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## Promotion of International Peace

THE attention which has been given in Great Britain during the past few months to considerations of defence and the Government's programme of rearmament, despite all the scepticism expressed as to any effective defence against attack from the air, has rather over-shadowed the other side of defence against war—the removal of its causes. To this positive aspect of the question the International Peace Campaign has the great merit of directing attention, and the appeal for support of the British National Committee of the Campaign, which has recently been issued over the signature of Viscount Cecil, has claims on the interest of every scientific worker.

The need for a more balanced handling of the problem of peace and national defence is unquestioned by well-qualified observers. The International Peace Campaign, as Viscount Cecil points out, has come into existence for the sole purpose of arresting the drift towards war, and aims at strengthening and co-ordinating organizations which already exist and are interested in peace, and although its organization takes no part in party politics, it is all the more important that it should secure support from all sections of political opinion if its policy and development are to be free from bias, however unconscious or unintentional.

The four objectives of the campaign naturally include the reduction and limitation of armaments by international agreement and the suppression of profit from the manufacture and trade in arms. This objective is not, however, over-stressed, and its practical impossibility at the time need not deter the most convinced supporter of the Government programme from supporting the Campaign, while at the same time it serves as a reminder of the necessity of such action when international

tension is lessened and a positive defence policy bears fruit.

The first objective of the Campaign, however, the recognition of the sanctity of treaty obligations, should command universal assent. However inapplicable the provisions of the Versailles treaty may be under the conditions of to-day, and however overdue their supersession, the method of unilateral repudiation adopted by Germany has dealt heavy blows at the assumption of international good faith and the respect for treaties upon which all international order and co-operation are finally based. It is not merely that Germany's other treaty obligations are viewed by other countries with the same cynicism and distrust as have been Italy's since her Abyssinian expedition—a cynicism which no announcements of Mediterranean agreements or understandings can dispel—but also confidence has been undermined, and mutual distrust, itself the chief enemy of peace, has been greatly multiplied.

It is on this main point that Dr. L. P. Jacks insisted in a recent thoughtful criticism of the League Covenant contributed to the *Hibbert Journal* under the title "Alexander Hamilton and the Reform of the League". Covenants between sovereign States can depend only on the good faith of the contracting parties, and if that is insecure nothing can be made safe. Coercive measures intended to circumvent bad faith are exposed to the bad faith they would circumvent, and indeed are more vulnerable to it, since they tend to emphasize any bad faith which exists, inflame it and afford fresh opportunities of mischief. Accordingly, Dr. Jacks urges that the elimination from the Covenant of the last traces of the coercive element and the fatal assumption upon which it

rests would have an immense and salutary psychological effect.

This argument that the better atmosphere thus created would permit the League of Nations to achieve far more effectively its proper function of protecting human welfare by international co-operation on positive lines finds strong support in a careful study of public opinion as a safeguard to peace delivered by Prof. E. H. Carr as the inaugural lecture of the Wilson chair of international politics at University College, Aberystwyth, on October 14. Reviewing the various divergent sections of opinion, from the pacifist and the isolationist to the collectivist, which to-day are found supporting the cause of peace, Prof. Carr emphasizes the necessity of regarding international politics not as a pure but as an applied science, in accordance with Aristotle's assertion that "the end of the study of politics is not knowledge but practice". Accordingly, he does not regard a system of collective security involving automatic military obligations as likely to gain sufficient support in Great Britain to be practical. He believes, on the contrary, that in this country public opinion is not prepared to support war as an instrument of any kind of policy, whether in defence of collective security or not.

Prof. Carr maintains that support of the Covenant in Great Britain is, in fact, subject to the over-riding consideration that it involves no risk of bringing the country into war, and that public opinion will not be prepared for many years to apply the Sanctions article against a Great Power. Although he does not discuss the amendment of the Covenant, as a matter of practical politics, support of Dr. Jacks' suggestion might be read as a corollary of his remarks.

There will accordingly be perhaps less unqualified support for the third objective of the International Peace Council—the strengthening of the League of Nations for the prevention and stopping of war by the organization of collective security and mutual assistance. Though Prof. Carr's belief in the possibility of isolating war will not be shared by many, and though he asserts his disbelief that the time is ripe for the establishment of anything like an international police force, there is still plenty of ground in common with the supporter of collective security. Public opinion undoubtedly presents a far more determined obstacle to war-mongering in any form than it did a generation ago. The area of the world's surface over which war has become unthinkable has been immensely

extended, and with wise handling might even yet be much greater, despite the great tragedies of missed opportunities which have marked the last two decades. The increased power of Governments to-day of influencing public opinion, whether by broadcasting or through the Press, should warn us against overrating the restraining effect of public opinion in any time of crisis except in so far as it is really informed and independent. Moreover, the whole trend of events in Spain and in Abyssinia strengthens the case for organizing effectively collective force behind law if civilization is to be preserved.

The most urgent problem if peace is to be preserved and democracy survive is in fact that of peaceful change, which forms the fourth objective of the Campaign and upon which Prof. Carr lays the greatest stress. The establishment within the framework of the League of effective machinery for remedying international conditions which might lead to war is the most urgent task of our generation, and offers an immense field for impartial scientific investigation. There can be no rule of law unless there is working machinery for making and re-making law, and no sanctity of treaties without effective means for altering or re-making treaties which are no longer applicable to the prevailing conditions.

Nothing in fact is so imperative at the present time as the need for demonstrating that such questions as raw materials, population, colonial territories and the like can be dealt with justly and impartially by a process of peaceful change and not merely at the demand of *force majeure*. The greatest function of public opinion, whether expressed through the International Peace Campaign, or in any other way, is to insist on the Government exploring the possibilities in this way to the utmost so as to remove and not engender further friction. Nor should it be forgotten that peace is dynamic and not static, and, just as much as war, involves risks and ventures. Only as the nations and the Governments are prepared to run those risks and to make those ventures can we hope to develop a civilization and a social and international order in which in days of peace the human mind and spirit can find expression no less nobler than they have done in the past in days of national extremity or calamity in war. A creative peace is in fact a first essential if science, no less than art and religion, is to retain its full freedom of expression and bring yet richer treasures to the service and inspiration of mankind.

## A Compendium of Bengal

**Life and Experiences of a Bengali Chemist**  
By Prafulla Chandra Rây. Vol. 2. Pp. viii+469.  
(Calcutta : Chuckervetty, Chatterjee and Co.,  
Ltd. ; London : Kegan Paul and Co., Ltd., 1935.)  
6s.

THE second volume of Sir P. C. Rây's "Life and Experiences" is concerned chiefly with economics and politics and very little with chemistry. The author calls it "a compendium of India under British rule"; but this description is rather too comprehensive. The book is written by a Bengali who loves Bengal and has devoted his life to its welfare. To him, the rest of India is an incident, sometimes even an encumbrance. Other patriotic Indians hold similar views regarding their particular province or State, and the reader may thus readily realize some of the difficulties which confront the Central Government and the reasons for the establishment of provincial autonomy.

A quarter of the book is devoted to an illuminating history of education. There is little doubt that education in India has gone seriously astray. The uneducated masses have no real desire for their children to be educated, and thus we meet the phenomenon of the school which hurriedly comes into existence on the arrival of the inspector, to vanish as rapidly when he has departed. In such circumstances, progress can scarcely be rapid. But what is progress? Experts hold fundamentally divergent opinions as to what constitutes a suitable form of education, and, even if there could be some general agreement as to the system, how is the education of some three hundred million people to be paid for when they are too poor to contribute even fourpence a head per year (the amount of the much-debated salt tax)? It would seem that the only solution of the problem is for patriotic Indians in every village to devote an hour or so daily to the instruction of their weaker brethren.

It is generally assumed that universal primary education is a desirable goal, but is this so? If any conclusions can be drawn from the thousands of luckless graduates who, after many years of self-denial and overwork, are unable to secure the salary of a cook or a chauffeur, even primary education may not always be a blessing.

A recitation of the misdeeds of the Government of India fills most of the remainder of the volume. No one will deny that blunders have been committed, the greatest of which, perhaps, was when,

with seven dead Delhis before them, Government set to work to construct an eighth, and this not merely a temporary winter residence for officials but a city which was to surpass in magnificence and costliness any of its predecessors. Small wonder if critics assume that Government has no desire for economy and no real interest in the welfare of the country, and, indeed, that behind every action, no matter how well-meaning, there lurks some sinister intention.

A man of science, however, who knows how readily his carefully planned experiments may go astray, before leading to improvement and final progress, should be chary of finding fault with others until he can point out a better way. Granted that Government has made mistakes, is it not going rather far to accuse it of spreading malaria by building a railway embankment many years before the cause of the disease was known, or to speak of their "criminal and wilful neglect of irrigation" when they have initiated schemes which are the admiration of the world? The peace which India has so long enjoyed is said to have emasculated the people, and communalism to have been deliberately fostered. Statements such as this, in which the book abounds, can do nothing but detract from its value. Nor does it help greatly to compare modern India with the more prosperous India of the past. Infant welfare, improved sanitation, inoculation against disease, albeit but a fraction of what might be done, and the reduction of famine mortality by the opening up of communications, have all resulted in the presence of three million extra mouths to feed every year. As the struggle for existence grows keener, individual strives against individual, community against community and province against province. Is this the fault of Government, or some inherent defect in the character of man?

Japan and Italy are held up as examples of what may be accomplished, but there is a fundamental difference. The Japanese are bound together by a patriotism greater, perhaps, than that of any other nation, while the progress made in Italy is the result of a compulsion which would never find favour in India, even if it were administratively possible. The Indian, on the other hand, is essentially an individualist, although there have been many broad-minded and great men who have the country's interest at heart. Sir P. C. Rây is fully aware of this trait; indeed, he says: "A great drawback in our national character is that, as soon as the founder of the concern dies,

his sons or successors quarrel among themselves as to who should manage it". He points out frankly many other shortcomings of his people and exhorts them to frugality, honesty of purpose, self-reliance and patriotism. Those who know him are well aware there could be no better preacher, for, throughout his long life, he has practised

every precept he preaches with a vigour which is beyond admiration—yet how many heed his advice? True reform must come from within; until the individual learns that service to others is as vital as self-interest, no Government on earth can bring prosperity in place of poverty and misery.

H. E. W.

## Shabti Figures

### Shabtis

Illustrated by the Egyptian Collection in University College, London: with Catalogue of Figures from many other Sources. By Sir Flinders Petrie. (British School of Archaeology in Egypt and Egyptian Research Account, Forty-first Year, 1935.) Pp. x+16+45 plates. (London: British School of Egyptian Archaeology, and Bernard Quaritch, Ltd., 1935.) 25s.

**I**N this volume, which forms part of the series of monographs planned by the author to cover the development of the principal departments in the civilization of ancient Egypt, Sir Flinders Petrie has surveyed from its origins the history of the custom of placing one or more small representations of the mummy in the tomb. The survey is more complete than any previous study that has been attempted, and covers not only the collection at University College, London, numbering 650 examples, but also a further 565 from the Italian and other museums. In addition to the register or catalogue of these, there is a corpus of the inscriptions, and the types are illustrated in a series of excellent photographs.

In an analysis of the material which precedes the catalogue, Sir Flinders first examines the evidence bearing on the origin of the custom. Although the ushabti figure, properly speaking, does not appear until the Twelfth Dynasty, he traces the conception from which it grew back to the pre-dynastic custom of separating the skull from the disarticulated bones and burying it either in an unnatural relation to them, or above the pile of stones which covered them. Evidently burial had been delayed in order to secure the help of the ancestral spirit, possibly by keeping the skull in the house. Analogous customs of West Africa are quoted in support. By the Twelfth Dynasty the idea of the terrestrial habitation for the soul, involving the provision of house, furniture and other appurtenances of a life on earth, had given place to a translation to the realm of Osiris, where not only were pleasures to be enjoyed, but also duties had to be performed. When once the conception had gained currency

that such duties were the function of the ushabti figure, it was only a step, though it was not a step taken until the end of the Eighteenth and beginning of the Nineteenth Dynasties, to the idea that the ushabti was not a representation of the deceased, but a slave. Then the one figure, hitherto single, except in Royal burials, took on added numbers, until it was necessary to include overseers with whips. In the later dynasties there were frequently so many as four hundred or just under. The duties the shabti figures were to perform were by no means light: originally the weaving of cloth, to this was added the carrying of sand and later the cultivation of the soil. Sir Flinders, by his study of the date at which variations in the inscriptions on the shabti appear, is able to trace the development at various periods in the conception which inspired their use.

The material from which the shabti figures were made varies from stone to wood, and even mud was used. The most familiar form is perhaps that made of pottery and covered with blue or green glaze. The form varies in like manner, and at times becomes almost shapeless.

In connexion with the use of wood for a figure with magical properties, Sir Flinders refers to the Greek parody of the idea in Lucian in the story in which a magician turns a piece of wood or a household article into a servant to perform any function for which he requires it, and then transforms it back again, the jest being that the teller of the story, knowing part of the formula, sets an animated piece of wood to carry water, but being unable to make it stop, cuts it in two and doubles the danger of inundation. Sir Flinders tells us that the story has been revived in a modern French symphonic poem; but there are many other versions. It was a familiar story in the Middle Ages and is told of a pupil of the thirteenth-century magician, Michael Scott, who tried to emulate his master. It is interesting to note that the duty of carrying sand associated with the dead in the realm of Osiris, also appears in connexion with Michael Scott, who set the Devil to carry sand on the shores of Fife.

## Aromatic Diazo-Compounds in Industry

### The Aromatic Diazo-Compounds and their Technical Applications

By K. H. Saunders. Pp. xii + 224. (London: Edward Arnold and Co., 1936.) 12s. 6d. net.

IN this very concise treatise the author has summarized the history of the industrially important diazo-compounds since their earliest recognition by Peter Gries in 1858 until the present time. The various methods of preparing diazonium salts are reviewed, including the recent outstanding discovery made independently by Hodgson and Schoutissen that *o*-diamines can be made to give the reactions of bisdiazonium compounds.

The rapid development of industrial activity in the ice colours based on Naphthol AS and its analogues has led to many devices for stabilizing diazo-compounds. Among these the use of the stable forms of diazo-sulphonates is noteworthy as leading to valuable monoazo-dyes of the variamine blue class. The author presents a clear and comprehensive account of the abstruse researches on the constitution of diazo-compounds carried on for a number of years by Hantzsch, Bamberger and many others, and more recently by Angeli.

At present the industrial utilization of diazo-compounds is much in advance of our theoretical knowledge concerning their constitution. It is pointed out that the score or more of aromatic amines supplied commercially in a high degree of purity for ice-colour work could now furnish for research purposes diazo-derivatives which were not available formerly. In addition to the couplings which lead to industrially important hydroxyazo- and aminoazo-dyes, the diazo-compounds serve for many synthetic operations in aromatic chemistry, whereby the halogens, including fluorine, and several other non-metals and some metals are introduced into benzenoid nuclei. All these reactions are described and there is a full bibliography which includes references to the literature of heterocyclic diazo-compounds.

In spite of the intricacy of the subject matter, the text is remarkably free from errors and there are adequate author and subject indexes, although the former does not always tally with the references at the end of each section. This book may be recommended with confidence as the most up-to-date monograph on the diazo-reaction in the English language.

G. T. M.

## Racial Portraiture: a Sculptor's View

### A Sculptor's Odyssey

By Malvina Hoffman. Pp. xxii + 416 + 128 plates. (London and New York: Charles Scribner's Sons, Ltd., 1936.) 24s. net.

SIX years ago, the Field Museum of Chicago formulated a bold and novel project. Dissatisfied with the conventional lay-out of the anthropological section of the average ethnographical museum, it conceived the plan of a sculptural Hall of Man, to consist of one hundred sculptured heads and figures, modelled from life, and embracing the main surviving anthropological types—a far-sighted break with museum tradition, which, if judged solely on the statistical evidence of subsequent visitors, has amply justified the trustees' vision. To Miss Malvina Hoffman, who already at that time filled a unique and outstanding position in the world of sculpture, was entrusted this colossal task; and this volume—well named her *Odyssey*—leads up, through her

early years of struggle, to the inner story of its achievement.

As an unassuming record of travel and observation, of perseverance in the face of unexpected difficulties, of the transport of the hundred precious clay figures in China and Japan, Java and the South Seas, Burma, India, and Europe, it is a fascinating piece of writing, though marred at times—particularly towards the close—by an odd sentimentality: but for the technical reader it has a wider and two-fold significance. Here was a comprehensive anthropological problem, which might have been approached *ex cathedra*, from the academic angle, each sculptured figure being created an elaborate synthesis of exact facial angles and accurate anatomical measurements. In practice, mercifully, the task was planned and executed by an artist: and, as Sir Arthur Keith writes of Miss Hoffman's work, "we professional anthropologists can never hope to obtain by mere measurements the accuracy of racial portraiture

which comes by instinct to the true artist". In London, there is small opportunity to study Miss Hoffman's sculpture, though some idea is given by the two heroic figures above the entrance to Bush House: but the large success of her Hall of Man can readily be estimated from the magnificent plates in this volume.

A further significance of the book is implicit and to some extent explicit in Miss Hoffman's narrative. Hers is not an art in which the hand of the master is withdrawn immediately the original clay is modelled, leaving all subsequent work to plaster caster, *metteur au point*, or bronze founder. It is abundantly evident from her writing that Miss Hoffman has served an apprenticeship to her craft comparable to that served by the medieval and Renaissance craftsman: and while, obviously, the casting of a heroic bronze is essentially a piece of fine team-work, she has herself mastered in

practice every detail—building the armature, modelling, plaster casting, and all the subtleties and scientific tricks of casting in bronze by the sand and lost-wax techniques. The book is an opportune reminder of the ancient gospel once more being preached to young artists and craftsmen—clear recognition of the limits imposed upon execution by the material properties of the medium: and complete mastery and understanding of technique, in contradistinction to mere empirical facility.

Not the least interesting section of the book is that which gives in compact form the succession of exact manipulations which lies between the clay model and the patinated bronze. Nevertheless, the book is essentially one for the non-specialist, for whom a friendly narrative of travel is woven through pages of magnificent photographs.

P. D. R.

## Survey of British Agriculture

### Regional Types of British Agriculture

By Fifteen Authors. Edited by J. P. Maxton. Pp. 318. (London: George Allen and Unwin, Ltd., 1936.) 12s. 6d. net.

ALTHOUGH Great Britain is a small country, it presents a surprising diversity of soils, a wide range of altitude and rainfall, and extreme variations in density of population. These factors have resulted in a large number of farming systems which only have one thing in common, namely, a very close suitability to the environment in which they have grown up. A good general knowledge of the type of agriculture carried on in the more important natural divisions of the country should be part of the equipment of all students and teachers of agriculture, and for the increasing numbers of those who, while not actually in the farming industry, are interested in its development in relation to national policy.

The description of farming systems has certainly not been an overworked field in the past. There are the classical county surveys done for the Board of Agriculture at the end of the eighteenth century, and numerous articles describing farming districts in the volumes of the *Journal of the Royal Agricultural Society*. We have also descriptions of farming tours made in recent years, of which those of Rider Haggard (1901–2), and Sir Daniel Hall (1910–12) are perhaps the best known. But much has happened since then, and types of agriculture that held their own for generations have yielded before the pressure of present-day

economic movements, while others have entered into relative prosperity as a result of Government action.

The units of the present volume are the fifteen advisory provinces into which Great Britain is divided, and the agriculture of each is described in almost all cases by the head of the department of agricultural economics. Naturally the province is far too large an area to be treated as an agricultural whole, so that a system of farming zones within provinces has been adopted, and the characterization of the separate regions has been set out. Since some eighty separate regions are treated, it will be understood that descriptions are necessarily brief, and the authors have in many cases been compelled to hold very close to the matter in hand, avoiding the entertaining detours and personal touches that writers who have had more elbow-room have been able to allow themselves.

The treatment of each province is on uniform lines. After a general discussion of the physical and geological features of the area and a note on the distribution of population, the regions are set out and described in more detail. There are numerous references to the modification in classical systems of husbandry designed to meet changing economic conditions. Clear maps are provided showing altitude, chief features, towns and the boundaries of the separate agricultural zones.

The book makes a useful addition to the rather scanty and scattered information on regional agriculture in its present-day aspects. H. V. G.

**Magnetochemie**

Von Prof. Dr. W. Klemm. (Physik und Chemie und ihre Anwendungen in Einzeldarstellungen, Band 1.) Pp. xv+262. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1936.) 18 gold marks.

By magnetochemistry is meant the examination of the problems of chemical structure in the light of magnetic measurements and modern magnetic theory, and it is clear that the author of this book has thoroughly studied the more important methods of susceptibility determinations and the theoretical significance of the results. He does not assume that his readers already know all about the matters on which he writes, and his work is a fine example of careful exposition based upon a proper attention to fundamental conceptions and definitions. The outline of experimental methods and technique is by no means exhaustive, but it should be adequate for the average chemist who is likely to read the book.

The author gives a very full discussion of the earlier theories of para- and diamagnetism, although he follows other writers in obtaining an expression for the molar susceptibility of a diamagnetic substance in which a 6 appears, without giving a complete explanation of how the 6 gets there. The survey of the newer quantum theory of magnetic moments is particularly good, and the explanation of the temperature-independent type of paramagnetism, predicted by Van Vleck, is very neatly set forth. The influence of temperature and chemical combination upon magnetic susceptibilities is also fully discussed.

A large portion of the book is naturally devoted to problems of chemical structure, and the treatment of the magnetic properties of inorganic compounds and metals is especially helpful, for it includes data which the reviewer has not found elsewhere. It can be cordially recommended to all who are interested in the magnetic aspects of chemical problems.

L. F. B.

**Le plateau de Meghalaya (Garo-Khasi-Jaintia): étude géographique d'une région naturelle de l'Inde.** Par Dr. Shiba Prasad Chatterjee. Pp. 170. (Paris: Les Presses modernes; London: The Bibliophile, 1936.) 10s. 6d. net.

"MEGHALAYA" is the name given by Dr. Chatterjee to that isolated block of peninsular India which sticks out westwards like a promontory from the Naga Hills into the plain of Assam-Bengal. The meaning is 'abode of cloud', on the analogy of Himalaya, 'abode of snow'. Although the "Khasi and Jaintia Hills", as the name appears on maps, are connected by a high ridge with the Naga Hills, they form no part of them, being very much older.

Dr. Chatterjee, who is a geologist, is the right person to have written this little study, and he has done it very thoroughly. He clearly distinguishes between the Shillong Plateau in the centre, the Garo Hills in the west, leading down to the plains, and the Jaintia Hills in the east. The physiographical distinction, well shown in the contoured sketch map, is convincing, based partly on structural and partly

on climatic differences; but to call them natural regions is to exaggerate their importance. The distinction is mainly one of relief.

The author gives a clear account, illustrated by line drawings and by sections, of the structure and evolution of the region, followed by a chapter on the climate. Cherrapunji has attained world-wide fame for its 600 inches of rainfall—not every year! The attempt to divide the flora of Meghalaya into three sub-floras, corresponding with the three physiographical areas, is not so successful; and the vegetation map naturally suffers from compression. The drawings by Mr. Frank Simpson are pleasant, and give a good idea of this interesting country of which we have heard little since Hooker's "Himalayan Journals".

**(1) Heat Engines**

By S. H. Moorfield and H. H. Winstanley. Second edition. Pp. vii+326. (London: Edward Arnold and Co., 1935.) 6s. 6d.

**(2) Examples in Heat and Heat Engines**

By T. Peel. Second edition. Pp. vi+146. (Cambridge: At the University Press, 1935.) 5s.

(1) For those beginning the serious study of the theory, Messrs. Moorfield and Winstanley's primer "Heat Engines" has already obtained recognition as a suitable medium of introduction to the subject. The second edition follows the lines of the first, but is enlarged by the addition of a chapter on steam turbines. It thus covers the work usually required for the Ordinary National Certificate and presents a difficult subject in an easy and convincing way very suitable for those of limited attainment in mathematics.

(2) "Examples in Heat and Heat Engines", by T. Peel, also in its second edition, contains fifty sets of graduated and arranged questions taken from *A* and *B* papers of the Cambridge Engineering Tripos or prepared in accordance with that standard—a very useful series for those preparing for the advanced examinations.

**Lorenz Oken und Georg Büchner:**

Zwei Gestalten aus der Übergangszeit von Naturphilosophie zu Naturwissenschaft. Von Jean Strohl. (Schriften der Corona, Band 14.) Pp. 106. (Zürich: Verlag der Corona; München und Berlin: R. Oldenbourg, 1936.) 5 gold marks.

Few people to-day have ever heard of Georg Büchner, while their ideas about Oken turn mainly on his "Lehrbuch der Naturphilosophie", a rather fantastic work, and his controversy with Goethe as to the vertebral origin of the cranium. They lived in a period of controversy which played around irrational theories but was often somewhat poetic in its conceptions. The philosophers of the early part of the last century were indeed imaginative and honest, but too abstract to provide a popular theory of life. The author of the little book before us, however, does not set out to expose this, but to produce a pleasant and readable book on two interesting personalities—and he has succeeded.

