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CONTENTS

Co-operation of Industries in Research

THE summer meetings of the Society of Chemical Industry at Cardiff were notable for at least three addresses which dealt with different, but important, aspects of scientific and industrial research. In his presidential address on "Science and Industry : the Fertility of Ideas", without, we imagine, wishing to stress a distinction between 'pure' and 'applied' research which to-day is more and more difficult to draw, Dr. J. T. Dunn emphasised the enormous value to industry of scientific research as such, apart from the research directed to specific industrial purposes.

We shall no doubt witness in the future examples of purely scientific inquiries yielding results to industry and to society fully as valuable as those with which the names of Faraday, Langmuir, Prout and Rayleigh are associated ; but the changed conditions of modern science make it doubtful whether such examples are quite as probable as in the past, at least, so far as the physical sciences are concerned. There the field has already been so thoroughly explored that it is now possible for the specialist to state very exactly where lie problems still to be solved or the directions of advance. What is required, however, is a much more determined and enterprising support of purposeful long-range or fundamental research by industry, both within and without its own immediate bounds.

Dr. Dunn's address was an appeal for wider support of this type of research, and his plea found strong support in two subsequent lectures. In the first of these, Prof. H. Freundlich's discussion of plasticity as the servant of industry showed the manifold bearings of research in this field. Our knowledge of the properties and behaviour of plastics is of fundamental importance to the manufacturer of synthetic resins, cement or concrete, briquettes, paints, varnishes or adhesives, to the ceramic industry, the cellulose industry, the rubber industry, while other industries such as those concerned with the properties of dyes or of dispersions may equally benefit from the knowledge and technique developed in this field. It would, in fact, be difficult to find a more striking example of the way in which many industries may find a common field for research or of the way in which advance in one section may prepare the way for advance elsewhere.

Prof. Freundlich's lecture abounded in suggestions, and indicated how invaluable contact

between different industries might be in solving outstanding problems in this field. It provided an unmistakable plea for more co-operation in research between different industries, for the pooling of knowledge and technique in an attack upon fundamental problems of common interest.

Striking examples of co-operation in this way have already been seen in some of the work of the research associations under the Department of Scientific and Industrial Research, notably that of the Non-Ferrous Metals Research Association and the Refractories Research Association. There are, however, many fields, for example, chemical engineering, in which a great deal more could be done by co-operative effort between two or more industries; and the suggestion implicit in Prof. Freundlich's paper might well be taken up widely by industry. It may contribute materially to the solution of the problem of financing the all-important long-range research.

What is needed is some sense of perspective and a wide vision, and the Messel Memorial Lecture delivered by Sir Harry McGowan was a welcome reminder that these are not lacking in some of our leading industrialists. Under the title "The Uneven Front of Research", Sir Harry, besides directing attention to gaps in our existing structure of research, displayed that imagination and vision which are indispensable if scientific or industrial research is to be carried out on the broad front required. Reference was made once more to the far more vigorous developments in the physical sciences than in the biological, but examples of uneven development are also apparent in other spheres of life where knowledge and practice are still largely empirical and not scientific. Cooking, for example, as Sir Harry McGowan pointed out, remains a traditional art, and the chemistry of cooking, dietetics, the handling and transport of food, offer a field of research which will afford an accurate knowledge of food values and the effects of treating food likely to revolutionise our ordinary household ideas and practice in the next fifty years or so.

In spite of the complexity of the problems presented by agriculture, the fishing industry, the breeding of animals and other biological industries, the amount of research being carried out in these fields is still insignificant compared with that being prosecuted in the comparatively simple sciences of chemistry and physics. Air-conditioning and ventilation still present most fertile fields for research, while the application of the results of investigations in this field has only just begun in industry and scarcely at all in private building.

