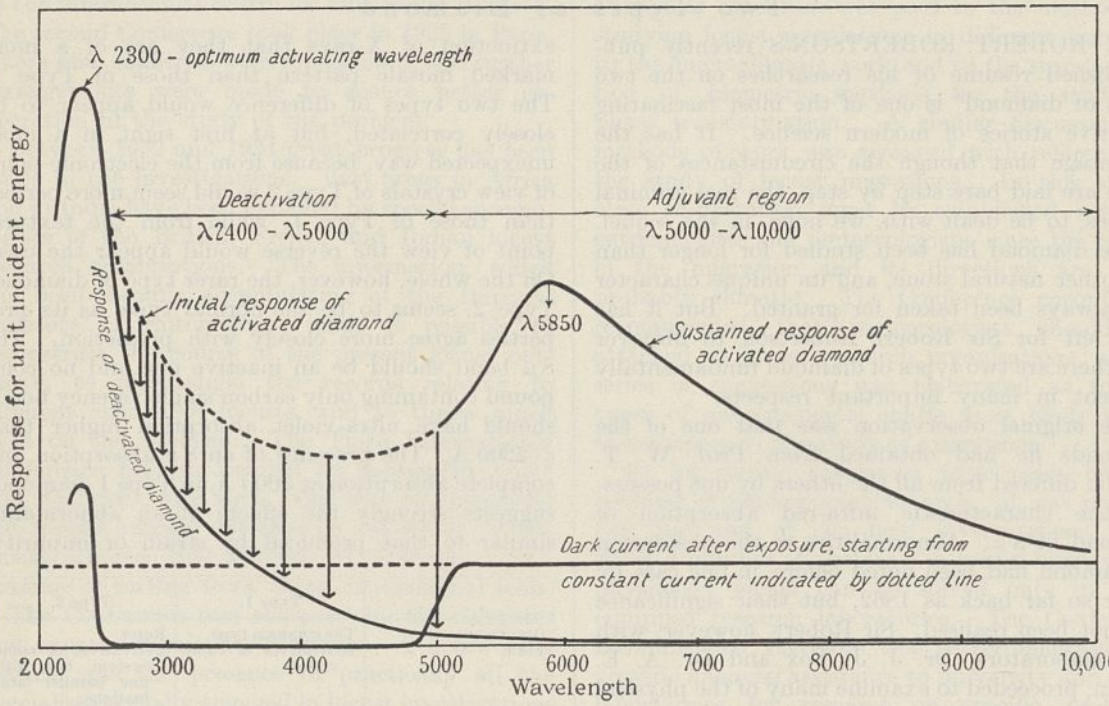

FIG. 1. Diagram showing effects of radiation on diamonds of Type 2, indicating activation, deactivation, adjuvant effect and dark current.

by red light. The general nature of the phenomenon is shown in Fig. 1 reproduced by permission of Sir Robert Robertson from the recent paper by Sir Robert and his collaborators.

A further remarkable feature of some diamonds of Type 2 is the production of currents without applied voltages. On illumination with activating light, certain parts of the diamond acquire positive, others negative, polarity and yield currents indefinitely as long as the illumination continues.

The explanation of these complex phenomena is still somewhat obscure. The activating light clearly is able to move some electrons to metastable levels where they have a certain limited mobility yielding a small dark current, and a much greater current when lifted to still higher levels by red light. They can, however, only

The differences brought out may have considerable geochemical implications and may help to throw light on the vexed question of the origin of the diamond. G. Friedel has shown that the strain bands of diamond are probably due to the fact that diamonds have passed through a transition point from another cubic form at 1855° C. (at atmospheric pressure). Now diamonds of Type 2 do not show these bands. Therefore, either they have been formed below the transition temperature, or, having passed through it, they have been able to recrystallise. This may have been assisted by the strain for which the evidence is shown by the slip planes of the Type 2 diamonds.

There is room for much further experiment and plenty already for the theorist to explain in the new chapter on crystals opened by Sir Robert Robertson.

Obituary

PROF. W. MCFADDEN ORR, F.R.S.

WILLIAM MCFADDEN ORR was born on May 2, 1866, and died in his sixty-eighth year on August 14, having resigned his professorship of pure and applied mathematics in University College, Dublin, and retired from active work less than a year ago. In the Ireland of Orr's youth, the examinations for the different grades of secondary education were intensely competitive, the exhibitions and prizes being valuable, and Orr, a student of the Methodist College, Belfast, although two years under age, had an unbroken and amazing series of successes. In Queen's University, Belfast, and St. John's College, Cambridge, his mathematical triumphs were repeated, and following the example of another alumnus of Queen's University, now Sir Joseph Larmor, he became Senior Wrangler in 1888; he was also given a fellowship in St. John's College, Cambridge. He became fellow of the Royal Society in 1909, and received the honorary degree of D.Sc. from Queen's University, Belfast, in 1919. In 1892 he was appointed professor of mathematics in the Royal College of Science for Ireland, and on this institution being absorbed by University College, Dublin, in 1926, he was transferred to an equal position with the title of professor of pure and applied mathematics. He retired on September 30, 1933.

Practically Orr's first published paper dealt with Bessel functions, a subject to which he returned twenty years after in a series of researches on Fourier and Bessel-Fourier expansions. In the early days of the electron theory, he was interested in giving precision to some of the mechanistic conceptions, which thirty years ago seemed the only possible points of view of this Larmor-Lorentz supplement to the Maxwell theory, and in the domain of electric waves he showed the impossibility of undamped waves in an unbounded dielectric space, whether simply connected or not. The duties of his chair turned his attention to many aspects of the work of Clausius on entropy and, in addition to some critical papers, he has left a small book, "Notes on Thermodynamics for Students", a model in its precision of formulation of principles. He will always be best known for his great work on the stability of the steady motions of a liquid (*Proc. Roy. Irish Acad.*, 1907). Improving on the results of Reynolds, his results are continually referred to in the writings of Kelvin, Rayleigh, Hopf, v. Mises and others, and are of importance in aerodynamics and fluid researches of the present day. His last published researches were important contributions to the whirling of shafts.

Everything that Orr wrote contained something of permanent value, and if the total quantity seems small, it was because of his highly developed critical faculty which he directed with the fiercest intensity against his own work. His views were esteemed and appreciated by writers like Lamb, Love and many others. In latter years, in University College, Dublin, he had a free hand to give any lectures he pleased, but, from choice, he undertook the difficult task of instilling accurate elementary ideas in the minds of science and engineering students. A firm disciplinarian and the strictest of examiners, he took a direct personal interest in all his students, who, without exception, came to like him before they parted from the College, however sternly they had been treated. He was the most modest of men about his own attainments, but was always ready to give help in applying mathematics to difficult technical and other problems, and one always had the comforting feeling that when Orr produced a result it was accurate and left little to be said on the subject.

Outside mathematics, Orr's chief interest was in cycling, and it is on record that in his Tripos year at Cambridge he carried off with great ease all the events at the University meeting of that year. This interest lasted to the end, and those in Dublin will miss the sight of his lean bearded figure going through the streets on a racing bicycle, without an overcoat, even in the coldest weather. A. W. C.

DR. R. F. SCHARFF

BY the death on September 11 of Dr. Robert Francis Scharff, Ireland has lost one of her foremost zoologists. Born at Leeds in 1858, he studied at Edinburgh and Heidelberg, and at the Marine Laboratories of St. Andrews and Naples. He entered the Science and Art Museum in Dublin in 1887, and there he spent most of his life, holding the keepership of the Natural History Division from 1890 until 1921.

While keeping in touch with the general progress of zoology and with the museums of the Continent, Scharff devoted himself especially to the study of the Irish fauna. He produced critical lists of several groups, such as the non-marine Mollusca and the woodlice, and to his assistance and encouragement was largely due the advances made in the knowledge of the distribution of many sections of the fauna of Ireland. The fossil fauna also occupied his attention, and he devoted much time to the Mammalia of the cave deposits. The origin of the various breeds of Irish domestic animals he also investigated, as well as the Gaelic names of native species.

Scharff took a keen interest in the Dublin Zoological Gardens, being secretary of the Royal Zoological Society of Ireland from 1903 until 1910, and long a member of its Council. He was also a leading member of the Royal Irish Academy, and chairman of its Fauna and Flora Committee from its inception in 1893 until he went recently to reside in England.

Among general zoological problems, Scharff selected for study the distribution and migration of animals, and published several books dealing with the subject —"History of the European Fauna" (1899), "European Animals" (1907), "Distribution and Origin of Life in America" (1911). He was emphatic on the difficulties offered by barriers of sea to animal migration. He was twice married, and leaves a widow, whose work on Irish sponges is well known to students of that group, and three children.

News and Views

The Cunard White Star Liner *Queen Mary*

In connexion with the launch of the Cunard White Star Atlantic Liner No. 534, named at the launch on September 26 by the Queen, S.S. *Queen Mary*, the *Times* on September 25 published a supplement containing a series of articles and illustrations dealing with Atlantic travel in general and the new vessel in particular. Though it is several times pointed out that No. 534 has been designed with the definite objective of maintaining a weekly service between Great Britain and the United States with two ships instead of three as at present, yet many will hope that her performances will be such that she will in every way prove a worthy successor to the famous *Mauretania*, and regain for Great Britain the record lost a year or two since to Germany and then to Italy. The commercial aspects of the Atlantic service, however, are touched upon by Mr. E. F. Spanner who, when speaking of high speed and sailing schedules, says that speed is expensive at all times and only such speed as is essential to provide for the maintenance of a regular weekly schedule of sailings could be regarded as justifiable. The designed speed of No. 534 is 28 knots, and to have given her a speed of 30 knots would have required 21 per cent more power.

Though but few definite figures are given as to the size, power and speed of the new vessel, it is stated that she has an overall length of 1,018 ft. and will be about 70,000 tons displacement. Before her final form was decided on, no fewer than sixteen models were tried in the experimental tank of the builders, Messrs. John Brown and Co., Ltd. The propelling machinery was the subject of inquiry by a committee appointed in 1929, of which the late Sir Charles Parsons and the late Mr. Andrew Laing were members. Five types of machinery were considered and the final decision was for water-tube boilers and geared turbines. There will thus be 24 oil-fired water-tube boilers generating steam at 400 lb. per sq. in., superheated to 700° F., with four sets of turbines with single reduction gear driving four shafts. In addition to these boilers, however, there will be three cylindrical boilers in a separate stokehold generating steam at 250 lb. per sq. in. for what is referred to as the "hotel services". The electric generating plant will include seven 1,300 kw. turbo-generators, generating direct current at 220 volts. By no means the least interesting of the many articles in the *Times* supplement are those dealing with the chain cables and the launching arrangements. For the cables, steel with an ultimate strength of 31–35 tons per sq. in. is being used. Every other link in the cables is a drop forging, and these are connected by links made in halves and then electrically welded in a resistance welding machine. A sample chain cable for No. 534 required 693 tons to break it.

In an article on the preparations for launching, a description is given of the special precautions taken to prevent any damage to the hull during its passage down the ways into the water, and the layman is given some idea of the calculations necessary and the procedure followed when carrying out one of the most important and imposing of all technical operations. Needless to say, a large number of firms have contributed towards the construction and equipment of this exceptional vessel. Cunard White Star, Ltd., has lent for exhibition in the Science Museum, South Kensington, a series of photographs showing the new liner in various stages of construction.

Centenary of Schorlemmer (1834–92)

Carl Schorlemmer, the German chemist to whose memory a laboratory was erected in Manchester in 1895, was born at Darmstadt on September 30, 1834. The son of a master carpenter, he began life as an apothecary, but while an assistant in Heidelberg he was able to attend the lectures of Bunsen, and at the age of twenty-five years abandoned a business career and entered the University of Giessen, where he studied under Heinrich Will (1812–90) and Hermann Kopp (1817–92). Coming to England, he followed Wilhelm Dittmar (1833–92) as private assistant to Roscoe at Owens College, and from 1861 until 1874 was official laboratory assistant. In this situation, he began original researches in hydrocarbons, investigated the action of chlorine on the paraffins and described a valuable general method for the conversion of secondary into the corresponding primary alcohols. He was elected a fellow of the Royal Society in 1871. In 1873, he was appointed lecturer in Owens College and the following year professor of organic chemistry, the chair being the first created for this subject in England. This chair he held until his death at Manchester on June 27, 1892, having by his labours assisted Roscoe to raise the Owens College school of chemistry to the first rank. He became a naturalised British subject in 1879, but was never married. His publications have a permanent place in chemical history. In 1867 he translated Roscoe's "Elementary Chemistry" into German, and in 1871 published a manual of organic chemistry. With Roscoe, in 1877, he published the first volume of their well-known "Systematic Treatise in Chemistry". Like his countryman Kopp, Schorlemmer was much interested in the history of science, and from 1883 onwards this absorbed a great part of his time. An appreciation of him by Sir Henry Roscoe appeared in Nature of August 25, 1892, and three years later we recorded the opening of the Schorlemmer memorial laboratory which had been erected at a cost of nearly £5,000.

International Conference on Physics

The conference which will be held in London on October 1–6 promises to be as remarkable a gathering as any which has been held for many years in the metropolis. The membership of the conference has mounted to the neighbourhood of six hundred, and

delegates have been appointed to attend from almost all civilised countries. It was a fortunate chance that the dates arranged for an international conference on nuclear physics under the auspices of the Physical Society should have coincided with those of a proposed meeting in London of the International Union of Pure and Applied Physics ; the fusion of the two meetings into a joint conference has resulted in a programme of absorbing interest and importance. On October 1 there are meetings of the executive committee of the International Union of Physics and of its Commission on Symbols, Units and Nomenclature (S.U.N.). On October 2–5, the sessions of the Conference will be divided between discussions on the solid state and on nuclear physics, under the presidencies of Lord Rayleigh and Prof. R. A. Millikan respectively. Opening surveys will be given by Sir William Bragg and Lord Rutherford. Meetings will take place at the Royal Institution, at the Royal Society and at Cambridge. The afternoon session of October 5, to be held at the Royal Institution, will receive the report of the S.U.N. Commission, and the meeting on October 6 at the same place will consider a communication concerning Dr. Hale's Committee on Instruments, discuss future work of the S.U.N. Commission and other business, concluding with a final meeting of the executive committee of the International Union of Physics. Titles of papers to be read will be found in our columns of "Forthcoming Events".

THE programme includes several social events of interest. The Royal Society is holding a reception on Tuesday evening, and a visit will be paid to the National Physical Laboratory on Saturday afternoon. Some of the sessions on nuclear physics will, most appropriately, be held at Cambridge, and the members of the Conference visiting Cambridge are invited to lunch at Trinity College and to tea at the Cavendish Laboratory. The major portion of the scientific sessions will be devoted to papers and discussions on the solid state and on nuclear physics ; but the work assigned to Friday afternoon and Saturday morning, covering as it does certain proposals concerning symbols, units and nomenclature, is of considerable importance in the present confused state of affairs, and it is greatly to be desired that the findings of the Commission will result in a much needed approach to uniformity in definitions and nomenclature. The report of the Conference will appear soon after the meeting. The more important papers will be published *in extenso*, and the report should prove a valuable record of a historic conference.