## A New Alloy of High Density

By Dr. C. J. Smithells

THE use of large masses of radium in beam therapy necessitates the provision of adequate protection. At the same time, the actual container should be as small as possible if the radium is to be used efficiently, particularly in inaccessible positions. Absorption of the harmful  $\gamma$ -radiation by metals is directly proportional to their density, and for this reason a smaller container, or bomb, can be used if it is made of a metal of high density. The bomb and nose-piece, to give the necessary protection, weigh 50–100 lb. and have usually been made of lead, which has a density of 11.35

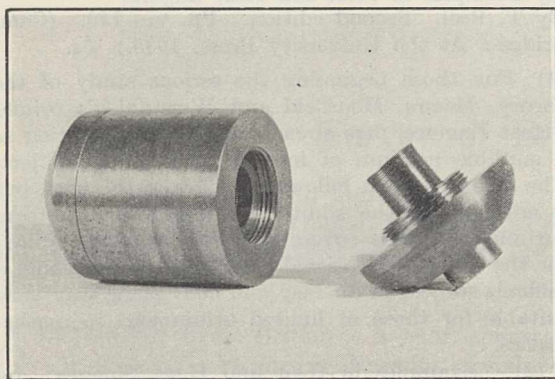


Fig. 1.

TUNGSTEN ALLOY RADIUM CONTAINER.

gm./c.c. The actual nose-piece has sometimes been made of gold, but this metal is too expensive to be used for the bomb itself.

The problem of producing an alloy of high density at a reasonable cost was suggested to me by the late Sir John McLennan. The only metal which is reasonably cheap, having a density comparable with that of gold, is tungsten; but a high density is only attained when the metal has been sintered at about 3000° C., and no means are available for heating masses approaching 1 cwt. to such a high temperature.

The problem has been solved at the Research Laboratories of the General Electric Co. at Wembley by mixing tungsten powder with a small proportion of a metal of lower melting point, so that a liquid phase is formed on heating to a moderate temperature. If the tungsten particles are wetted by the liquid metal, shrinkage results, and densities closely approaching the theoretical are obtained. Either nickel or copper are suitable additions for this purpose. Copper melts at 1084° C., whilst

nickel and tungsten form a eutectic melting at just above 1400° C. If the heating is carried out in an atmosphere of hydrogen, the tungsten particles are wetted in both cases. 5–10 per cent of either nickel or copper powders, or a mixture of the two, is added to the tungsten powder, which is then pressed to the required shape in a steel die and heated in hydrogen at 1450° C. for an hour. Since a linear shrinkage of about twenty per cent occurs during sintering, allowance must be made for this in designing the dies.

The alloy generally used for radium bombs contains 5 per cent copper and 5 per cent nickel, and the density of the finished pieces lies between 16.3 and 16.5 gm./c.c. With a smaller proportion of added metal it is possible to obtain densities in excess of 17. The density of the new alloys is therefore fifty per cent greater than that of lead, and a corresponding reduction in the size of the bomb is possible.

The microstructure shows particles of tungsten embedded in a matrix of copper, copper-nickel, or nickel-tungsten according to the composition employed. Although tungsten itself is practically not machinable, the alloys can be readily machined with ordinary tools, drilling, tapping and screw-cutting presenting no difficulties. Where large surfaces have to be machined, it is an advantage to use a tool of the cemented tungsten carbide type.

Owing to the difficulty of pressing very thick sections, it has been found most economical to construct radium bombs by welding together a number of annular rings. These may be up to one inch thick and five inches in diameter. Their surfaces are accurately machined and then placed on one another with 0.1 mm. nickel foil between them. On heating to 1450° C. in hydrogen, the nickel melts and forms a perfect weld. A complete bomb is shown in Fig. 1. About ten bombs have now been made in this way and are in use in various hospitals in Great Britain. One or two installations employing them have already been referred to in NATURE<sup>1</sup>.

Although developed primarily for radium work, tungsten alloys made on this principle are finding several industrial applications. An alloy of this type has been used successfully for balancing crankshafts for internal combustion engines used in racing motor-cars. It seems likely to find a similar application in aircraft engines. It has



also been used in gyroscopes and for similar purposes where high density combined with strength is necessary. The tensile strength of the sintered alloys is about twenty-two tons per square inch, but although they can be hot worked, they have very little ductility cold.

The largest application, however, is as a contact material for heavy-current circuit breakers. For this purpose, the alloy is applied as a facing brazed

on to the copper contact arms. Contacts having a superficial area of about two square inches have been used successfully to break currents of 130,000 amperes at 6,000 volts. Tungsten has, of course, long been recognized as a useful contact material, owing to its low vapour pressure, but the pure metal could not be produced economically in the large sections required for high-power electrical engineering purposes.

<sup>1</sup> NATURE, 139, 52 (1937).

## The Starling in the United States of America

By Dr. Walter E. Collinge

THE dangers arising from the introduction of foreign species of animals have frequently been dwelt upon by zoologists of all nationalities. The results of such acclimatizations have nowhere been more pertinently summarized than by Palmer<sup>1</sup> in 1893.

The species to which we here wish to direct attention is the European starling (*Sturnus vulgaris* Linn.). Thirty-five years ago we possessed a very meagre knowledge of the feeding habits and economic status of this bird, and it was introduced into various countries in the belief that it was distinctly beneficial to the farmer and fruit-grower.

The earliest record I can find of its introduction into the United States is that made by the Acclimatization Society of Cincinnati, Ohio, which liberated a number in the winter of 1872-73. In 1877 the American Acclimatization Society liberated a number in Central Park, New York, and again in 1890 about sixty birds were released. In 1889 and 1892 thirty-five pairs are reported to have been released at Portland, Oregon. In April 1890 eighty birds were released in Central Park, New York, and forty more in March of the following year. Later, smaller numbers were liberated in different localities.

From these various importations the starling has increased and spread throughout the whole of the north-eastern States, and it is gradually spreading westwards. The extension of the range and the methods of spread have been fully dealt with by Mrs. Mary Thacker Cooke<sup>2</sup>, while a fully detailed account of the food and feeding habits has been published by Kalmbach and Gabrielson<sup>3</sup>. To this latter I shall refer later.

Few seem to have regarded the starling as a potential danger to the United States. Writing in 1916, Forbush<sup>4</sup> stated, "Already the starling

has begun to show a capacity for harmfulness which may be expected to become more prominent as its numbers increase. . . . Perhaps it is too early yet to say what will be the final result of the introduction of the starling into this country. Its value as an insect destroyer is plain; but its unchecked increase may prove a calamity to several species of useful native birds, and from the experience of other countries we may assume that it is likely to become a pest to the fruit grower."

In any attempt to arrive at the true economic position of this bird, we must not lose sight of the fact that it is a powerful animal with a strong and formidable weapon of defence in the shape of its beak. Moreover, it exhibits great powers of caution and intelligence.

A further point of interest is its great fecundity; it is exceedingly difficult to estimate even approximately the actual number of pairs of breeding birds in the United States; but for the purpose of illustrating the rate of increase, we will presume that in 1933 there were 200,000 pairs, and that each pair reared three pairs of young, half of each sex, and that all lived together with their offspring. The progeny and parents in a single year would total 1,600,000. At the end of 1934 this number would have increased to 6,400,000, the addition in 1935 would make the total 25,600,000, while at the end of 1936 there would be more than 102,000,000 birds.

These figures are calculated on the basis of a single brood per year, though in many parts of the country there are two broods. Even allowing for a very high rate of mortality, it is clear that the annual increase is enormous. Herein lies a potential danger which should not be overlooked.

Knowing how injurious this bird has become in Great Britain and also in Australia, New Zealand

and Tasmania, let us consider the nature of its food in the United States. An examination by Kalmbach and Gabrielson of 2,157 stomachs shows that 57 per cent of the food consists of animal matter and 43 per cent vegetable matter, and of this animal content 41.55 per cent is composed of insects. The full details are as follows: weevils 8.50 per cent, ground beetles 5.71 per cent, May beetles 2.24 per cent, other beetles 3.14 per cent, grasshoppers 12.41 per cent, caterpillars 6.04 per cent, millipedes 11.71 per cent, Hymenoptera, Hemiptera, Diptera and other miscellaneous insects 5.93 per cent, animal garbage 1.32 per cent, cultivated cherries 2.66 per cent, other cultivated fruits 1.75 per cent, wild fruits 23.86 per cent, grain 1.16 per cent, vegetable garbage 13.57 per cent.

In Great Britain, we obtain rather different figures: animal food constitutes 51 per cent and vegetable food 49 per cent. Of the former, 26.5 per cent consists of injurious insects, 2.5 per cent of beneficial insects and 3.5 per cent of neutral insects, 8.5 per cent of earthworms, 6.5 per cent of slugs and snails, 1.5 per cent of millipedes, and 2 per cent of miscellaneous animal matter. Of the vegetable food, 20.5 per cent consists of cereals, 2.5 per cent of cultivated roots and leaves, 15.5 per cent of cultivated fruits, 7 per cent of wild fruits and seeds of weeds, and 3.5 per cent of miscellaneous vegetable matter. Summarizing these figures, we find that 36.5 per cent of the starling's food constitutes a benefit to the agriculturist, 41 per cent an injury, and 22.5 per cent is of a neutral nature.

A brief comparison of the figures resulting from the above two investigations shows that in Great Britain the starling has taken to feeding upon cereals and cultivated fruits to a much greater extent than in the United States, and we have little doubt that as this bird increases in numbers a similar change in its feeding habits will take place in America.

There was a time, no doubt, when in Great Britain this bird was a most useful and beneficial

one to the agriculturist, just as it is at the present time in Ontario<sup>5</sup>, but once let it reach the high-water mark of abundance, and it becomes equally injurious. It is this fact which we wish to stress, for once this bird reaches the high-water mark it will prove a much more serious pest than the European house-sparrow.

By the enactment of wise repressive measures this calamitous state of things may be averted; but if the situation is not properly realized and things are allowed to drift, then the agriculturists and fruit-growers of the United States will suffer as seriously as, or even more than, those of Great Britain.

Writing in 1912, I stated<sup>6</sup>: During the first six months of the year the food in an urban district was distinctly of an insectivorous character, and the evidence from the food generally would lead us to place the species amongst those birds beneficial to the agriculturist and horticulturist, but a similar record extending over the same period taken in an agricultural district would, in all probability, reveal the starling as a destroyer of newly sown grain, and extended over the summer months, would show that it inflicts considerable losses upon fruit growers. As the result of further investigations, I was forced to the conclusion that "the starling has become a plague in the land and a source of great national loss".

It is a pity that this undesirable alien was ever introduced into the United States, but that is past history; what must be looked to at the present is to see that a very careful watch is kept upon this bird from all aspects, and that its numbers be strictly limited. For the information of how this may best be done American citizens may look with every confidence to their famous and unrivalled Department of Economic Ornithology in the Biological Survey.

<sup>1</sup> Year Book, U.S. Dept. Agric. for 1893, pp. 87-110.

<sup>2</sup> U.S. Dept. Agric., Dept. Circ. No. 336, 1-7 (1925).

<sup>3</sup> U.S. Dept. Agric., Bull. No. 868, 1-66 (1921).

<sup>4</sup> Mass. State Bd. Agric., Circ. No. 45, 1-23 (1916).

<sup>5</sup> Lewis, Univ. of Toronto, Biol. Studies. No. 30 (1927).

<sup>6</sup> Second Rpt. Econ. Biol., 1912, pp. 65, 66.

## A New Method in Biogeography

THE last two or three decades have witnessed great progress in the studies of ecological and geological factors of distribution of plants and animals, but the results of these studies have had little influence on biogeographers, whose work is still mainly concerned in the parcelling out of the globe's surface into regions, provinces, etc., characterized by statistical ratios of endemic forms and

those common to several divisions. The methods of biogeographical work remain generally the same as in the time of Wallace, and a great proportion of literature (zoogeographical in particular) is devoted to discussions of the exact boundaries between formal divisions. When, however, two types of fauna or flora, different in their geological origin and adjusted to different ecological

conditions, have to develop in close geographical proximity, there can be no linear boundary between them. Their various elements will penetrate more or less deeply into the main area occupied by the other type, this process being usually favoured in the case of one of the types by slow climatic changes in a certain direction. When such changes, for example, favour the spread of forests over a steppe area, some 'islands' of steppe with their characteristic plant and animal population will still remain as evidence of former conditions. Usually, in calculating statistical ratios, such inclusions of alien fauna, or flora, are not distinguished from the elements of the dominating population, which is obviously incorrect.

The need for more careful analysis of populations of geographical areas is better realized by botanists than by zoologists, and modern plant geographers (Braun-Blanquet, Eig, and others) base their analyses on 'phytogeographical elements', and discriminate between continuous distribution of a species, its penetration into a strange area and its 'insular' occurrence in the latter. Zoogeographers, on the other hand, are generally satisfied with the old methods of characterizing the fauna of a country by the full quota of its species regardless to the type of their occurrence, and by drawing line boundaries where, at the best, a more or less broad transitional zone exists in Nature.

Partial attempts to improve on these antiquated methods are not lacking in biogeographical literature, but no definite proposals of a new way of representing distributional facts have been made until the recent paper by Dr. B. K. Stegmann "On the Principles of Zoogeographical Division of the Palæarctis as the Basis of a Study of Types of its Ornithofauna" (*Bulletin Acad. Sci. U.S.S.R.*, pp. 523-563 + 7 maps; 1936). Dr. Stegmann condemns the idea of mapping zoogeographical divisions separated by line boundaries, and bases his work on the 'types of fauna' which are characterized by the common ecology and past history of their members. The distribution of each type

of fauna is to be shown on a map in a special colour, whether it is continuous, or disrupted and 'insular'. Unfortunately, no coloured map is given in the paper (which is only a preliminary one), but a series of black and white maps, each showing the distribution of one type of fauna, is most instructive. Two of these maps are reproduced here (Figs. 1 and 2) in the hope that this will make clear the principle, which is of course very simple.

In the Palæarctis the author distinguishes seven types of bird fauna, as follows:

(1) *Arctic type*, which has a circumpolar distribution, being connected ecologically with the



Fig. 1.

DISTRIBUTION OF THE SIBERIAN TYPE OF FAUNA.

arctic zone north of the tree limit. Some arctic elements occur discontinuously in the alpine zones of European and Asiatic mountains, so far south as the Pyrenees, the Alps, the Urals, Tarbagatai, Altai, Khankhai and Kentei mountains. They are absent from the Caucasus and Tian-Shan.

(2) *Siberian type*, or the fauna of taiga (boreal coniferous forests). This populates a continuous area in Eastern Siberia and extends, with gradual reduction in the number of species, to the south Siberian mountains, and those of northern Mongolia, as well as through the northern half of western Siberia into Scandinavia. Some typical taiga birds occur sporadically also in the forests of Central European mountains, in the Pyrenees, in Tian-Shan and even in the mountains of Kansu, Szechwan and Khawin, south-eastern Tibet (see Fig. 1).

(3) *European type*, connected with the western European deciduous forests, and extending continuously, but in a gradually narrowing zone, to the southern Urals. Many species belonging to this type penetrate into northern Europe and south-western Siberia, while some occur sporadically in southern Siberia and even trans-Baikalia. The forests of North Africa are also populated by birds of European type, and the same applies to forests of the Caucasus and Turkestan (see Fig. 2).

(4) *Mediterranean type*, comprising species connected with xerophilous scrub, steppes and deserts. This fauna populates southern Europe, North

south-eastern Asia. It prevails in Japan and China, where it gradually passes into the Indo-Malayan fauna. To the west, this type of fauna extends over the Himalayan forests to Kashmir, a few elements penetrate to Afghanistan and Turkestan, and one even to the Caucasus. Northwards, many Chinese elements extend to Amurland and some even to trans-Baikalia and the Altai; isolated occurrences are recorded so far north as Yakutsk.

It will be seen, even from this very brief summary, that the result of a careful application of the new principle will be either a series of maps, each showing the distribution of one type of fauna (like the two reproduced here), or a composite map in colours showing the great complexity of population of the Palæarctis, and proving the futility of any linear boundaries, since these would inevitably cut across the actual faunistic and ecological connexions and produce a highly artificial picture. There can be no doubt, therefore, that this new method of biogeographical mapping represents a great step towards a more scientific treatment of distributional problems, as compared with the statistical biogeography of the present day. Of course, this type of investigation

requires a thorough analysis of the ecology, phylogeny and past history of each taxonomic group before it can be referred to one or the other faunistic type, but this is the only way to put biogeography on a sound scientific basis.

The difficulties of such work are great and the pitfalls are many, as can be seen even in the example of the paper under review, where the Mediterranean type of fauna obviously includes at least two profoundly distinct faunas, those of the dry Mediterranean scrub and those of treeless deserts. Even in the case of birds, the differences are striking, and this is still more so for other groups of animals. However, this is only a minor fault of the paper, which should mark a new period in the development of biogeography, and deserves the serious attention of zoologists and botanists.

B. P. UVAROV.

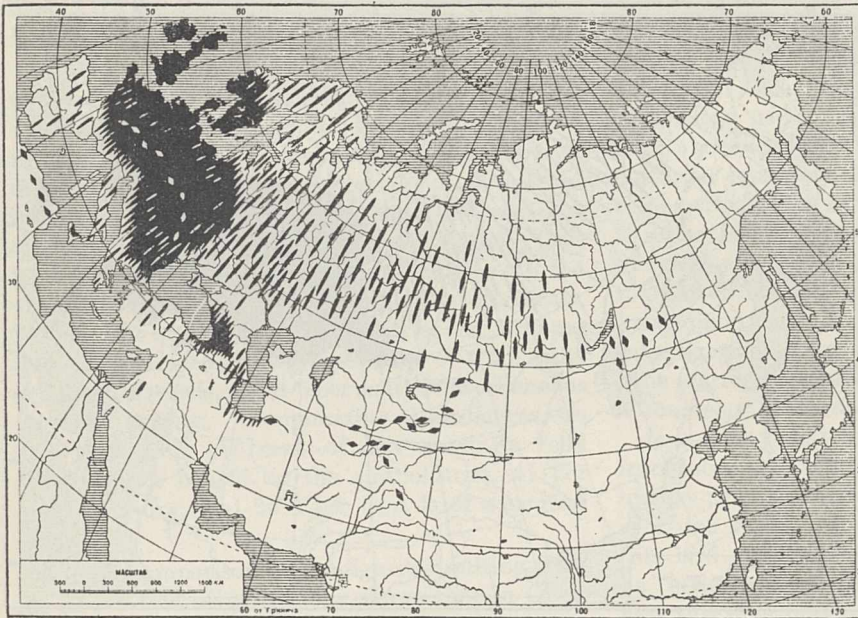


Fig. 2.

DISTRIBUTION OF THE EUROPEAN TYPE OF FAUNA.

Africa and south-western Asia up to Iran and Afghanistan. Only a few Mediterranean elements penetrate farther east to the Mongolian Altai and Alashan. Northwards, these elements extend to southern England, Germany, the Hungarian plain and the south Russian steppes.

(5) *Mongolian type*, consisting of species living in the steppes and cold deserts of Mongolia, whence many of them extend into Turkestan. A few Mongolian species occur so far west as Iran, Syria, Asia Minor, Egypt and even northern Africa (two species). In the north they occur in isolated steppe 'islands' in the midst of the Siberian taiga.

(6) *Tibetan type*, found in the alpine zone of Tibet and the Himalayas and, sporadically, on all high mountains of Palæarctis and even of North America.

(7) *Chinese type*, consisting of elements ecologically connected with broad-leaved forests of

## Obituary Notices

### Prof. Giuseppe Sergi

BY the death on October 17, 1936, of Giuseppe Sergi, professor emeritus of anthropology in the University of Rome, at the advanced age of ninety-five years, the science of man has lost not only its senior exponent, but also a student whose interests in that many-sided field of knowledge were both broadly distributed and profoundly rooted.

Giuseppe Sergi was born at Messina, Sicily, on March 20, 1841. He was educated at Bologna; and at the age of nineteen years, he took part in Garibaldi's expedition to Sicily. After that adventure, he devoted himself to scientific studies and in 1880 was appointed to a chair in the University of Bologna. Four years later he became a professor in the University of Rome, where he founded the Institute of Anthropology, of which he remained the head, occupying the chair of anthropology in the University until 1916, when he retired, receiving the title of professor emeritus. In retirement, however, he was far from inactive; and during the remaining twenty years of his life many publications, some of considerable importance, came from his pen. At the time of his death, he had made more than four hundred contributions to the printed literature of science, and in addition had written frequently on social and political subjects.

Sergi's early published work, of which the first recorded item appeared in 1868, was concerned with the history of certain concepts in philosophy; but it was not long before he manifested his interest in ethics and psychology. Like many of his countrymen, he had come under the influence of Herbert Spencer. Not only did he contribute an introduction to an Italian version of Spencer's system of ethics; but also he himself wrote a history of moral philosophy, and contributed to the discussion of Spencer's conception of the State as an organism. Psychology, however, proved a more lasting, or at least a more prominent, interest in his mental development, to which he returned time and again. He was one of the first to give attention to experimental methods in this science. Nor did he neglect psychic manifestations, upon which he produced a book in 1880; but here his point of view had special reference to the biological aspect, an aspect which is prominent in all his not inconsiderable work on abnormal and criminal psychology. His "Principi di Psicologia sulla Base della Scienza sperimentale", first published in 1873, appeared in several revised editions, and he was the author of a number of works on this subject of an authoritative character. He also wrote with understanding on the methods of pedagogy and discussed the merits of the Froebellian system.

During the years, formative as they may be regarded, between the late 'seventies and the early 'nineties, Sergi's attention had been turning more and more towards what was his main life-work. In

1876 he had been joint editor of the Bulletin of the Academy of Medicine at Rome, and not long after, as his publications show, he began to take a serious interest in anthropology. In 1882 he published a paper on an improved method of measuring the facial angle. It was, however, in the following year that a decisive interest determined his future bent. In the introduction to a little volume published towards the close of his life, "Alba Longa" (1934), he tells us how in 1883, when he was spending a holiday in the valley of the Po with his friend Eduardo Brizio, the archaeologist, he was attracted by the problem of the ancient inhabitants of that region, and it was, he says, in three papers dealing with the Ligurians, the Celts and the necropolis of Villanova, which he wrote and published in that year, that he began the long series of studies which led up to and culminated in his determination of the physical characters and ethnic history of the Mediterranean race.

From this time onward, Sergi was busily engaged in preparation for his great work. Every skull to which he could obtain access, ancient and modern, not only from Italy and the Mediterranean, but also from every quarter of the globe, was carefully examined. The list of his papers published at this time bears eloquent testimony to his activity. Nor did he neglect collateral lines of inquiry. So far back as 1872, in a work entitled "History and Philology", a book of Indo-European studies, he had shown his interest in the derivation and history of the early peoples of Italy. He now gave renewed attention to the archaeology of the Mediterranean area, as appears in a book on the method of racial history, "Antropologia e Scienze Antropologiche" (1889), which is remarkable for its insight into the nature of the problem and its breadth of view, especially when the date of its publication is taken into account.

A second product of these years of preparation was an innovation in the method of craniology, which Sergi himself undoubtedly considered his most important contribution to the method of anthropological science. Anthropological method, he maintained, should not differ from zoological method; and, therefore, he argued, more attention should be given to the morphology of the skull: the anthropologist should be able to determine race by inspection, just as the zoologist is able to determine species, whatever it may be, and whatever region it may come from. In reaction both from the extravagant comparisons of the day, in which similarities and identities were discerned in widely distributed types solely on the basis of similarities of craniological measurement, and from fallacies of interpretation, Sergi proposed to substitute for measurement the observational examination of the skull, more especially when viewed *in norma verticali*. He therefore classified skulls into groups, according to the outline, which he distinguished by various terms such as

'beloid', 'ovoid', 'pentagonoid' and the like. These revolutionary views were first put forward at the International Anthropological Congress at Moscow in 1893. Commenting some years later on the results of his researches on the Mediterranean race, Sergi said that he had followed the various peoples of the Mediterranean with their racial names in ancient and modern history, and had examined the ancient and modern skulls of the peoples of Iberia, Liguria, Central and Southern Italy, Greece, Asia Minor and Egypt, and among them all, from Spain to Hissarlik, he had found about a dozen forms of skull, and these were common to all, while the ancient cranial form invariably resembled the modern, whatever foreign influence might have intruded. Further, he maintained that these forms did not occur at all among other peoples of Europe, such as Celtic, Germanic and Finnic—a statement, be it said, which has been regarded by his critics as at least subject to qualification.

Sergi's great work, "Origine e Diffusione della Stirpe mediterranea", which must be regarded as the crown of his labours, appeared in 1895. A German translation was published in 1897, and an English version appeared in 1901. This last contained so much additional matter as to constitute what was virtually a new work. It is of interest, and of indubitable importance in assessing Sergi's position, to bring "The Mediterranean Race" into relation with the anthropological thought of the time of its publication. Without in any way impugning Sergi's impartiality in viewing the facts, it may be said that he was inspired by a reaction against 'Germanism', the view then held in certain quarters that the early civilization of Europe, that is, the civilization of the Mediterranean, was due to the impact on the peoples of that area of a tall, long-headed, fair race, identified with the Aryans, who were held to have originated in Northern Europe, and further, were said to be represented in the modern population by the Germans and their racial affinities. In reply to this last contention, Sergi argued that the Germans were not to be distinguished from Celts and Slavs with whom they had always been associated, and with whom they were often confused; while the long-headed fair peoples of northern Europe, the Reihengraber and Viking types, were of Mediterranean origin.

Sergi, in fact, maintained that the neolithic population of Europe and the Mediterranean area, the Mediterranean race, the North African peoples, and the long-headed population of Northern Europe were three offshoots, or varieties of one original Mediterranean, or Eur-African race, which had sprung from Africa, and of which the Mediterranean was the centre of dispersal. The Mediterranean culture, which had ultimately blossomed into the civilization of Greece and Rome, was entirely a product of this Mediterranean race, developing a seed which had been brought from Asia Minor. So far was this development from being the work of the Aryan speaking peoples, that it was they, the peoples of Asiatic, and not European, origin who, he maintained, had been the destroyers of that culture. It will be remembered that at the time this was written, Sergi had before

him only the evidence of the so-called Mycenaean age, and the Minoan civilization of Crete, which would have added strength to his argument, was as yet almost unknown.