The building industry, indeed, like the paint and varnish industry, provides an excellent example of an industry in which practice is still largely empirical and traditional, and in which science is only now being applied to provide a rational basis for practice. The possibilities have been enormously expanded in recent years by the provision of new materials such as synthetic resins, new alloys, new lacquers, varnishes or other plastics of improved properties. The utilisation of such material involves frequently a complete break with traditional practice, and only an industry imbued with a scientific outlook and vigorously prosecuting its own research can hope to profit by the new materials and new knowledge.

The housing problem indeed offers many opportunities for science to benefit the community. The adoption of the new building materials and new methods of making light, cheap and sound-proof internal partitions may make revolutionary demands on our ideas of building. It is well within the bounds of possibility for the mere application of present knowledge to provide us with houses meeting a much higher standard in regard to comfort, ventilation, heating, lighting, freedom from noise and pests such as the bed bug and dry rot, at a much lower price and in a shorter time of construction than is possible by present methods.

If these advantages are to be secured, it is probable that some degree of co-ordination or co-operation may be required. This was indeed suggested by Sir Harry McGowan; and both Dr. Dunn and Prof. Freundlich from different points of view indicated the advantages to be gained in this way. Close contact must be maintained with research workers in various branches of science and of industry, if the building industry, for example, is to have at its disposal all the knowledge of the facts required. Air-conditioning is another example of direct interest to almost the whole field of industry, and researches on noise and its prevention have a similar wide bearing. Such investigations might well be planned and directed by one national organisation instead of being carried out piecemeal and ineffectively in different industries with overlapping and waste of effort. Problems of heating are similarly of general interest, while the concern of the building industry in plastics, whether from the point of view of new constructional materials or protective varnishes, etc., is so great that the fundamental investigations required on

the properties of plastics have a fair claim on it among other industries for support.

It is impossible to leave the fundamental research work entirely to the support of individual industries, even those at first sight most closely concerned, if the gaps in our existing organisation are to be filled and research maintained evenly over the wide front now required. Much the same point was made by Sir Harry McGowan in regard to accident prevention when he suggested an Accident Research Department which, besides conducting much more scientific investigations into the causes of accidents, might lead to fundamental improvements in the design of automobiles, etc. Apart from this, at present, inadequate use is being made of the facilities which exist for fundamental research in such matters. For example, the opportunities provided by the William Froude tank at the National Physical Laboratory have been severely restricted by the reluctance of the shipbuilding industry to provide the necessary financial support even on a fifty-fifty basis with the Government offer, and not merely is testing being delayed or carried out on the Continent, but also urgently needed fundamental investigations bearing on design have been similarly hindered.

The matter of co-operation is vitally important where such fundamental work is concerned. The really creative work leading to revolutionary changes in design and outstanding advances, on the necessity for which Sir Harry McGowan laid repeated stress, is much more likely to come as a result of co-operative effort over a wide front than from efforts in one field of science or section of industry alone. It is difficult to over-estimate the stimulating effect of the contact thus received between workers in different industries or different branches of science, above all in days when sectionalism and specialisation present a perpetual menace in science as in society. If the meetings of the Society of Chemical Industry at Cardiff have done nothing else, they have reminded us once more of the imperative need of facing this problem of the lopsided development of research and of the stimulating results which may flow from wisely co-ordinated co-operative research on a wide front. Both the creative thought and the progressive and co-operative outlook required might be attained the more readily did men of science and industrialists alike utilise more widely the opportunities for contact and free discussion which annual meetings and congresses afford.

New Interpretation of Tissue Excitation

L'Excitation électrique des tissus : essai d'interprétation physique. Par Dr. A.-M. Monnier. Pp. xvi+326. (Paris : Hermann et Cie., 1934.) 85 francs.