Japanese Typhoon of September 21

A TYPHOON that is reported in the daily Press to have passed across the south-western parts of Japan on September 21, and to have maintained its intensity there for a whole day, with winds up to about 130 miles an hour, is said to have been the most destructive tropical storm of this type that has visited Japan since 1917. In the *Times* of September 26, it is stated that the Japanese Home Office on September 25 gave the casualties as 2,305 killed, 7,839 injured and 399 missing, with a total of more than 34,576 houses totally destroyed and more than ten times that number washed away, and some 3,000 ships damaged. Information about the meteorological aspects of the typhoon is scanty. The cyclone season in that neighbourhood virtually covers the whole year, although storms are very rare in February and March. As Japan lies altogether north of latitude 30°, a typhoon that reaches that country is approaching the stage when it becomes a cyclonic depression of temperate latitudes, and having 'recurved', is generally moving north or north-east. This would account perhaps for the south-west of Japan being affected, but the north-east comparatively little. September is the month of greatest frequency of typhoons, and there is a rapid falling off in the last three months of the year. During the recent storm, trains were derailed, among which was the Tokyo-Shimonoseki express, which, with 250 passengers on board, left the rails while crossing a bridge, to be held fortunately by the parapet. There seem to have been the usual sea-waves, which penetrated far inland, and enough rain to cause serious flooding after the storm had abated. The track is said to have been from Nagasaki in the extreme south-west to the neighbourhood of Wakasa Bay, about four hundred miles to the north-east, Tokyo fortunately escaping with minor damage only.

German Association of Men of Science and Physicians

FAVOURED by the continued fine weather, the Gesellschaft Deutscher Naturforscher und Aerzte held its ninety-third meeting on September 16–20 in Hanover, well-known as the home of Leibniz. The attendance of some four thousand found a wide range of topics awaiting their consideration, for thirty allied societies also took part in the proceedings. Among these may be mentioned the Deutsche Chemische Gesellschaft, which contributed half a dozen papers, including one from Prof. The Svedberg on the applications of the ultra-centrifuge, and the Kolloid-Gesellschaft, which for its tenth general meeting devoted two very full days to "Röntgenoskopie und Elektronoskopie von dispersen Systemen, Fäden, Filmen und Grenzschichten". In addition to the more specialised discussions within the two main divisions of natural science and medicine, there were combined discussions and discourses of wider appeal addressed to the meeting as a whole, after the manner of the British Association. Among the last-mentioned, particular interest was aroused by Prof. W. Heisenberg's lecture, "Wandlungen der Grundlagen der exakten Naturwissenschaften in jüngster Zeit", in much the same field as that covered by Sir James Jeans's address at Aberdeen. An exhibition of apparatus, preparations and scientific books was held in the Ausstellungshalle, one of scientific films in the Tierärztliche Hochschule, and another, the travelling exhibition of the Dresden Museum of Hygiene, "Leben und Gesundheit", in the Künstlerhaus, while lighter moments were provided for by the Opera House and theatre and the usual excursions to neighbouring centres of attraction.

Radio Communication Conference at Lisbon

THE third meeting of the Comité Consultatif International des Radiocommunications (C.C.I.R.) opened at Lisbon on September 22, and will extend over a period of about two weeks. This committee was formed at the Washington Radiotelegraphic Conference in 1927 to provide a means for representatives of those administrations operating radio communication services to meet and discuss various technical matters of mutual interest, with the view of facilitating international radio communication. The previous meeting of the C.C.I.R. was held in Copenhagen in 1931, concurrently with the meeting of the Union Radio Scientifique Internationale, which has just held its plenary congress in London. The Lisbon meeting is considering a number of problems relating to broadcasting, which arose out of the Lucerne conference, in addition to questions of more general interest. The British delegates now at Lisbon include representatives of the Post Office, the British Broadcasting Corporation, the National Physical Laboratory, the Defence Services and the commercial organisations operating radio communication services in Great Britain.

Exploring the Greenland Ice-Sheet

DURING the recent summer, several attempts have been made to explore the mountainous interior of King Christian IX Land on the east coast of Greenland, between Scoresby Sound and Angmagssalik. The coast of this land, though somewhat inaccessible on account of pack-ice, has been explored by Amdrup, Mikkelsen, Watkins, Wager, Rasmussen and others, but penetration to the interior has so far proved to be baffling. Mr. Martin Lindsay has been successful in reaching this unknown area by crossing the Greenland ice-cap from the west coast. The *Times* reported his safe arrival at Angmagssalik on September 8, after a sledge journey of 1,050 miles from Rittenbäk near Jakobshavn. He was accompanied by Lieut. A. S. T. Godfrey and Mr. A. Croft, and they took with them dog teams and stores for the entire journey. Details of the work are still lacking, but the plan was to go eastward on the seventieth parallel of north latitude towards the head of Scoresby Sound and then turn south by Mount Forel to Angmagssalik. Apart from the survey work in King Christian IX Land, this expedition will have thrown new light on the ice-sheet, which it crossed in one of its wider parts. The party is returning to Aberdeen in the trawler *Jacinth*, having arrived on the coast too late to take passage in the Danish Government ship *Gertrud Rask*.

Two other attempts on the east coast of Greenland have been less successful. The *Times* reports that an Italian expedition of five, under the leadership of Count L. Bonzi, did some work on the south of Scoresby Sound, but, owing to difficulties with the pack-ice, had to abandon the project of penetrating inland from Cape Brewster. The expedition returned to Iceland on September 16. A French expedition under Dr. P. Victor failed to penetrate the belt of pack-ice off the Blosseville Coast and was landed by the *Pourquoi Pas?* at Angmagssalik in order to pass the winter in preparation for an attempt next year. Another crossing of the Greenland ice-sheet was made in August by Mr. Grierson, who flew from Angmagssalik to Godthaab in the course of his flight from England to Ottawa. Mr. J. M. Wordie's expedition to Ellesmere Island returned to Aberdeen on September 15, after charting new territory in Baffin Island. Earlier in the season, heavy pack in Melville Bay had held them on the west coast of Greenland and prevented access both to Cape York and to Ellesmere Island. There was in consequence no time to push westward to the Parry Islands and Banks Island, and any hope of making the North-West Passage was frustrated. Valuable work, however, is reported.

Effects Produced by Large Electric Currents

IN the *Electrician* of September 21, an account is given of experiments carried out in the high-voltage laboratory of the International General Electric Co. at Pittsfield, Mass., where artificial lightning at ten million volts was first produced. The engineers of the company have observed the effects produced by electric currents up to a quarter of a million amperes, which is much greater than any currents hitherto obtained. The object of the research was to find out the best way of protecting electric equipment against lightning discharges. A copper wire one tenth of an inch in diameter was completely vapourised in the few millionths of a second required for the discharge. When a piece of iron wire was used, it 'exploded', the ends of the wire that were left remaining white hot for several seconds A section of reinforced concrete placed between the electrodes was broken into bits by the current in the same way that a concrete structure is shattered when struck by natural lightning. Most of a silver-plated tea-spoon vanished in a shower of sparks, but the bowl, discoloured by heat, was left. Metallic armoured cable was in some cases destroyed, and occasionally caught fire. If the arc is confined to a small fibre tube, the tremendous pressure developed blows the tube to pieces even although it has a wall a quarter of an inch thick. In the open air, the pressure produced by the discharge shatters a pane of glass several inches away. When the current is passed through a flat copper strip, the strip is crumpled until its section is nearly round. The high ampere generator is formed by a battery of condensers suitably arranged. The discharges have to be confined within strong protecting cylinders as the explosion is very violent and makes a loud report.

Illuminating Engineering in the United States

AN address on illuminating engineering in the United States given by S. G. Hibben, the director of the Westinghouse Lamp Company, New York, has been published in the *Illuminating Engineer* of September, 1934. For underwater use, the Americans have developed special lamps. They have very strong bulbs, and both the base and the wires are wrapped

in soft rubber which at great depths is highly compressed. By their use, visibility is quite good at a depth of 400 ft. and photographs have been obtained at this depth. They are also used for salvage operations. Lamps at voltages which give them a life of about an hour only are used for photographic work. At still higher pressures we get the 'photoflash' lamp which is only used for instantaneous flashes. When used in a bulb of special blue-coloured glass, the blinding effect is negligible and the photographic effect is little impaired. In Europe, remarkable progress has been made in developing electric discharge lamps. In the United States, sodium and mercury lamps are used; the latter is the more popular for interior lighting. The Statue of Liberty in New York Harbour is flood-lighted, the intensity of the illumination being 30 foot-candles. Golf courses are now being lighted and playing at night is proving popular. A few courses are lighted by filament lamps, the consumption being 5–10 kilowatts per hole. Steam and sailing yachts are sometimes flood-lighted, the canvas and the funnels being illuminated. As well as being decorative, this adds to their safety. One of the chief uses of ultra-violet energy is for the purification of liquids. By means of a cinema film, the purification of water by killing the bacteria with ultra-violet rays was shown.

Steam Tables

WHEN a conference of American engineers and physicists decided in 1921 on a research programme to produce more accurate data on the properties of steam, investigation of the properties of saturated steam was assigned to the National Bureau of Standards. Recent research both in America and in Great Britain has increased the available data, and in the July issue of the *Journal of Research* of the Bureau, Messrs. N. S. Osborne and C. H. Meyers give the results of their examination of it in the form of tables of the saturation pressure and of its rate of change with temperature in both atmospheres and kilograms per square cm. units for each degree Centigrade and Fahrenheit between −5° C. and 374° C., the critical point being 374·1° C. The results of Holborn, Scheel and Henning of the Reichsanstalt, Egerton and Callendar, Osborne and his colleagues of the Bureau, Keyes and his colleagues of the Massachusetts Institute of Technology have all been utilised. At temperatures below 200° C. they differ very little from each other, and even near the critical temperature the differences are less than 0·1 per cent of the pressure, which is nearly 218 atmospheres. Both saturation pressure and its variation with temperature are expressed in terms of absolute temperature by empirical formulæ modified from those in common use, but it is not intended that for practical purposes the formulæ should replace the tables.

The University in the New Age

MR. MAYCOCK, in a contribution to the *Hibbert Journal* (32, No. 4), hopes that the universities may save us from an anarchic and materialistic society "where all will live for the moment in a chaos of pure sensation". This salvation will be possible only if the universities have due reverence for the traditions of their past, and for the value and dignity of learning. A survey of their history shows that they have to-day a great opportunity. They are once more as influential as they were in the Middle Ages; all that is wanting is an equivalent of the medieval synthesis. Mr. Maycock sees hope for this in the present-day pre-occupation with the social sciences, since these lead more readily to integration than the nineteenth century development of physical science. Over-specialisation has put learning out of touch with life, and has endangered our social order, and this the universities can remedy, not by becoming technical schools but by teaching an attitude to knowledge; the new age needs to recover the spiritual values of the Middle Ages, and, like Aquinas, to call those men wise "who control things rightly and set them in order".

Nations and the Public Health

INTERNATIONAL co-operation in public health is assuming much importance at the present time, and formed the subject of Sir George Buchanan's Milroy Lectures, delivered before the Royal College of Physicians, London, in February and March last (reprinted from the *Lancet*, April and May, 1934, pp. 879, 935, and 992). After some introductory remarks respecting the Rockefeller Foundation, the Red Cross and League of Red Cross Societies, he proceeds to survey some of the public health activities of the League of Nations, and of the Office International d'Hygiène Publique, Paris. The former have included health missions to various countries, international regulation of opium and drugs of addiction, statistics and radiological treatment of cancer, standardisation of biological products such as therapeutic sera, and inquiries into the laboratory procedures employed in the Wassermann test for syphilis. At the International Office in Paris, a permanent committee of delegates, representing fifty-one Governments, meets in regular half-yearly sessions, and is concerned with the prevention of plague, cholera and some other communicable diseases. It drafted the International Sanitary Convention, 1926, which deals with quarantine and de-ratisation of ships, it co-ordinates the sanitary control of the Mecca Pilgrimage, and it drew up the International Sanitary Convention for Aerial Navigation, 1933, which has already been signed by many nations. These international meetings also serve to establish a personal relationship with fellow-workers overseas and in foreign countries, and are invaluable as a time-saver when dealing with common problems.

Meteorology of India

IN a lecture delivered to the Royal Society of Arts on April 13, an account of which appears in the *Journal* of the Society (82, No. 4256), Mr. J. H. Field discussed the meteorology of India. In his lecture, Mr. Field gave interesting accounts of recent developments, such as the detection of cyclones at sea by the indications of seismographs, a subject developed

by Dr. S. K. Banerji with the aid of a Milne-Shaw seismograph located in Bombay, and also of recent researches into the system of upper winds over India. At the present time, maps are prepared daily showing the wind systems at seven different levels between 500 metres and 6,000 metres above the ground. These maps are of great service to aviation. Speaking of the dangers to flying in India, Mr. Field pointed out that these include most of those encountered in Europe with the addition of dust storms, and of hail storms that at their worst probably surpass any that occur in Europe ; he spoke of cases where hail stones of at least five inches diameter have destroyed Indian villages and killed every living creature in them. A point that emerged very clearly was the inadequacy of the financial provision for dealing with the requirements of aviation over the Indian section of the air route from England to Australia. The service was described as a "skeleton provision, materially below the standards recommended in the International Air Convention". This, fortunately, can be regarded as a matter that in the forward march of aviation must inevitably be set right, sooner or later. It is to be hoped that realisation of the importance of more complete meteorological information will not be delayed until after numerous fatal accidents have directed public attention to the subject.

Plant Collecting in Asia

MR. F. KINGDON WARD contributes the first of a series of articles about his twelfth expedition in Asia to the *Gardeners' Chronicle* of August 4. His object was, of course, to find new plants with which to enhance the beauty of gardens, and to add to the knowledge of the systematic botany of Asia. He was accompanied on part of the journey by Mr. R. Kaulbach, and by Mr. Brooks-Carrington, who is a kinematographer sent out by Ray-Col British Corporation Ltd. Ten thousand feet of colour film illustrating "Plant Hunting on the Edge of the World" have been prepared, and will shortly be on view in Great Britain. Mr. Kingdon Ward's journey began at Calcutta on February 25, 1933 ; thence he journeyed to Sadiya by way of Shillong, the capital of Assam. From Sadiya he went to Rima and beyond, to the snow range, entering the unexplored regions beyond Shugden Gompa. Returning to Zayul, he explored that province, and finally returned from Tibet to Assam via the Delei valley. A number of new plants were collected on the expedition, and will be described in subsequent instalments of the narrative, which is also highly descriptive of the country traversed.

Pollen Carried by Dust Storms

IN connexion with a note published in NATURE of June 16, p. 905, on the high proportion of pollen found in the dust storms experienced this year in the United States, Mr. K. Biswas, curator of the Herbarium, Royal Botanic Garden, Calcutta, directs attention to the "Puspa-bristi" (rain of flowers) frequently noticed in India. During late February and March, which is the flowering period of a large number of trees in the plains and *terai* of the Eastern Himalayas, the pollen seems often to be carried up to high levels in the hot air and then distributed over a wide area by dust storms. The pollen settles later with the dew or rain in drops of liquid, which dry upon the foliage of the plants leaving residues of pollen grains.

Useful Birds

THE Royal Society for the Protection of Birds has just added to its attractive series of coloured food-charts of birds, pictorial representations of the proportions of useful, harmful and neutral work (so far as human interests are concerned) done by the jackdaw, kestrel, nightjar and yellow-hammer. The cards, which are issued at 4*d*. each post free, or 4*s*. 4*d*. for the series of 16, are telling exhibits for use in museums or school-rooms. Recently the Ministry of Agriculture and Fisheries has issued Advisory Leaflets describing the characteristics and habits of the barn owl, woodpeckers, starling, swallow, martins and swift, lapwing and wagtails. A leaflet in the same series describes some simple nest boxes for the encouragement of the breeding of useful birds in gardens, orchards and allotments. They cost 1*d*. net each.