Any attempt to estimate the value of Sergi's work and methods in the subsequent development of anthropological studies must take into account at least two factors. Of these, one was the development at about the same time of the application of biometric methods to the study of man, which to a certain extent and with limitations rehabilitated anthropometric measurement as a means of observation; and the second was the publication of Deniker's classification of the races of Europe (1897 and 1904) and Ripley's work "The Races of Europe" (1901), which following more nearly traditional methods of study, appeared to afford greater precision in working than Sergi's scheme. Sergi himself, though continuing to employ his method of inspection and classification of form throughout his life, later abandoned his extreme attitude towards craniometry; but his arguments, though not adopted in full by his fellow anthropologists, have secured in an increasing degree that reliance should be placed on observational study of the skull to bring out differences which are obscured by or escape measurement.

Of Sergi's later work, considerable though it is in volume, little need be said here. It never attained the international importance of his Mediterranean studies. In 1908 he published the results of an application of his theories to study of the relation of the Mediterranean race to the peoples of Europe generally, and later extended his published work to cover the field of the races of man as a whole, and the question of the origin and descent of man, where he turned to consider the geological and palaeontological evidence bearing on anthropological studies. In this field his most important work is "L'Uomo", which appeared in 1911. That he maintained fully his mental vigour and flexibility to the end is demonstrated in a remarkable book "La più antica Umanità vivente" (1930), in which he skilfully interpreted the evidence of Rhodesian man in tracing a line of descent from Neanderthal man to representative types in modern races. E. N. F.

#### Dr. A. Daniell

By the death of Dr. Alfred Daniell in Edinburgh on January 12, there passed one who had made a distinct mark in the world of science. Born at Llanelly eighty-three years ago, he early showed a bent towards educational attainment. In consequence, while still a boy, he was sent north to pursue his studies in the University of Edinburgh. He had a distinguished course in arts, medicine and science, obtaining many successes and distinctions, particularly in science. For a time he was lecturer in the Medical School. He also worked under Prof. (afterwards Lord) Lister in the old Royal Infirmary, where he had charge of the Out-patient Department. He was the author of the well-known "Text Book of the Principles of Physics" published by Messrs. Macmillan and Co. so long ago as 1884, and "Physics for

Students of Medicine". These publications were successful, especially the former, which was translated into various foreign languages.

In 1886 Dr. Daniell became an advocate of the Scottish Bar, and in 1894 he sought a wider sphere, becoming an English barrister—in each case seeking to utilize his scientific attainments in his new profession.

Dr. Daniell was faithful through life to his Alma Mater at Edinburgh, of which he became M.A., D.Sc., and LL.B. He took part in certain of its activities while health permitted. He was also a fellow of the Royal Society of Edinburgh.

The last twenty years of Dr. Daniell's long life were spent in Edinburgh. He was chiefly occupied in writing a new book called "Problems in Physics", which he was able to finish, but was not destined to see published. He also revised, and partly rewrote, his "Text Book". But for some time before his death, failing health greatly curtailed his activities.

WE regret to announce the following deaths :

The Right Hon. Sir Austen Chamberlain, K.G., P.C., Chancellor of the University of Reading since 1935, and chairman of the Court of Governors of the London School of Hygiene and Tropical Medicine and of the Governing Body of the British Postgraduate Medical School, on March 16, aged seventy-three years.

Mr. A. Gallenkamp, founder of A. Gallenkamp and Co., Ltd., makers of laboratory equipment, on February 26, aged eighty-eight years.

Prof. A. Pictet, honorary fellow of the Chemical Society and formerly professor of organic chemistry in the University of Geneva, on March 12, aged eighty years.

Dr. Elihu Thomson, the well-known American electrical engineer, who received the Hughes Medal of the Royal Society in 1916, on March 13, aged eighty-three years.

## News and Views

### Prof. T. C. Hodson

THE announcement of the impending retirement of Prof. T. C. Hodson from the William Wyse chair of social anthropology in the University of Cambridge in September next will be received with regret by all who are interested in the advancement of studies in that branch of the science of man, not only within the University but also at large. When Prof. Hodson was placed in charge of this subject at first in 1926 as reader in ethnology and from 1932 as occupant of the chair which he now relinquishes, he brought to the teaching of a subject which, more than almost any other in the academic curriculum, demands breadth of view and a sense of realities, a wide and varied experience. This began after he had taken his degree at Queen's College, Oxford, with some years as a member of the Indian Civil Service stationed in Assam, and embraced service with the Indian forces during the Great War, and a period as principal of an ex-Service men's college, of which the curriculum had been strongly influenced by his faith in the educative and broadening influence of the point of view of the anthropologist in the approach to educational and cultural problems. It is in some sense a mitigation of the regret which will be felt at Prof. Hodson's retirement that his successor, who has also served in India, by experience and by conviction, is well qualified to continue the work which Prof. Hodson has always had most nearly at heart, in the firm belief that a knowledge of anthropology is the best and the most essential qualification in the administration of the affairs of the varied peoples of the British Empire.

### Social Anthropology at Cambridge

DR. JOHN HENRY HUTTON, of St. John's College, Cambridge, who is to succeed Prof. T. C. Hodson, was educated at Chigwell School, and Worcester College, Oxford. Dr. Hutton was appointed lecturer in the Faculty of Archaeology and Ethnology at Cambridge last year, on his retirement from the Indian Civil Service. He entered the Service in 1909, serving under the Government of Assam, and being awarded the honour of C.I.E. in 1920. In addition to his administrative duties, Dr. Hutton was responsible as honorary director for the ethnographic survey of the tribes of Assam, and himself produced two volumes, one on the Angami Nagas (1921) and one on the Sema Nagas (1929) in the series of monographs on the Naga tribes published under the auspices of the Assam Government. Dr. Hutton's abilities as an anthropologist and as an organizer of survey work in anthropology and demography were recognized when he was seconded from the service of the Assam Government to take charge of the Census of India, 1931. As superintendent of the Census, he wrote an introductory study of the ethnic problem involved in the composition of the population of India, summing up and analysing the evidence which has accrued since the publication of Sir H. H. Risley's Census of 1901 and calling for modification in the views then put forward. Reference was made to Dr. Hutton's work in NATURE of September 5, 1936, p. 394. Mr. Gregory Bateson, of St. John's College, Cambridge, has been elected to the William Wyse studentship in social anthropology in the University of Cambridge for a period of three years. Mr. Bateson is the author

of the recently published work "Naven" (see NATURE of March 13, p. 454) in which he gives an account of some of his observations among the Iatmul tribes in an expedition to the Sepik River, New Guinea, in 1933, and elaborates an extension of the 'functional' method in sociological investigation.

#### Iron and Steel Institute : Bessemer Gold Medals

THE Bessemer Gold Medals for 1937 of the Iron and Steel Institute have been awarded to Colonel N. T. Belaiew and Aloyse Meyer. Colonel Belaiew of Paris, a former pupil of Prof. Tschernoff of the Military Academy, Petrograd, has, during the last twenty-five years, published a number of papers of outstanding importance on metallurgy. These have dealt mainly with the crystallization of metals, and in particular steel. His studies of the constitution and solid geometry of pearlite, sorbite and troostite demonstrated the true width of the lamellæ in these structures and the relation between the angle of section and the apparent width. His suggestion of a definite unit of crystal size of iron has been confirmed from other sources. He also studied the primary and secondary crystallization in steel and the origin of the 'Widmanstätten' structure in steel and meteorites. His insight is strikingly shown by his insistence on 'granulation' in the austenitic zone, the explanation of which has been provided by the subsequent discovery of the delta-gamma change in iron at very high temperatures. He has studied the manufacture and uses of Damascene steel and related the results to the manufacture of high-class steels at the present time, in particular high-speed steel.

M. ALOYSE MEYER, of Luxemburg, is an honorary vice-president of the Institute, and is well known as head of the Société Anonyme ARBED, the great Luxemburg combine and the second largest iron and steel company in Europe. He has rendered unique services to the iron and steel industry as president, since 1928, of the Entente Internationale de l'Acier. In addition, his encouragement of the acquisition and diffusion of technical information and metallurgical knowledge in the Luxemburg-Lorraine district has been invaluable to the progress of the industry; he was actively connected with the introduction of the Thomas-Gilchrist process of steel manufacture into the district—the Hauts Fourneaux et Acieries de Dudelange was one of the first works in Europe and the first in the Luxemburg-Lorraine district to adopt this method, which revolutionized the manufacture of steel on the Continent. Since the Great War, he has been responsible for the introduction of modern American blast-furnace practice in the works under his control.

#### Richard Anthony Proctor (1837-1888)

IN the mid-Victorian era there were no more popular books on astronomy than those of Richard Anthony Proctor, the centenary of whose birth falls on March 23. Possessing a remarkable power of lucid exposition and almost unbounded energy, in his comparatively short life he published about sixty

separate works, wrote numerous memoirs and delivered many lectures in Great Britain, the United States and Australia. He was, however, no mere exponent, and in the little leisure he enjoyed he studied the planet Mars, plotted on a single chart the 324,198 stars of Argelander's "Durchmusterung" and made the important discovery of 'star-drift'. Proctor was the son of a London solicitor and was born in Cheyne Row, Chelsea. His father died in 1850 and left the family ill-provided for; so Proctor became a clerk in the London and Joint Stock Bank, but was able after a year or two to study at the University of London; at the age of nineteen years he entered St. John's College, Cambridge, graduating as 23rd Wrangler in 1860. He then read for the law, but this was soon abandoned for science, and in 1865 he published his first book, "Saturn and its System".

PROCTOR married before leaving Cambridge and for a time was in pecuniary difficulties. In 1868 he scored his first financial success with his "Half Hours with the Telescope". This was followed by his "Other Worlds than Ours". It was about the time this appeared that after working five years without a holiday he wrote, "I would willingly have turned to stone-breaking or any other form of hard and honest but unscientific labour if a modest competence in any such direction had been offered me." For a short time he taught mathematics in a school at Woolwich. He was elected a fellow of the Royal Astronomical Society in 1866; in 1872 he became honorary secretary to the Society, but this he resigned in order to undertake a lecture tour in America. The tour was a success and in 1879, after the death of his wife, he made a tour to Australia. In 1881 he founded the periodical *Knowledge*, and then returned to the United States, marrying a widow, Mrs. Crawley, and settling at St. Joseph, Missouri. A few years later he transferred his house and observatory to Florida. In September 1888 he was about to sail from New York on a visit to England but was attacked by fever and died in hospital on September 12, at the age of fifty-one years.

#### Printing and Allied Trades Research Laboratories

THE new Laboratories of the Printing and Allied Trades Research Association were officially opened by H.R.H. the Duke of Gloucester on March 9 in the presence of the Advisory Council of the Department of Scientific and Industrial Research and the Council and members of the Research Association. The laboratories are situated just off Fleet Street in the centre of London's printing district, and comprise about seven thousand square feet devoted to chemical and physical laboratories, library and offices for the investigation of the major and the day-to-day problems of the printing, newspaper, ink and paper industries. The basement has been converted into an optics laboratory for colour measurement in connexion with colour printing and the measurement of the opacity of paper, etc. A strong-room in the basement has been converted into a constant humidity laboratory where the temperature and relative humidity are maintained at 65° F. and 65 per cent.



All paper-testing work, on strength and printing quality, is carried out in this laboratory, where is also installed a small printing machine on which printing tests can be carried out under controlled conditions.

GENERAL offices and library are housed on the ground floor of the Laboratories. From the library, the Intelligence Section of the Association's work is operated and the "Review of Literature" published. The physics department is contained on the first floor where work on colour fading, examination of adhesives and bookbinding materials are carried out. This department also contains a section for photomicrographic work on paper fibres, inks, prints and printing alloys, and a dark room for ultra-violet and infra-red work. The upper floor has been converted into two chemical laboratories. One is mainly for analytical work in connexion with the day-to-day problems submitted by member firms, and the other set aside as a chemical research laboratory for dealing with the longer-ranged problems connected with the working properties and drying of printing inks, lithography, photogravure printing, stereotyping and electrotyping, etc. It is the aim of the Research Association to deal with both the day-to-day problems and the longer-ranged work connected with printing processes and raw materials, and to build up a scientific background to one of the 'craft' industries so that the inherent difficulties, now aggravated by increased speeds of production, can be eradicated and the future developments of the industry guided by scientific research.

### The West Indian Volcanoes

At the Friday evening discourse delivered at the Royal Institution on March 12, Sir Gerald P. Lenox-Conyngham described "Montserrat and the West Indian Volcanoes". The island of Montserrat has recently suffered from a series of earthquakes. They began about the beginning of 1934 and continued with varying intensity all through 1934 and 1935. In the autumn of 1935 the inhabitants sent a petition to the Governor praying that steps should be taken to discover, if possible, whether there was danger of an eruption. Their anxiety was due to their recollection of the events of 1902 when eruptions of the Soufrière of St. Vincent and of Mont Pelé of Martinique did terrible damage. Such an eruption in Montserrat would be most dangerous to the town of Plymouth. As a result of the petition, a small expedition consisting of a geologist and a physicist was sent out. Frequent severe shocks were felt up to November 1935. After that date the activity of the volcano became steadily less. A good measure of success was attained in locating the positions of the foci, and it is now known that they were all situated in a belt about four miles wide which crosses the island from south-west to north-east. The West Indian island arc bears strong resemblance to the East Indian arc that runs eastwards from Java. In 1929-30 Dr. Vening Meinesz of the Dutch Geodetic Commission made a gravity survey of the seas around these islands and found that there is a belt of negative

gravity anomaly lying outside the island arc. The circular form of island and mountain arcs is suggestive. It is probable that the form is determined by the intersection of a thrust plane with the sphere. Mr. P. Lake has pointed out that the radius of the arc gives the dip of the fault where the thrust plane cuts the surface. It is believed that gravity determinations combined with the consideration of the curvature of the island chain and of the probable position of the over-thrusting foot of the tectonic arc on which the islands have been built up by volcanic agency will throw light on the structure of the region.

### New University Studies

At the recent annual meeting of the Court of Governors of the University of Birmingham, the vice-chancellor, Sir Charles Grant Robertson, noted a small decline in the number of students in the University, possibly due to the decline in the birth-rate (though periods of 'boom' in trade have on previous occasions been associated with a slackening in the entry to the University). The Faculty of Medicine, however, shows no such falling off. He commented with satisfaction on the success of the Appointments Board and the evidence of an increasing demand for the product of the University in industry—in fact, during the past year the demand on the Appointments Board exceeded the supply. Sir Charles dealt with the lack of the study of the social sciences in English universities. It has been suggested that the education of a university graduate is incomplete without some such study, but there is the difficulty of finding the time without omitting some other part of the curriculum. It appears probable that little can be done unless there is a specialist social science degree course, or the subject is made one for a post-graduate course of at least one year; and then there is the problem of finding posts for such graduates, with adequate pay and prospects of promotion, so long as the wide field of municipal civil service is barred to university graduates. Sir Charles expressed sympathy with the Government's desire to promote physical training in universities, but, in addition to the fact that the necessary trainers do not at present exist, the thorny problem of compulsion or non-compulsion would have to be solved.

### The Universities and Social Science

A SPEECH entitled "A Citizen Challenges the Universities", delivered by Sir Ernest Simon at the summer, 1936, meeting of the Council of the Association of University Teachers in Cardiff, appeared in the *Universities Review* of November last, and a reprint of it has reached us. The challenge relates to the imminent threat to democracy involved in our tolerance of such conditions as those of South Wales and other depressed areas, and the universities' alleged neglect, in the face of that threat, to do their duty by the social sciences: their failure alike to provide adequate inducements, staff and equipment for research in those sciences and for specialized study in them, and to employ effectual measures for ensuring that students, of whatever schools, shall

not graduate without an active and realistic interest in the broader problems of the world to-day. The challenge is not a new one, but its urgency grows with the growing prestige of 'corporative' States. It was an outstanding motive of the remarkable series of eight university supplements published in *Time and Tide* in 1935. To that series Sir Ernest himself contributed an article on "Where our Universities Fail".

SIR ERNEST SIMON's estimate of the responsibility of the universities in this matter is based partly on the assumption (the validity of which tends to diminish) that public opinion in Great Britain is largely determined by men and women educated at the universities, and partly on the influence the universities exert on the teaching in secondary schools through university scholarships and entrance examinations, and control over examinations in those schools. His argument finds some support in the last report of the University Grants Commissioners. But arguments must be cogent indeed to overcome the inertia of university governing bodies, especially since no provision was made for research in the social sciences when the Government of the day set up the Department of Scientific and Industrial Research. In a postscript to his paper, Sir Ernest announces that the Association for Education in Citizenship is proposing to appoint a committee on the whole problem of the universities and citizenship and invites communications from persons interested in this matter. His address is, Broom Croft, Didsbury.

#### Public Affairs Forums in the United States

ADULT civic education through "public affairs forums" is now being energetically pushed by the United States Federal Office of Education, the present head of which, Dr. Studebaker, played a principal part in the launching, several years ago, of the pioneer forums in Des Moines. The latest official publication on the subject, a pamphlet entitled "A Step Forward" (Superintendent of Documents, Washington, D.C. 10 cents), includes an account of ten forum demonstration centres in as many different States, managed by local educational authorities. A foreword by the Commissioner strongly emphasizes the principle of local responsibility and control, but the enterprise has been financed largely out of the Federal Emergency Relief Appropriation, and several hundred relief workers have taken part as assistant librarians, research assistants, artists, writers, accountants, typists, etc. The Secretary of the Interior, in commending the Commissioner's scheme, observes that it has brought about an essential and practical contact between "those few of our citizens who are concentrating their time and effort on the pursuit of truth in the field of social problems" and the average citizen who cannot devote much time to a specialized study of these complex questions. The success of the scheme hinges on finding competent leaders for the forums, for they have the difficult task of first presenting a topic in simple language in a way calculated to sustain interest, giving a fairly comprehensive and impartial outline of the problem

and the alternative solutions, and then stimulating, leading and organizing a free discussion for forty or fifty minutes. Most of them have been obtained on leaves of absence from colleges and universities. The improvement of social intelligence for the democratic control of our material resources is, says the Commissioner, the challenge of our day.

#### Social Services in Great Britain

"PUBLIC SOCIAL SERVICES" (Cmd. 5310. London: H.M. Stationery Office. 4d.) portrays statistically what may, without much exaggeration, be called the social revolution of the twentieth century in Great Britain. It shows that in the first thirty years of the century the cost of the social services referred to increased just thirteen-fold, namely, from thirty-six millions to four hundred and sixty-eight millions sterling. The first decade was marked by a rise in expenditure under Education Acts from 20 to 34 millions and the coming of old age pensions which cost 7 millions in 1910. The next decade saw a leap in education expenditure from 34 to 90 millions and in old age pensions from 7 to 21, the introduction of unemployment insurance (11 millions), national health insurance (30 millions), the mental deficiency acts, and, of course, war pensions. Between 1920 and 1930 the expenditure under unemployment insurance increased to 102 millions and under old age pensions to 37½ millions, and the widows', orphans' and old age contributory pensions acts came into force, involving, in 1930, an expenditure of 34½ millions. During this period, expenditure under the housing acts increased from 4½ to 40 millions.

#### Natural History Exhibition at Wye

THE Wye College Branch of the University of London Animal Welfare Society (ULAWS) held a Natural History Exhibition at the South-Eastern Agricultural College, Wye, on March 11-13. The greater part of the Exhibition was given up to natural history specimens exemplifying the classification of the animal kingdom. Several dissections caused much interest. A fine collection of beaks and feet of birds made by a member of the Branch was on view. Specimens of bacteria, minerals and other microscopic objects were shown. In addition, there were films of animal life, including the ULAWS film on the care of dogs, which proved to be very popular. At the entrance to the Exhibition were exhibits dealing with the oil menace and the rabbit problem. The former showed how the discharged waste oil from ships and tankers floats on the surface of the sea and covers the feathers of sea-birds. Very little is enough to kill birds, causing them to die of pneumonia due to the water being able to get at the skin. A live guillemot from which the oil had been removed was shown. In all cases so far, however, the solvent used to remove this has also removed the natural grease from the feathers, with the result that the bird gets sodden when placed in water. Further experiments are being carried out by Mr. R. S. Pitcher. A gin trap for catching rabbits was demonstrated and its unsatisfactory character explained. Instead of decreasing the animals, it often leads to an increase,

as has been shown in Carmarthenshire and by experiment in Devon and Pembrokeshire. Various humane traps and snares were shown together with apparatus for cyanide fumigation, but the latter was put forward as by far the best method for the painless and effective control of the rabbit. A bookstall was provided by the Cathedral Bookstall, Canterbury, and departments of the College provided many of the specimens and the apparatus. Messrs. Flatters and Garnett, Ltd., W. Watson and Co., E. Gerrard and Co., Ltd., Thomas Murby and Co. provided material, and the Folkestone Museum lent some cases and specimens.

### Physics in 1936

THE rapid advances now being made in our knowledge of the physical properties of matter have made it desirable that progress reports should be published at frequent intervals; three such reports have been issued by the Physical Society, and a number have appeared from time to time in the issues of the *Physikalische Zeitschrift*, the latest being on nuclear physics by Profs. S. Flügge and A. Krebs, which occupies twenty-four pages of the issue of January 1. The Physics Forum in the issue of the *Review of Scientific Instruments* of January occupies twelve pages devoted entirely to a review of some of the most noteworthy advances, by Prof. T. H. Osgood of the University of Toledo, Ohio. It deals with the collisions of slow and fast neutrons with atomic nuclei and the knowledge of the effective cross-sections of nuclei which has been derived from them; with the scattering of one type of nuclear particle by another and the applicability of gravitational and electrical inverse square laws of action of one particle on another; the changes of mass when atoms are built up of their constituent parts; the recent removal of doubts as to the validity of the momentum explanation of the Compton effect; the frequent transformations from matter to radiation and back again which take place in the path of a cosmic ray, which make complete investigation difficult; the discovery that the oscillations of the atoms in a crystal lattice are not isotropic and the question whether supraconductivity in metals, which is suppressed instantly by a magnetic field and more slowly by a rise of temperature, is due to a surface or a volume effect. Prof. Osgood also touches on the increased accuracy of newspaper articles on scientific subjects and on "the growing recognition of the importance of physics and the training which physics gives in industrial fields". His report will be much appreciated by readers who have not the time to devote to more detailed accounts.

### Electricity Costs and Factors

IN a paper read to the Institution of Electrical Engineers on March 11, Mr. J. A. Sumner pointed out some of the modern factors which affect electricity costs and charges. He makes a brief comparison between rural and urban distribution and concludes that rural areas quickly become remunerative. He suggests that the expansion of demand must be preceded by a reduction of charges for domestic supply,

and a halt should be called in the downward trend of charges for power. The alteration in charges must be accompanied by a greater unification of charges and tariffs, and this can only be achieved quickly by means of a single executive authority which would have the exclusive right to direct and initiate the unification of tariffs and charges. Prices for domestic supply are generally too high to permit an extensive use of electricity, and statistics show that reductions in price tend to follow an increased demand instead of preceding it. So far as the domestic consumer is concerned, for large modern undertakings the original Hopkinson definition, namely, that the fixed charge per quarter should be proportional to the greatest rate at which a consumer may ever use electricity, is no longer applicable. If we are to retain the two part system of charging for electricity, we must reconsider the basis to be adopted for charging. The correct kilowatt charge for each consumer depends upon the time of demand, the 'diversity' of the consumers' load and of the group of consumers with whom he is associated, the voltage of supply and many other factors. It looks as if it were a problem which would not admit in practice of even an approximate solution applicable to all cases.

### Cotton Growing Research

AT a meeting of the Administrative Council of the Empire Cotton Growing Corporation held in Manchester on January 26, the director mentioned the extremely bad cotton season that had been experienced in Nyasaland. He said that information received by the Corporation indicated that the loss of crop has been caused to a large extent by insect pest damage, and if this is to be reduced effectively a close season for cotton of at least two months is a necessity. The Government is anxious to extend cotton growing on the Lilongwe Plateau. The Corporation's staff has pointed out, however, that the Plateau is at about the limit of altitude at which successful cotton-growing in Nyasaland is possible; it seems, therefore, that it would be wise to try cotton there on a small scale only, before any attempt is made at extensive production. A pest survey would also be needed as a preliminary in the adjacent area. The Director referred to the importance to the natives of Nyasaland of an economic crop as a means of restricting the present uncontrolled emigration of adult males into other countries in search of work, which is the cause of the breaking up of village life and much consequent poverty and distress.

THE report of the executive stated that over a large part of Africa insect pest damage is probably the limiting factor in cotton production. One insect, the jassid, has now been to a large extent controlled by the breeding of a resistant type of cotton by the Corporation's staff at the Experiment Station at Barberton in South Africa. This variety is now grown in many parts of Africa, including Rhodesia and Nyasaland, and in parts of Tanganyika and Uganda. The Corporation's staff have therefore been turning much of their attention to work on bollworms

and stainers, and it is suggested that some increase in staff is necessary. The Director decided, however, that before he would feel justified in recommending the executive committee to sanction this, he needs to be assured that the work already being done is on the right lines, and that the methods by which the different problems are being attacked are those best calculated to lead to the possibility of devising some means of control of these pests. The executive committee accordingly invited Prof. J. W. Munro, professor of entomology at the Imperial College of Science and Technology, to make a tour of the experiment stations in South Africa, Rhodesia and Nyasaland, where the work is going on, and to advise the Corporation whether this work should be continued on the present lines or modified, and to report whether the prospects of success justify extension of the work, or its maintenance on the present, or on a reduced, scale.