WHEN an effective stimulus is applied to an irritable tissue, there results a characteristic disturbance which may be propagated to a point more or less distant from the locality of the stimulus. In the central nervous or the autonomic systems, the success of this conduction depends upon factors of a highly complex kind involved in terms such as 'facilitation' and 'inhibition'. The principal phenomena in the physiology of irritable tissues may thus be divided into two groups : those concerned (*a*) with the properties of the

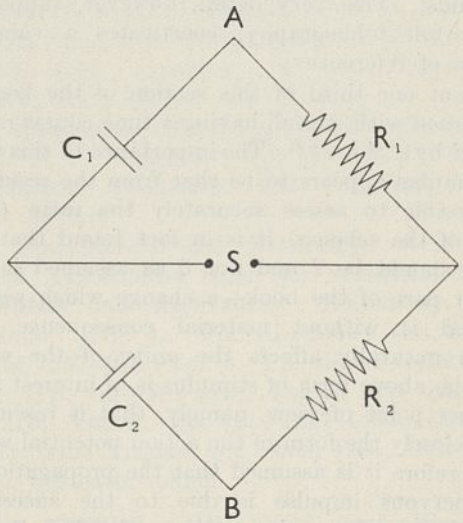

FIG. 1.

stimulus by virtue of which it is effective, (*b*) with the conduction of the propagated disturbance once it has been initiated, including the special phenomena associated with conduction in the central nervous system, etc.

Many attempts have in the past been made to treat theoretically isolated phenomena in this field, and though in many cases an excellent correspondence has subsisted between theory and experiment, this has invariably broken down on application to a wider range of observation.

The outstanding advantage of Monnier's treatment described in the work under notice is that it contemplates the whole range of irritable phenomena. To accomplish this without undue complexity, he has sacrificed quantitative treatment and contented himself with the demonstration that his theory will account qualitatively for the greater part of relevant observations.

(*a*) In treating the phenomena of electrical

stimulation, Monnier assumes that tissues react to any kind of stimulus according to the schema shown in Fig. 1. If the stimulus is applied to the terminals S, the excitatory effect is supposed to be given at each moment by the potential difference AB. This potential must attain some fixed value in order to excite.

Monnier assumes that $C_1R_1 = 6C_2R_2$ for all tissues and all circumstances, and shows that there is a good general qualitative correspondence between theory and observation for stimuli of very different time courses. A criticism of this section of the work is that experimental observations are treated in too great detail. When the qualitative applicability of the theory has been shown for one kind of stimulus, it scarcely requires another chapter to show all over again that a slightly modified stimulus still more or less corresponds. This very detail, however, supported by a full bibliography, constitutes a valuable source of reference.

About one third of this section of the book is concerned with stimuli having a time course represented by $e^{-\alpha t} - e^{-\beta t}$. The importance of this form of stimulus appears to be that from the results it is possible to assess accurately the ratio C_1R_1/C_2R_2 of the schema. It is in fact found that the value should be 2 and not 6 as assumed in the earlier part of the book—a change which we are assured is without material consequence, but which naturally affects the unity of the work. But the above form of stimulus is of interest from another point of view, namely, that it resembles very closely the form of the action potential wave. If therefore it is assumed that the propagation of the nervous impulse is due to the successive stimulation of inactive regions of tissue by the advancing action potential wave, the efficacy of conduction will be dependent upon the potency of a stimulus of the above form.

(*b*) The treatment of the phenomena of *conduction* thus arises immediately out of the foregoing, for the stimulating value of a current of the known form of the action potential wave may be found by reference to the schema. From such investigation it appears that conduction is favoured by factors which diminish the rate of development of the wave, relative to the rate of development of the excitatory process in the adjacent tissue (that is, its chronaxie), and conduction is impaired by the converse effect. Upon this deduction is based the rest of the book. This attempts the ambitious task of placing upon a more or less physical basis the remarkable claims that have been made by Lapicque's school, that the supreme condition permitting conduction from one cell to the next is equality of their rates of excitation (= chronaxie).