Dinosaur Discovery in Wyoming

DR. BARNUM BROWN, leader of the American Museum Sinclair Dinosaur Expedition, has discovered (according to Science Service, Washington, D.C.) an extraordinarily rich collection of fossil dinosaurs in Red Gulch Quarry, twenty-five miles east of Greybull, Wyoming. The number of skeletons unearthed up to the end of July was twelve, and Dr. Brown believes that they represent the remains of a herd of gigantic sauropod dinosaurs, caught in drying lakes and swamps, during an extended drought in the area some 125 millions of years ago.

An Automatic Firedamp Recorder

THE Safety in Mines Research Board has issued as Paper No. 86 an account of an automatic firedamp recorder, reference to which has already been made and a picture of the plant published in the twelfth annual report of the Safety in Mines Research Board, whilst the recorder had previously been described in the *Transactions of the Institution of Mining Engineers*. The present paper, however, gives the construction in more detail than either of the previous publications above referred to. The paper is by Mr. H. Lloyd, who designed the instrument in question.

Stemming Materials

THE Safety in Mines Research Board has just published Paper No. 84 dealing with stemming materials and written by Prof. J. A. S. Ritson and Mr. H. Stafford. This paper is practically a résumé of a number of papers and observations which Prof. Ritson and his colleagues have been carrying out for a number of years. The first paper was published by them in the *Transactions of the Institution of*

Mining Engineers of 1930, and they have continued their work practically up to the present. They find that sand between 1/10 in. and 1/100 in. is the most effective material, and that a mixture of sand and clay (three of the latter to one of the former) is practically as efficient as sand alone and is much more convenient for stemming horizontal shot holes. To enable the material to be stored without getting dry, the authors recommend 3–5 per cent of calcium chloride to be added, and they state that by the use of a sand and clay stemming, blown-out shots can be prevented, the amount of fumes can be reduced, and up to one third of the cost of the explosives can be saved. From the practical point of view this paper, published at 6*d.*, is of very great value.

The Sir John Cass Technical Institute

THE Sir John Cass Technical Institute, Aldgate, in the City of London, announces the completion of a new wing adding some seventy-five feet to the frontage of the main building, and providing accommodation for new library and reading rooms, a students' common room, a geology room and museum, and laboratories for metallurgy and pyrometry, assaying and mechanical testing and engraving, and a research laboratory. The new wing is to be opened on October 10 by the Earl of Athlone, Chancellor of the University of London. The Institute provides instruction in pure science as well as in the biochemistry of fermentation, petroleum technology, and fuel technology, in arts and crafts, tailoring and languages, and includes a Nautical School. Sir John Cass, to whose charitable interest in education the Institute owes its origin, was an alderman of the Ward of Portsoken from 1710 until 1718 and sat in Parliament as one of the representatives of the City of London.

Social Hygiene Congress

A CONGRESS of social hygiene will be held at Lyons on October 7–9, with M. Edouard Herriot as president of honour and M. Risler, member of the Institut de France, as president. The following papers among others will be read: Thirty years' campaign against tuberculosis, by Prof. Courmont; the work done by the Rhône Departmental Committee in the campaign against tuberculosis, by Dr. Mouisset; the efforts made on behalf of cheap housing at Lyons, by M. Lévy; the Lyons regional centre and the campaign against venereal diseases, by Prof. Nicolas; biological and medical foundations for the campaign against infantile mortality, by Prof. Mouriquand; the municipal work for infantile and maternal protection at Lyons, by Drs. Vigne, Trillat and Gardère; the Franco-American foundation for children, its work and results, by Prof. Lépine; the social hygiene centre of the school of nurses and health visitors of Lyons, by Dr. Charles Gardère; and the work of the anti-cancer centre at Lyons, by Prof. Bérard. Further information can be obtained from the general secretary, Prof. Rochaix, 61 rue Pasteur, Lyons, or from Alliance d'Hygiène Sociale, 5 rue Las-Casas, Paris.

Announcements

BY an order of the Committee of Privy Council, the Most Hon. the Marquess of Linlithgow is appointed a member of the Medical Research Council on the retirement of the Right Hon. the Viscount D'Abernon. Lord Linlithgow will succeed Lord D'Abernon as chairman of the Council.

ON Wednesday, October 3, Prof. G. Barger, professor of chemistry in relation to medicine in the University of Edinburgh, will deliver the inaugural sessional address of the Pharmaceutical Society of Great Britain at its School at 17 Bloomsbury Square, London, W.C.1.

EARLY in 1935, a new international botanical yearbook, to be known as *Chronica Botanica*, will be published by Fr. Verdoorn, P.O. Box 8, Leyden, Holland. The journal will include important dates of the past, present and future of interest to botanists; announcements and reports of the International Botanical Congress, and other international societies, congresses, etc.; elections of officers and the reports of botanical societies; a survey of pure and applied botany during the previous year; and correspondence.

"How to Use a Medical Library" is the title of a booklet by Leslie T. Morton, assistant in the library of the Royal Society of Medicine (London: John Bale, Sons and Danielsson, Ltd., 2*s.* 6*d.* net). It should prove a useful guide for research workers and others to the sources of information respecting medical literature and the compilation of medical bibliographies. A list of the principal medical indexes and abstracting journals is included, together with an account of the facilities afforded in medical libraries in Great Britain.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant for work on electrical equipment for aircraft in the Directorate of Technical Development—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Oct. 3). An assistant investigator of coal measure strata, in the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Cromwell House, Dean Stanley Street, London, S.W.1 (Oct. 6). A mechanical engineer in the Department of the Chief Officer, London Fire Brigade—The Clerk of the Council, County Hall, Westminster Bridge, S.E.1 (Oct. 15). A permanent advisory economist at Seale-Hayne Agricultural College, Newton Abbot, Devon—The Secretary. A head of the Department of Mechanical Engineering at the Municipal Technical School, Gamble Institute, St. Helens—The Secretary for Education, Education Office, St. Helens. A teaching scholar in the Department of Botany, University of Birmingham—The Secretary. A technical assistant in the Department of Economics, South Eastern Agricultural College, Wye, Kent—The Secretary.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Seeing in the Ultra-Violet

ACCORDING to different authors[1,2], under appropriate conditions seeing is possible in the ultra-violet down to a wave-length as small as 3100 A. This fact has been confirmed on 21 persons (age 25–50 years) using as light sources discharge tubes containing (1) high-pressure mercury, (2) low-pressure cadmium and zinc (both in neon). The tubes were of quartz, 15 mm. × 120 mm. Visible light and short waves (< 2700) were cut out by a red purple corex filter. Using one or more filters (each 5 mm.) the intensity of the Hg line 4047 relative to 3650 and 3130 could be varied within wide limits. A small monochromator

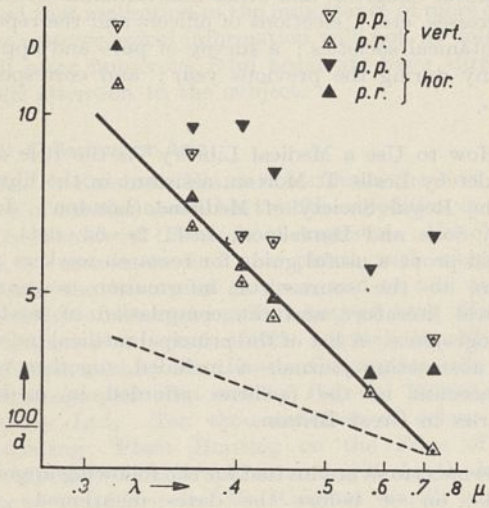

FIG. 1. Distance in dioptres of the *punctum remotum* and *proximum* of the author's left eye for vertical and horizontal focal line, λ 7080–3130. The dotted line refers to the refractivity of water (Listings eye).

(without second slit) was used to separate the different wave-lengths. As a result, the visibility for λ = 3650 relative to 4047 could be determined. It was also possible to estimate the visibility for 3130.

The values are very different for different persons.

$$V_{3650}/V_{4047} = 0{\cdot}015 - 0{\cdot}0003$$
$$V_{3130}/V_{4047} = 0{\cdot}005 - 0{\cdot}000004$$

One person could not see 3650, three persons were unable to see 3130. Even the most sensitive persons could not see the Zn line 3076. The Zn triplet 3345–3282, the Cd triplet 3612–3403 and the Cd line 3261 were seen by them with great ease. The description which these persons gave of the colour is very remarkable. They described it as clear blue, whereas the Hg line 4047 and the Zn line 4057 were described as violet. It seemed to them as if the succession in the spectrum was reversed[3]. To myself the colour appeared more greyish, although with a hue distinctly bluer than that of the recognised 'violet' lines (my visibilities are 0·0003 and 0·00002). The intensities used (expressed in mwatt/cm.² steradian) were

Hg	4047 (36)	3650 (60)	3341 (5)	3130 (50)
Cd	3612 (8)	3466 (8)	3403 (3)	3261 (100)
Zn	3345–3282 (10)		3076 (10)	

At the same time the dispersion of the eye could be studied by determining the distance (d) for which the image of the slit in a certain wave-length is seen sharply with the unaccommodated and well-accommodated eye respectively (*punctum remotum* and *proximum*). The reciprocal of the *p.r.* distance proved to be a nearly linear function of $1/\lambda$ from λ = 7082 to λ = 3130 A. For an eye which is emmetropic in the red, the degree of myopy at λ = 3130 A. amounts to about 10 D. From this it results that the dispersion in the region covered by the measurements is about 2½ times that of water. A slight indication of anomalous dispersion at λ = 3130 is present. By adjusting a horizontal cross wire perpendicular to the slit, the influence of astigmatism could be investigated. The accompanying diagram (Fig. 1) shows the results for my own left eye, which happens to be astigmatic with a nearly vertical axis.

From the description of these experiments, it will be clear that real retinal vision is observed and not the fluorescence of the other parts of the eye such as the lens, which of course was also very strong.

Whether the retinal process is due to the cones or to the rods and if fluorescence of the retina plays a rôle are still open questions[4].

W. DE GROOT.

Natuurkundig Laboratorium der
N. V. Philips' Gloeilampenfabrieken,
Eindhoven, Holland.
Aug. 25.

[1] Helmholtz, cf. Kayser, "Hb. d. Spektroskopie", **1**, 600; 1900.
[2] Nutting, "Outlines of Applied Optics". Cf. W. Graham, *J. Opt. Soc. Am.*, **6**, 605; 1922.
[3] cf. Helmholtz, "Physiol. Optik", 3 Aufl., **2**, 61.
[4] Helmholtz, l.c.

Detection of Neutrons Liberated from Beryllium by Gamma Rays: a New Technique for Inducing Radioactivity

WE have observed that a radiation emitted from beryllium under the influence of radium gamma rays excites induced radioactivity in iodine, and we conclude that neutrons are liberated from beryllium by gamma rays.

Chadwick and Goldhaber were the first to observe a nuclear disintegration due to the action of gamma rays. In their pioneer experiment[1], they used a small ionisation chamber filled with heavy hydrogen and observed that protons were ejected from the heavy hydrogen under the influence of gamma rays from thorium C. Their method can be used for the detection of the gamma ray disintegrations of other elements, as such a disintegration would generally be accompanied by the ejection of *charged nuclei* which their method is designed to detect. On the other hand, apart from the unique case of heavy hydrogen, their method does not appear to give direct evidence on *neutron* radiations, which may in certain cases accompany gamma ray disintegrations.

It appeared to us of interest to search for such neutron radiations, and we thought that the Fermi effect might conveniently be used as an indicator of their presence. For certain reasons, we chose to use as indicators elements which, like iodine, are trans-

muted in the Fermi effect into their own radioactive isotopes.

In order to make our test more sensitive, we applied in this work the new principle of isotopic separation which we recently described[2]. In the present experiment we have used iodine as indicator, and separated radio-iodine from the bombarded iodine.

In one experiment we surrounded 150 mgm. of radium (in sealed containers of 1·0 mm. platinum filtration) with 25 gm. of beryllium, which was further surrounded by 100 c.c. ethyl iodide. The silver iodide precipitate obtained after irradiation from the ethyl iodide showed an activity decaying with a half period of 30 minutes. In spite of the inefficient geometrical arrangement of the beryllium in this experiment, we obtained from the active precipitate 200 impulses of the Geiger-Müller beta ray counter per minute. In the control experiment omitting the beryllium, we obtained less than 12 impulses per minute. The effect observed is sufficiently strong to be easily detected without separating chemically the radioactive element.

Our observations show that it will be possible to make experiments on induced radioactivity by using the gamma rays of sealed radium containers, which are available in many hospitals for therapeutic purposes. Further, it will be possible to have very much stronger sources of neutrons and to produce thereby larger quantities of radioactive elements by using X-rays from high-voltage electron tubes.

LEO SZILARD.
T. A. CHALMERS.

Physics Department,
Medical College,
St. Bartholomew's Hospital,
London, E.C.1.
Sept. 17.

[1] NATURE, **134**, 237, Aug. 18, 1934.
[2] NATURE, **134**, 462, Sept. 22, 1934.

Annihilation Radiation from Paraffin Bombarded with Neutrons

LEA[1] has shown that paraffin when bombarded with neutrons from a (Po + Be) source emits heterogeneous γ-radiation of quantum energy 2–4 × 10^6 e.v. By bombarding graphite with the same radiation and by testing paraffin with the γ-radiation of ThC″ it was shown that the effect was due to impacts between the bombarding neutrons and protons and it was, therefore, suggested that the γ-radiation arose as a result of the union of a proton and neutron to form a diplon.

However, if the γ-radiation arose in this manner, evidence of the recoil tracks of diplons should be found by means of the expansion chamber and stereoscopic photography, and the short tracks due to diplons should be mainly directed away from the neutron source. But the distribution found by Auger and Monod-Herzen[2] shows, on the contrary, a minimum in this direction, and in addition observations by Auger[3] have indicated that the tracks are due to recoil protons. Auger[3], and more recently Chadwick and Goldhaber[4], have therefore concluded that the γ-radiation does not arise as suggested. Auger suggests that it arises as a result of the excitation of the protons by inelastic collisions with the bombarding neutrons, although this could only involve the neutrons of highest energy or those which could excite the proton to higher energy states by resonance.

Perrin[5] has shown, however, that a particle of mass M_1 may produce a pair of electrons on colliding with a particle at rest of mass M_2 if its kinetic energy is greater than $2m_0c^2 \frac{(M_1 + M_2 + m_0)}{M_1} = 2 \times 10^6$ e.v. for particles of equal mass, which is much greater than that of the electron.

Thus, as the neutrons used by Lea and Auger had energies 2–4 × 10^6 e.v., electron pairs might be produced as a result of collisions between the incident particles and the protons. The negative electron of the pair being produced in the positive nuclear field of the proton might be captured, the positron of the proton being annihilated with this electron to produce a quantum of γ-radiation, the proton being thus transformed into a neutron. The heterogeneity of the γ-rays observed would then be due to the fact that there are four bodies involved in the action, the incident neutron, the newly-formed neutron, the recoil positive electron of the pair and the quantum.

If this explanation is correct we should also expect to observe γ-radiation of energy 0·5 × 10^6 e.v. due to the annihilation of the positron produced. In addition, the minimum number of recoil protons in the forward direction is thus due to the transformation of these particles into neutrons, as the probability of the action would be much greater in cases of direct impact.

H. J. WALKE.

Department of Physics,
Washington Singer Laboratories,
University College,
Exeter.