#### British Bird Sanctuaries

THE biannual report of the Watchers' Committee of the Royal Society for the Protection of Birds, issued privately, covers the 1935 and 1936 seasons at the Society's bird sanctuaries in thirteen English counties, three Welsh counties and four Scottish counties, and contains the scheme and appeal for the purchase of Dengemarsh, a stretch of shingle on the south coast of Kent that, with the adjoining sanctuaries of Walkers Outland and the Open Pits shingle, will form a continuous 1,281 acres sanctuary for terns, waders and winter visitors. The Durham (Teemouth) sanctuary has also a scheme for the extension of watching throughout the year to protect winter visitors. The most extensive reports are made by the watchers in Lakeland, Kent, Orkney and Shetland. All the Scottish sanctuaries report 1936 as being far better than 1935. The Orkney sanctuary at Stenaday reports hen-harriers, which include an albino strain, shelduck and eiders are increasing and merlins and short-eared owls decreasing there: red-necked phalaropes are holding their own where nesting on north Ronaldshay and have a new nesting ground at Papa Westray. In the Shetland sanctuaries gannets, eider, terns, great skuas, arctic skuas, fulmars, starlings, puffins, guillemots, mallard and shags have increased but kittiwakes, razorbills (in parts) and the common gull (which no longer nests on Hermaness) have decreased. Disease has wiped out the house-sparrows from Mid Yell. Very detailed returns are made by the Dungeness and Dengemarsh watchers of Kent, this sanctuary in addition to its ternary being very rich in migrants which last year included the black redstart. Stone-curlews and red-legged partridge have also nested successfully there, but oil and oiled birds are still frequent shore troubles.

#### The R.H.S. Lily Year-Book

THE Royal Horticultural Society's Lily Year-Book for 1936 (London, from the Society's Office, Vincent Square, Westminster, S.W.1, 5s. paper, 6s. cloth, 1936) includes a number of contributions to a scientific understanding of lily culture. Dr. Fred Stoker has

made a study of the contractile roots of these plants. He shows that members of the *Eulirion* section of the genus *Lilium* possess such structures. Much interesting information as to how contractile roots of daughter bulbils penetrate the root-plate of the mother bulb, is imparted, and the microscopic anatomy has been investigated. An attractive feature of the volume is a bibliography of more than 550 references to published works upon lilies. This has been compiled by the Abbé Souillet, and although it appears comprehensive, it does not claim to have included a large number of articles which have appeared in English periodicals from time to time. A paper by Dr. M. A. H. Tincker shows that a suitable soil temperature of 65°-70° F. is an important factor in the propagation of lilies from bulb scales. It is interesting to note that soil heating by electric cables or hot-water pipes is suggested as an aid to this method of propagation. Many other papers communicate knowledge upon geographical or horticultural aspects of lily growing, and an interesting note by Mr. P. Rosenheim announces the discovery of an early treatise on the lily, contained in a German encyclopaedia by Kruenitz and Floerke, dated 1800.

#### Soviet Medical Films

ACCORDING to the Soviet Union Year Book Press service, moving pictures are being used in the U.S.S.R. for the treatment of nervous and mental diseases. Prof. Sukharebsky, of the Yakovenko Psychiatric Hospital in Moscow, has obtained remarkable success by showing epileptic patients films depicting calm lakes, picturesque landscapes, etc. He has also obtained good results by the use of a film in which he hypnotizes alcoholic addicts. A plan for a series of 102 short medical films has recently been approved by the Film Committee appointed by the Commissar of Health. The series includes brain operations and diseases of the spinal cord and brain. Other films are designed to assist surgeons to carry out rapid field operations in time of war. A film entitled "A Sick and a Healthy Heart" will be made under the direction of the heart specialist Prof. Zelenin, and another will deal with the development of the child between the ages of one month and two years. The last of the series will be a film entitled "Twenty Years of Soviet Medicine".

#### Early Man in Japan

EVIDENCE of the presence of palaeolithic man is reported from an island in southern Japan. The discovery, it is stated by Science Service (Washington, D.C.), was made by Prof. Shigeyasu Tokunaga, geologist of Waseda University, who while exploring the Island of Itoe in the Loochoo group, found numerous fossil bones of deer, which bore marks of having been worked by human hands. The deer from which the bones were derived has long been extinct, having died out in the neolithic age. Numerous teeth, antlers and bones of the same species of deer of the same age, which Prof. Tokunaga dates at anything from 30,000 to 70,000 years ago,

were found in a cave. If the bones in question have in fact been worked by man, this is the first evidence of palaeolithic man to be found in Japan.

#### Acute Poliomyelitis

THE Ministry of Health has issued a memorandum upon acute poliomyelitis, an infectious disease commonly known under the name of infantile paralysis, though it may occur in adults (Memo. 166/Med. London: H.M. Stationery Office. 2*d*. net). The epidemiology, clinical characters and after-effects of the disease are described and discussed, and the special diagnostic features are considered, together with a description of the changes in the cerebro-spinal fluid which serve to differentiate acute poliomyelitis from the normal and from other nervous diseases with which it may be confused.

#### Ray Society

AT the annual meeting of the Ray Society on March 12, Prof. F. E. Weiss was elected treasurer in succession to Sir David Prain. Sir David Prain and Mr. A. W. Sheppard were elected vice-presidents, and Mr. Chas. Oldham, Mr. H. R. Darlington and Prof. F. Balfour-Browne were elected new members of Council. The Council's report stated that a translation of Linnaeus's "Critica botanica" by the late Sir Arthur Hort, with an introduction by Sir Arthur Hill, would form part of the issue for 1937, which would be completed later by Mr. P. Ullyott's "British Freshwater Planarians". Others works in preparation are "British Tunicata" by Dr. John Berrill and "British Freshwater Beetles" by Prof. F. Balfour-Browne. Inquiries regarding membership of the Society should be addressed to the secretary, Dr. W. T. Calman, c/o British Museum (Natural History), Cromwell Road, London, S.W.7.

#### Royal Academy of Sciences, Turin

THE *Atti* of the Royal Academy of Sciences of Turin (72, Part 1, 1937) announces the opening of the one hundred and fifty-fourth year of the Academy's existence. It contains the address of the president, Prof. Vittorio Cian, relating the progress of the Academy during the year 1936. As in the case of other learned societies in Italy, new statutory regulations, approved by the Fascist Government, have come into operation. This publication also includes papers submitted to the Academy in the branches of mathematical, physical and natural sciences. It is intimated that the twenty-ninth Bressa Prize will be awarded during 1937 to a scientific worker of any nationality who shall have, in the opinion of the Academy, made during the period 1933-36 "the most noteworthy and useful discovery or produced the most celebrated work in the physical and experimental sciences, natural history, pure and applied mathematics, chemistry, physiology and pathology, not excluding geology, history, geography and statistics". The prize is valued at 9,000 lire, and candidates who wish to have their work considered by the Academy are invited to submit printed copies to the Secretary (3 Via Maria Vittoria, Turin) not later than March 31, 1937.

#### Comets

A TELEGRAM from the U.A.I. Bureau, Copenhagen, announces the discovery of a new comet, 1937 *d* (Kozawa), on March 9 in R.A. 11<sup>h</sup> 17.3<sup>m</sup>, N. Decl. 6° 19', magnitude 10. The object is diffuse with central condensation, and a tail less than 1° in length. The telegram has the remark "Unconfirmed", and further details are awaited. The Rev. Dr. M. Davidson, using observations on February 4 at Harvard, February 15 at Lick, and February 26 by Steavenson at Norwood, finds that Comet 1937 *b* (Whipple) is moving in an elliptical orbit, the period being about 250 years. More recent observations have been sent in by Hay and Kellaway, and Dr. Davidson is re-computing the elements with the longer time-intervals to determine the exact period. The date of perihelion passage was previously given as January, owing to an error in the telegram; it should have been June.

#### Announcements

THE Right Hon. W. G. A. Ormsby-Gore, Secretary of State for the Colonies, and Sir Henry Tizard, rector of the Imperial College of Science and Technology, have been elected to the Board of Trustees of the British Museum, in succession to Mr. H. A. L. Fisher and Sir David Prain, who have resigned.

PROF. S. A. WAKSMAN, professor of soil microbiology in the Rutgers University, New Brunswick, U.S.A., has been elected *correspondant* of the Section of Rural Economy of the Paris Academy of Sciences, in succession to the late Sir Arnold Theiler.

AT the annual general meeting of the Institution of Petroleum Technologists held on March 9, the Redwood Medal was presented to Mr. Harry Ricardo, in recognition of his contributions to the advancement of the science and technology of petroleum. Colonel S. J. M. Auld, chief technologist of the Vacuum Oil Co., Ltd., was inducted as president of the Institution at the same meeting in succession to Sir John Cadman.

AT the annual general meeting of the Microchemical Club, held on March 13, the following officers were elected: *Hon. Treasurer*, Dr. L. H. N. Cooper; *Hon. Secretary*, J. R. O'Brien; *Hon. Librarian*, Miss I. Hadfield; *Members of the Committee*: Prof. H. V. A. Briscoe, Dr. J. Matthew and Dr. S. J. Folley.

THE British Drug Houses, Ltd., have issued a guide in eleven pages to the Addendum (1936) to the British Pharmacopœia 1932. This guide, which should be very useful to those who have not made a detailed study of the Addendum, will be sent free of cost to members of the medical profession.

ERRATUM.—The name of the new secretary of the International Commission of Zoological Nomenclature (see NATURE, March 13, p. 442) is Mr. Francis Hemming.

## Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 513.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

### Isotope Effect in Hydrogen and Hydroxyl Bonds

THE substitution of deuterium for hydrogen has a characteristic effect on the bond lengths in hydrogen compounds, depending on the type of linkage involved. The effect has been described for ionic and covalent linkages<sup>1</sup>. In the case of structures involving intermolecular hydrogen bonds, no theoretical prediction of the effect could be made, because the nature of the hydrogen bond is not fully understood.

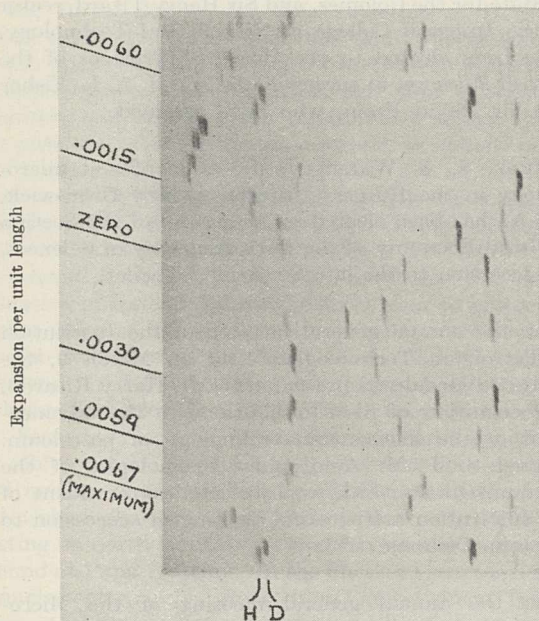


Fig. 1.

We have now studied the effect experimentally in oxalic acid dihydrate, for which the structure has been accurately determined by X-ray analysis<sup>2</sup> and in which the direction of the hydrogen bonds is known with some certainty. Oxalic acid  $d_2$ ,  $2D_2O$ , was prepared by repeated crystallization of anhydrous oxalic acid from 99.6 per cent heavy water ( $D_2O$ ). The melting points of the dihydrate and dideuterate are as follows:

ACID	M.P.
$(COOH)_2 \cdot 2H_2O$	99.8-100.7° C.
$(COOD)_2 \cdot 2D_2O$	95.9-97.5° C.

This difference in melting points is in the same direction and is of the same order of magnitude as for succinic acid<sup>3</sup> and for other carboxylic  $d$  acids.

In oxalic acid  $d_2$ ,  $2D_2O$ , there is a small expansion

of the spacings of certain crystal planes, as compared with oxalic acid  $2H_2O$ , and this expansion reaches a maximum near the direction of the hydrogen bond. The effect is shown in Fig. 1, which is part of a moving film exposure taken with a Weissenberg type of spectrometer.

In this experiment a needle-shaped crystal of oxalic acid  $d_2$ ,  $2D_2O$ , elongated along the  $b$  axis, was selected for comparison with a similar but slightly smaller crystal of oxalic acid  $2H_2O$ . The specimens were mounted in succession on the spindle of the spectrometer, with a small relative displacement in angular setting, and the reflections from the ( $h0l$ ) zones recorded on the same moving film, with copper  $K$  radiation. The reflections occur in overlapping pairs (cf. Fig. 1) the upper and darker component being due to oxalic acid  $d_2$ ,  $2D_2O$ . The glancing angle of the reflection  $\theta$ , and hence the spacing of the plane concerned, is given by the horizontal co-ordinate in the photograph, whilst the angular position of the reflecting plane in the crystal is given by the vertical co-ordinate.  $\sin\theta$  varies from about 0.60 on the right to 0.97 on the left, and in this region, where the dispersion is large, the displacement of the oxalic  $d_2$ ,  $2D_2O$  lines is very marked. The expansions calculated from the displacements are shown at the side. On the extreme left the reflections split, showing the  $K\alpha_1$ ,  $K\alpha_2$  doublet.

The expansion of the oxalic acid  $d_2$ ,  $2D_2O$  lattice reaches a maximum near the top and bottom of the photograph, an interval which corresponds to a crystal rotation of about  $180^\circ$ , and in the middle it is practically zero. The directional nature of this expansion in relation to the structure is shown in Fig. 2.

Along the direction of the deuterium bonds, shown by the heavy dotted lines, the expansion is about 0.0063 per unit length. This corresponds to an expansion of the bond by about 0.016 Å., or, if all the expansion occurs in the bond and not elsewhere in the structure, by about 0.044 Å.

It should be emphasized that with the present technique the amount of the expansion can be measured much more accurately than the absolute value of the length of the bond itself, which is about  $2.52 \pm 0.02$  Å. This applies also to the axial ratios of the crystal. The monoclinic unit cell of oxalic acid  $2H_2O$  has the dimensions

$$a = 6.120 \pm 0.020 \quad b = 3.600 \pm 0.010 \\ c = 12.030 \pm 0.030 \quad \beta = 106.2^\circ$$

The comparative values for the cell of oxalic acid  $d_2$ ,  $2D_2O$ , which roughly account for the observed expansion, are:

$$a = 6.149, \quad c = 12.074, \quad \beta = 106.65^\circ$$

So far, accurate observations have only been made in the (*h*0*l*) zone, but any change in the *b* axis is probably small.

The isotope effect on the lattice parameter of lithium hydride<sup>4</sup> and on the alloy of palladium with hydrogen<sup>5</sup> is a contraction when deuterium is substituted for hydrogen, in agreement with the lower zero point energy. The converse effect of an expansion when deuterium is substituted for hydrogen in oxalic acid is apparently due to the resonance between two molecular structures<sup>6</sup> required for this type of linkage. When the isotope effect on each structure separately is considered, the energy and probably the dimensional difference between alternative deuterium structures will usually be bigger than in the case of hydrogen. Resonance will be less complete

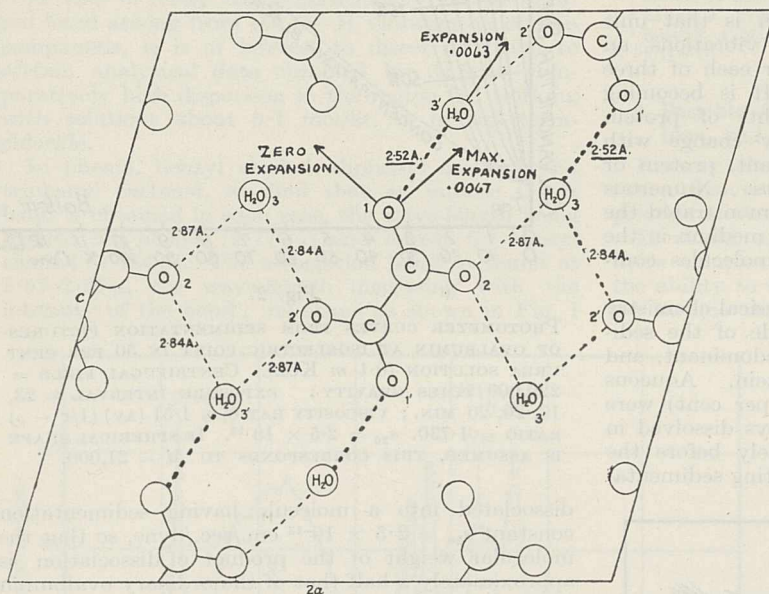


Fig. 2.

in consequence, and a larger distance between the associated groups will result when these are linked by deuterium atoms.

Preliminary results for other compounds under investigation show that the isotope effect depends upon the type of linkage involved. Thus, for the hydroxyl bond in  $\alpha$ -resorcinol, the resultant effect is very small, which is in agreement with the observations of Megaw on deuterium oxide<sup>7</sup>. In addition to throwing light on the mechanism of the hydrogen bond, the results promise to be of considerable value in locating certain types of hydrogen linkage in complex structures.

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March 4.

<sup>1</sup> Ubbelohde, A. R., *Trans. Far. Soc.*, **32**, 525 (1936).  
<sup>2</sup> Robertson, J. M., and Woodward, I., *J. Chem. Soc.*, 1817 (1936).  
<sup>3</sup> Halford, J., and Anderson, L., *J. Amer. Chem. Soc.*, **58**, 736 (1936).  
<sup>4</sup> Zintl, E., and Harder, A., *Z. phys. Chem.*, **28B** 478 (1935).  
<sup>5</sup> Ubbelohde, A. R., *Proc. Roy. Soc. A*, (1937), in the press.  
<sup>6</sup> Sidgwick, N., *Ann. Rep. Chem. Soc.*, **31**, 38 (1934).  
<sup>7</sup> Megaw, A., *NATURE*, **134**, 900 (1934).

### Relations in $\beta$ -Ray Transformations and the Neutrino Theory

It is now generally agreed that the theory of the  $\beta$ -transformations of atomic nuclei developed by Fermi<sup>1</sup> on the hypothesis that a neutrino is emitted as well as a  $\beta$ -particle gives a formal explanation of the main phenomena. Fermi introduced an interaction of a new type between the heavy particles in the nucleus and the electron and neutrino. His theory was later modified by Konopinski and Uhlenbeck<sup>2</sup>, in order to avoid certain discrepancies with experiment. Both the original Fermi theory and the Konopinski-Uhlenbeck form give a relation between the period of the transforming nucleus and the maximum energy of the emitted  $\beta$ -ray, and predict the shape of the  $\beta$ -ray spectrum.

Recent work<sup>3</sup> on the  $\beta$ -spectrum of radium D makes it possible to apply a stringent test to any formula connecting the period and maximum energy in  $\beta$ -decay. The three nuclei, thorium C'', thorium B and radium D, all give rise to permitted  $\beta$ -transitions and have periods in the ratios 1 :  $2.05 \times 10^2$  :  $3.6 \times 10^6$ . Taking the end-points of the  $\beta$ -ray spectra as 1790, 362 and 15 kV. respectively, the Fermi formula gives for the ratios of the periods 1 :  $2.7 \times 10^2$  :  $4.6 \times 10^6$ , in good agreement with experiment. The Konopinski-Uhlenbeck expression, however, predicts corresponding ratios of 1 :  $3.8 \times 10^3$  :  $2.7 \times 10^{10}$ ; here the end-points must be taken as 2250, 510 and 22kV. respectively, in order to obtain agreement with the shape of the  $\beta$ -spectra at lower energies.

Thus the Konopinski-Uhlenbeck expression is in marked discrepancy with observation. On the other hand, there is no doubt, as shown by Bethe and Bacher<sup>4</sup>, that it gives a correct representation of the relative periods of  $\beta$ -decays of high energy, that is, with end-points between about 2 MV. and 12 MV.

The recent results of Lyman<sup>5</sup> now show that neither the Konopinski-Uhlenbeck nor the Fermi expression gives the correct shape of the  $\beta$ -ray spectrum for radium E or for radio-phosphorus, <sup>32</sup>P. It is possible, however, to obtain close agreement with his results by a linear combination of the two expressions each using the same high-energy endpoint  $\epsilon_0$ , taken as the energy of the fastest observed electrons. The shape of the spectrum is then given by

$$N d\epsilon = F \times \left\{ 1 + \left( \frac{\epsilon_0 - \epsilon}{K} \right)^2 \right\} d\epsilon,$$

where  $N$  is the number of electrons with energy between  $\epsilon$  and  $\epsilon + d\epsilon$  in units of  $mc^2$ , and  $F$  is the value of  $N$  given by the Fermi expression alone.

To fit the results for radium E and <sup>32</sup>P, values of  $K$  of 1.4 and  $2.2 mc^2$  are required respectively. If this difference in  $K$  between the two disintegrations is connected with a difference in the matrix elements of the heavy particles rather than with the higher value of  $\epsilon_0$  for <sup>32</sup>P, then the value of  $K$  may be expected to be approximately constant for  $\beta$ -decays of the same type. For small  $\epsilon_0$  the term involving  $K$  will be small, so that for low-energy spectra the shape

and the relation of the period and energy should be given by the Fermi expression. For high-energy spectra the shape (except near  $\epsilon = \epsilon_0$ ) and the period should be given by the Konopinski-Uhlenbeck expression owing to the dominance of the second term.

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Feb. 23.

<sup>1</sup> *Z. Phys.*, **88**, 161 (1934).

<sup>2</sup> *Phys. Rev.*, **48**, 7, 107 (1935).

<sup>3</sup> Richardson and Leigh-Smith, *NATURE*, **134**, 772 (1934).

<sup>4</sup> *Rev. Mod. Phys.*, **8**, 82 (1936).

<sup>5</sup> *Phys. Rev.*, **51**, 1 (1937).

### Dissociation of Ovalbumin in Urea Solvent

THE physical molecule in solution is that unit which will acquire from thermal vibrations an average of  $1/2 kT$  ergs of energy for each of three translational degrees of freedom. It is becoming increasingly evident that the weights of protein molecules defined in this way may change with solvent temperature, dielectric constant, protein or salt concentration, and other factors. Numerous studies from this Laboratory have demonstrated the effect of change of *pH* of the solvent medium in the dissociation and association of the molecules comprising the fundamental component.

In connexion with work on the physical chemistry of zein, observations have been made of the sedimentation velocities of the light, predominant, and heavy constituents of the normal zein. Aqueous alcohol (60 per cent) and urea (50 per cent) were used as solvents. The zein was always dissolved in the aqueous urea solution immediately before the centrifuging was begun, and the resulting sedimenta-

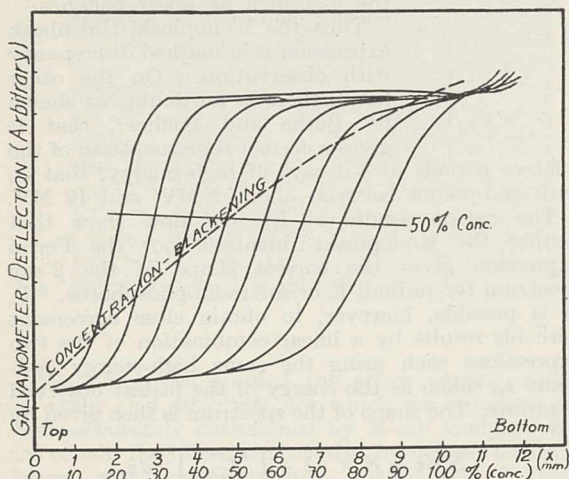


Fig. 1.

PHOTOMETER CURVES FROM SEDIMENTATION PICTURES OF OVALBUMIN IN AQUEOUS BUFFER SOLUTION, *pH* = 6.0 (0.1 *m* NaCl + 0.085 *m* KH<sub>2</sub>PO<sub>4</sub> + 0.005 *m* Na<sub>2</sub>HPO<sub>4</sub>). CENTRIFUGAL FIELD = 233,000 TIMES GRAVITY; EXPOSURE INTERVAL = 15 MIN. VISCOSITY RATIO = 0.810; (1/*v* -  $\rho$ ) RATIO (SEDIMENTATION 'DRIVING FORCE') = 1.027.  $s_{20} = 3.6 \times 10^{-13}$ . IF SPHERICAL SHAPE IS ASSUMED, THIS CORRESPONDS TO *M* = 36,000.

tion constants agreed with those found by using the alcoholic solvents. A preliminary report of this work has already appeared in *NATURE*<sup>1</sup>.

At the time the use of urea as solvent for zein was begun, it was realized that this and other compounds containing nitrogen must influence, sooner or later, the condition of the protein in the solution. Accordingly, centrifugal studies were made of purified ovalbumin dissolved in aqueous urea (50 per cent). This protein was found to have been almost completely

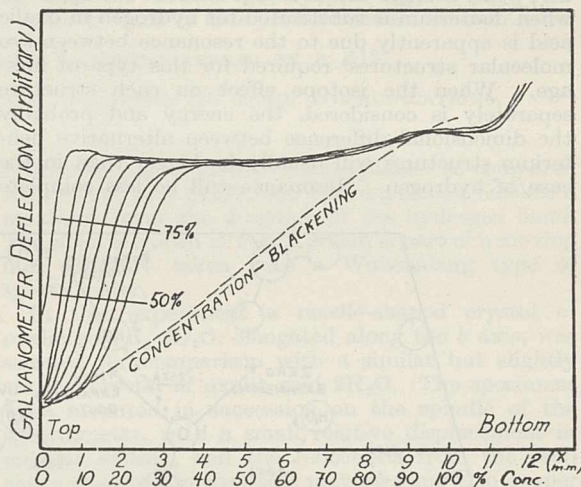


Fig. 2.

PHOTOMETER CURVES FROM SEDIMENTATION PICTURES OF OVALBUMIN AT ISOELECTRIC POINT IN 50 PER CENT UREA SOLUTION (0.1 *m* KCl). CENTRIFUGAL FIELD = 220,000 TIMES GRAVITY; EXPOSURE INTERVAL = 23, 17, 20, 20 MIN.; VISCOSITY RATIO = 1.51 (AV) (1/*v* -  $\rho$ ) RATIO = 1.730.  $s_{20} = 2.5 \times 10^{-13}$ . IF SPHERICAL SHAPE IS ASSUMED, THIS CORRESPONDS TO *M* = 21,000.

dissociated into a molecule having sedimentation constant  $s_{20} = 2.5 \times 10^{-13}$  cm./sec./dyne, so that the molecular weight of the product of dissociation is approximately a half that of the ordinary ovalbumin molecule. The effect of the urea solvent in dissociating the protein is shown clearly by Figs. 1 and 2, in which are presented sedimentation diagrams (light absorption method) for the normal ovalbumin in buffered aqueous solvent and for the dissociated ovalbumin in urea solvent. Sedimentation experiments were performed with the original ovalbumin in aqueous solution before and after the observations in the urea solvent.

Further experiments were carried out to determine whether or not the dissociation is reversible. Purified ovalbumin was dissolved in the 50 per cent aqueous urea solution, and the resulting solution was placed in a collodion sack and dialyzed against *m*/150 phosphate buffer solution, *pH* = 6, to remove the urea. After a four-day period, the urea had been dialyzed out but a considerable portion (three fourths) of the ovalbumin had coagulated. The ovalbumin solution was then centrifuged. In spite of some inhomogeneity, the experiment demonstrated the presence of protein molecules having the same sedimentation constant as that of the original ovalbumin. Although this molecule, of normal sedimentation behaviour, must have been formed from the dissociated portions, we prefer to leave open for the present the question of the reversibility of the dissociation. Similar studies with several solvents, using observations of diffusion constants of the components to characterize the molecular species present, are now nearing completion,



and we hope to give a complete answer to this particular question in the near future.

The experiments described above were performed during the spring of the academic year 1934-35. We wish to thank Prof. The Svedberg and his associates for their interest and assistance with the work.

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\* Watson, Arrhenius and Williams, NATURE, 137, 322 (1936).

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### Some Infra-Red Bands in the 3μ Region

IN view of recent communications<sup>1,2,3</sup> on the infra-red band arising from the O—H vibration in certain compounds, it is of interest to direct attention to certain analytical data obtained by us with comparatively high dispersion in the region 3μ, working with solutions about 0.1 mol./lit. in carbon tetrachloride.

In phenol, benzyl alcohol, diphenyl carbinol and triphenyl carbinol, we find that an intense O—H band is obtained in each case, the wave-length being highest for phenol (2.770 μ) and lowest for benzyl alcohol (2.764 μ). The association band<sup>1</sup> is found at 2.87-2.97 μ, the wave-length increasing with the intensity of the band; its shape as shown in Fig. 1

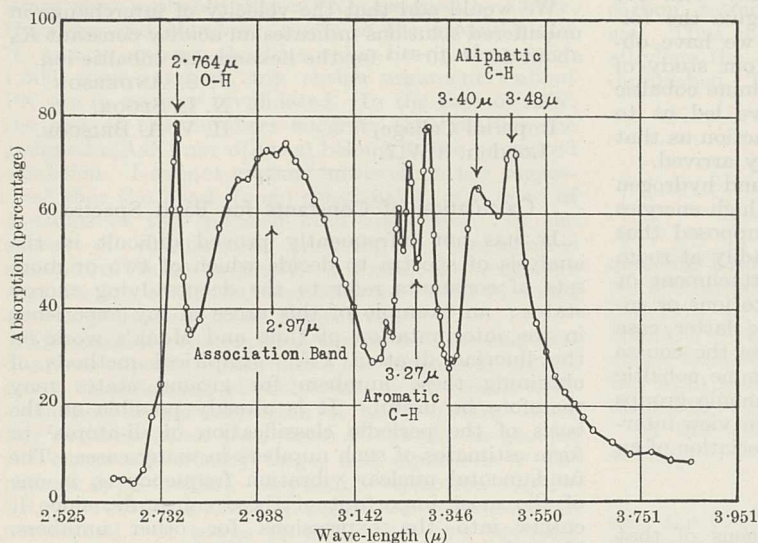


Fig. 1.

ABSORPTION OF A 1.3 MM. LAYER OF BENZYL ALCOHOL IN CARBON TETRACHLORIDE (0.169 MOL./LIT.) AT 18° C.

for benzyl alcohol is similar to that for ethyl alcohol in carbon tetrachloride<sup>1</sup>. The intensity of the association band was about the same for phenol and benzyl alcohol, was less for diphenyl carbinol, and with triphenyl carbinol was visible as a small 'hump' on the general absorption at 2.87 μ. These results suggest that the replacement of hydrogen by phenyl groups in benzyl alcohol suppresses intermolecular association.

Dilution was found to reduce the intensity of the association band in the case of phenol much more rapidly than the O—H band (cf. Errera<sup>2</sup>). The

former band dropped from 80 per cent absorption in 0.174 mol./lit. (O—H band 94 per cent) to 5½ per cent at 0.0145 mol./lit. (O—H band 58 per cent). The triphenyl carbinol showed 12.5 per cent for the association band at 0.066 mol./lit. as compared with 29 per cent for phenol at the same concentration.

Fig. 1 shows bands due to OH and association, the aromatic C—H bands around 3.27 μ and the aliphatic C—H bands at 3.40 and 3.48 μ.

A full account of the bands of these and other organic compounds will be described elsewhere.

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Feb. 17.

<sup>1</sup> Errera, J., and Mollet, P., NATURE, 138, 882 (Nov. 21, 1936).

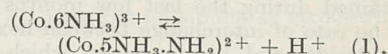
<sup>2</sup> Errera, J., Trans. Far. Soc., 33, 120 (1937).

<sup>3</sup> Buswell, A. M., Deitz, V., and Rodebush, W. H., J. Chem. Phys., 5, 84 (1937).

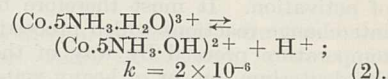
### A Possible Acid-Dissociation of Metal-Ammonia Ions, and its Bearing on Certain Reactions

RECENT observations<sup>1</sup> on exchange reactions between heavy water and cobaltammines suggest a possible mechanism for certain reactions of the latter.

It would seem that the ammonia molecules in these complexes must, by co-ordination, have lost the ability to form ammonium ions, and therefore if we assume that the exchange reactions take place through the D<sup>+</sup> ion, we must conclude that these co-ordinated ammonia groups can dissociate as acids:

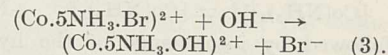


This seems plausible, since the co-ordination of the analogous water molecule enables it, as is well known, to dissociate as an acid:

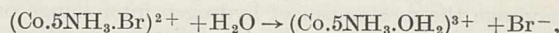


The corresponding dissociation constant for the co-ordinated ammonia molecule would presumably be much smaller, but might still be appreciable.

On this basis it would be possible to account for the rapid replacement of acido-groups by hydroxyl ions:



This reaction is unique, in that such replacements by other anions only take place much more slowly if at all. Alternatively, it may be regarded as catalysis by hydroxyl ion of an aquotization reaction,

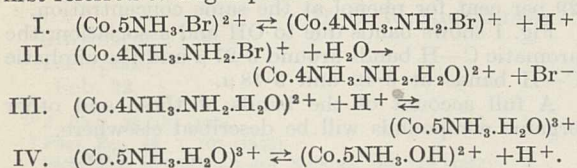


followed by instantaneous establishment of the hydroxo-aquo equilibrium.

Now the kinetics of the aquotization of acido-aquo complexes have led to the conclusion<sup>4</sup> that the hydroxo-acido ion undergoes this change much more rapidly than the aquo-acido ion with which it is in equilibrium, presumably in virtue of its smaller positive charge—a conclusion which harmonizes with

the general observation that diacido complexes undergo aquotization more rapidly than mon-acido complexes.

By analogy, then, the acido-hydroxo replacement first referred to might proceed as follows :



I, III, and IV represent instantaneously established equilibria, while II would be much more rapid than the 'spontaneous' aquotization of the bromo-pentamine ion. The whole process would give a velocity equation of the same form as that for the direct replacement by hydroxyl ion and would account for the unique behaviour of the latter in this respect.

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<sup>1</sup> Erlenmeyer and Gartner, *Helv. chim. Acta*, **17**, 1008 (1934); James, Anderson and Briscoe, *NATURE*, **139**, 109 (1937).

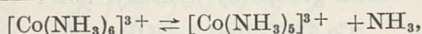
<sup>2</sup> Brønsted and Volquartz, *Z. phys. Chem.*, **134**, 97 (1927).

<sup>3</sup> Brønsted and Livingstone, *J. Amer. Chem. Soc.*, **49**, 435 (1927).

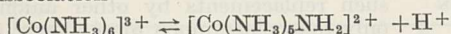
<sup>4</sup> Brønsted, *Z. phys. Chem.*, **122**, 333 (1926).

MR. GARRICK has very courteously allowed us to see the foregoing letter before publication, and indeed suggested that he would publish it only with our concurrence. This encourages us to give the following brief outline of certain results we have obtained during the last few months in our study of the rate of interchange between hexammine cobaltic chloride and heavy water, which have led us to precisely the same view of the basic reaction as that at which Mr. Garrick has independently arrived.

The direct exchange of covalently bound hydrogen for deuterium must necessarily involve high energies of activation. It must therefore be supposed that interchange reactions which proceed readily at room temperature proceed by way of the attachment of the deuterium ion, or of heavy water, to ions or co-ordinately unsaturated groups; in the latter case elimination of light water may complete the course of the reaction. In the case of hexammine cobaltic chloride, the nitrogen atoms of the ammonia groups are co-ordinately saturated, so that in our view interchange must pre-suppose either: (a) dissociation of an ammonia molecule:

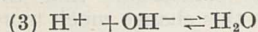
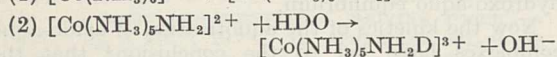
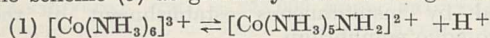


followed by interchange of the hydrogens of that ammonia through addition of water, or (b) an ionic dissociation



such as Mr. Garrick also supposes.

The great stability of the hexammine cobaltic ion toward acids rules out possibility (a), so that we envisage the mechanism of hydrogen interchange on the scheme (b) as given by the following reactions:



Reactions (1) and (3), as ionic equilibria are sensibly instantaneous; reaction (2) is the step determining the rate of reaction.

We are led on this basis to an expression for the velocity constant

$$K = \frac{1}{t} \cdot \frac{[\text{H}^+]}{[\text{A}]^{\frac{1}{2}}} \cdot \frac{[\text{HDO}]_{\infty}}{\xi_0} \cdot \log_e \frac{[\text{HDO}]_{\infty}}{[\text{HDO}]_{\infty} - [\text{HDO}]}$$

in which [A] = concentration of hexammine cobaltic chloride,

$\xi_0$  = initial 'heaviness' of the cobalt-ammine,

$[\text{HDO}]_{\infty}$  = concentration of heavy water after complete interchange,

[HDO] = concentration of heavy water at the time  $t$ .

This particular form of the expression is adapted to the conditions of our own experiments, in which we have found it convenient to reverse the normal procedure by measuring the rate of interchange between heavy cobaltamine and light water.

In agreement with the above expression, we find that (a) the rate of interchange varies inversely as the hydrogen ion concentration; (b) for constant [A], the rate of interchange is independent of the heaviness  $\xi_0$  of the salt; (c) for salt of a constant heaviness  $\xi_0$ , the rate of interchange varies inversely as  $[\text{A}]^{\frac{1}{2}}$ .

The underlying hypothesis of the ionic dissociation of the ion  $[\text{Co}(\text{NH}_3)_6]^{3+}$  appears therefore to be substantiated. Further aspects of this, and in particular the significance of the term  $[\text{A}]^{\frac{1}{2}}$  in the above expression, we hope to discuss in presenting our detailed results.

We would add that the velocity of interchange in unbuffered solutions indicates an acidity constant  $K_a$  about  $10^{-12}$ – $10^{-11.5}$  for the hexammine cobaltic ion.

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### Calculation of Constants for Band Spectra

It has not infrequently proved difficult in the analysis of spectra to decide which of two or more sets of constants refer to the deepest-lying energy states: an example of this arose in my experience in the interpretation of Gale and Monk's work on the fluorine di-atom FF. Empirical methods of obtaining these numbers for ground states may therefore be useful. It is already possible on the basis of the periodic classification of di-atoms<sup>1</sup> to form estimates of such numbers in many cases. The fundamental nuclear vibration frequency  $\omega_e$  is one of the most important of these constants, since it enters into the expressions for other numbers. Methods by which the equilibrium internuclear distance  $r_e$  may be obtained from  $\omega_e$  have been recently improved<sup>2</sup>.

It has so far proved practicable to derive an empirical formula for  $\omega_e$ 's of di-atoms XX, XY and YY, so that if any two are known the third may be derived, but only so long as X and Y contribute equal numbers of valency electrons to the shared group of XY, or, in other words, so long as X and Y belong to the same atomic periodic group. In terms of the proposed classification, the di-atoms XY must be chosen from the symmetrical molecular groups designated II, IVs, VI, VIII, Xs, XII and XIV<sup>1</sup>. For such cases, Howell<sup>3</sup> and I<sup>1</sup> independently observed that  $a = \omega_e(\text{XY})$  is approximately the arithmetic mean of  $b = \omega_e(\text{XX})$  and  $c = \omega_e(\text{YY})$ , so that—

$$a = 0.500(b+c) \quad . \quad . \quad . \quad . \quad (1)$$

As it turned out that the errors in  $a$  using (1) were always positive, I suggested<sup>1</sup> a reduction of 1.8 per cent in  $a$ , giving—

$$a = 0.491(b+c) \quad (2)$$

It seemed probable that a more accurate formula could be reached by assuming that the contributions made by  $b$  and  $c$  to  $a$  might be unsymmetrical, the larger frequency  $c$  having a greater influence than the lower frequency  $b$ . Proceeding by empirical methods, I have searched for a better relationship on this basis, and have derived the following:

$$a^3 = 0.800bc^2, \quad (3)$$

which appears to give remarkably reliable results.

Calculation from the available data on 36 di-atoms of the specified type, where  $a$ ,  $b$  and  $c$  are known, shows that the average difference errors, neglecting sign, between  $a(\text{calc.})$  and  $a(\text{expt.})$  are 15.0, 9.8 and 3.8 wave-numbers by the three formulæ (1), (2) and (3) respectively. The corresponding percentage difference errors are 4.6, 3.3 and 1.6 per cent respectively. Judged either way, (3) gives the best results; moreover, the errors are no longer wholly positive. It may be added that in some cases the experimental uncertainty in  $a$  may amount to 1 or 2 per cent. If we may therefore trust this formula, it becomes possible to estimate  $a$ 's for a score of di-atoms for which no definite experimental data are available.

The results seem to support Howell's view<sup>3</sup>, that it is not very probable that  $a(\text{PN})$ , assigned by Curry, Herzberg and Herzberg, refers to the ground state. If, as may appear, the true value lies in the region 1,500 wave-numbers, my earlier arguments<sup>4</sup> about PN are in no way invalidated. In the case of AsN, the run of the numbers suggests that neither the assigned  $a(\text{AsN})$  nor  $a(\text{AsAs})$  belong to the unexcited condition. I cannot concur, however, in the suggestion<sup>5</sup> that the bond (force) constants  $k_0$  of a triad of di-atoms of the specified kind are equal. In the course of calculations involving a considerable number of these constants, I found, for example, that the  $k_0$ 's of OO, SO and SS were 117.7, 78.8 and  $49.7 \times 10^4$  dynes per cm. respectively<sup>6</sup>.

The limitation observed in this note to symmetrical di-atoms appears to emphasize the suggested periodic group classification of molecules, as of considerable assistance in the discussion of band spectral data. For di-atoms other than those of the chosen groups, the errors are usually large, and equations of the present type useless. (A possible exception may be CP, where I am inclined to regard the coincidence as accidental). It seems probable that the 'reduced' mass will enter into suitable expressions for di-atoms of unsymmetrical groups, and efforts will be made to find a suitable formula of more general application on these lines.

I would be pleased to be of any possible assistance to workers who are interested in a particular estimate. Details of the calculations here reported will be published in another place.

C. H. DOUGLAS CLARK.

Department of Inorganic Chemistry,  
University, Leeds.  
Feb. 3.

<sup>1</sup> Clark, C. H. Douglas, *Trans. Faraday Soc.*, **31**, 1017 (1935).

<sup>2</sup> Clark, C. H. Douglas, and Stoves, J. L., *Phil. Mag.*, (vii), **22**, 1137 (1936).

<sup>3</sup> Howell, H. G., *NATURE*, **133**, 36 (1936).

<sup>4</sup> Clark, C. H. Douglas, *NATURE*, **135**, 544 (1935).

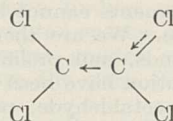
<sup>5</sup> Howell, H. G., *NATURE*, **133**, 290 (1936).

<sup>6</sup> Clark, C. H. Douglas, *Proc. Leeds Phil. Soc.*, **3**, 26 (1935).

## Force Constants and Structure

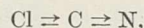
IN a recent letter in *NATURE*<sup>1</sup>, Duchesne has discussed the values of the 'force constants' of the potential energy function of the molecules ethylene and tetrachlorethylene, and has attempted to draw inferences from the calculated data about structural properties. In a paper at present in the press<sup>2</sup>, we have examined the values of the force constants of the linkages in different molecules of a given series, such as the methyl and ethyl derivatives of a metal, in so far as these are given by the values of their normal vibration frequencies. The results suggested that in different molecules of a particular type variation in the force constant of a given link or of the 'bending constant' of a given angle might throw light on the electronic arrangements in the different linkages. We have accordingly now calculated the force constants of linkages in a very large number of molecules from the known vibration frequencies. It becomes clear that in some cases, structural problems, such as the phenomenon of resonance, may be studied by this procedure. The detailed results will appear shortly elsewhere, but since our conclusions with the two molecules mentioned above appear to go further than those given by Duchesne, it may be fitting to summarize them here.

For ethylene we find:  $k_{\text{C-C}} = 9.0 \times 10^5$ , and  $k_{\text{C-H}} = 4.85 \times 10^5$ . For tetrachlorethylene:  $k_{\text{C-C}} = 5.8 \times 10^5$  and  $k_{\text{C-Cl}} = 5.2 \times 10^5$ . Now for methane, we have  $k_{\text{C-H}} = 4.98 \times 10^5$ , and for carbon tetrachloride  $k_{\text{C-Cl}} = 4.38 \times 10^5$  dynes per cm. Thus in passing from ethylene to tetrachlorethylene the constant of the C-C link is markedly diminished. This suggests the possibility of structure



agreeing with the idea of Duchesne. On this basis we should perhaps expect an increase in the C-Cl constant, as compared with that in carbon tetrachloride. This increase is noticed. The C-H constant, however, does not appreciably change in passing from methane to ethylene, since the hydrogen atoms have no electron donating capacity.

In the same way, cyanogen chloride might be written



and the C-Cl constant ought to exceed the value in carbon tetrachloride. This is again found, the values being 5.15 and  $4.38 \times 10^5$ . The C-N link constant, on the other hand, should be lower in cyanogen chloride than in hydrogen cyanide, as it is in fact, the values being 16.65 and  $17.8 \times 10^5$ . Precisely similar results are found with cyanogen bromide and carbon tetrabromide.

Thus it is clear that calculations of this kind may well be instructive in connexion with structural problems. Some anomalies are found, however, which may arise from defects in the potential energy functions used. These will be discussed fully elsewhere, but it should be noticed that in the case given above (ethylene and tetrachlorethylene), regardless of the type of potential function used (valency force system, central force system, Delfosse<sup>3</sup> function), the C-C constant has approximately the same value, and changes in the same way and to approximately

the same extent. This is strong indication of the reality of the effect suggested.

The corresponding variations of the bending constants of the angles is also interesting, as well as translation of the deduced force constants into distances by the method of Badger<sup>4</sup>, but these will be fully given later.

J. W. LINNETT.

H. W. THOMPSON.

St. John's College,  
Oxford.

<sup>1</sup> NATURE, 139, 288 (1936).

<sup>2</sup> Thompson, H. W., and Linnett, J. W., *Proc. Roy. Soc.* (in the Press).

<sup>3</sup> *Ann. Soc. Sci. Brux.*, 55, 114 (1935).

<sup>4</sup> *J. Chem. Phys.* 3, 710 (1935).

### Dipole Moments of some Aliphatic Aldehydes

SEVERAL determinations of the moments of aliphatic aldehydes have been made, but some uncertainty in the values exists.

The results previously published are given below.

Compound	Moment	Temperature	Solvent	Reference
Acetaldehyde	2.72	16°C.	(vapour)	1
	2.69	27°-182°	(vapour)	2
Propionaldehyde	2.4	—	benzene	3
<i>n</i> -Butyraldehyde	2.46	18°	benzene	4
<i>n</i> -Heptylaldehyde	2.56	22°	benzene	5

The values of the moments are given throughout in Debye units

The ease with which these compounds are oxidized and also the volatility of the lower members makes solution measurements difficult, and an accurate comparison of the moments cannot be made, as the results are incomplete. We are therefore reinvestigating these compounds, and preliminary measurements in benzene solution have been completed.

The moments of acetaldehyde, propionaldehyde, valeraldehyde and isovaleraldehyde are, we find, 2.49, 2.54, 2.57 and 2.60 respectively in benzene solution. The compounds were fractionated and measured in an atmosphere of nitrogen and the dielectric constants of the solutions determined by the apparatus described by Martin and Partington<sup>6</sup>.

The physical constants of the materials, and the values of the polarizations and moments determined in benzene solution at 20°, are given below.

Compound	b.p.	$d_4^{20}$	$n_D^{20}$	$PE$	$P_{25}$	$\mu$
Acetaldehyde	20.6° C./764 mm.	0.8058 (0°)	1.3437 (0°)	11.5 c.c.	143 c.c.	2.49
Propionaldehyde	48.2° /764	0.8058	1.3639	16.0	153	2.54
<i>n</i> -Valeraldehyde	102.5° /766	0.8105	1.3947	25.5	165	2.57
<i>iso</i> -Valeraldehyde	92.5° /754	0.8004	1.3904	25.5	169	2.60

Further work on other aldehydes is in progress, and the results will be discussed when completed.

J. R. PARTINGTON.

D. I. COOMBER.

Queen Mary College,  
University of London.  
Feb. 13.

<sup>1</sup> Højendahl, Thesis, Copenhagen, 1928; calculated from experimental results of Pohrt, *Ann. Phys.*, 42, 569 (1913).

<sup>2</sup> Zahn, *Phys. Z.*, 33, 686 (1932).

<sup>3</sup> Herold and Wolf, *Z. phys. Chem.*, B, 12, 165 (1930) (result corrected for  $P_A$ ).

<sup>4</sup> Hassel and Naeshagen, *Z. phys. Chem.*, B, 6, 152 (1929).

<sup>5</sup> Errera and Sherrill, *J. Amer. Chem. Soc.*, 52, 1993 (1930).

<sup>6</sup> Martin and Partington, *J. Chem. Soc.*, 602 (1935); 158 (1936).

### Insect Drift over the North Sea

FROM August 5 until August 13 last year, one of us (A. C. H.) was kindly permitted to accompany the Ministry of Agriculture and Fisheries research

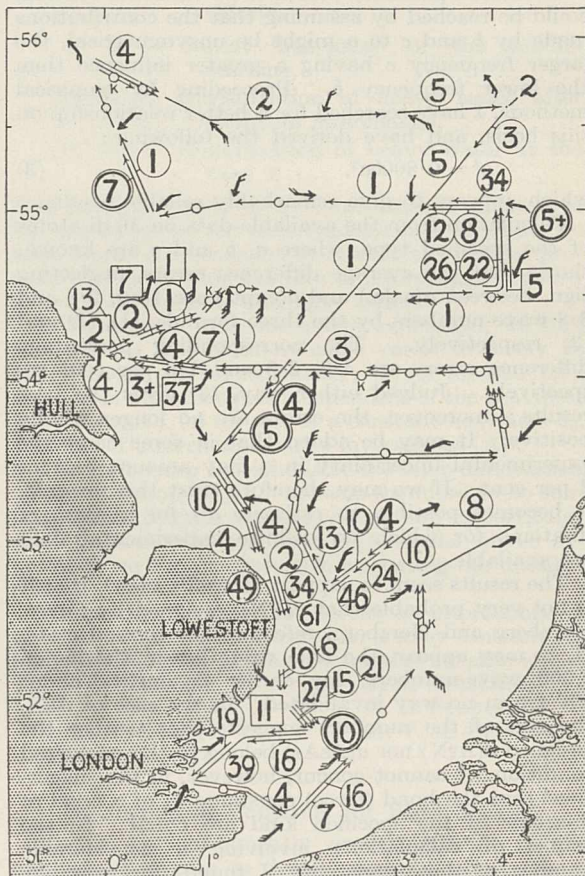


Fig. 1.