[1] Lea, NATURE, **133**, 24, Jan. 6, 1934.
[2] Auger and Monod-Herzen, *Comptes rendus*, **196**, 543; 1933.
[3] Auger, *Comptes rendus*, **198**, 365; 1934.
[4] Chadwick and Goldhaber, NATURE, **134**, 237, Aug. 18, 1934.
[5] Perrin, *Comptes rendus*, **197**, 1302; 1933.

Electric Arcs with Fused Metals and Salts as Electrodes

ONE of us (M.P.) announced in a letter to NATURE two years ago[1] that electric arcs had been obtained between electrodes of substances which are insulators at ordinary temperature. By heating glass, porcelain, quartz, etc., to a very high temperature, it is possible to start the arc between electrodes of these substances.

We have now extended these researches. Metals and metallic salts, fused in a carbon crucible—fusion is brought about by previously starting the arc between the negative carbon above and the positive carbon crucible—which is connected with the positive or negative pole of a powerful battery of accumulators, can be positive or negative electrodes of an arc.

The properties of these arcs vary greatly. For example, with molten sodium, or sodium salts as positive electrode, the arc appears spectroscopically at its start, as a flame. The spectrum is restricted to D_1D_2, which appears as a single line. Presently, the spectrum becomes richer. The D doublet appears as a very large, luminous line, that sometimes broadens to some thousands of angstroms, so that it invades all the visible region of the spectrum, with a large zone of autoinversion at the centre, which reaches, at times, a width of 500 A. Moreover, the lines of the accessory series also appear and are auto-inverted.

When the salt, or the metal, begins to boil, the density of vapour surrounding the arc is very great. The arc has a characteristic aspect like that of an enormous, very luminous flame, sometimes 20 or 30 cm. high, which completely surrounds the overhanging negative carbon. The degree of spectroscopic excitation increases little by little until the arc (especially with molten salts) opens a passage, attaching itself on the carbon of the crucible lying below. The positive crater then becomes extremely narrow; and the arc takes on the appearance of an ultra-forced arc, with a long, very luminous dart, which also presents a spectrum of a high excitation. In such conditions it seems that some lines (for example, *D*) present some spectroscopic fission, with which we shall probably deal later on.

The arc with liquid copper as positive presents a minute crater which moves with extreme rapidity on the molten metal. All the bulk of the latter very soon begins to boil, especially if the other electrode possesses many negative bases[2]. Then the number of autoinverted lines is great. Also some of the carbon and cyanogen bands are inverted. Arcs with positive boiling porcelain are very white and luminous. The crater involves the whole crucible (that is, many square centimetres in extent). The ultra-violet spectrum abounds in lines, many of which are autoinverted. The lines of aluminium are more intense in this case than in the case of arcs having a positive electrode of boiling aluminium.

The electric and spectroscopic properties of these arcs will be more fully discussed in *Nuovo Cimento*.

MARIANO PIERUCCI.
LUIGI BARBANTI SILVA.
Istituto di Fisica della R. Università,
Modena. Aug. 3.

[1] M. Pierucci, NATURE, **129**, 724, May 14, 1932.
[2] M. Pierucci, *Nuovo Cimento*, 1925 and 1932.

Spark Investigation by the Wilson Chamber

SEVERAL years ago, one of the present writers (U. N.) engaged in a study concerning the form of long electric sparks at the laboratory of the Institute of Physical and Chemical Research in Tokyo under Prof. Terada. We succeeded then, by using a quartz-fluorite lens, in taking a photograph of the brush discharge immediately preceding the main spark[1]. This preceding discharge is rich in ultra-violet light, and more complicated and extended in its form than the succeeding main spark, giving an aspect as appendages to the luminous spark track. This result led us to look for the other form of discharge which cannot be photographed even with the quartz-fluorite lens. The use of Prof. Wilson's cloud chamber is at our present stage of knowledge the only method suitable for observing a process of discharge that is not accompanied by any luminous phenomenon. We then tried, on the suggestion of Prof. T. Terada, to take a Wilson photograph of the ions produced by a spark, but did not succeed in obtaining a satisfactory one. Later on, in the course of conversation with Prof. C. T. R. Wilson at Cambridge, I was given a great deal of advice on this problem and decided to take up this subject again.

We studied the formation and distribution of ions produced at the initial stages of spark formation. A surge was sent from an ordinary impulse generator to the electrodes enclosed in the cloud chamber, and its front was cut down by a spark discharge through a secondary gap l inserted parallel to the electrodes. The electrical system was similar to that used by Torok and others for photographing the suppressed spark. As high-voltage source, a Wommelsdorf's influence machine was used. By varying l we could see the successive stages of formation of ions in the preliminary stage of a spark.

The first series of experiments was carried out with nickel electrodes 1·7 mm. in diameter and rounded to hemispherical shape at the ends, gap distance being kept at 2·0 cm. The voltage impulse was sent just after the expansion of the chamber was completed and an illuminating spark was passed

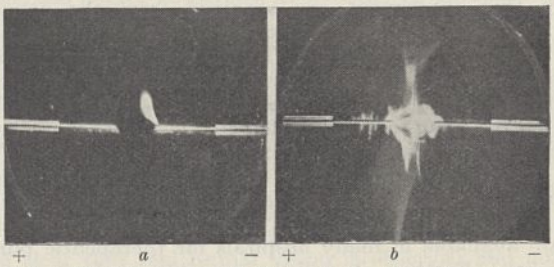

FIG. 1. Positive clouds with (*a*) l = 3 mm. and (*b*) l = 10 mm.

a few hundredths of a second after the impulse was applied, the synchronisation being done by a pendulum. With l = 3·0 mm., an ion cloud of spindle shape begins to appear from the negative electrode, but a cloud from the positive electrode does not appear so easily, and with higher voltage (say, l = 7·0 mm.), it begins to extend from the electrode. The positive cloud consists of a bundle of branched or non-branched streamers, in form resembling a positive Lichtenberg's figure. In this series of experiments all these clouds appeared as if they were drifted to a direction perpendicular to the gap line, as shown in Fig. 1. This effect was found to be due to the potential difference between the wall

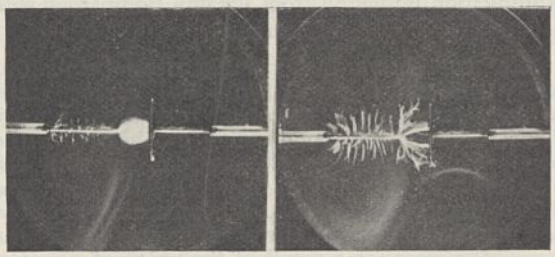

FIG. 2. (*a*) Negative cloud with l = 7 mm.; (*b*) positive cloud with l = 6 mm.

of the chamber and the electrodes after the impulse was applied. When using an influence machine without connecting one side to earth, the potential distribution of the two electrodes is not symmetrical and the surge circuit can be at higher potential than the surrounding earth just after the discharge. This effect could be avoided by connecting the surge circuit to earth through water resistance. The results obtained up to this stage were published in January[2]. Recently, we have seen a letter from Drs. Snoddy and Bradley[3], which states that they are engaged on an almost identical investigation.

The second series of experiments was carried out with a gap of a needle electrode and an earthed

plate, the distance chosen being 1·5 cm., in order to see clearly the difference between the positive and negative clouds. Typical photographs are reproduced in Fig. 2. The negative cloud is of a diffuse character, and usually forms a thick spindle (Fig. 2*a*), but is sometimes divided into a few thin spindles still diffuse in character. Sharp tracks appearing on the surface of the needle electrode wire seem to be positive tracks resulting from an electrical oscillation of the circuit excited by a spark at gap *l*. The characteristic of the positive clouds is seen clearly in Fig. 2*b*. The streamer or canal of ionisation is of a fair width but the boundary is very sharply defined, terminating in a pointed end. Most of them are branched and show the characteristics of the positive figure obtained on a photographic plate. In some electrical conditions these streamers become very thin and sharply defined, when they tend to be more sinuous in form.

In order to get some idea of the nature of the surge producing these ion clouds, a box for recording Lichtenberg's figure was inserted parallel to the chamber electrodes. Those figures showed some electrical oscillations of the circuit. We are endeavouring to obtain more definite results by improving the electrical circuit.

U. NAKAYA.
F. YAMASAKI.

Physical Laboratory,
Faculty of Science,
Hokkaido Imperial University,
Sapporo, Japan.
June 22.

[1] T. Terada, U. Nakaya and R. Yamamoto, *Sci. Pap. Inst. Phy. Chem. Res.*, Tokyo, **8-16**; 1928–1931.
[2] U. Nakaya and F. Yamasaki, *Kwagaku*, Tokyo, **4**, Jan. 1, 1934.
[3] L. B. Snoddy and C. D. Bradley, *Phys. Rev.*, **45**, March 15, 1934

Anomalous Diamagnetism of Selenium

THE diamagnetic susceptibilities of samples of selenium powdered to different degrees of fineness have been measured with a magnetic balance of the Wilson type. The diamagnetism of the samples decreases as the fineness of the powdering is increased, and at a certain stage the sample becomes paramagnetic. The paramagnetic value increases on further powdering. Further, the colloidal selenium has been found to be more paramagnetic than any of the powdered samples.

A considerable amount of work on the susceptibility of the colloidal powder of bismuth and other metals (antimony, silver, gold) has been done by Vaidyanathan[1], Rao[2] and others. They find that, with the decrease of the size of the particles, the diamagnetic susceptibility also decreases. Mathur and Varma[3] have shown that a large part of the decrease in diamagnetism of bismuth is due to oxidation, while Rao still finds a change even when the oxide is removed by suitable means.

Consequently, the powdered samples of selenium were washed with absolute alcohol in which the selenium oxides are known to dissolve, and their susceptibilities were re-determined. It was found that the paramagnetism still persisted in all the samples so far examined.

Chemical Laboratories,
Royal Institute of Science,
Bombay.
S. S. DHARMATTI.

[1] Vaidyanathan, *Indian J. Phys.*, **5**, 559; 1930.
[2] Rao, *ibid.*, **6**, 241; 1931.
[3] Mathur and Varma, *ibid.*, **6**, 181; 1931.

Binding Energies of the Neutron and the Proton

PROCEEDING from the assumption that both the proton and the neutron are of elementary nature, D. Iwanenko[1] concludes that the sum of the binding energies of the proton and the neutron equals $2mc^2$ (where m is the mass of the electron) and that the difference between these quantities cannot exceed mc^2, hence the mass defect of the neutron (or proton) cannot exceed this value.

The experimental data[2] lead us to suppose that the transformation of a proton into a neutron or vice versa can result only from the interaction of the nuclear particles and photons, by which the 'electrofission' of a photon into an electron and a positron takes place[3].

Consequently, the energy balance of the processes of transformation of proton into neutron, or neutron into proton, may be represented by the following equations :

$$n + 2mc^2 = n + e^+ + e^- = p + E_p + e^- \quad (1)$$
$$p + 2mc^2 = p + e^+ + e^- = n + E_n + e^+ \quad (2)$$

where the letters designate the energies of the neutron (n), proton (p), positron (e^+), electron (e^-); m is the mass of the electron, E_p the binding energy of the proton, E_n the binding energy of the neutron.

Adding equations (1) and (2) we immediately get Iwanenko's equation :

$$E_n + E_p = 2mc^2 \quad (3)$$

Subtracting equation (1) from (2) we get :

$$E_n - E_p = 2(p - n) \quad (4)$$

Equations (3) and (4) give :

$$E_n = mc^2 + (p - n) \quad (5)$$
$$E_p = mc^2 - (p - n) \quad (6)$$

Thus the binding energies of the neutron and the proton may be calculated, if the masses of the proton the neutron are known exactly.

According to Chadwick[4], the mass of the neutron is 1·0067 ($O^{16} = 16$) which gives :

$$p - n = mc^2 \quad (7)$$

If this definition of the neutron mass is correct, from equations (5), (6) and (7) it follows that :

$$E_n = 2mc^2$$
$$E_p = 0 \quad (8)$$

From the fact that $E_p = 0$, we cannot draw conclusions about the instability of the proton or about the possibility of a spontaneous reaction $p \rightleftarrows n + e^+$.

If we agree with the above-mentioned assumption that the processes of mutual transformation of proton and neutron may take place only with the interaction of photons, equations (1) and (2) have to be rewritten as follows :

$$n + 2mc^2 = n + e^+ + e^- = p + e^- \quad (1^1)$$
$$p + 2mc^2 = p + e^+ + e^- = n + 2mc^2 + e^+ \quad (2^1)$$

The physical meaning of these equations is as follows :

Let us admit that a particle is interacting with a photon of the energy $h\nu$.

Let ν_0 be the frequency of a photon with the energy

$$h\nu_0 = 2mc^2 \quad (9)$$

that is, 1·02 × 10^6 e.v.

Then the energy balance of the transmutation of the neutron into a proton and an electron will be written as follows:

$$n + h\nu = n + e^+ + e^- + E^1 = p + e + E^1 \quad (10)$$

where

$$E^1 = h\nu - h\nu_0 = h\nu - 2mc^2 \quad (11)$$

The energy E^1 can be manifested in the form of the kinetic energy of the proton and the electron, or in the form of a quantum of radiation, the energy of which is

$$h\nu^1 = h\nu - h\nu_0 = h\nu - 1{\cdot}02 \times 10^6 \text{ e.v.} \quad (12)$$

(if the kinetic energies of the proton and the electron vanish).

The energy balance in the transmutation of a proton into a neutron and a positron is:

$$p + h\nu = p + e^+ + e^- + E^1 = n + e^+ + E^1 + h\nu_0 \quad (13)$$

where E^1 is also given by equation (11).

It therefore follows that if the scattering of γ-rays is accompanied by the transmutation of a neutron into a proton and an electron, the maximum hardness of the scattered rays is determined by equation (11). If the scattering of γ-rays is accompanied by the transmutation of a proton into a neutron and a positron, then a scattered component of $1{\cdot}02 \times 10^6$ e.v. appears.[5]

L. STRUM.

Institute of Physics,
Academy of Sciences,
Kiev.

[1] D. Iwanenko, *C.R. Acad. Sci. U.R.S.S.*
[2] F. Joliot, *C.R. Acad. Sci.*, **197**, 1623; 1933. J. Thibaud, *C.R. Acad. Sci.*, **197**, 1629; 1933.
[3] cf. M. N. Saha and D. S. Kothari, NATURE, **132**, 747, Nov. 11, 1933. **133**, 99, Jan. 20, 1934.
[4] J. Chadwick, *Proc. Roy. Soc.*, A, **142**, 1; 1933.
[5] L. H. Gray and G. T. P. Tarrant, *Proc. Roy. Soc.*, A, **143**, 681, 766; 1934.

Absorption Spectrum of Mercuric Sulphide

FROM a recent note by Iredale and Gibson[1], it seems that the authors have not been able to isolate the absorption spectrum of HgS, observed by me[2], from that of sulphur vapour in the range of temperatures they have worked, and they are of opinion that the absorption continua ascribed by me to HgS probably belong to sulphur vapour, because these lie in the neighbourhood of the absorption maxima of sulphur vapour at 4000 A. and 2670 A. when raised to the temperature of 400° C.