CHART SHOWING INSECT CAPTURES OVER THE NORTH SEA.

ship *George Bligh* during one of her routine cruises over the North Sea and, by flying collecting nets either from the mast-head or from kites flown from the ship, to study the drift of insects over the sea. It is hoped that further surveys will be made this year. Whilst a full discussion of the data will be reserved until further evidence is available, the results of this first survey were so unexpected that a preliminary note may be of interest.

Fig. 1 is a chart of the area covered. Each of the fine arrows shows the direction and distance over which a net was collecting. The nets were flown almost continuously, so that by following the arrows one may follow the track of the ship starting from Lowestoft in a southerly direction. A small circle on an arrow indicates a blank haul. Arrows side by side indicate nets collecting at the same time. The enclosed figures against the arrows show the total number of insects taken in each net. Those in circles were from nets flown from the mast-head, about 40 ft. above sea-level, those in squares from nets flown from kites at heights between 200 ft. and 400 ft. Blank kite hauls are marked with a 'K.'

The nets were of muslin with an opening of 3 ft. diameter, except when occasionally a larger net, 6 ft. diameter, was used (shown by a double circle). A glass collecting tube was fitted to the end of each net; twice these broke, presumably losing most of the catch (indicated by + sign on chart).

Altogether 730 insects were collected, distributed amongst the following families thus :

HEMIPTERA		DIPTERA	
Aphididae .. ..	171	Cecidomyiidae ..	21
Psyllidae .. ..	1	Chironomidae ..	54
NEUROPTERA		Culicidae .. ..	1
Chrysopidae .. ..	1	Mycetophilidae ..	53
Hemerobiidae .. ..	2	Psychodidae .. ..	20
TRICHOPTERA		Phoridae .. ..	3
.. ..	1	Syrphidae .. ..	7
LEPIDOPTERA		.. ..	355
(Noctuidae .. ..)	1)	Acalyptera .. ..	6
Micro-lepidoptera .. ..	5	Spiders .. ..	..
HYMENOPTERA		Unrecognizable ..	16
Chalcidoidea .. ..	5	(damaged in net)	..
Ichnemonoidea .. ..	7		

The broad arrows on the chart indicate the direction of the wind at points where the ship stopped for marine work, and the number of 'feathers' on the arrows indicate the strength of the wind by the Beaufort scale : 1, 2, 3 or 4. The speed of the ship was approximately 8 knots.

The insects taken in the north-eastern area, mostly Aphididae and small Diptera but also lacewing flies and micro-lepidoptera, were 120-150 miles from the nearest land.

There is, on the whole, no apparent difference between the number of insects taken at the mast-head and at heights of 200-400 ft. in the kite nets. Considering the small size of the nets used, the number of insects collected indicates a very large population of 'aerial plankton' drifting across the sea. All were taken in the nets except the Noctuid *Plusia gamma* and one Hemerobiid, which flew on board ('2' at north-east corner of chart), and all except the Noctuid must be regarded as too small and weak in flight to be true migrants. All observed in the collecting tubes (the majority) were alive and active; a few were crushed in handling the nets, especially when wet through fog. They were taken both during the day and night, and some in rain or fog.

Distinct areas can be seen in the chart: richer, poorer or apparently devoid of insect life. The barren areas perhaps represent blocks of air which have moved off the land during the night when convection currents are at a minimum.

It appears likely that the study of insect drift over the sea, in giving definite evidence of the distances (minimum when measured from nearest land) travelled by insects, may be of value in understanding the spread of insect pests over the land, in addition to indicating the infection of Great Britain from the Continent and throwing light on the origin of the insect faunas of islands. It is hoped that with the co-operation of steamship lines across the North Sea and Channel, a regular survey may be inaugurated.

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P. S. MILNE.

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Feb. 15.

### A Comparison of Certain Properties of Timbers from Tropical and North Temperate Regions

EXAMINATION of the results of standard mechanical tests on more than three hundred species of timber reveals a striking difference in the properties of timbers from tropical and north temperate regions

respectively. The results were taken from tests carried out in the Timber Mechanics Section of this Laboratory, together with those published by the Forest Research Institute, Dehra Dun, India<sup>1</sup>, and the United States Forest Products Laboratories, Madison<sup>2</sup>.

Two strength properties of the timbers were considered, namely, the strength in impact bending as measured by the maximum drop of a 50 lb. hammer, and the strength under compression parallel to the grain. When the species-averages of these two properties were plotted separately against specific gravity, it was observed that for both of them the values for tropical and north temperate zone timbers have quite distinct distributions. Although these distributions overlap, it is clear that, for any given specific gravity, tropical timbers are, on the whole, weaker in impact bending though stronger under compression parallel to the grain than north temperate zone timbers.

There appear to be no constant differences in gross anatomical structure between temperate and tropical timbers such as might account for the observed differences in their strength properties, and it would seem that the causes must lie in the composition of the cell walls. A comparative study of thin transverse sections of species from each group indicated that, on the average, the fibres of the temperate zone timbers show a greater affinity for the so-called cellulose-stains (for example, Light Green in a Safranin-Light Green combination), particularly after the sections have been subjected to prolonged boiling in distilled water, whereas the tropical timbers usually show a stronger reaction with so-called lignin reagents (for example, Phloroglucin). Furthermore, a comparison of six English-grown timbers with material of the same or closely related species grown in the tropics revealed a somewhat greater affinity for so-called cellulose stains on the part of the English-grown specimens.

Although the reactions of these microstaining reagents are not closely related to the results of standard chemical analyses of woody tissues, it may be inferred that variations in the concentration of some substance or in the physical condition of the cell walls affect the two strength properties in different directions. It is interesting to note that the positive relation between strength in impact bending and under compression parallel to the grain is an indirect one, since both strength properties are positively related to specific gravity. Mr. E. D. van Rest, of this Laboratory, has demonstrated statistically that the indirect positive relation masks a significant negative relation between the two types of strength.

The investigation so far has been of a preliminary nature and it is hoped to publish the complete results later; the evidence already obtained, however, strongly suggests that the influence of tropical conditions of growth on the composition of wood cell walls is such that, where weight is the primary consideration, timbers of outstanding toughness must be sought in the temperate regions, as they are not likely to be produced under tropical conditions.

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Forest Products Research Laboratory,  
Princes Risborough.  
Feb. 15.

<sup>1</sup>Limaye, V. D., *Ind. For. Rec.*, 13 (Part X) (1933).

<sup>2</sup>Markwardt, L. J., and Wilson, T. R. C., *U.S. Dept. Agr., Tech. Bull.*, No. 479 (1935).

## Urea as a Hygroscopic Substance

WHILE pure urea shows no tendency to absorb moisture when exposed to air under ordinary conditions, it becomes a remarkably hygroscopic substance if the humidity of the air is at a relatively high level. It is only recently that American chemists from the Bureau of Chemistry and Soils, Washington, D.C., have directed attention to this phenomenon in connexion with the behaviour of urea when present as a constituent of various mixed fertilizers.

Adams and Merz<sup>1</sup> have shown that while pure urea becomes hygroscopic only when the relative humidity of the air is at 72.4 per cent (at 30° C.), mixtures with various salts give rise to products which become hygroscopic when the relative humidity of the air is at a much lower level. They found, for example, that a mixture of equimolecular proportions of urea and ammonium nitrate became hygroscopic at a relative humidity of 18.1 per cent, whereas pure ammonium nitrate itself only becomes hygroscopic at a relative humidity of 59.4 per cent.

While the American investigators<sup>2,3</sup> have been mainly concerned in determining the effect of urea on the hygroscopicity of mixtures with various salts used as fertilizers, no results have been hitherto recorded as regards the maximum amount of water which urea can absorb when exposed to an atmosphere at its maximum hygrometric state. In order to obtain information upon this point, the following experiments were made: A small quantity (0.6 gm.) of pure dry urea in fine powder was spread over the surface of a watch-glass, which was supported over a dish containing 30 c.c. of water. The whole was covered with a beaker so that the connexion with the outer air was confined to a small opening due to the lip of the beaker. The temperature during the experiments averaged 16° C.

The results, which are of a remarkable nature, were as follows:

Time (hours)	Water absorbed (per cent)	Time (hours)	Water absorbed (per cent)
1	4.23	96	111.48
24	31.70	144	145.40
48	49.73	168	166.60
72	77.70	192	176.06

Thus after a period of eight days, after which there was no further increase in weight, urea had absorbed slightly more than one and three-quarter times its own weight of water. At the end of three days, the urea had completely dissolved in the absorbed water, yet the solution continued to absorb considerably more water than occurred up to this time. This is remarkable for a substance that separates from aqueous solution in the anhydrous form. Repetition of the experiment with urea in coarse powder and as crystals gave 174.8 per cent and 173.9 per cent absorption respectively, when equilibrium had been established with the surrounding atmosphere.

It is very remarkable that urea, which is non-hygroscopic until the relative humidity of the air reaches 80 per cent at 15° C. (Adams and Merz), should show such a great avidity for water when placed in a saturated atmosphere. In this connexion the contrast in the behaviour of (a) urea, (b) urea hydrochloride, and (c) urea nitrate is of interest. Equal weights of the three well-dried substances were exposed on watch-glasses on the laboratory bench, and whereas (a) and (c) showed no increase in weight after exposure for six days, (b) absorbed 53.5 per cent of water after only 24 hours exposure. Furthermore, (c) showed no increase in weight when exposed

for six days in a saturated atmosphere under the conditions of the experiment with urea. Thus we have urea hydrochloride very hygroscopic even at a low relative humidity, urea itself hygroscopic only when the relative humidity is very high, and urea nitrate non-hygroscopic even when exposed to air saturated with water vapour. Can the physical chemist offer any explanation to account for these phenomena?

The subject is one which seems to be well worthy of a more extensive investigation, and this is the chief reason for bringing the foregoing results to the notice of those who may be interested in the matter.

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Trinity College,  
Dublin.

<sup>1</sup> Adams and Merz, *Ind. and Eng. Chem.*, **21**, 305 (1929).

<sup>2</sup> Whittaker, Lundstrom and Skimp, *Ind. and Eng. Chem.*, **26**, 1307 (1934).

<sup>3</sup> Davis, Scholl and Miller, *Ind. and Eng. Chem.*, **27**, 69 (1935).

## Structure of Agar-Agar

WE now communicate some preliminary results of the investigation on methylated agar prepared from the acetate previously described in NATURE<sup>1</sup>. By the simultaneous deacetylation and methylation of acetylated agar ( $[\alpha]_D^{20} = -32^\circ$  in chloroform;  $\text{CH}_3\text{CO} = 38.5$  per cent), an apparently homogeneous methylated agar was obtained ( $[\alpha]_D^{20} = -78^\circ$  in chloroform;  $\text{OCH}_3 = 31$  per cent), the methoxyl content of which remained constant despite repeated methylations.

This derivative on hydrolysis yielded a mixture of methylated sugars (yield c. 75 per cent), together with an acid. The sugars on conversion into the glycosides yielded a new crystalline trimethyl  $\alpha$ -methylgalactoside (yield, c. 70 per cent) from which on complete methylation and suitable treatment crystalline tetramethyl *d*-galactopyranose anilide was obtained in excellent yield, indicating the absence of substitution in position 5 of the trimethyl galactose molecule. This sugar gave a crystalline dimethyl galactose phenylosazone indicating substitution in position 2, and oxidation with bromine under conditions favourable to the formation of a  $\gamma$ -lactone yielded a trimethyl galactonolactone of high positive rotation ( $[\alpha]_D^{20} = +150^\circ$  in water), which fell rapidly on standing to an equilibrium value of  $+50^\circ$  in less than 24 hours, this behaviour being characteristic of a  $\delta$ -galactonolactone. Furthermore, galactoside formation at room temperature regenerated exclusively the galactopyranoside, so that there appears to be no doubt of the fact that position 4 is occupied by a methoxyl residue, and the trimethyl galactose cannot therefore be the 2:3:6-trimethyl galactose isolated from varianose by Haworth, Raistrick and Stacey<sup>2</sup>. There thus exists the possibility that the methylated sugar in question is 2:3:4- or 2:4:6-trimethyl galactopyranose. The former has been previously described<sup>3,4</sup>; but both the properties of the lactone and its derivatives and the results of oxidation with nitric acid indicate that the latter formulation is correct in this case.

In view of these facts therefore, and the strong negative rotations of acetylated and methylated agar, we consider it probable that the 'main carbohydrate portion' of agar-agar consists of  $\beta$ -galactopyranose units linked at positions 1 and 3, an arrangement

unique so far in polysaccharide chemistry. From an inspection of models it appears either that the galactopyranose units are present in the form of a six-membered ring, or alternatively as a zigzag chain terminated by residues as yet undetermined. It is not yet possible to form an opinion on the 'fine structure' of the agar macro-molecule, whether for example the supposed sulphuric ester residues exist as cross-linkages, or indeed their approximate location. Further work will also be necessary to decide the constitution and mode of union of the acid portion of the hydrolysed product.

These investigations will be discussed elsewhere.

Chemistry Department, University of Edinburgh,  
E. G. V. PERCIVAL.  
J. MUNRO.  
J. C. SOMERVILLE.

<sup>1</sup> Percival and Sim, *NATURE*, **137**, 997 (1936).

<sup>2</sup> Haworth, Raistrick and Stacey, *Biochem. J.*, **29**, 2668 (1935).

<sup>3</sup> Challinor, Haworth and Hirst, *J. Chem. Soc.*, 258 (1931).

<sup>4</sup> Onuki, *Chem. Zentr.*, **II**, 367 (1933).

### The Theory of Dimensions

IN reviewing Dr. F. W. Lanchester's book "The Theory of Dimensions and its Application for Engineers" in *NATURE* of January 9, I stated with

regard to Appendix VI that "in my opinion the author was unwise to include this section in a book the avowed object of which is to help the young engineer". Dr. Lanchester has written to me pointing out that although this was the primary object of writing the book, it is stated in the preface that the author hopes that it "may be found of service to others besides those to whom it is primarily addressed. As a book of reference for workers in the physical laboratory, auxiliary to existing works on the same subject, it may prove of service as conveying its message in a simple and direct manner".

I should be sorry if the book were prejudiced in any way by my reference to what was only the primary object as the avowed object. In an editorial reference to the book in the *Wireless Engineer*, I remarked that "like many another book written avowedly for the young, it will be read with enjoyment and profit by many who are no longer young; in fact, the latter class of reader will be better able to appreciate the vigorous attempts to extirpate dimensional heresy—that is, anything with which the author does not agree".

G. W. O. HOWE.

University,  
Glasgow.

### Points from Foregoing Letters

THE effect of substituting deuterium for hydrogen on the intermolecular bonds of oxalic acid has been examined by Dr. J. Monteath Robertson and A. R. Ubbelohde using X-ray methods. A small expansion of the lattice occurs, mainly in the direction of the deuterium bonds, an effect which throws light on the mechanism of the hydrogen bond, and promises to be of value in locating certain types of hydrogen linkage in complex structures.

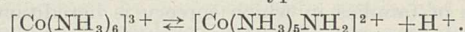
In order to predict the shape of the curve expressing the energy distribution of the electrons emitted in radioactive transformations, several formulæ have been proposed, based on the theory that (unobservable) neutrinos are simultaneously emitted. Dr. H. O. W. Richardson points out that the equation of Fermi fits low-energy transformations, whilst that of Konopinski-Uhlenbeck applies in the case of high-energy electrons.

Diagrams of the rate of sedimentation of ovalbumin in water solution (buffered at pH 6.0) and in 50 per cent urea solution, are given by Prof. J. W. Williams and Dr. C. C. Watson. The data indicate that, in urea solution, the ovalbumin is dissociated into a product of approximately half the molecular weight in water solution. This dissociation appears to be reversible.

The presence of an absorption band in the region of  $2.7\mu$  in various organic compounds containing O—H groups is discussed by Dr. J. J. Fox and Dr. A. E. Martin. A curve showing the infra-red absorption of benzyl alcohol in carbon tetrachloride, showing both the O—H absorption band and the 'association' band is submitted. The authors state that replacement of hydrogen by phenyl groups suppresses intermolecular association.

Dr. J. S. Anderson, N. L. Spoor and Prof. H. V. A. Briscoe report that the rate of interchange between water and hexamine cobaltic chloride containing deuterium is independent of the heaviness of the salt at any given concentration, and

for salt of given heaviness varies inversely as the hydrogen ion concentration and inversely as the square root of salt concentration. These facts suggest the explanation (independently reached by F. J. Garrick) that co-ordinated ammonia can undergo an acid dissociation of the type



Dr. C. H. Douglas Clark has reviewed methods available for the calculation of the band spectral constants of di-atoms, and has introduced a formula connecting the fundamental vibration frequencies  $a$ ,  $b$  and  $c$  of members of a diatomic triad  $XY$ ,  $XX$  and  $YY$ , respectively, which belong to 'symmetrical' molecular groups, as follows:  $a^3 = 0.8bc^2$ .

Tropical timbers show on the whole less resistance to impact, though greater strength under compression parallel to the grain, than north temperate zone timbers of the same specific gravity. S. H. Clarke suggests that the differences in strength properties are caused by growth conditions acting through the medium of the cell wall composition.

Prof. E. A. Werner directs attention to the fact that urea, a non-hygroscopic substance under ordinary conditions, can absorb one and three-quarter times its weight of water when exposed to air saturated with moisture. This rather remarkable result for a substance which separates from aqueous solution in an anhydrous form is discussed in connexion with the marked contrast in the behaviour of urea, urea hydrochloride and urea nitrate towards water absorption under similar conditions.

The hydrolysis of completely methylated agar-agar yields as the main product a trimethyl galactose which appears to be 2:4:6-trimethyl galactose. Dr. E. G. V. Percival, Dr. J. Munro and J. C. Somerville consider it probable therefore that portion of the polysaccharide which is derived from galactose is composed of  $\beta$ -galactopyranose units linked at positions 1 and 3.

## Research Items

### Malay Magic

THE various classes of the magical dance performed in the Malay Peninsula, notwithstanding innumerable variations in character and underlying principle, present a general uniformity of type, while the associated traditions conform to certain common patterns. Details of the dance and the magical beliefs connected with it in the State of Kelantan studied by Jeanne Cuisinier (*Inst. d'Ethnol. Trav. et Mém.*, 22) were corroborated by the author in Perak, Pahang and Trengganu, as well as in Patani, Siam. In these dances, the spirits, especially the ancestral spirits, are invoked for a variety of purposes, mostly connected with the treatment of disease, especially epidemics. The performers fall into the possessive trance characteristic of this type of dance. In order to understand the character of the dances, it was found necessary to study the whole nexus of magical belief, on which they rest. Observations of the unbalanced mentality characteristic of those subject to supernatural influence were recorded, though without any attempt at psychological diagnosis, owing to the author's lack of medical training. The essential conditions in the 'make up' of the medicine-man belief in Malaya are: revelation, heredity and secrecy; while symbolism plays a large part in magical practice. Revelation may be either voluntary and induced, or involuntary. The voluntary revelation is sought by going into retreat, fasting, prayer, etc. Involuntary revelation is most commonly found in members of families in which sorcery is hereditary, going back to remote ancestors—a matter in which it links up with totemism. Secrecy is maintained, even when incantations have to be uttered aloud, by speaking in a peculiar and incomprehensible voice or by omitting part of the charm, until it is reduced to perhaps no more than one or two words.

### A Peruvian Manuscript

IN 1908 Richard Pietschmann, director of the Göttingen Library, when attending as German delegate the xvth International Congress of Orientalists at Copenhagen, discovered in the Royal Library the manuscript, hitherto unnoted, of a chronicle written by a Peruvian, Don Felipe Guaman Pomo de Ayala. This manuscript, consisting of 1,174 pages quarto, it was Pietschmann's intention to publish with commentary; but he died before his work was complete. It is now published in facsimile by the Institut d'Ethnologie of Paris (*Trav. et Mém.*, 23). The chronicle, which is in corrupt Spanish interspersed with many Quichua words, was written in the early years of the seventeenth century—it embodies a letter by the author's father, which is dated 1587. Guaman claimed to be a descendant of the rulers of the powerful northern State, which long resisted the power of Cuzco. Whatever his descent, his circumstances were abject, a condition which he attributes to his devotion to the cause of his fellow countrymen. About one quarter of the manuscript is devoted to a description of the country and its inhabitants before the conquest by Francisco Pizarro, in which the historic period is preceded by four legendary epochs, beginning with that of the

divine, or semi-divine Viracocha, followed by those of the authochthones or "giants", the men of the desert, and the warriors. Historical and biographical sketches and an account of the Inca constitution and social orders follow. The story of the acts of the conquistadores and the rule of the viceroys, Indian risings and sufferings, is rounded off by an idealistic sketch of Indian Christendom, and the Indian calendar of agricultural operations. The remarkable and most valuable feature of the manuscript, overshadowing the text, is the very large number of full page drawings, illustrating the narrative, which convey much information throwing light on Indian appearance, vocabulary, dress, custom and belief.

### Birds of the South Orkney Islands

THERE are no truly resident birds in the South Orkney Islands, and very few are to be seen in winter, although one or two sheathbills, thanks to their omnivorous diet, find it possible to live through the winter months upon the refuse of human habitations in the neighbourhood of the meteorological station, as they did about the winter quarters of the *Scotia* expedition. In the "Discovery Reports" (12, 349; 1936) R. A. B. Ardley gives an account, illustrated by eight photographic reproductions, of the members of this oceanic bird fauna, supplementing the description of plumage and breeding given by Dr. Eagle Clarke in his account of the *Scotia* material, and adding records of the presence of several species from islands in the group not investigated by the Scottish National Antarctic Expedition.

### Marine Research at Millport

THE annual report of the Scottish Marine Biological Association for 1935-1936 shows that a large amount of good work has been accomplished. Research on herring by Drs. Orr, Marshall and Nicholls is progressing, but, as is usually the case with trying to rear herring from artificial fertilizations, the young only lived about three weeks. Various growth stages, however, were obtained from the plankton, and both larval and metamorphosed fish studied. From hatching to metamorphosis they grew rapidly and fairly regularly, increasing in length 2-3 mm. weekly. Metamorphosis began at a little over 40 mm. At hatching, a single larva weighed about a fifth of a milligram, at a length of 20 mm., reached when the fish was about five weeks old, it weighed 1½ mgm.; and at 40 mm. when about twelve weeks old, 35 mgm. Estimations of fat and protein were made, the fat content increasing rapidly as the fish approached metamorphosis. Vertical hauls for plankton were taken whenever the young herring were caught. The food eaten by the fish corresponded in size with the size of the fish, as is usually found. The smallest were eating small *Pseudocalanus*, *Microcalanus*, etc., and the larger were eating adult *Pseudocalanus*, *Centropages*, *Temora*, etc. Dr. Marshall is continuing her work on the biology of the small copepods and Dr. Orr his work on the composition of the food of fish by making analyses of the chemical composition of numerous species of crustaceans, molluscs, echinoderms, worms, etc.; Dr. Nicholls his study of the



copepod genera *Leptosyllis* and *Paramesochra*, and Dr. A. C. Stephen has paid special attention to the spat-falls of *Tellina tenuis*, continuous observations having been made since the autumn of 1926. Dr. D. C. Gibb has carried out an ecological survey of marine algae of an area of coast at the north end of Cumbrae.

#### Boll-worms of Cotton in South Gujerat

MESSRS. B. P. DESHPANDE and N. T. Nadkarny have examined methods for controlling the two species of spotted boll-worms, *Earias faba* and *E. insulans* in south Gujerat, Bombay Presidency. The results of their investigations have been published as Scientific Monograph No. 10 (1936) of the Imperial Council of Agricultural Research, India. Various methods of controlling the larvæ of these two moths are discussed, and the results of experiments recorded. It appears that no advantage is likely to be derived from biological methods of control since all the known parasites of *Earias* are found to be present locally. A study of the most important parasite, *Microbracon lefroyi*, also showed that it was not possible to increase the incidence of this species by artificial methods. Advantage has been taken of the fact that the larvæ of *Earias* get their supply of food, between the two cotton-growing seasons, from the fresh shoots sprouting from standing plants of cotton or their stumps, and from stray malvaceous weeds. The authors claim that it will be possible to prevent the carry over of the *Earias* from one season to another by the destruction of cotton plants and weeds at the appropriate time and by withholding the cultivation of 'bhindi' during that period since it is also used as a food plant by the larvæ. A clean-up scheme has, therefore, been started in order to determine the efficacy of the proposed measures, and is still in progress. The scheme, it may be added, is being financed by the Indian Central Cotton Committee.

#### Hæmostatic Action of Ayapin and Ayapanin

P. K. BOSE and B. B. Sarkar, writing from the University College of Science, Calcutta, report preliminary observations on the hæmostatic action of two substances isolated from the leaves of *Eupatorium ayapana* Vent., a decoction of which has long been a popular remedy against various kinds of hæmorrhage in Hindu medicine. The substances are termed ayapanin, identical with 7-methoxycoumarin, and ayapin, identical with 6:7-methylenedioxcoumarin; in each case similar hæmostatic effects were found with the synthetic and natural compound; no effects on heart, respiration or blood pressure were observed. The coagulation time of rabbits' blood was diminished when traces of finely divided ayapanin or ayapin were added *in vitro*, when saturated solutions of the compounds in physiological saline were injected subcutaneously, and when the substances were given by mouth, the effect in the latter instance lasting approximately one hour. The closely related substances coumarin, 7-hydroxycoumarin and sodium *p*-methoxycinnamate had no effect on clotting time.