I have shown[3] how the HgS continua could be distinguished from those of sulphur. The HgS absorption spectrum was investigated chiefly at 500° C. and above. At this temperature there is always some decomposition of HgS, but the decomposed sulphur is in the S_2 state, not the S_8 state, so that it is impossible for the S_8 bands to manifest themselves at this temperature. The observed continuous absorption at 4450 A. could thus be only that of HgS. It would not matter if the concentration of the decomposed product (sulphur) be greater than that of the original compound (HgS), because there is still sufficient vapour of the compound to give good absorption. Now, the S_2 bands present at 500° C. or at a slightly higher temperature lie in the region 3500–3200 A., as seen from a separate experimental observation by me. This region was almost completely superposed by the continuous absorption by the sulphide. The second absorption at 3100 A. could only be due to HgS alone, as at this temperature no absorption due to sulphur is obtained in this region.

The next point refers to the constitution of HgS. I have not assumed an electronic structure like Hg $(^1S_0) - S\,(^3P)$ for HgS, as Iredale and Gibson seem to believe. My conclusions were based on the assumption that HgS is ionic, having a structure $Hg^{++}\,(^1S_0) - S^{--}(^1S_0)$ giving a $^1\Sigma$ state. Under the influence of light, both the electrons in S^{--} go to Hg^{++} simultaneously, giving two normal atoms, as I have already explained.

My results and views on the subject receive further support from the fact that the deduced value of the heat of dissociation of sulphur agrees very closely with some other values determined by other experimental methods.

P. K. SEN-GUPTA.

Physics Department,
Rajaram College,
Kolhapur, India.
Aug. 1.

[1] NATURE, **133**, 985, June 30, 1934.
[2] Sen-Gupta, *Proc. Roy. Soc.*, A, **143**, 438; 1934.
[3] loc. cit.

Absorption Spectrum of Nitrous Oxide and Energy of Dissociation of Nitrogen

OWING to the importance of the determination of the energy of dissociation of nitrogen, it seems of interest to mention the value of D_{N_2} obtained by the study of the absorption spectrum of nitrous oxide (N_2O). This method, although an indirect one, gave a value of $D_{N_2} = 6{\cdot}9 \pm 0{\cdot}2$ volts, which is in fairly good agreement with the latest value of Herzberg and Sponer[1], $D_{N_2} = 7{\cdot}34$ volts.

We have measured the absorption spectrum of nitrous oxide at various temperatures and pressures. The limit of the continuous absorption is shifted towards the long wave-length with rising temperatures. From measurements made on photomicrometric curves for a wide range of temperatures, the limit of absorption extrapolated for $T_{abs} = 0$ was found to be 2140 ± 130 A.; this corresponds to the energy $D_{N_2O} = 132{,}000 \pm 8{,}000$ calories. We studied in Prof. Victor Henri's laboratory in Liège the photochemical decomposition of nitrous oxide by the radiations of a powerful cadmium spark filtered through layers of acetic acid of various concentrations. The absorption spectrum taken after the photochemical reaction showed the appearance of increasing amounts of nitric oxide; the mechanism of photochemical reaction can thus be explained as:

$$N_2O = NO + N.$$

Nitrous oxide being diamagnetic, according to Herzberg[2] its fundamental electronic state can only be a singlet ($^1\Sigma$). Such a state can only result from the adiabatic combination of individuals (NO and N) of equal multiplicity. The normal state of NO is $^2\Pi$; the normal state of the nitrogen atom is ^4S; N_2O cannot be formed by the adiabatic union of a normal NO molecule with a normal N atom. The next state of N is a metastable (^2D), 2·27 volts higher than (^4S). The photochemical decomposition of N_2O can thus be explained as:

$$N_2O\,(^1\Sigma) = NO\,(^2\Pi) + N\,(^2D) - 132{,}000 \text{ calories.}$$

This liberation of metastable atoms of nitrogen accounts for the shift of the absorption limit towards the long wave-lengths with rising temperatures

(transfer of energy to N_2O molecules not yet decomposed). Accepting this mechanism of decomposition, a series of simple thermochemical equations gives for the energy of decomposition of the normal nitrogen molecule into normal nitrogen atoms :

$$(D)_{N_2}(^1\Sigma) \rightarrow {}_{N_2}(^4S) = 6{\cdot}9 \pm 0{\cdot}2 \text{ volts} = 158{,}000 \pm 8{,}000 \text{ calories.}$$

This value is much lower than the 8·7 volts deduced by Dutta[3] ; however, it is in good agreement with the latest results of Lozier[4] who gave 7·42 volts, of Kaplan[5], 7·42 volts, of Maier and Sponer[6], 6·7 to 7·2 volts and with the quite recent and safe value of Herzberg and Sponer[1], 7·34 volts.

It is hoped that the study of decomposition of nitrous oxide by electron impact, being made, combined with a careful study of the energy states of the decomposition products, will give a more accurate value of D_{N_2}.

LOUIS HENRY.

Fondation medicale Reine Elisabeth,
Brussels.
Aug. 6.

[1] Herzberg and Sponer, *Z. Phys.*, **26**, 1 ; 1934.
[2] Herzberg, *Z. phys. Chem.*, **17**, 68 ; 1932. *Ann. Phys.*, **5**, 677; 1934.
[3] Dutta, *Proc. Roy. Soc.*, A, **138**, 84 ; 1932.
[4] Lozier, *Phys. Rev.*, **45**, 841 ; 1934.
[5] Kaplan, *Phys. Rev.*, **45**, 757 ; 1934.
[6] Maier and Sponer, *Z. Phys.*, **89**, 431 ; 1934.

Photosynthesis of Amino Acids *in Vitro*

RECENTLY we have been successful in synthesising amino acids by exposing solutions of glycol or glucose and nitrates to sunlight for six to eight hours in presence of titania, used as a photocatalyst. The amino acids formed can be estimated colorimetrically by the valuable 'ninhydrin' (triketo-hydrindene hydrate : $C_6H_4<\begin{matrix}CO\\CO\end{matrix}>C(OH)_2$) test. The following results were obtained by exposing to sunlight 100 c.c. of $N/2$ nitrate solutions and 5 gm. of glucose and 1 gm. of TiO_2 in open 250 c.c. pyrex glass beakers :

Time of exposure.	Amount of amino acids formed with different nitrates. $N/2$ NH_4NO_3	$N/2$ $NaNO_3$	$N/2$ KNO_3
2 hours	nil	nil	0·000120 *N*
4 hours	0·000055 *N*	0·000274 *N*	0·00040 *N*
6 hours	0·00125 *N*	0·00040 *N*	0·00084 *N*
8 hours	0·001096 *N*	0·00024 *N*	0·00110 *N*
10 hours	0·00053 *N*	0·00020 *N*	0·00034 *N*
12 hours	nil	0·000185 *N*	0·00027 *N*
Dark	nil	nil	nil

The foregoing results show that the amount of amino acids photosynthesised is a maximum with ammonium nitrate and less with sodium nitrate. Moreover, the amino acid photosynthesised reaches a maximum value with increase of exposure and then falls off as the exposure is continued. After 15–20 hours exposure, very little amino acid is detected. The disappearance of the photosynthesised amino acids is due to their oxidation. When $N/2$ ammonium hydroxide or ammonium salt is substituted for the nitrate, no amino acid is photosynthesised, neither is there any amino acid formation in the dark. When the concentration of glucose is increased, the yield of amino acid is increased.

Tartaric acid, glycol, glycerol, arabinose, fructose, mannose, galactose, etc., can also be used instead of glucose in photosynthesising the amino acids, which are also formed when ammonium lactate is exposed to sunlight with TiO_2. Our experiments show that glycine is mainly formed with glycol and potassium nitrate, and arginine with glucose and potassium nitrate. Small amounts of amino acids are also synthesised by exposing solutions of glucose and nitrates with ammonium uranium carbonate used as a photocatalyst instead of TiO_2.

N. R. DHAR.
S. K. MUKHERJEE.

Chemical Laboratories,
Allahabad University,
Allahabad,
India.
Aug. 1.

The Philosophy of Sir James Jeans

THE excellent article by "H. D." with the above title[1] seems to me to require a little historical emendation. To regard science as a process of describing and co-ordinating sensations, and matter, space, time and so on as mental concepts introduced to make this co-ordination easier, is not characteristic of the new physics unless we are prepared to date the latter from the eighties of last century. Analyses on these lines were given quite explicitly by Mach then, and were further developed by Karl Pearson in "The Grammar of Science". Full acknowledgment to Mach was made by Einstein in his earlier papers, but both these pioneers seem to have got overlooked in later developments.

Nor am I satisfied that the new physics shows any more understanding of the nature of its methods than the old. One realism is disposed of merely to be replaced by a different realism ; the relation to observation of parallel displacements and ψ-functions is as hazy as that of anything in the old physics. The problem of inference is still shirked ; the a priori certainty of Euclidean mensuration and Newtonian dynamics has gone, but in its place we have the a priori certainty of the principle of general relativity. The new wine is there, and so are suitable bottles, though the latter are not as new as they were ; but the old bottles are still being used.

HAROLD JEFFREYS.

St. John's College,
Cambridge.

[1] NATURE, **134**, 337, Sept. 8, 1934.

I GLADLY join in Dr. Jeffreys's tribute to Mach and Karl Pearson, but I would suggest that these thinkers do not constitute 'science'. I do not think it can be gainsaid that the great majority of the most prominent scientific workers (Lord Kelvin, of course, springs to mind, and I think he is typical) did not regard science as Dr. Jeffreys defines it. Indeed, if the views of isolated individuals are to be accepted as 'science', I am not sure that we ought not to go back much further than the eighties of last century—at least to Newton, who regarded the absoluteness of motion as having an experimental and not an a priori foundation.

Space obviously precludes a proper discussion of Dr. Jeffreys's second paragraph, which I do not altogether understand. In speaking of "the new physics", is he still thinking only of the most far-seeing of new physicists, or has he tacitly changed to the general body ? If the former, I certainly dissent ; if the latter, it is a question of the degree of generality. My own view is that while, of course, "the old bottles are still being used", their use is far less general than it was thirty years ago, and the present generation of physicists is relatively so enlightened as to justify the statements of my article. H. D.

Research Items

Kent's Cavern, Torquay. A report on the continued excavation of Kent's Cavern, Torquay, presented at Aberdeen by a Research Committee of Section H (Anthropology) of the British Association, states that an area of 160 sq. ft. of floor space, one half of which is beneath the 'Black Band' Magdalenian hearth worked by W. Pengelly between 1865 and 1880, has been excavated, the greatest depth reached being 10 ft. 6 in. below the general floor and 16 ft. below the old stalagmite floor. Remains of large animals were found between large fallen blocks of limestone. The animals usually found in the cave were present in good number, including horse, rhinoceros, deer, Irish deer, bear, fox, ox, badger, pine-marten and mammoth. Among the more interesting finds were three foot bones of deer, all articulating, three vertebræ of (?) rhinoceros in correct relation, a first phalanx of a human finger, 2 ft. below floor level, eight flint implements, a flint core, 3 in. by 2 in. by 2½ in., at a depth of 13 ft. 6 in. below the original floor level, small tines of deer, probably used as borers, and a quartzite pounder.

Archæology of Kahoolawe, Hawaii. A study of the archæology of Kahoolawe presents certain points of special interest in view of its sharply marked differences as a waterless, barren and desolate island, from the rest of Hawaii. A report based, in part on a study of the material in the Bernice P. Bishop Museum made in 1913 by Mr. J. F. G. Stokes, and in part on a recent survey by Mr. J. G. McAllister and Mr. F. H. Bryan is published as *Bulletin* 115 of the Museum. Attention was directed especially to the problem of the existence of a pre-Hawaiian culture. From the remains found, it is evident that there was on the island at one time a semi-permanent population. House foundations, and the ruins of religious structures are as permanent as anything found elsewhere in Hawaii: but environmental conditions were such that it seems unlikely that people could have inhabited the island for an indefinite period. Water is only procurable after heavy rains. At no time could there have been more than 150 people on the island. It was probably a base for fishing peoples, who established semi-permanent huts, numerous fishing shrines and two *heiaus* for propitiating the fish deities. The evidence of the remains and artefacts established these former inhabitants as Hawaiians at the time of discovery. Many of the usual remains of other islands, such as taro terraces and irrigation ditches, are absent. One unusual find was a family shrine, previously known only in the literature. The culture, however, is not typical of that of Hawaii as a whole, but represents the fishing phase only. The most important remains of this phase represented the technique of the manufacture of fish-hooks, a technique which had been forgotten. The offerings at the fishing shrines were also preserved in an exceptional condition.

Affinities of the Crab Fauna of California. An analysis of the Brachyuran fauna of the Gulf of California, by Steve A. Glassell, shows that an infusion of southern forms accounts for the main features of the fauna (*J. Washington Acad. Sci.*, 24, 296; 1934). The total number of species of cancroid, grapsoid and spider crabs in the Gulf of California is 197, a long list considering that only 181 marine decapods are known to occur within the 100 fathom line off the coast of California. Of the 197 species, 75 are indigenous to the Gulf, 96 are intrusive species from the south having their headquarters in the Panama region, and only 24 are northern intrusive forms. A complete list is given with indications of the centre of dispersal from which each species has migrated.

Phytoplankton of the *Discovery* Expedition. Mr. T. G. Hart in a recent monograph describes the phytoplankton collected by the *Discovery* Expedition from the south-west Atlantic and the Bellingshausen Sea, 1929–31 ("Discovery Reports", 8, pp. 1–268. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Cambridge, 1934). This forms the continuation of Prof. Hardy's pioneer work on the phytoplankton of South Georgia. The economic importance of the phytoplankton in these areas is great for it forms the greater part, if not the whole of the food of *Euphausia superba*, the euphausiid which is eaten in such huge quantities by the southern rorquals when migrating southwards in summer on their feeding migration. The diatoms *Fragilaria antarctica*, *Thalassiosira antarctica* and fragments of *Chaetoceros criophilum* were constantly found inside the *Euphausia*. Of the phytoplankton organisms, the diatoms preponderated in such a marked degree that the research was practically on the diatoms, the dinoflagellates and other groups being quite insignificant. Mr. Hart is of the opinion that nutrient salts are not at any time limiting factors within the Antarctic surface waters, and he emphasises the importance of physical factors—weather and currents, light, ice conditions and temperature. He attributes the seasonal variations and yearly fluctuations in the area investigated mainly to the following factors: the stabilisation of the upper layers when the ice melts, and, conversely, instability whether due to convection or wind action; transportation by surface currents and the possible return of resting spores by sub-surface currents followed by upwelling; the action of ice in various ways and of light intensity and duration.

Cruciform Muscle of Lamellibranchs. Mr. Alastair Graham (*Proc. Roy. Soc. Edin.*, 54, Part 1, No. 3) has made some very interesting investigations into the details of the structure known as the cruciform muscle with its attendant sense organ which occurs in certain bivalves. *Donax vittatus*, *Tellina crassa*, *Macoma balthica*, *Scrobicularia plana*, *Gari tellinella* and *Solecurtus scopula*, representing five distinct families, have been examined in this connexion. *Donax vittatus* differs from all the others, and agrees with *Tagelus dombeyi* as previously described by Hoffmann, in having the sense organ (or ciliated pit) opening into a small closed cavity. In all the others it opens to the exterior. As the author says, there must be some use for this organ, and he suggests that in those species where it is open it is a means of testing the purity of the water in which the mollusc finds itself, but it is difficult to accept this function for the closed organ of *Donax*, and for this form the question is left open. The open condition is probably the most primitive. Certain questions of nomenclature arise in these investigations, and the

author shows that the classification of Thiele where the Tellinacea, consisting of the families Tellinidæ, Semelidæ, Psammobiidæ and Donacidæ, and the Solenacea, which contains the sole family Solenidæ, are grouped together in the suborder Hemidapedonta, is more natural than that of Pelseneer, and also of Ridewood, where the Tellinidæ, Scrobiculariidæ (= Semelidæ) and the Donacidæ are grouped in the suborder Tellinacea, and the other two families, the Psammobiidæ (= Asaphidæ) and the Solenidæ, being placed in the Myacea. He also suggests that the Solenidæ be broken into two families, those without a cruciform muscle and those which possess one.