#### Hot-water Treatment of Bulbs

HOT-water treatment is now the standard method for dealing with Narcissus bulbs infected by eelworm, but although it has given a considerable measure of success, its efficiency has not reached the standard which was to be expected on theoretical grounds, or could be usually obtained with small-scale trials. The

question has been under investigation during the past few years by Messrs. Staniland and Barber of Seale-Hayne Agricultural College, and the results of their inquiry have been issued by the Ministry of Agriculture as Bulletin 105, "The Efficiency of Baths used for the Hot-Water Treatment of Narcissus Bulbs" (H.M. Stationery Office, price 1s.). Unsatisfactory results could be traced to a number of different causes, but the factor which seems to have led most frequently to the survival of eelworm during treatment is the use of sacks to hold the bulbs, for penetration and circulation of the water within a sack is slow, and the majority of the bulbs fail to reach the requisite temperature under these conditions. Practical suggestions are given for improvements, such as the use of rigid containers in place of sacks and the introduction of a circulatory system where rectangular tanks are employed. Attention is also directed to the fact that inaccurate thermometers or incorrect steam pressures are frequently the cause of apparent inefficiency of the method. It is hoped that the practical recommendations provided in the bulletin will result in the hot-water treatment giving even greater satisfaction than it has in the past, for there is no doubt that such treatment has been the saving of the bulb industry.

#### Transfusion of Quartzite

DORIS L. REYNOLDS has described (*Min. Mag.*, 24, 367; 1936) in great detail the most convincing example which has yet been recorded of the transformation of quartzite into rocks that are indistinguishable from common igneous types. The hornblendite of three small composite intrusions in Colonsay is thickly sprinkled with blocks of white quartzite, most of which exhibit various stages of replacement by micropegmatite, syenite and appinitic. Completely replaced xenoliths are represented by felspathic patches and schlieren. Finally, the process of transfusion gave rise to syntectonic magma, of syenitic and appinitic composition, now represented by veins which emerge from metasomatized quartzite. By study of successive replacement zones and chemical analyses, it is found that differential migration into the quartzite of various magmatic constituents took place. The paper is followed by one in which A. Holmes describes the augite-rimmed xenoliths of transfused quartz which occur in many of the alkali basic and ultrabasic lavas of south-west Uganda. (*Min. Mag.*, 24, 408; 1936). Transfusion begins with the development of intergranular channels of glass and continues until only isolated relics of quartz remain. Microchemical analyses (by F. Hecht) of three samples of glass from pure quartzite or vein-quartz show that the glass has the composition of silica-rich potassic obsidian. The constituents which migrated into the quartz were mainly those of alumina, potash and water. Comparison is made with the Colonsay phenomena, and in both papers references to many comparable but less well-authenticated examples are given.

#### Effect of a Magnetic Field on Adsorption

THE effect of a magnetic field on the rate of crystallization and some physical properties of substances is well-known. S. S. Bhatnagar, P. L. Kapur, and A. N. Kapur have recently reported the results of the effect of a magnetic field on the extent of adsorption (*Phil. Mag.*, (7), 23, 256; 1937). The systems studied were the adsorption of potassium

permanganate, potassium dichromate, potassium ferrocyanide, and ferric chloride on sugar charcoal, and that of potassium permanganate and potassium ferrocyanide on barium sulphate. In the case of potassium permanganate, potassium dichromate, and potassium ferrocyanide, there was a small but definite increase in the adsorption by sugar charcoal in the magnetic field. With ferric chloride on sugar charcoal there was a decrease, whilst for adsorption of potassium permanganate and potassium ferrocyanide on barium sulphate there was no effect. The authors discuss the effects with sugar charcoal in the light of the view put forward by a number of workers, but particularly by Burrage, that active charcoal is covered with a film of active oxide which cannot be removed even by prolonged heating in a vacuum. The filtrate from the potassium permanganate experiments with charcoal was found to contain a suspension of manganese dioxide, the presence of which may be ascribed to the interaction of the permanganate with the active oxide. Similarly, chromic ions were found in the filtrate from the dichromate adsorptions. In the adsorption of ferric chloride it is probable that the active oxide forms iron carbonyl and is thus removed. Potassium ferrocyanide was found to be partly oxidized to the ferricyanide during the process of adsorption. These facts favour the existence of an active oxide of carbon, and a chemical theory of adsorption. The authors go on to show that the effect of a magnetic field on the adsorption which was found by experiment is in agreement with the rule put forward by them in 1929, that a reaction would be accelerated, retarded, or remain unaffected according as whether the sum of the molecular susceptibilities of the products is greater than, less than, or equal to the sum of the molecular susceptibilities of the initial substances.

#### Protein Films

IN *Science* of January 15, Drs. Irving Langmuir and V. J. Schaefer of Schenectady collaborate with Dr. Dorothy M. Wrinch of Oxford in a very interesting study of films of protein transferred to solids from water surfaces. In order to facilitate optical study of these films, they were deposited on a polished chromium-plated surface. The method of deposition was similar to that already worked out by Langmuir and Miss Blodgett, dipping the slide into water covered by a film; and two different types of protein film were obtained according to whether the slide was dipped into water already covered by a film, or dipped first into clean water, a film then put on, and the protein afterwards spread before withdrawing the plate. The two types of film probably differ in that one is applied the opposite way up to the other, and their outer layers are hydrophilic or slightly hydrophobic according to the manner in which they have been applied. Many successive layers can be built up, and any even number of layers of protein can be inserted between layers of stearate molecules, thus giving a close approach to possible structures for the surfaces of living cells. Studies of the penetration of liquids into these films have been commenced, and it appears that hydrocarbon liquids can easily penetrate into the holes (of molecular dimensions) left by the removal of the stearic acid molecules from a mixed barium stearate - stearic acid film. The water-retaining properties of these films depend on the orientation of the protein molecules.

#### Encounters between Pluto and the Neptunian System

MR. RAYMOND A. LITTLETON, who has already contributed an interesting paper (*Mon. Not. Roy. Astro. Soc.*, 96, 566) on the origin of the solar system, prompted by Russell's severe criticism of the theory of Jeans, has a paper on this subject in the same journal (97, 2; Dec. 1936). The high eccentricity of Pluto, exceeding 0.25, implies that it may be nearer to the sun at times than Neptune, and for this reason encounters of Pluto have an important bearing on certain problems relating to the past history, as well as to the future, of the solar system. A rigid mathematical investigation leads to several interesting conclusions, amongst which the following may be noticed. Encounters between Pluto and the Neptunian system may have occurred in the past and may occur again. It is even possible that the orbit of Pluto may come within that of Saturn, and an encounter with Saturn could eject Pluto from the solar system, but as such an encounter is most improbable, the matter is of little interest. The action of Neptune, on the other hand, may cause great alterations in the orbit of Pluto, though it cannot eject it. The considerations in the paper lead to the conclusion that Pluto may originally have been a direct satellite of Neptune, and that an encounter which gave it an existence as an independent planet also reversed the general direction of motion of Triton. It is admitted, however, that this explanation of the retrograde motion of a true satellite is rather speculative.

#### The Gas Impregnated Cable

DURING the last few years, the development of cables suitable for high-tension currents has proceeded rapidly. In a paper read to the Institution of Electrical Engineers on March 10 by A. W. Arman, various types of these cables are described. The earliest type consisted of a copper core for carrying the current, separated by impregnated paper from a co-axial hollow copper cylinder which formed the return path. It was found that a limiting factor in this type of cable was due to the vacuous spaces (voids) which formed in the dielectric and caused ionization to occur at high electric pressures. The next type of cable was the oil-filled cable, in which low viscosity oil was introduced under moderate pressure from the hollow conductor and filled up the voids, thus avoiding ionization. It has been successfully applied to 132 kV. systems. The main drawbacks are that the cable and the associated apparatus are expensive. Another and more recent method of preventing the formation of voids in three-core cables is to use an impregnated dielectric of the usual type for the three cores and encase them in a thin flexible sheath. The cable is then drawn into a steel pipe, and the latter is filled with gas at high pressure. As the compound in the cable expands and contracts as the current it carries varies, the sheath 'breathes' to accommodate the varying volume and the high external pressure prevents the formation of voids. This type of cable is called the 'pressure cable'. The 'gas impregnated' cable, which the author describes, is intended to produce a 132 kV. cable based on sound principles. The insulation consists merely of high-pressure gas and dry paper. It is unaffected by heat cycles and so the dielectric can be run at a higher temperature than in other cables. Nitrogen at a pressure of 200 lb. per sq. in. was first employed but later on it was found that carbon dioxide gave a better performance.

## Fuel Research

THE report of the Fuel Research Board\* for the year ending March 31, 1935, differs from its predecessors in the emphasis given to problems arising from the preparation of coal for sale. This follows naturally on the changes taking place at British collieries, where increasing proportions of coal are obtained by mechanical methods, and are also subjected to various cleaning processes. Again, consumers become more reluctant to pay a premium for size. Apart from the open fire, there are few uses for large lump coal. It is the modern tendency to employ automatic mechanical methods of firing boilers, furnaces and producers, and for such uses coal must be small in size and uniformly graded. Formerly, small coal was often deliberately rejected by the use of forks for loading underground. To-day collieries are increasingly finding it necessary to break lump coal to supply the demand for small fuel, and this has brought into prominence many chemical and physical problems previously unknown. The best methods of breaking to preserve sizes and avoid the production of dust have been investigated. Coals broken and graded suitably at the colliery were found to suffer little further degradation in normal transport to the consumer.

The development of schemes for coal marketing has disclosed the need and opportunity to reduce the number of sizes of marketable coal. The Board is collaborating with the Midland Institute of Mining Engineers and the South and West Yorkshire Coal Owners in an attempt to do this. It was found, in this area, that no less than 106 different size grades of coal below 3 in. size were being marketed; and

yet seventy per cent of the coal fell within 15 size grades. With slight adjustment of the size mesh, these 15 grades would cover ninety-five per cent of the tonnage. It is difficult to see any technical reason for marketing coal in so many sizes, and there must be advantage in selling to reduce the number.

Considerable attention has been given to the question of mixing or blending coal from different seams. It is often forgotten that the supply of good coking coal is limited. The problem of blending coals, which though unsuitable alone, give good coke when carbonized after blending with others, is receiving increasing attention.

The supply of active carbon suitable for respirators and gas masks is obviously a very important matter. Some materials on carbonization yield an active residue, but it is known that less active carbon can be activated by gasification with steam. The report records that it has been found possible at the Fuel Research Station to carbonize selected coals, of the durain type, and treat the coke with steam at a high temperature to obtain an active carbon nearly as good as the best obtainable and at a considerably lower cost. The importance of this observation needs no emphasis. The cost of active carbon is a limiting factor in processes for recovery of vapours.

Systematic work on the hydrogenation of coal and tar oils has been continued. Attempts to prepare first-class lubricants from coal tar oils have not been successful—possibly because the molecular structure of these hydrocarbons is unsuitable. It now appears that the most hopeful line is to synthesize hydrocarbons from carbon monoxide and hydrogen, and experiments in this direction have been initiated.

The report touches most aspects of national fuel problems and may be commended to those who seek a conspectus of the current position. H. J. H.

\* Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March, 1936; with Report of the Director of Fuel Research. Pp. x+217. (London: H.M. Stationery Office, 1936.) 4s. net.

## Twenty-fifth Anniversary of Laue's Diagrams

IT has been a pleasure to men of science in Great Britain to see the growing interest taken and progress made in science in India. The rapidly increasing list of original investigators, and the importance of many of their papers, contributed not only to their own institutions but also to learned societies in Great Britain, are a source of sincere gratification. Forty years ago (1896) I was present at the opening of the completed Indian Institute in Oxford, by the ex-Viceroy, Lord Dufferin, accompanied by Mr. Asquith (afterwards Prime Minister and Lord Oxford), who made a remarkable speech in welcoming our Indian co-subjects of the British Crown to partake of the best of our educational facilities. The fraternal lead then given has borne such wonderful fruit that India itself is now providing all that is needful, without any longer feeling the necessity of expatriating its sons to Europe for their higher education.

These facts are remarkably illustrated at the moment by the appearance of a special number of

*Current Science*, a monthly journal devoted to science published at Bangalore, with the aid of thirty natives of India. This special number is devoted entirely to marking the twenty-fifth anniversary of the discovery by Laue of the diffraction of X-rays by crystals, and to the review of the years of intense research into crystal structure which have followed. It contains a dozen articles by the leaders in this work, the first being by Prof. Max von Laue himself, with his portrait as frontispiece. Succeeding articles are by Sir William and Prof. W. L. Bragg, Prof. P. P. Ewald, Prof. M. Siegbahn, Prof. A. Sommerfeld, Dr. L. Pauling, Prof. C. G. Darwin, Prof. H. Mark, Prof. J. A. Prins, Dr. S. K. Allison, Prof. H. A. Kramers, and Dr. S. Rama Swamy; an introduction is also contributed by Sir C. V. Raman. The mere fact that such a remarkable jubilee 'Festschrift', celebrating Laue's epoch-making discovery, should be organized by our Indian scientific brethren, speaks volumes for the advance of science in India.

There is every reason why I should feel specially warm towards this interesting brochure. For, twenty-five years ago (1912) I was the guest for a week of Prof. P. von Groth, the veteran crystallographer, at Munich almost immediately after the discovery made in the adjacent laboratory, and was shown the first negatives taken by Laue and Sommerfeld's assistants, Friedrich and Knipping, of copper sulphate and zinc blende. I was, indeed, by Dr. Laue's kindness, provided with duplicates of these and of the negatives of the apparatus used, and lantern slides from them were shown in a Friday evening discourse given by me at the Royal Institution shortly after my return to England. It was only in the preceding year, 1911, that my treatise on "Crystallography and Practical Crystal Measurement" was published by Messrs. Macmillan and Co. Ltd., representing the state of crystallography at the moment of Laue's discovery; and the twenty-five years of X-ray analyses of crystals which have followed, have confirmed and substantiated the contents of that work, which was expanded to two volumes in 1922, including a full account of X-ray work. No structure has been revealed by X-rays which does not conform to one or other of the 230 types of possible crystal structure clearly defined by the independently corroborating work of Schoenflies, Fedorow, and Barlow. The relative dimensions of the crystal unit cells, containing one or more molecules of the substance, which were given by me for the members of the several series of isomorphous substances which I had investigated in sufficient detail, were not only confirmed but also—and this was the greatest achievement of X-ray analysis—converted into absolute measure, in Ångstrom units.

Moreover, the generality of the law that the whole of the crystallographical and physical constants of the members of isomorphous series showed a regular progression with the atomic number of the interchangeable elements forming the series, was at this moment being somewhat criticized (but only as to the generality of its application), on account of an apparent important exception in the case of the haloid salts of the alkali metals. I had been careful to stipulate that the law only applied so long as the type of structure (one of the possible 230 types) remained rigorously the same throughout the whole series. X-ray analysis at once cleared up the mystery, for it indicated that there was a change of type between rubidium and caesium chlorides; for while potassium and rubidium chlorides resemble sodium chloride in belonging to the face-centred cubic type of space-lattice, caesium chloride belongs to the body-centred type, so that the law is totally inapplicable, the members of the series not being all strictly comparable with each other.

Many other instances of the assistance afforded by X-ray analysis to the clearing up of doubtful cases could be quoted. It should further be pointed out that in obtaining the results, which led to the law of progression, extreme refinement in angular and other fine measurement was essential, and the use of only the most perfect small crystals, grown with the greatest care free from either mechanical or thermal disturbance, such, in fact, that those crystal-angles which were of equal value with respect to the symmetry would not vary more than two minutes of arc. The so-called 'mosaic' crystals, which appear to give better reflection results in X-ray analysis, owing to the use of the rotating integrating method of using the X-ray spectrometer, are merely

imperfect hastily grown crystals, which I would have ruthlessly rejected as being useless for the purpose in view.

It is thus obvious that it is the combination of the most refined of the older (pre-1912) crystallographic methods, with the newer X-ray analysis, that will give us the fullest knowledge of crystal phenomena and structure, one being complementary to the other, and the two together giving us the truth in full. The fascination of X-ray analysis has caused almost a cessation of crystal-angle and optical and other physical constants measurement, and one must hope that now so many structures have been unravelled by X-rays, of both inorganic and organic substances, more attention will be paid to goniometrical, optical, elastic, magnetic and electrical measurements with crystals. The purely structural X-ray work will then occupy its proper important position in the complete research.

In his personal article, Prof. von Laue throws a little further light on the circumstances in which in February 1912 his discovery was made. One evening in that month, P. P. Ewald went to him for advice as Privatdozent as to a difficulty which had arisen in preparing his (Ewald's) thesis for the Munich doctorate, on a subject which he had undertaken at the instance of Prof. Sommerfeld. During the discussion, the fact became prominent that a crystal is essentially a three-dimensional lattice, and the question suddenly dawned in Laue's mind, as to what would happen if such a lattice were approached by a radiation of which the wave-length was short compared with the lattice-constant (unit cell dimension). The analogy of light waves and gratings suggested that diffraction must ensue. Remembering that Wien and Sommerfeld had only recently found Röntgen rays to possess a wave-length of the order  $10^{-8}$  cm., and that the lattice constant must be somewhere about  $10^{-8}$  cm., Laue came at once to the inspiring conclusion that the conditions for diffraction were highly favourable. Just at that moment entered W. Friedrich, Sommerfeld's assistant, and hearing the conclusion of the discussion, at once expressed a wish to put the matter to an immediate experimental test. Now Laue was obviously accepting Sommerfeld's view that the X-rays were a wave-motion, electromagnetic waves of excessively short wave-length, and not corpuscular, as was at that time supposed by Prof. W. H. (now Sir William) Bragg.

Friedrich obtained the help of a specially able experimental colleague, P. Knipping, and the apparatus was soon rigged up for passing a beam of X-rays through a crystal, and interposing a photographic plate in the path of any transmitted or diffracted rays. But unfortunately the crystal chosen, from being so easy to obtain well developed, was copper sulphate, which crystallises in the triclinic system of lowest symmetry. The effect on the photographic plate after development, although very promising, was confused, owing to the lack of symmetry. But on substituting a crystal of zinc blende, as advised by Prof. von Groth who lent the crystal, which is of cubic symmetry, the now well-known excellent pattern of cubically symmetrically arranged spots was obtained. After repeated confirmations and discussions of the meaning of the results, Prof. Sommerfeld was able to present the epoch-making paper of Laue, Friedrich and Knipping, on June 8, 1912, to the Munich Academy.

It would appear that the subsequent entrance of Sir William Bragg, and of his son W. L. Bragg, into

the field was due to an attempt to discover whether Laue's effects were caused by the X-rays themselves (as corpuscular) or by electromagnetic wave-radiation associated with corpuscular rays. W. L. Bragg, then a student at Cambridge, was soon able to show that the zinc blende pattern of spots was due to the symmetry of the crystal, and not to the character of an X-ray spectrum; and he followed it up by determining the actual arrangement of the atoms in the still simpler cubic crystals of potassium and sodium chlorides. Sir William Bragg then found that the reflected X-rays, when analysed by an ionization spectrometer, consisted both of a general (continuous) spectrum and of rays of characteristic wave-lengths (Barkla's *K* and *L* rays), and that indeed Laue's explanation of the effect as a diffraction of electromagnetic waves must be accepted.

Moseley's brilliant measurement of the wave-lengths or frequencies of the characteristic X-radiations of the various elements immediately followed, and their relations were shown to offer a complete explanation of the Periodic Law of the elements; and the sequence number (atomic number) of the element suddenly developed a wonderful and unanticipated meaning, in expressing the positive charge on the nucleus of the atom, and the number of the surrounding planetary negative electrons. By a combination of the use of the Laue photographic method and the Bragg ionization spectrometer, together with the Debye powder method when good crystals are not available, and the rotating methods more lately introduced, all the important subsequent progress in unravelling the internal structure of crystals, not only of very simple substances but also of many complicated ones, including organic substances containing a large number of atoms in the molecule, has been achieved.

In their article Sir William and Prof. Bragg scarcely

do justice to the really great progress which had been made in crystallography previous to 1912. They state that "at that time crystallography was so much a science apart, and played so little part in physics and chemistry, that the idea of a crystal pattern had never presented itself to the majority of scientists". If this were really the case it was the fault of workers in other scientific fields; for a small band of devoted crystallographers were insistently, in season and out of season, directing attention to the subject, and to its immense importance to physicists and chemists.

My own "Crystallography and Practical Crystal Measurement" set it forth clearly in the year 1911. The Laue discovery came at the most psychologically appropriate moment, to clinch the facts, to arouse universal interest in the subject, to reveal the 230 types of crystal structure already specified and defined by the genius of Barlow in Great Britain and simultaneously and independently by Schoenflies and Fedorow on the Continent, as real entities and not merely the natural deductions from all the accumulated experimental work on crystals, and to add that to crystallographic knowledge which rendered it assured and incontrovertible.

Sufficient will have been said to indicate the value of this Laue special number of *Current science*, and it is with all sincerity that we congratulate our Indian scientific colleagues in so admirable a production. In the preface, it is foreshadowed that other special numbers are being prepared, on canal rays, genetics, and on animal development, and among the articles in the first mentioned we are promised contributions by Sir J. J. Thomson, Dr. F. W. Aston, and Dr. J. D. Cockcroft. We shall look forward to these further special numbers with all the greater interest, from the pleasure which the perusal of the present issue commemorating the initiation of Laue diagrams has afforded us. A. E. H. TUTTON.

## The Chemical Research Institute, Warsaw

THE Chemical Research Institute of Warsaw (Chemiczny Instytut Badawczy w Warszawie) was founded by Prof. Ignacy Mościcki, who is now President of Poland. Firm in his conviction that the independence of Poland would be restored and that the country would then need the services of such an institute, Prof. Mościcki took the first steps to realize this aim during the Great War, in 1916. He founded the Metan Company in Lwów, the object of which was to carry out chemical research for industry. The shareholders of the Metan Company voluntarily resigned from their material interests in this organization in 1922, and transformed it into the Chemical Research Institute Association, which pays out no dividends, in accordance with its by-laws, and expends all revenue and earnings on the prosecution of new research work. Having thus arisen without the help of the Government or of industry, the Institute was in 1925 transferred to Warsaw, where it has since 1927 occupied its own commodious, modern building, erected thanks to the donations of Poles, both at home and abroad. The building was officially declared open in 1928 by Prof. Mościcki, who had in the meantime been elected President of the Republic. The Institute contains a Department of Inorganic Industry, a Coal Research Department,

an Analytical Department, an Alcohol Research Department, a Department of Rubber Synthesis, etc.

The personnel of the Institute at present numbers 161. The director is Prof. Kazimierz Kling, one of the co-founders of the Metan Company. The other members of the executive board are: Prof. Wojciech Świątowski (at present Minister of Education), Prof. Jan Czochoński, Prof. Wacław Leśniński, Mr. Jerzy Pfanhauser, Miss Halina Starcewska and Mr. Zdzisław Zaleski. The chairman of the Board of Curators is Mr. Eugeniusz Kwiatkowski, the present vice-premier and Minister of Finance.

The Institute is engaged in tracing out the lines of the technical progress of the chemical industry of Poland, with special reference to the possibilities of extending the use of and improving Polish raw materials on one hand and of substituting imported raw materials by home-produced ones on the other.

The research work conducted by the Institute is chiefly concerned with petroleum, natural gas, sulphuric acid, aluminium, the analysis and standardization of coal, metallurgical coke and rubber. The twentieth anniversary of the foundation of the Institute was celebrated in the Warsaw Polytechnic on December 9, the president of the Republic of Poland being present.

## University Events

**BIRMINGHAM.**—At the recent annual meeting of the Court of Governors, the pro-chancellor, Mr. Walter Barrow, announced a bequest of £5,000 by the late Lady Scott-Moncrieff, who was one of the original students of Mason College. The late Prof. R. F. C. Leith, emeritus professor of pathology, bequeathed a sum of £15,000 to the Department of Pathology and £15,000 to be used for scholarships to promote the study of pathology and bacteriology. The late emeritus Prof. Lewis and Sir John Robertson also bequeathed their libraries to the new Medical School. An anonymous donor has given £2,000 to enable an investigation to be carried out under the personal direction of Prof. W. N. Haworth with the view of producing an improved form of insulin for use in the treatment of diabetes, and two research fellows are already at work on the subject.

Part of the new Hills Chemistry Block is already in occupation, and it is expected that the whole will be ready for use in the summer term. A further sum of £6,050 has been received in donations towards the equipment of the building.

The fund for the Medical School, which received £50,000 as its share of the proceeds of the Hospitals Centre general appeal, has received further donations to the amount of £12,000, including £10,000 from Sir Charles Hyde for a Chamberlain Memorial Museum, £500 from the Dean of the Faculty of Medicine (Dr. Stanley Barnes) and £101 from the Guild of Graduates. It is hoped that the school will be ready for occupation in 1938, but a considerable increase in available funds is required.

The Department of Industrial Hygiene and Medicine has received donations to the amount of nearly £1,670 from various industrial firms and has been actively engaged, evidently meeting a widely felt want. Arrangements have been completed for the establishment, under the joint auspices of the Birmingham United Hospital and the University, of consultation centres in industrial hygiene and medicine at the Queen's and General Hospitals.

As a consequence of the death of Prof. J. S. Haldane, the Mining Research Laboratory is being transferred to the Imperial College of Science and Technology, London, on April 1.

**CAMBRIDGE.**—R. G. Hawtrey, formerly of Trinity College, has been appointed to the Alfred Marshall lectureship for the year 1937–38.

The following grants from the Worts Fund have been made: £25 to J. K. S. St. Joseph, towards the expenses of a visit to certain Continental museums for the purpose of studying the palæontological collections there; £40 to W. V. Lewis, towards the expenses of an expedition to East Iceland to study the geography and natural history of this region; £50 to J. W. Wright, towards the expenses of an expedition to Ellesmere Land to study the geology and the birds of that country; £10 to Miss W. Lamb, towards the expenses of a visit to Turkey for archaeological purposes; £40 to J. R. B. Stewart, towards the expenses of a visit to Cyprus for archaeological purposes; £40 to Miss M. Fearnside, towards the expenses of a journey across Scandinavia for the purpose of studying the ecology of certain areas; £40 to H. E. Hinton, towards the expenses of a journey to Lake Titicaca, Peru, to study the aquatic insects there; £12 to Miss E. M. McIndoe, towards the expenses of a visit to the Stazione Zoologica at

Naples for the purpose of studying the acclimatization of animals to temperature; £40 to J. L. Mason, towards the expenses of a visit to Algeria to study the fauna of the hot springs there.

The General Board recommends that the following additional teaching offices be established on October 1: a university demonstratorship in the Department of Geology; a part-time University lectureship in the faculty of Mathematics; two University lectureships in the Department of Chemistry (temporarily replacing two demonstratorships); a university lectureship in the Department of Physics, replacing an assistant directorship of research; two University demonstratorships in the Department of Botany (replacing a University lectureship); a university lectureship in the Department of Parasitology. The General Board recommends that a readership in plant morphology be established for one tenure only, and that it be authorized to appoint Dr. H. H. Thomas to this post from October 1.

**OXFORD.**—H. M. Sinclair, University College, has been elected to the Radcliffe travelling fellowship in medicine for 1937.

H. S. Brodribb, University College, and Miss J. Wright, Somerville College, have been granted the degree of M.D.

**SHEFFIELD.**—J. A. Wragg has been appointed assistant to Dr. W. A. Timperley, research fellow in the Department of Physiology.

R. Ibbotson has resigned his post of demonstrator in non-ferrous metallurgy.

## Science News a Century Ago

Karl Himly (1772–1837)

MARCH 22 marks the centenary of the death of the eminent German eye specialist Karl Gustav Himly, to whom scientific nomenclature is indebted for the words 'ophthalmology' and 'mydriatics'. He was born on April 30, 1772, at Brunswick, where he attended the medico-chirurgical college from 1790 until 1792, and then continued his medical education at Göttingen under Richter. In 1795 he was appointed professor at the College at Brunswick, where he remained until 1801, when he was elected to the chair of medicine at Jena. Two years later he was made director of the Academy Hospital at Göttingen, where he inaugurated a course of theoretical and practical instruction in ophthalmology and gained a well-merited reputation both as lecturer and as operator, so that in 1816 he was made an honorary professor of the University of Pisa.

Himly's importance in the history of ophthalmology lies not only in his systematic use of mydriatics, but also in his having founded the first journal devoted to his speciality. In conjunction with Johann A. Schmidt, between 1802 and 1806, he brought out three volumes of a journal entitled *Ophthalmologische Bibliothek*, which was continued by himself alone under the name of *Bibliothek für Ophthalmologie* in the period 1816–19 during which two volumes appeared. He was also the author of a text-book on practical therapeutics (1807), and from 1809 until 1814 was co-editor with Hufeland of the *Journal für praktische Heilkunde*. His posthumous work on diseases and malformations of the human eye and their treatment, with additions by his son, E. A. W. Himly, appeared in 1843.

## The Surface of the North American Continent

ON March 22, 1837, the Geological Society listened to a paper by Mr. Roy entitled "On the supposed ancient state of the North American continent, especially on the extent of an inland sea, by which a great portion of its surface is conjectured to have been covered". The author, who had been employed on extensive surveys in the Lake District of North America, found on drawing sections for professional purposes that the country everywhere exhibited successive ridges which encircled the lakes; and upon comparing sections to the north of Lake Ontario with others to the south, that the ridges exactly corresponded in elevation. The highest of these ridges is 996 ft. above sea-level or 762 ft. above that of Lake Ontario. Connecting this elevation with the physical features of the valleys of the Mississippi and Missouri, Mr. Roy supposed that the whole area from the Rocky Mountains to just below Quebec down to the Gulf of Mexico formed one vast inland sea 960,000 square miles in area.

## British Railways

IN a notice in the *Athenaeum* of March 25, 1837, of F. Whishaw's "Analysis of Railways", the following quotation from the book was given: "The number of proposed Railways, including Diversions, Extensions and Branches in England and Wales, for which plans have been lodged in the Private Bill Office in the present Session, is seventy-five, of which only forty-eight are under the consideration of Parliament; these amount in length to 1233 miles, and are estimated at the sum of £19,352,726 or £15,625 per mile. The whole length of tunnelling is twenty-five miles and the number of bridges, exclusive of viaducts and culverts, 2,825 or nearly two and a third per mile. The weight of iron required for the rails is 193,500 tons, and of stone for the blocks 2,670,000 tons. The area of the land is upwards of 1,500 acres; and of felt for the chairs 130 acres. These Railways, if carried into execution, would employ at least 5,000 men and 1,500 horses for three years for the earth-works alone."

Dumont D'Urville's Voyage in the *Astrolabe*

IN the *Nautical Magazine* of 1837, it is stated: "The king of the French has by a decision of the 26th March approved of a proposal for a new voyage round the world, the conducting of which is to be confided to M. Dumont D'Urville. Two vessels will be employed in this expedition; the *Astrolabe*, commanded by Captain D'Urville and the *Zelee* by Captain Jacquinot. Leaving Toulon about the middle of September, they will proceed due south to the polar sea to pursue Weddel's track, who it will be remembered reached the latitude of 74° 15'. The vessels will penetrate as far south as possible and return to the Magellan Straits. In the spring of 1838 they will leave Valparaiso for the Polynesian Archipelago, and in June will be at Vavoo, where M. D'Urville will finish the work left undone by the *Astrolabe* in 1827. They would then visit in turn Banks Island, the Solomon Islands, the Dutch Settlements in Aroo and Key Islands, Amboina, New Holland, Tasmania, New Zealand, Borneo, Sumatra and return home by the Cape. Commenting on the announcement the *Nautical Magazine* said: "We look on this as a most interesting expedition and one that will yield important results. We cannot, however, but regret to see so extensive and important

an island as New Guinea, left year after year, in its original neglected condition and with but little addition to its coasts since the time of Dampier."

Jean Sebastian Cesar Dumont D'Urville, who was born on May 23, 1790, had circumnavigated the globe under Captain Duperrey (1756-1865) in the *Coquille* in 1822-25. Promoted to captain, in this ship, renamed the *Astrolabe*, he left Toulon in April 1826 and proceeded to the Pacific, returning in March 1829. His third voyage began on September 7, 1837. After his return home he began the publication of the results of his voyage and had completed the second volume, when on May 8, 1842, with his wife and son, he was killed in a railway accident on the line from Paris to Versailles.

## Societies and Academies

## Dublin

## Royal Dublin Society, February 23

J. BREEN, G. M. KENNEDY, J. KEANE and T. J. NOLAN: Chemical constituents of lichens found in Ireland—*Lecanora sordida*. *Lecanora sordida* was found to contain atranorin, chloratanorin, roccellic acid, and, in minor amount, a product similar to thiophanic acid and containing fourteen per cent chlorine. Roccellic acid, C<sub>17</sub>H<sub>32</sub>O<sub>4</sub>, was established by synthesis as  $\alpha$  methyl  $\alpha'$  dodecyl succinic acid.

J. W. PARKES, W. S. HAMILTON, E. J. SHEEHY, P. A. MURPHY, G. SHERRARD, M. J. GORMAN, D. MELLON and T. O'CONNELL: A symposium on fertilizers.

## Paris

Academy of Sciences, February 15 (*C.R.*, 204, 457-532).

JACQUES HADAMARD: Observations on notes by Destouches and by Appert. These authors have arrived independently at the same results. The present note raises a question of nomenclature.

ARMAND DE GRAMONT and DANIEL BERETZKI: The determination of the surface of a piezo-electric plate as a function of its frequency.

MARCEL LINSMAN: Real left arcs and curves of the fourth order.

L. KANTOROVITCH and E. LIVENSON: Some theorems concerning the theory of projective ensembles.

JEAN DELSARTE: A generalization of Taylor's formula.

LAURENCE C. YOUNG: A generalization of the idea of variation of the  $p$ th power in the sense of Wiener, and on the convergence of Fourier's series.

JOSEPH BARTA: The fundamental vibration of a membrane.

F. GRUSON: The representation of the ground in aerodynamic trials of vehicles.

SVETOPOLK PIVKO: A rational definition of the quality of supporting helices.

LÉOPOLD ESCANDE and GEORGES SABATHE: Remarks on the calibration of hydrometric velocity meters by displacement in a confined medium. Study of the effects of the transversal dimensions of the channel in which the instrument is moved.

DIMITRY PANOFF and PAUL RIZ: An apparatus for recording the deformations and vibrations of an aerial screw during flight.

MILLE, PAULETTE FÉVRIER: The uncertainty relations of Heisenberg and logic.

JEAN ROUBAUD-VALETTE: The relations between the polarisation of a photon and the spins of constituent corpuscles.

J. J. PLACINTEANU: The properties of the electronic photon.

R. BERNARD: The influence of pressure on the function of stimulation of bands of the ionized nitrogen molecule.

MARCUS BRUTZCUS: The intrinsic values of the linkages (C—O) and (C—H) in hydrocarbons.

RENÉ DELAPLACE: The vapour pressure of saturated and unsaturated hydrocarbons at low temperatures. The method is based on previous work on the conductivity of gases under low pressures. Vapour pressures of nine gases are given over a temperature range of from  $-120^{\circ}\text{C.}$  to  $-196^{\circ}\text{C.}$

PIERRE VALLET: A tetrahydrate of zinc sulphate.

MARCEL PATRY: The action of alcohol on aqueous solutions of potassium tellurate.

JEAN MARIE MERCIER: A double bromide of iron and ammonium. The double bromide  $\text{NH}_4\text{FeBr}_3 \cdot 6\text{H}_2\text{O}$  was isolated: it gave a characteristic X-ray diagram, differing from those of its constituents.

PANOS GRAMMATICAKIS: The action of mixed organo-magnesium compounds on the phenylhydrazones of ketones. A new mode of action of mixed organo-magnesium compounds.

MAURICE MARIE JANOT and THÉODOR TOMESCO: The hydrogenation of some glucosides by active nickel. Details of the hydrogenation in the presence of Raney nickel of eleven glucosides.

GEORGES DARZENS: A new contribution to the synthesis of glycerol. The starting point is ethoxyacetic ester, and the series of reactions proposed give good yields throughout.

MAXENCE MEYER: Two new ethylenic aldehydes.

RENÉ PERRIN: Non-metallic meteorites can give no information on the nature of stony rocks.

Mlle. FERNANDE FLOUS: The evolutive characters of the cone of the Abietinæ.

MME. H. HOCQUETTE: Considerations on the Anabœniolum of the guinea pig and the rabbit.

MARIUS CHADEFAUD: Intracellular cyclosis in the basidium of certain Hymenomyces.

ALBERT BERTHELOT and Mlle. GERMAINE AMOUREUX: The sensibility of some aseptic seedlings to some carcinogenic substances.

CONSTANTIN DAWYDOFF: The supposed metamorphosis of the larvæ of the Hexacorallæ.

CHARLES LAPICQUE: The coloration of retinal images and chromatism in general.

RENÉ SALGUES: The elements of normal phosphatemia in amphibians and reptiles.

ALEXANDRE GOURÉVITCH: The distribution of flavin in the tissues of mammals, in relation with their residual respiration in the presence of cyanides.

MME. VÉRA DANTCHAKOFF: The effects produced by a dose of 0.05 mgm. of testosterone on the histogenesis of the female in the guinea pig.

#### Moscow

Academy of Sciences (*C.R.*, 4, No. 8; 1936).

S. SOBOLEV: A direct method for the solution of polyharmonic equations.

P. L. KALANTAROV: Fundamental values in the study of electromagnetism phenomena.

I. A. KHVOSTIKOV and A. N. SEVČENKO: Application of the polarimetric method to the study of the upper layers of the atmosphere.

A. E. FAVORSKIJ and P. A. TIKHOMOLOV: The problem of mutual influence of radicals on their migration. (2) Dehydration of tertiary phenylhexylcarbinol.

F. M. ŠEMIÁKIN and A. I. LAZAREVA: Investigation of the reaction in which magnesium hydroxide is produced in gelatine.

A. V. FROST, D. M. RUDKOVSKIJ and E. K. SEREBRJAKOVA: Reversible catalytic conversion of *n*-butylenes into isobutylene.

B. L. ISAČENKO and N. N. MALČEVSKAJA: Biogenic spontaneous heating of peat.

I. A. GOLJANIZKIJ and K. A. BRJUŠKOVA: Vitamin C (*l*-ascorbic acid) in tea.

V. GLIVENKO: Mendelian algebra.

L. V. POLEŽAEV: Determination of initial stages in the development of extremities in amphibians.

#### Sydney

Royal Society of New South Wales, October 7.

M. D. GARRETTY: Some notes on the physiography of the Lake George region, with special reference to the origin of Lake George. Following the work of Taylor in 1907, Lake George, New South Wales, has long been held to have had its origin in recent normal faulting along its western shore. The streams to the east were bestruck, deprived by the fault scarp of their connexion with the Murrumbidgee System, and impounded to form the lake. In the present paper the pertinent physiography of the region is described, and the tectonic origin of the western escarpment questioned. An alternative explanation for the lake based on normal stream development and gentle warping is submitted.

November 4.

D. P. MELLOR and H. MULHALL: The electrode potential of thin films of zinc on platinum. An attempt is made to determine the minimum thickness of zinc when plated on platinum to produce the same electrode potential as the massive metal. Experimental results indicate that it is impracticable to answer this question definitely.

R. LEMBERG and R. A. WYNDHAM: Some observations on the occurrence of bile pigment hæmochromogens in Nature and on their formation from hæmatin and hæmoglobin. Observations are dealt with on the formation of bile pigment hæmochromogens by autoxidation of hæmatin in presence of nitrogenous compounds and reducing substances, on their occurrence in Nature, and on the removal of iron from them. Verdohæmochromogens are found in catalase preparations from horse liver, in preparations of cytochrome *c* from yeast and (in traces) in extracts from blood of horse and pig. Verdohæmochromogens have to be considered as intermediate products of physiological bile pigment formation. Cytochrome *a*<sub>2</sub> is probably a biliviolin hæmochromogen.

ALMA G. CULEY and GERMAINE A. JOPLIN: Evidence of magmatic stoping in a dyke at Hartley, N.S.W. Field evidence is based on the facts (1) that the dolerite of the dyke follows prominent joint planes in the granite which it intrudes, (2) that inclusions of granite occur in the dolerite, and (3) that a small tongue or vein of dolerite surrounds a block of granite which is incompletely rifted off. This is probably the only recorded example of stoping in a small dyke. It is of interest, as emplacement of



small intrusions is usually attributed to the lateral displacement of wall-rock.

A. BOLLIGER: Chemistry of Jaffe's reaction for creatinine. Jaffe's reaction, that is, the interaction of creatinine and picric acid in an alkaline medium, was studied. If this reaction is executed in alcohol, an orange-red crystalline compound can be obtained which consists of one molecule of creatinine, one of picric acid, and two of sodium. This substance may be responsible for the red colour obtained in Jaffe's reaction. The chemical constitution of this compound has been considered to be that of an organic molecular complex between sodium picrate and 'sodium creatinine'. On treatment with acid it furnishes a red isomer of creatinine picrate.

E. H. BOOTH: Some observations of zonal discordance in diurnal magnetic variations. Sets of readings have been (and are being) taken at the station "Hills and Dales", Mittagong, a district where the magnetic variations from point to point are small, for comparison with concurrent readings at the magnetic station of the Victorian Government at Toolangi. "Hills and Dales" is on the side of the magnetic mass of the "Gib", a syenite hill rising 800 feet above the surrounding country; so that it is both on a magnetized body and on a prominence. The results, after full correction, show that though there is generally fair co-ordination with Toolangi readings, the "Hills and Dales" readings are often swinging in a direction opposite to those of the Victorian station, and sometimes show magnetic fluctuations twice as great as those occurring at the same time at Toolangi even when atmospheric conditions are not abnormal. The conclusion is drawn that it is not safe to accept the variations at an established magnetic station to apply as corrections to a survey over magnetic prominences.

M. D. GARRETTY: Geological notes on the country between the Yass and Shoalhaven Rivers. The regional geology of about 1,600 square miles of country on the southern tablelands of New South Wales is briefly described. Probable representatives of the Upper Ordovician, Lower and Upper Silurian, Middle and Upper Devonian, Kamilaroi and Tertiary systems occur. Granites of epi-Silurian and epi-Devonian age cover considerable areas, and associated with them are examples of differentiated and hybrid rocks. The general structure of the region is discussed.

### Vienna

Academy of Sciences, December 3.

E. DITTLER and A. HOFMANN: Substitution of the group ( $Mg_2$ ) by (LiAl) in magnesium silicates.

W. J. MÜLLER: Local current theory of metal potentials (2). Metal potentials in oxidizing solutions.

J. LINDNER, W. WIRTH and B. ZAUNBAUER: Aromatic halogen phosphine and its suitability for gravimetric analysis of water.

O. KRATKY and G. GIACOMELLO: Crystal structure of paraffin carboxylic choleic acid.

H. DOSTAL: Fundamentals of the kinetics of mixed polymerizations.

HANS SEELMEIER: Upper Silurian graptolites of the Gugel (Carnic Alps).

OTMAR M. FRIEDRICH: Mineralization of the Nock region.

KARL PRZIBRAM: Red fluorescence band of divalent samarium. The red fluorescence, observed in many fluorites after irradiation with radium, is shown to be due to traces of samarium.

LEONORE BRECHER: Coloration of the chrysalides of the cabbage white butterfly, *Pieris brassicae* L., and of the Vanessa, *Vanessa io* L. and *V. urticae* L. The effect of severing various nerves on the adaptation of the colour of the chrysalis to its surroundings is studied.

MARTHA GEIRINGER: Adrenalin as a synergist of thyroxin in the metamorphosis of toads (*Bufo vulgaris* Laur.).

JOSEF GLASER: Innervation of one or two legs grafted on *Dicippus morosus* Br. and Redt.

December 10.

ERWIN KAMPTNER: Coccolites of the south-west coast of Istria.

F. BUKATSCH: Influence of salts on the production of light by bacteria. Addition of salts increases the production of light, not by increasing the number of cells, but by increasing the light production of the individual cell.

## Forthcoming Events

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

Monday, March 22

VICTORIA INSTITUTE, at 4.30.—Rev. T. E. R. Phillips: "Some Recent Views of the Universe and their Reactions on present-day Thought".

ENGINEERS' STUDY GROUP, at 7.30—(at 23, Grosvenor Place, S.W.1).—Prof. R. A. Fisher, F.R.S.: "Family Allowances".\*

Tuesday, March 23

HOUSE OF INDUSTRY LEAGUE, at 8.15—(Essex Hall, Essex Street, Strand, W.C.1).—Dr. V. Cofman: "The Scientist's Task in the New Order".\*

Wednesday, March 24

INSTITUTION OF CHEMICAL ENGINEERS, at 6—(at the Chemical Society, Burlington House, W.1).—Dr. D. Hunter: "Prevention of Disease in Industry".

## Appointments Vacant

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

SCIENTIFIC OFFICERS (radio and line communication), JUNIOR SCIENTIFIC OFFICERS (radio and line communication) and ASSISTANTS (Grades II and III—physics or electrical engineering) at the Bawdsey Research Station, Bawdsey Manor, Woodbridge, Suffolk—The Superintendent, Bawdsey Research Station, Bawdsey Manor, Woodbridge, Suffolk (March 22).

JUNIOR ASSISTANT ENTOMOLOGIST (sugar beet pests) in the School of Agriculture, Cambridge—The Secretary (March 30).

PRINCIPAL of the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield (March 31).

LECTURER IN MATHEMATICS in the Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C.3—The Principal (April 3).

HEAD OF THE MECHANICAL ENGINEERING DEPARTMENT in the Rutherford Technical College—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne (April 7).

LECTURER IN CHARGE OF THE DEPARTMENT OF BOTANY in University College, Leicester—The Registrar (April 10).

PRINCIPAL AND HEADMASTER of the Gravesend Technical Institute and Junior Technical School—W. A. Clench, Bank Chambers, Windmill Street, Gravesend (April 10).

LECTURER IN GEOLOGY in the University of Birmingham—The Secretary (April 10).

CURATOR of the Nottingham Natural History Museum—The Town Clerk, The Guildhall, Nottingham (April 12).

ASSISTANT KEEPERS OF ZOOLOGY AND MINERALOGY in the British Museum (National History), S.W.7—The Secretary (May 1).

ASSISTANT CHEMIST for the Colne Valley Water Company—The Chief Engineer, Colne Valley Water Co., Aldenham Road, Watford, Herts.

## Official Publications Received

## Great Britain and Ireland

- National Health Insurance. Insurance Committees Regulations, 1937. Draft dated February 5, 1937, of Regulations proposed to be made by the Minister of Health under the National Health Insurance Act, 1936. Pp. 29. (London: H.M. Stationery Office.) 8d. net. [62]
- Physical Training and Recreation: Memorandum explaining the Government's Proposals for the Development and Extension of the Facilities Available. (Cmd. 5364.) Pp. 12. (London: H.M. Stationery Office.) 2d. net. [62]
- Department of Scientific and Industrial Research. Report for the Year 1935-36. (Cmd. 5350.) Pp. iv+195. (London: H.M. Stationery Office.) 3s. net. [82]
- The Hastings Natural History Society. Report and Balance Sheet for the Session 1935-36, Council, and List of Members. Pp. 15. (St. Leonards: Hon. Sec., 23 Charles Road.) [82]
- War Office. Report of the Air Survey Committee. No. 2, 1935. Pp. 183+12 plates. (London: H.M. Stationery Office.) 4s. net. [92]
- Imperial Institute. Annual Report, 1936. Pp. 64. (London: Imperial Institute.) [112]
- Empire Cotton Growing Corporation. The Work of the Experiment Stations, Season 1935-36; an Explanatory Review. By W. Nowell. Pp. 21. (London: Empire Cotton Growing Corporation.) 1s. 6d. [112]
- Carnegie Trust for the Universities of Scotland. Thirty-fifth Annual Report for the Year 1935-36 submitted by the Executive Committee to the Trustees on 10th February 1937. Pp. iv+84. (Edinburgh: Carnegie Trust for the Universities of Scotland.) [152]
- A Programme of Priorities. Pp. 12. (Oxford: Next Five Years' Group.) 3d. [152]
- University of Leeds: Department of Coal Gas and Fuel Industries, with Metallurgy. Report of the Livesey Professor (John W. Cobb) for the Session 1935-36. Pp. 12. (Leeds: The University.) [152]
- Poverty and Over-Taxation: The Way Out. By the Most Hon. the Marquis of Tavistock. Pp. 56. (Coventry: Prosperity Office.) 6d. [182]
- University of Leeds. Thirty-second Report, 1935-36. Pp. 168. (Leeds: The University.) [182]
- Our Money. By Dr. W. H. Coates. Pp. 24. (London: Institute of Chemistry.) [222]
- International Tin Research and Development Council. Bulletin No. 5: Le fer-blanc et les conserves en France. Pp. 96. (London: International Tin Research and Development Council.) Free. [222]
- Department of Scientific and Industrial Research. Deterioration of Structures of Timber, Metal and Concrete exposed to the Action of Sea-Water. Sixteenth (Interim) Report of the Committee of the Institution of Civil Engineers. Edited by A. H. Naylor and H. J. Grose. Pp. iv+22. (London: H.M. Stationery Office.) 6d. net. [222]
- S.P. Tract No. 48: Linguistic Self-Criticism, by Otto Jespersen; Terminology in Physics, by C. G. Darwin; The Irregularities of English, by Sir W. A. Craigie. Pp. 267-292. (Oxford: Clarendon Press; London: Oxford University Press.) 2s. 6d. net. [222]
- University of Leeds. Publications and Abstracts of Theses by Members of the University during Session 1935-36. Pp. 29. (Leeds: The University.) [222]
- Development Commission. Twenty-sixth Report of the Development Commissioners being for the Year ended the 31st March 1936. Pp. 184. (London: H.M. Stationery Office.) 3s. net. [222]
- Proceedings of the Royal Society of Edinburgh, Session 1936-1937. Vol. 57, Part 1, No. 5: Microphthalmia and other Eye-defects throughout Fourteen Generations of Albino Rats. By Dr. A. M. Hain. Pp. 64-77. 1s. 6d. Vol. 57, Part 1, No. 6: Ovarian Rhythm in *Drosophila*. By Dr. H. P. Donald and Rowena Lamy. Pp. 78-96. 1s. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [222]
- The Imperial Forestry Institute: University of Oxford. Twelfth Annual Report, 1935-36, and Prospectus. Pp. 38. (Oxford: Imperial Forestry Institute.) [222]

## Other Countries

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