Classification of British Elms. It has been said with some truth that even good systematic botanists find considerable difficulty in the determination of species of the genus *Ulmus* (elm). A series of articles by Dr. Helen Bancroft appearing in the *Gardeners' Chronicle*, beginning with the issue of August 18, should do much to remove this incubus ("Notes on the Status and Nomenclature of the British Elms"). The account reports new work upon anatomical characters suitable for the differentiation of species, and on the origin of the forms occurring in Great Britain. The nomenclature of Elwes and Henry ("Trees of Great Britain and Ireland") is adopted as a basis, but some of the chief synonyms are also quoted. Descriptions of reasonably true species are to be dealt with first, and three have been described in the first two articles, namely, *Ulmus minor*, *U. montana* and *U. nitens*. Descriptions are given in considerable detail, and the distribution of each species is outlined. The account is to be continued, and if the present detail is maintained, should provide a valuable contribution to systematic botany.

The South Atlantic Earthquake of June 27, 1929. As this important earthquake (referred to in NATURE of August 18, p. 257) can have had few observers, an account sent to us by Commander T. M. Chaplin, Hydrographic Department, Admiralty, Whitehall, S.W.1, possesses considerable interest. At the time, he was engaged in carrying out coastal surveys for the Discovery Committee, and was occupying the Marine Biological Station at Grytviken in Cumberland Bay. On the morning of June 27, while drawing a chart, he was disturbed by a loud rumbling noise and vibration. The hanging electric lamps swung so as almost to touch the ceiling, and the glass chemical measures in the laboratory drawers were rolled about violently. The sound and shock suddenly ceased together at 12h. 51m. 30s., G.M.T., the duration of the shock being estimated at about 3 minutes. On looking out immediately after the earthquake, no agitation of the surface of the sea was observed and there appear to have been no changes in the land surface or in the soundings. The glaciers evidently calved with unusual frequency about this time, but this may have been due as much to the heavy rains that followed as to the earthquake itself.

The Arc Discharge. L. S. Ornstein and H. Brinkman discuss in *Physica*, 1, 9, July 1934, the mechanism of the electric arc. The study of the atomic and molecular spectra excited in the arc has shown that the gas atoms have a velocity distribution corresponding to a temperature of 4000°–7000° K, and in this paper the equilibrium between atoms and molecules, ions, electrons, and radiation is considered. In the arc stream the processes of excitation, dissociation and ionisation are mainly due to collisions between the *uncharged* particles. Radiation and collisions involving ions and electrons play only a subsidiary part, and the conditions are therefore similar to those which exist in a flame. In the neighbourhood of the electrodes and in the discharge at lower pressure, electron collisions become important. The relative importance of 'thermal ionisation' by collision between atoms and of electron impact provides a distinction between 'arc' and 'glow'.

Heavy Hydrogen and Heavy Oxygen. The *Journal of the American Chemical Society* (August, 1934) contains several short communications dealing with heavy hydrogen (deuterium, H^2). W. H. Claussen and J. H. Hildebrand have compared the vapour pressures of HF and H^2F, prepared by the action of hydrogen and deuterium on silver fluoride. Deuterium fluoride has the higher vapour pressure, the deviation being in the same direction as with the acetic acids. Both acetic and hydrofluoric acids are highly polymerised in the liquid phase. The exchange reaction between deuterium and water vapour on catalytic hydrogenating surfaces of chromium and zinc oxides, studied by H. S. Taylor and H. Diamond, shows that heavy hydrogen may rapidly be displaced by the light isotope in the moist gas in contact with catalytic surfaces. N. F. Hall, H. R. Wentzel and T. Smith find that the lower consolute temperature of nicotine and water is lowered, and the upper consolute temperature of phenol and water raised by increasing the deuterium content of the water. Some experiments on heavy oxygen, O^{18}, are reported by H. S. Taylor and A. J. Gould. W. R. Smythe has given the ratio $O^{16} : O^{18} = 503 \pm 10$ for the oxygen obtained by heating lead peroxide, and since the process involves a solid solution, there is a possibility of isotopic separation. Several specimens of the liberated gas, examined by W. Bleakney by the mass spectrograph, gave, however, practically the same ratio, $O^{16} : O^{18} = 468$ to 478. Measurements by Manian with gas from meteorites and potassium chlorate gave 514 ± 13. Oxygen from 30 per cent hydrogen peroxide and colloidal platinum gave 462 ± 8 and 426 ± 4 for initial and final specimens, indicating a separation of the isotopes, O^{18} being less rapidly liberated.

Recent Work on Relativity. Very few exact solutions of Einstein's equations are at present known. The most important, after Schwarzschild's statical form with spherical symmetry, is Levi-Civita's statical form with axial symmetry. In "Sur les ds^2 d'Einstein à symétrie axiale" (Hermann, 1934), J. Delsarte obtains a non-statical form with axial symmetry. It is hoped that this work gives the solution of the problem of two bodies moving in the same straight line. The mathematics reveals some unexpected connexions with certain problems in Euclidean infinitesimal geometry studied by Darboux. In a paper read recently in India before the United Provinces Academy of Sciences, the Hon. Sir Shah Mohammed Sulaiman, Chief Justice of the Allahabad High Court, put forward a modified theory of relativity. He claimed that this new theory incorporated Einstein's corrections to Newtonian mechanics without Einstein's complete abandonment of Newtonian principles. Moreover, it led to the conclusion that nebulæ can approach (as at least five are known to do) as well as recede, and that the universe is not exploding, but is stable.

The International Scientific Radio Union

THE fifth general assembly of the Union Radio Scientifique Internationale (U.R.S.I.) was held in London on September 11–19. This is the first occasion on which the Union has met in London, the previous general assemblies having been held in Brussels, Copenhagen and Washington. The congress was attended by nearly sixty delegates representing fourteen countries interested in the scientific aspects of radio communication. At the opening meeting, Prof. J. C. McLennan, vice-president of the Royal Society, welcomed the delegates at Burlington House on behalf of the Council, by the courtesy of which the rooms of the Society were made available for the business meeting of the congress.

Prof. W. H. Eccles acted as president of the general assembly, and in his opening address he described the origin of the Union in a meeting in Brussels held early in 1914, and arranged by Dr. R. B. Goldschmidt, now the general secretary. After the War, the U.R.S.I. was one of the first to be included under the International Council of Scientific Unions. The science of radio communication demands the attention of both the engineer and the physicist, and by its very nature it necessarily involves international co-operation. One example of the material results which have emerged from such co-operation in recent years is to be found in the remarkable progress in the precision of frequency measurement. In his presidential address to Commission I of the U.R.S.I., Dr. E. H. Rayner described the results of the comparison of the frequency standards of different countries. So far as Europe is concerned, these comparisons were carried out by employing the frequency standard of the National Physical Laboratory either to modulate waves radiated directly from the Laboratory's transmitting station, or with the co-operation of the B.B.C. to modulate the carrier wave of the Daventry broadcasting station. For the purpose of comparison with the United States, measurements have been made at the National Physical Laboratory of the standard frequency carrier wave emitted regularly by the Bureau of Standards. Experiments carried out in this manner have shown that the constancy and accuracy of apparatus in use for the measurement of radio frequency have reached a standard which would scarcely have been thought possible a few years ago. In two of these comparisons, measurements made in three different countries were in agreement to within one part in ten million, while it is considered that frequency measurements can be effected in a laboratory to about five times this accuracy (that is, 2 parts in 10^8). On a time scale, this accuracy corresponds to less than one second in a year, and in its continued development of the technique of frequency measurement, the U.R.S.I. will explore the possibilities of the application of this technique to other branches of science, such as astronomy and geodesy.

Another example of the very fruitful results of international co-operation was provided by the work of the International Polar Year Sub-Commission. This Sub-Commission was appointed under the presidency of Prof. E. V. Appleton, at the Copenhagen meeting of the U.R.S.I. in 1931, to arrange a programme of radio work during the second Polar Year, 1932–33. Six countries sent expeditions to carry out special observations in polar regions, and the results which have so far been analysed were discussed at the London congress. Prof. Appleton gave an account of the results obtained by the British expedition which was sent to Tromsö, and directed attention to the very marked effects of magnetic storms on the reflection of radio waves from the ionosphere. In addition to their scientific interest, such results have an important bearing on the practice of radio communication involving the passage of waves in high latitudes. Many other aspects of the propagation of electric waves around the earth were discussed at the meetings of Commission II of the U.R.S.I. presided over by Dr. J. H. Dellinger.

The third Commission of the Union deals with the subject of atmospherics, and a joint paper by Prof. E. V. Appleton and Mr. R. A. Watson Watt presented at the London meeting throws a new light on the manner in which these disturbances travel through the atmosphere. By the aid of photographic registration, the life-history of an atmospheric has been studied from its source at the lightning flash up to a distance of 3,000 miles. A sub-commission held under the presidency of Dr. H. Norinder expressed the opinion that all investigations on the physical processes of lightning discharges would be of value in the investigation of the nature of atmospherics, and recommended that optical and photographic recording of lightning flashes should be developed as much as possible in order to assist in this work.

Dr. van der Pol presided over the Commission dealing with Radio-Physics. Consideration was given to the study of the mechanism of the generation of electrical oscillations of ultra-high frequency, and to the propagation of the corresponding ultra-short waves. Investigations of the theory of propagation and absorption of waves in the atmosphere were reviewed and it was considered desirable to extend the study of the theory of non-linear oscillations. Another matter which the London meeting of the U.R.S.I. has set down for further investigation is the inter-action of radio waves in their passage through the ionosphere. Dr. van der Pol presented an interesting summary of the experiments already made on this phenomenon, including an observation made in Holland of a 'cross-modulation' effect between Athlone in Ireland, and the new high-power broadcasting station at Droitwich.

Apart from the business meetings of the congress, the delegates visited the Radio Department of the National Physical Laboratory at Slough and Teddington, the Rugby and Baldock Stations of the Post Office, Broadcasting House, and the University of Cambridge. On the occasion of a reception at the Royal Institution, Sir William Bragg gave an experimental lecture on Michael Faraday, illustrated by some of the original apparatus used by Faraday. The delegates were further entertained by H.M. Government at a dinner at Grosvenor House, at which Sir Kingsley Wood, Postmaster-General, presided. At the closing session of the General Assembly, it was announced that Prof. E. V. Appleton had been elected president of the U.R.S.I. in succession to Prof. A. E. Kennelly, who has retired on the grounds of ill-health. The next plenary congress is expected to take place abroad in 1936 or 1937.

Planning and Economics

AT the recent Aberdeen meeting of the British Association, several interesting papers were contributed to a discussion on "Economic Planning" arranged by Section F (Economic Science and Statistics). In opening the discussion, Prof. D. H. Macgregor, of Oxford, said that the problem to be considered is the case of private enterprise versus the control of private enterprise. While it is admitted that mistakes and waste occur under private enterprise, yet under planning any mistake that is made would be much more serious and might involve very great losses and waste. From an examination of the records in Somerset House of joint stock companies, it has been found that 60 per cent of the companies formed over a certain period were dead in ten years, that less than 30 per cent survived twenty years and only 18 per cent survived for 40 years. This is a high mortality and indicates the risks involved. In money, the wastage amounts to about forty-four million sterling a year or one or two per cent of the national income of England and Wales at the time. A sixth of the year's savings was offset by the dead loss involved. These figures indicate that, under planning, the risk of loss which would result from serious mistakes is very great indeed.

Deprecating dramatic talk about a new order of things, Prof. Macgregor held that what is really required is to work our way gradually into a higher and better organisation of competitive industry such as would have worked itself out if the War had not taken place. There has been much talk about President Roosevelt's "New Deal", but it should be remembered that in Britain we dealt these cards long ago. For example, the Trade Board legislation dates back to 1909 and our social insurance scheme to 1911. America is not so much giving a new deal as dealing in a hurry.

Sir Josiah Stamp, who followed, stated that he felt that the change now going on is rather greater than Prof. Macgregor was prepared to admit. There is, he said, an instinctive feeling at the present time among many persons that unco-ordinated individualism has given rise to maladjustments, since under it every individual conducts his business entirely within the limits of his own estimations of the market, with resultant mistakes. When we have all these individual business judgments being made, the total supply forthcoming is practically accidental. The consequence of mistaken judgments has now become too serious for others to put up with it lightly. Therefore we are told that it is impossible to go back to the muddle of individualism. On the other hand, the technique of planning is likely also to lead to a muddle, and the question is, which muddle are we going to deal in ? Most persons to-day would seem to hanker after the middle line between unrestricted individualism and complete national planning. He agreed with Prof. Macgregor that if we do plan and make mistakes, then we shall be faced with something worse than we had under individualism. A solution cannot be found by imposing fixed prices on the community, since the more this is attempted, the more likely we should be to have the reactions which were prevalent during the War period. The possibilities of making profits must be there, for we cannot revive industries by sitting on the mainspring. If there were no profits—whatever form these may take—the industry would have to be subsidised by the community and would become merely parasitic.

Prof. W. F. Bruck, formerly of the University of Münster, maintained that planned systems which aim at excluding the market, with its free play between private undertakings, in favour of the State as leader of the national economy, exist only in theory. Even in Russia, such domination of the economic sphere is limited in the home market by capitalist methods and in the world market by the price mechanism of the liberal economy. However complete the socialist planned economy may be, it cannot eliminate risk ; it can only transfer it from private enterprise to the State. The forces of economic life, like the forces of Nature themselves, can only be influenced, not absolutely controlled. Complete abolition of the market is impossible and any attempt to submit the complex organisation of modern trade to regimental discipline is hazardous. These obstacles and our present incomplete knowledge of them will compel those who strive to exclude the market from their planned economies to re-invent the market that they have eliminated. To-day, no State shows either a perfect liberal economy or a perfect planned economy, but all show invasions in the economic sphere. The economy of our States is a mixture of both capitalism and socialism, and they only differ in the degree of the intensity of this mixture, ranging from present-day England through America, Germany and Italy to Russia. In advocating the formation of industrial units similar to the German 'mixed enterprises', which provide a compromise between public and private control, Prof. Bruck suggested that whole trades might be controlled in this way either in groups, cartels or co-operative societies. The 'mixed enterprise' combines the advantages of private organisation, which avoids red tape and politics, with those of State participation, which ensures proper consideration of the interests of the community.

Prof. A. Gray, of the University of Aberdeen, said that while he is not necessarily opposed to planning, it is difficult to know what exactly it is all about. Let us admit, he said, that planning may in certain cases bring health to an industry by the elimination of useless units and by the rationing of supply at such a level as would enable a profitable price to be exacted. But does this bring us any nearer to the ultimate solution of the problem ? It may merely result in placing the members of a particular industry in an advantageous position. There might be 'cut-throat' competition between different industries just as much as between different units in the same industry. Most industries are competing against each other for the favour of the consumer. Short of making people consume according to plan, nothing would prevent changes of tastes and desires ; men are inconsistent ever and women are a great deal more. One element of uncertainty in long-distance planning is the possibility of variation with regard to population. Thus the United States appears to be approaching a stationary stage and in many respects they have built for a larger population than they are likely to achieve. If the State be the planner, it must have a population policy. A planned State demands planning, not merely in industry, but also in all the diverse elements of national life.

Physical and Chemical Properties of Heavy Water

IN the recent joint discussion of Sections A (Mathematical and Physical Sciences) and B (Chemistry) on September 10, at the British Association meeting at Aberdeen, on heavy hydrogen, two points of some interest were referred to by those taking part. During the last two years, the experimental confirmation of the theoretical anticipations of the differences in behaviour, both physical and chemical, of the two hydrogen isotopes has proceeded at a remarkable speed. In the course of these investigations, in which both light and heavy hydrogen have been employed under similar conditions, it has been found possible to examine by isotopic labelling of the hydrogen atoms in a molecule a certain number of what may be termed exchange reactions.

The two simplest exchange reactions involve reactions between the gaseous isotopes themselves and between deuterium and water

$$H_2 + D_2 \rightleftarrows 2HD$$
$$H_2O + D_2 \rightleftarrows DHO + HD$$

In the catalytic hydrogenation of unsaturated organic compounds, such as ethylene or benzene in the presence of nickel or platinum as catalyst, the experiments on the replacement of the hydrogen by deuterium not only provide a confirmation of the view originally advanced by Sabatier that a metallic surface monohydride is the effective catalyst, but also reveal the interesting fact that exchange reactions occur and that these can proceed independently of the process of hydrogenation, namely :

$$C_2H_4 + D_2 \rightleftarrows C_2H_3D + DH$$

Whilst the energetics of these reactions have not been investigated in great detail, the qualitative evidence indicates that the energies of activation are small, suggesting that the reactions are brought about not so much by an unexpected fragility in the covalent link between carbon and hydrogen when the hydrocarbon is adsorbed, but rather by a species of atom interchange between adsorbed atoms, one being attached to the hydrocarbon, a mechanism similar in some respects to the *ortho-para* conversion in hydrogen effected by hydrogen atoms. Incidentally, our crude picture of the interactions which occur when a molecule such as ethylene is adsorbed on a nickel surface has to be modified to a very considerable extent, and also the migration of double bonds in complex organic compounds in the presence of such hydrogenating catalysts may merit thorough investigation.

Deuterium thus provides us with a tool to examine exchange reactions, some of which as we have seen are not only of a somewhat unexpected nature but also could not have been discovered by the ordinary methods of investigation. In addition, deuterium is proving of great value in assisting us to elucidate the mechanism of a number of chemical actions involving hydrogen.

Such reactions may involve participation of hydrogen atoms, hydrogen molecules or unstable intermediary compounds of hydrogen, for example, O_2H in the hydrogen-oxygen reaction or NiH in hydrogenating reactions at a nickel surface. By suitable experiments, it is possible to examine the changes both in the velocity and in energies of activation caused by the replacement of hydrogen by deuterium, and from such data to determine, sometimes uniquely, in other cases by elimination, which is the rate-governing step in the reaction mechanism and which of the three possible participants enumerated above is actually involved in this step. In this way, it has been found possible to confirm that the mercury photosensitised reduction of nitrous oxide takes place through an atomic mechanism, that the rate of the photochemical combination with chlorine is governed by the link involving a hydrogen molecule :

$$H_2 + Cl \rightarrow HCl + H ;$$

that the mercury photosensitised reduction of ethylene does not proceed through a chain mechanism; and that the chain mechanisms of the thermal combination of hydrogen with nitrous oxide and oxygen differ in that in the former a hydrogen atom is involved in the slowest link reaction and in the latter either a hydrogen molecule or a compound such as O_2H. Further information on the zero point energies of such complexes may permit of a decision between these two possibilities.

It was evident from the discussion that, quite apart from the more sensational and, at present, much more mysterious action of compounds of heavy hydrogen, especially water in biological processes, the new isotope provides an extremely effective weapon with which to extend our knowledge of the mechanism of the reaction kinetics of what are generally regarded as simple systems. E.K.R.

Hydrogenation of Coal in Germany

THE partial conversion of coal into liquid fuels by treatment with hydrogen gas under pressure at high temperatures is a technical process which is finding application in Great Britain, and a description of the method as used in Germany, given by F. Rosendahl (*Die Naturwissenschaften*, **33**, 554 ; 1934), is therefore of interest.

The development of the original process due to Bergius has been brought to a successful stage by the I. G. firm. The conditions for operation require that the reaction should be accelerated by suitable catalysts and that the sulphur, nitrogen and oxygen of the coal should be set free and united with hydrogen. The design of apparatus which could resist the action of sulphur and hydrogen under high pressure was also a difficult problem. As catalysts, the sulphides of iron, tungsten and molybdenum have been adopted, but the physical state of the contact mass is of great importance. In this way, two-thirds of the coal is converted into light liquid hydrocarbons, and it is possible to produce illuminating oil from coal.

The process occurs in two stages. In the first, the carbon compounds are decomposed and the carbon converted into hydrocarbons. This stage is practically quantitative, 15 per cent of gaseous and 85 per cent of a mixture of low and high boiling oils being formed. This stage is operated with a paste of

dried and powdered brown coal and oil under a pressure of 200 atmospheres in contact with hydrogen, the reaction chambers being tubes 18 m. long, 0·8 m. diameter, and with walls 13 cm. thick. The materials are heated to a temperature of about 500° C. The liquid product is then distilled, and heavy oil (used in mixing with the coal), petrol (benzine) and middle oil obtained.

The middle oil then undergoes the second stage of the treatment. It is again brought in contact with hydrogen under 200 atm. pressure, the whole mass being heated so that it becomes gaseous, and the reaction is allowed to proceed in a furnace, no details of which are given. The gaseous and liquid parts of the cooled product are separated, the excess of hydrogen being previously taken off under pressure. The liquid is distilled and the middle oil obtained again undergoes treatment.

The process is said to be capable of producing lubricating oils as well as petrol. About 20 per cent of the carbon of the coal is recovered as gaseous hydrocarbons (methane to butane), which may be used as such or converted into chemical compounds. Propane and butane are fairly easily liquefied, and can be used for lighting and heating. Such gases are used in the motors of 'zeppelins'. The gases may also be converted into hydrogen by reaction with steam.

In the hydrogenation process, which is strongly exothermic, the control of the temperature is very important, and the whole process must proceed within a narrow zone of temperature. If this is allowed to be exceeded, the temperature rises very rapidly and the reaction vessel may burst. To prevent attack of the steel vessels by sulphur, they are treated with zinc vapour, which produces a diffusion layer of iron-zinc mixed crystals. The vessels themselves are of chromium-nickel steel, containing vanadium, molybdenum and tungsten.

The whole process is one of considerable interest and importance, and possesses obvious advantages—apart from costs, which are not dealt with—over petroleum cracking, since the latter process does not produce lubricating oils of any value from the crude oil and also leaves a considerable proportion of coke.

University and Educational Intelligence

CAMBRIDGE.—The Frank Smart studentship in botany is vacant. Any graduate of the University is eligible provided that not more than fourteen complete terms have elapsed after the first term of residence. The value of the studentship is £200, and candidates' names should be sent to Prof. A. C. Seward at the Botany School before October 2. Candidates should submit a statement of the course of research it is proposed to undertake and such evidence of qualifications as they think fit.

ST. ANDREWS.—The date of the installation of General the Right Hon. J. C. Smuts as rector of the University has now been definitely fixed as October 17. The Senatus Academicus has resolved, on the occasion of the installation, to confer the honorary degree of LL.D. upon the following, among others: Sir Thomas Holland, principal of the University of Edinburgh; Mr. John Hutchinson, of Kew Herbarium; General the Right Hon. J. C. Smuts.

A COURSE of evening lectures on television will be given on Thursdays, commencing October 4, by Mr. J. J. Denton, at the Borough Polytechnic, Borough Road, London, S.E.1. The syllabus and further information can be obtained from the Principal of the Borough Polytechnic.

ACCORDING to the Berlin correspondent of the American Medical Association (*School and Society*, Feb. 17), German universities should be fortified against the debilitating influences of departmentalism and high specialisation by reforms recently decreed by the Prussian Minister of Public Instruction. A candidate for appointment to an instructional post will in future be required to have served several months in a field station or work camp in which conditions are such as to test his virility. Only after undergoing this test with credit will he be admitted to the *Dozentakademie*. Here, participating in a strictly organised community life while pursuing courses of a general scientific character, he will have to prove his worth in fields outside his specialty and will be expected to develop the general impulses requisite for the instruction of youth in the Germany of to-day. Lastly, he will be examined as a specialist. All this involves a radical breach with the tradition according to which the appointment of instructors used to be left to the unfettered discretion of the department, if not to a single member of it, with the result that candidates were selected for their scholastic attainments within their chosen special field without regard to their general qualifications. The *Dozenten* have, moreover, been organised as a society with bureaux which will deal, *inter alia*, with questions pertaining to reforms in curricula and the privileges of Germans who have emigrated to foreign countries.

Science News a Century Ago

A Lecture on Animal Physiology

Lecturers who dealt with the more popular aspects of natural science had, in early times, to consider the moods and composition of their audiences. Although no actual censorship existed, it was not deemed desirable to invest a discourse in physiology or in botany with too full details respecting the processes of function, for there was a risk of offending current established and entrenched habits of thought. The *Analyst*, in reporting a lecture on "Animal Physiology", delivered on September 29, 1834, by George Sheward, before the Worcestershire Literary and Scientific Institution, made the following comments:—"Mr. Sheward made choice of 'Animal Physiology' as the ground work of his lecture, and it becomes our duty to speak of it as a composition written for oral delivery. We wish it to be clearly understood that we do not entirely object to the peculiar matter chosen for the lecture. . . . The great difficulty however, suggested to our mind, was, how to steer clear of those technical explanations which are necessary to unfold the history of the animal economy, without trenching on the delicacy and fastidiousness of the auditors, one half of which possibly were females—but we are bound to say Mr. Sheward very dexterously contrived to throw becoming drapery over this department of his scientific research, and adapted it to the ears of the sensitive and the scrupulous. There can be no doubt

that the lecturer stripped much professional detail—but some downcast looks from the sisterhood convinced us that he had not pruned quite enough. In truth, although unwilling to check the progress of science, we begin to think that some very peculiar subjects, such as, 'the digestive and other organs, midwifery', etc. had better be confined to the lecture rooms of the hospital."

Distilling Water for Ships

The simple process of obtaining a supply of fresh water in ships by distillation only came in after a long series of experiments, and a century ago men-of-war still obtained their fresh water from shore. "Casks were landed, rolled up the beach, filled and rolled down the beach, and 'parbuckled' into the launches." Yet, so early as 1593, Sir Richard Hawkins had a distilling apparatus in his ship, and in 1762 Dr. Lind showed the Royal Society how fresh water could be obtained from sea water. One experiment just a century ago, on September 29, 1834, is recorded in the *Times*. The apparatus was the invention of Mr. Wells and the experiment was made in a vessel moored for the occasion alongside "Carey's floating bath off Westminster Bridge". The experiment was entirely successful, and was watched by several naval captains and other persons interested in shipping. "The apparatus itself is in height about 4 feet 6 and in breadth and length about 4 feet. It is a steam kitchen calculated to supply the place of a galley and caboose, and capable of cooking for 70 or 80 persons. It weighs about 11 cwt. and consumes in 12 hours about 2 cwt. of coal. It purifies sea water at the rate of a quart a minute; the steam or distilled water is condensed with great rapidity by means of a pipe or tube through which it passes being carried along the outside of the bows and side of the vessel, and brought into immediate contact with the ocean, by which means it is rendered immediately cool; the pipe re-enters the vessel and the fluid drops from it as from the worm of a common stile. This simplification of the process of condensation appears to be the principal novelty, and it is not the less valuable for its simplicity of contrivance."

Washington and the American Philosophical Society

At a meeting of the American Philosophical Society held on October 3, 1834, the librarian presented the original reply of General Washington to an address sent to him as one of the members of the Society in December 1781, on the occasion of the capture of Lord Cornwallis. In his letter, which was addressed to Dr. Thomas Bond, a vice-president, Washington said: "Permit me through you, to return my warmest thanks to the American Philosophical Society, for this very polite mark of their attention and esteem. I have ever set the highest value upon the honour which was conferred on me, when admitted into a Society instituted for the noblest of all purposes, that of 'promoting useful knowledge' and have long wished for an opportunity of rendering myself, in some degree, worthy of my election. Happy am I, therefore, in receiving this public assurance from Fellow members, that my Services, upon a late important occasion, have contributed to give them an additional security in their pursuit of Science. . . ." The minutes of the Society recording the election of Washington as a member having been lost, it was ordered that the letter be entered in the minutes.

Societies and Academies

PARIS

Academy of Sciences, August 6 (*C.R.*, 199, 393–444). H. DESLANDRES: A simple and general relation of the molecular spectrum with the electrons and rings of electrons of the constituent atoms. SERGE BERNSTEIN: The absolute convergence of trigonometrical series. A. BIGOT: The Bathonian reefs of Normandy. SAUVEUR CARRUS: The trajectories of the meridians of a surface of revolution. THADÉE PECZALSKI: Study of the internal radiation of the electric arc. L. COLOMBIER: The variation of the electrolytic potential of nickel with the acidity. PAUL CORRIEZ: The X-ray diagrams of various peranthracites and true anthracites. MLLE. ELLEN GLEDITSCH and ERNST FOEYN: The actinium-uranium ratio in radio-active minerals. From the examination of seven minerals from different sources, the value 0·128 is deduced for this ratio. PIERRE AUGER: Absorption measurements of the γ-rays by the method of coincidences. The case of the radiation of excited beryllium. ANDRÉ DE PASSILLÉ and MARIUS SÉON: The thermochemistry of the ammonium phosphates. HENRI TRICHÉ: Quantitative spectrographic analysis: application to silicon. LOUIS MÉDARD: New results on the Raman effect of the hydroxyl radical. Data are given for formic acid, monochlorhydrin, glycol, hydroxylamine and glycerol. MME. SIMONNE ALLARD: The structure of a paraxylylene. YVES RAOUL: A new technique for the determination of hordenine. MARCEL MATHIEU and CONSTANTIN KURYLENKO: Remarks concerning the absorption of acetone by the nitro-celluloses. Discussion of the effects of the presence of traces of water during the absorption of acetone by the nitrocellulose. ANTONIN LANQUINE: The structure of the Provençal chains in the north of the eastern Varois region. PAUL CORBIN and NICOLAS OULIANOFF: Aerial photography in the service of geology. An account of work done in the Alps. JACQUES FROMAGET: New observations on the age and structure of the oldest sedimentary and crystalline formations to the north of Tonkin. PAUL SELTZER: The influence of a forest on the temperature of the air. Discussion of continuous records of temperature carried out in the forest of Haguenau (Bas-Rhin) with the view of determining the influence of the forest on the temperature of the air. PAUL BERTRAND: Observations on the classifications of the true Pecopteris. AUGUSTE and RENÉ SARTORY, JACQUES MEYER and HANS BÄUMLI: An attempt at differentiating between the parasitic cellulolytic fungi of paper. Comparison of the action of *Cladosporium*, *Fusarium* and *Aspergillus* on pure cellulose, with special reference to the effect of the culture media added. LÉON BINET, M. LAUDAT and J. AUCLAIR: The lowering of the alkaline reserve and the movement of the chlorine in the blood in the course of hyperthermia produced by short waves. The rise of temperature produced by short waves (15–18 metres) leads to a fall in the alkaline reserve of the blood plasma accompanied by a slight increase in the proportion of chlorine in the plasma and a slight fall in the number of corpuscles.

Academy of Sciences, August 13 (*C.R.*, 199, 445–468). LOUIS DE BROGLIE: The wave equation of the photon. A. C. MUKHERJI: Continued functions possessing a perfect ensemble of singularities, everywhere discontinuous. GEORGES ALLARD: A general method of statistics applicable to groups of indiscern-

ible particles. JACOB J. BIKERMAN : The velocity of the establishment of potential. MME. LUCIE LEFEBVRE : The suppression of certain bands of the spectrum of ozone under the action of low temperature. A diagram is given showing the ultra-violet absorption bands at 20° C. and −80° C. RADU TITEICA : The absorption and fluorescence spectra of some hydrocarbons with two benzene rings. JEAN BOUCHARD : The influence of viscosity on the decrease of fluorescent power of solutions of certain colouring matters as a function of the concentration. CAMILLE LEFÈVRE and MAURICE RANGIER : The oxidation of organic sulphur applied to its determination. Organic sulphur can be determined by wet oxidation if the sulphur is not united to oxygen in the molecule. The presence of the SO or SO_2 groups confers a power of resistance to oxidation in solution. LOUIS MONTLAUR : Climate and the physical wants of the plant. Means of comparing them. B. S. LEVIN and C. PIFFAULT : Variations observed, following subcutaneous injections of colloidal lecithine in the guinea-pig, in the radio-resistance of its red blood corpuscles *in vitro*.

GENEVA

Society of Physics and Natural History, May 3. W. H. SCHOPFER : The technique of the preparation of extract of wheat for the study of the growth factor of micro-organisms. The author has studied the mode of preparation of the extract of the wheat germ containing the growth factors of the micro-organism. The method based on the precipitation of the active factor by phosphotungstic acid gives good results. A technique based on the elimination of the proteins by trichloracetic acid can be substituted. The final product, however, has lost part of its activity, some of the factor having been absorbed by the precipitated protein. E. MOLLY : Observations on the rocks of Abyssinia (1). The author has studied the problem of the relative age of the volcanic formations. G. GUTZEIT and R. GALOPIN : The chemical differentiation by the spot method on a polished surface of some similar sulphosalts. G. GUTZEIT, R. WEBEL and R. DÜCKERT : A new specific reaction for antimony cations. One of the condensation products of the hydroxyl derivatives of benzene has proved to be a remarkably specific colour reagent for the antimony cation. The exact constitution of this derivative has not been established. P. WENGER, G. GUTZEIT and TH. HILLER : A method of electrolytic attack of opaque minerals and its application to the technique of etching polished surfaces. The authors have found an extension of the method of etching allowing the elements to be identified directly starting with the insoluble minerals, through the action of the electric current (application of the Glazunov method to the polished surfaces of opaque minerals).

LENINGRAD

Academy of Sciences (*C.R.*, n.s., 2, No. 4). I. P. NATANSON : On the convergence of series of orthogonal polynomials. B. DAVYDOV : The Fokker-Planck equation in the phase space and the relaxation period of the Maxwellian distribution. L. I. MANDELSTAM : The problem of the diffusion of light in an unequally heated space. L. V. MYSOVSKIL and M. S. EIGENSON : Observations on the neutrons from cosmic rays in Wilson's chamber. Following Locher's work (*Phys. Rev.*, 44, 779 ; 1933) the authors obtained tracks from one to fifteen centimetres long of heavy particles. M. SAVOSTJANOVA and A. TOPOREZ : Formation of centres in the crystals of halogen-silver salts. R. E. ALBRANDT : Theoretical basis of the design of instruments for measuring temperatures. V. V. ALPATOV and O. K. NASTJUKOVA : Increase of the toxicity of quinine under the influence of the short ultra-violet rays. The toxicity increased by 20 per cent. A. V. FROST and M. I. SHAPIRO : Nature of the active spots of catalysts. It is suggested that the catalytic activity is connected with those points of the catalyser at which its crystalline structure is damaged. V. N. ORECHOVITCH and N. V. BROMLEY : Histolytic properties of the regenerating blasteme. An increased decomposition of proteins, due to the hystolitic properties of blasteme, takes place in the tissues of the part of the organ beyond the regenerating part. E. A. STERN and A. S. KRIVSKIJ : The action of metals at a distance on the structure and development of *Bacillus mycoides*, Fl. Heavy metals placed at 0·5–2 mm. from the colony of the bacilli depress the formation of spores. N. V. NASONOV : The structure produced in the axolotl by the subcutaneous insertion of a destroyed regeneration bud. L. S. BERG : A note on *Culter recurviceps*, Rich. (Pisces, Cyprinidæ). A Chinese species known under that name is discussed, and a new name *Erythroculter macrophthalmus* is offered for the Formosan fish determined as *C. recurviceps* by Tanaka. B. K. STEGMAN : Contribution to the phylogeny of the genus *Nucifraga*. The genera *Nucifraga* and *Cyanocephalus* represent a natural group, which must have originated in the ancient continent which existed in the Bering Straits.

ROME

Royal National Academy of the Lincei, April 22. U. CISOTTI : Determination of an analytic function. G. SCORZA : A certain real algebra of the fourth order. G. BRUNI and G. NATTA : Structure of unstretched rubber studied by means of electron rays. Unstretched rubber shows a non-crystalline structure when examined with X-rays, but when very thin laminæ are investigated by means of rapid electron rays, an orientated structure is revealed. The hypothesis that the molecules of rubber in thin, unstretched sheets are arranged in a contracted, spiraliform manner must be abandoned. P. ALOISI : Questions concerning the geology of Tuscany, particularly of Elba (1). A. TONOLO : The sine theorem for triangles traced on a surface. C. SEVERINI : Parseval's formula. E. BORTOLOTTI : Geodetic references along several lines in varieties with allied connexions. G. CALAMAI : The canonical system of a class of differential equations of the second order with periodic coefficients. MARIA PASTORI : The equations of the mechanics of non-Euclidean isotropic media. G. D. MATTIOLI : The dynamic theory of turbulence. B. FINZI : Integration of the indefinite equations of the mechanics of continuous systems (1). T. FRANZINI : The action of an external electric field on hydrogenated metals. E. AMALDI : Effect of the electric field on the limits of the absorption series of potassium. E. SEGRÈ : Effect of the electric field on the absorption series of sodium. C. ANTONIANI : New method of preparing xylose from maize cobs. Increased yields of xylose, with only slight formation of humous substances, are obtained by hydrolysing the cobs with 0·1 per cent nitric acid solution. Subsequent concentration in a vacuum results in the expulsion of most of the acid. V. CARMINATI : Cariometric determinations on the livers of rats bearing tumours in various stages of development.

Forthcoming Events

INTERNATIONAL UNION OF PURE AND APPLIED PHYSICS, October 1–6. Sessions on the solid state and on nuclear physics respectively.

Tuesday, October 2

At the Royal Institution, Albemarle Street, London, W.1.
At 10–12.30.
Sir William Bragg: Opening survey and general statement. Dr. E. Hückel: "Aromatic and Unsaturated Molecules: Contributions to the Problem of their Structure and Properties." Dr. F. Hund: "Description of the Binding Forces in Molecules and Crystal Lattices on Quantum Theory (Valency and Coordinate Binding)." Dr. J. M. Robertson will present a table of atomic distances in organic compounds determined by X-ray analysis. Succeeding discussion to be opened by Prof. J. E. Lennard-Jones.
At 2–4.30.
Lord Rutherford: Opening survey and general statement. Prof. R. A. Millikan: "Cosmic Radiation." Prof. A. H. Compton: "A Study of Cosmic Ray Bursts at Different Altitudes."

Wednesday, October 3

At the Royal Institution.
At 10–12.30.
Dr. C. D. Ellis: "β-Ray Type of Radio-Active Disintegration." Prof. Guido Beck: "Theoretical Consideration on the Radio-Active β-Decay." M. and Mme. Joliot: "Artificially Produced Radio-Elements." Prof. E. Fermi will take part in the discussion.
At 10–12.30.
At the Royal Society, Burlington House, London, W.1.
Dr. A. Joffé: (*a*) "On the Cause of the Low Value of Mechanical Strength." (*b*) "On the Mechanism of a Brittle Rupture." Dr. E. Orowan: "The Rupture of Plastic Crystals." Dr. E. Schmid: "Plastic Deformation by Slip." Dr. W. G. Burgers: "Shear Hardening and Recrystallisation of Aluminium Single Crystals." Prof. G. I. Taylor, Dr. H. J. Gough and others will take part in the discussion.
At 2.30–4.30.
Prof. P. P. Ewald and Dr. M. Renninger: "The Mosaic Structure of Rock Salt." Prof. A. Smekal: "The Fine Structural Characteristics of Salt Crystals." Prof. E. N. da C. Andrade and Dr. C. H. Desch will take part in the discussion.
At 2.30.
Prof. P. M. S. Blackett: "Cosmic Rays and the Absorption of High Speed Particles." Prof. G. Hoffmann: "The Connexion between Cosmic Radiation and Atomic Disintegration." MM. Auger and Leprince-Ringuet: "The Latitude Effect." Prof. Rossi: "Some Results obtained in the Study of Cosmic Rays."

Thursday, October 4

In the Arts School, Cambridge.
At 2–4.30 and 5.30–6.30.
Dr. J. Chadwick and Mr. N. Feather: "α-Particles and Neutrons." Dr. J. D. Cockcroft: "Transmutations Produced by High Speed Protons and Diplons." Dr. M. L. Oliphant: "Transformation Effects Produced in Lithium, Heavy Hydrogen and Beryllium by Bombardment with Hydrogen Ions." Dr. H. R. Crane and Prof. C. C. Lauritsen: "Protons and Diplons." Prof. G. Gamow: "General Stability Problems of Atomic Nuclei." Prof. Max Born: "Quantum Electrodynamics."

Friday, October 5

At the Royal Institution.
At 10–12.30.
Prof. A. Goetz: "Experimental Evidences of Group Phenomena in the Solid Metallic State." General Discussion: Prof. M. Born, Prof. W. L. Bragg, Prof. C. G. Darwin and others.
At 2–4.30.
Report of the Commission on Symbols, Units and Nomenclature: Part I: Electric and magnetic quantities; Part II: Thermodynamic quantities.

Saturday, October 6

At the Royal Institution.
At 10.
Communication from the International Council of the Unions concerning Dr. Hale's Committee on Instruments. Future work of the S.U.N. Commission.

Wednesday, October 3

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 3.—Prof. George Barger: Inaugural Sessional Address.

BRITISH MYCOLOGICAL SOCIETY, October 1–6. Annual general meeting at Norwich.
Dr. B. Barnes: "Variation" (Presidential Address).

Official Publications Received

GREAT BRITAIN AND IRELAND

International Tin Research and Development Council. First General Report, 1934. Pp. 37. Miscellaneous Publications, No. 1: Tin Research and Development; an Address delivered to the American Tin Trade Association. By D. J. Macnaughtan. Pp. 10. Technical Publications, Series B, No. 1: The Properties of Tin. Compiled by Dr. E. S. Hedges and Dr. C. E. Homer. Pp. 45. (London: International Tin Research and Development Council.)

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1933. Vol. 68, Part 3: Report on the Prices and Supplies of Agricultural Produce and Requirements in England and Wales, 1933–34. Pp. ii+95–180. (London: H.M. Stationery Office.) 1*s.* 6*d.* net.

Battersea Polytechnic. Evening and Afternoon Courses and Classes, Calendar for the Session 1934–1935. Pp. 30. Technical College for Day Students and Day School of Arts and Crafts, Calendar for the Session 1934–1935. Pp. 48. 3*d.* Department of Hygiene and Public Health, Calendar for the Session 1934–1935. Pp. 22. 3*d.* Domestic Science Department and Training College, Calendar for the Session 1934–1935. Pp. 32. 3*d.* (London.)

Imperial Bureau of Plant Genetics: Herbage Plants. Herbage Publication Series, Bulletin No. 15: Grassland and Forage Crops in Thuringia, Czechoslovakia and Hungary. By R. O. Whyte, in collaboration with Prof. E. Klapp, Prof. F. Chmelar, Ing. Rudolf Fleischmann and Dr. G. Lengyel. Pp. 58. (Aberystwyth.) 3*s.* 6*d.*

Reports of the Imperial Economic Committee. Twenty-seventh Report: Grassland Seeds. Pp. 75. (London: H.M. Stationery Office.) 1*s.* net.

OTHER COUNTRIES

Conseil International des Unions Scientifiques: Union Géodésique et Géophysique Internationale: Association de Séismologie. Comptes rendus des séances de la cinquième Conférence réunie à Lisbonne du 14 au 24 Septembre 1933. Rédigés par E. Rothé. Pp. 439. Publications du Bureau Central Séismologique International. Série A: Travaux scientifiques. Fasc. No. 10: Communications présentées à la Conférence de Lisbonne (Septembre 1933). Pp. 138. (Toulouse: Édouard Privat.)

Journal of the Indian Institute of Science. Vol. 17A, Part 6: Petrol-Water Emulsions. Part 2: Reproducibility and Viscosity. By B. N. Narayanaswamy and H. E. Watson. Pp. 75–84. 12 annas. Vol. 17B, Part 1: On Atmospherics at Bangalore during the Polar Year. By S. P. Chakravarti and B. H. Paranjpye. Pp. 18. (Bangalore.)

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, Dominica, 1933. Pp. v+25. (Dominica.) 6*d.*

Memoirs of the Geological Survey of India. Vol. 59: The Lower Gondwana Coalfields of India. By Dr. Cyril S. Fox. Pp. xvii+386+xlix+14 plates. (Calcutta: Geological Survey.) 8.4 rupees; 14*s.*

U.S. Department of Commerce: National Bureau of Standards. Research Paper 695: Variations in Refractive Index of CO_2-free Dry Air and a Statistical Correlation with Solar Activity. By L. W. Tilton. Pp. 111–124. (Washington, D.C.: Government Printing Office.) 5 cents.

Cornell University: Agricultural Experiment Station. Bulletin 586: Consumption of Certain Perishable Farm Products in Albany, New York. By Wilbert C. Hopper. Pp. 52. Bulletin 590: An Economic Study of Land Utilization in Tompkins County, New York. Pp. 58. Bulletin 592: Soils in relation to Fruit Growing in New York. Part 4: The Significance of the Oxidation-Reduction Potential in Evaluating Soils for Orchard Purposes. By Richard Bradfield, L. P. Batjer and Joseph Oskamp. Pp. 27. Bulletin 593: Further Studies of the Influence of Different Levels of Fat Intake upon Milk Secretion, 2. By L. A. Maynard, C. M. McCay, H. H. Williams and L. L. Madsen. Pp. 14. Bulletin 600: Soil, Field-Crop and Pasture Management for Suffolk and Nassau Counties, New York. Part 1: Soil and Field-Crop Management, by A. F. Gustafson; Part 2: Pasture Improvement and Management, by D. B. Johnstone-Wallace; Part 3: Soil Map and Soil-Type Descriptions, by F. B. Howe and A. F. Gustafson. Pp. 67. Bulletin 601: Cayuga Soybean, a Home-Grown, High Oil, High Protein Concentrate. By R. G. Wiggans. Pp. 32. Bulletin 604: Removal of Lead and Arsenic Spray Residues from New York Apples. By W. T. Pentzer. Pp. 27. Bulletin 606: The Cow as a Source of "Oxidised" Flavors of Milk. By E. S. Guthrie and H. J. Brueckner. Pp. 10. (Ithaca, N.Y.)