Monnier assumes that normally the action potential wave is not greatly above the threshold for stimulation of the next cell, so that if a drug (or other factor) retards the process in this second cell, and hence reduces further the efficacy of the stimulus, conduction will fail altogether. But naturally the author has to find a different explanation for the action of veratrine, which paralyses while accelerating the second cell, and for that of strychnine, which paralyses while slowing the action potential of the first cell.

The weakest part of the theory appears to lie in the assumption that the action potential wave is so nearly ineffective in the normal state that, if the threshold of the second cell is increased by only 20 per cent, conduction will fail. This assumption, which is fundamental, is difficult to accept in the light of the fact that two impulses may successfully follow each other in quick succession, though the threshold for the second appears to be raised some hundreds per cent.

A particularly satisfying feature of Monnier's analysis is that he is clearly aware of its shortcomings. He is careful to point out those places where the theory is too simplified to give more than an indication of the mechanism under consideration, and he directs attention to observations which are not accounted for by his theory, as well as to those supporting it. Finally, he has added a chapter to show the way in which the theory may be developed to explain phenomena in a more quantitative manner.

Monnier's book is intended primarily for the experimental physiologist, and to that end mathematical complexity is avoided. The solutions of the various equations are represented graphically as oscillograph records taken from actual experiments with a model of the above schema. Thus those interested in the excitation theory will find in the book an excellent compilation of experimental data, a balanced critical analysis and a well-defined embracing concept of wider application than any hitherto advanced.

North American Timbers

Identification of the Timbers of Temperate North America: including Anatomy and certain Physical Properties of Wood. By Prof. Samuel J. Record. Pp. ix+196+7 plates. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 18*s*. 6*d*. net.

PROF. RECORD by this book has forged another strong link in the chain which helps to bind the scientific worker to the intelligent wood enthusiast, whether a practical wood worker or interested in other directions. The book is

divided into two parts, and with plates and indexes occupies some 213 pages. The first part is styled "The Anatomy of Wood and certain Physical Properties of Wood"; and the second part "Timbers of Temperate North America", to which is attached a descriptive key.

Just as the surgeon requires accurate knowledge of the particular organ upon which he is to operate, so should the wood worker in like manner familiarise himself with the constitution and anatomy of wood. Hitherto this study has been far too much neglected, and a wide gap has existed between the scientific worker and workers in the practical field. Prof. Record's work bridges this gap. The student, who for the first time is opening his eyes to the marvellous wonders of tree growth, the ardent enthusiast who has progressed a long way on the road, and the wood scientist, all alike will gain knowledge from Record's conscientious work. Those pages in the first part, with illustrations of wood structure, relating to texture, grain, figure, colour, lustre, scent, taste, density and specific gravity, will probably capture the greater number of readers, although the second part, "The Timbers of Temperate North America", with the descriptive key, would appear to have been considered by the author as the more important, as he explains that the book is produced to replace an earlier edition now out of print.

Prof. Record says: "Woods deriving their odors from the presence of ethereal oils, as in many Cedars, apparently may be kept indefinitely and still emit their characteristic odors when a fresh surface is exposed." Evidence could be produced which conclusively shows that certain woods emit their scent after a lapse of certainly more than two hundred and fifty years, and probably twice that time, even without any fresh exposure of the surface.

In a book which teems with information it is difficult, if not impossible, to select those pages to which reference should be made in a short review, but the value of the work consists in the clear, concise information, supplemented by admirable plates, especially those descriptive of figure and the transverse section of grain shown of no less than twenty-seven of the best-known American timbers, as well as photomicrographs of vertical, radial and traumatic cells, and similarly well-produced plates of rays and cells with descriptive explanation, all of which invite a close and concentrated study from even those who have only a very modest knowledge of the subject.

As with other studies, the master here will find that his book attracts many new disciples to the world of knowledge of tree growth and structure.

ALEXANDER L. HOWARD.

Metallurgy and Foundry Practice

(1) *Practical Microscopical Metallography.* By Dr. R. H. Greaves and H. Wrighton. Second edition, revised and enlarged. Pp. xi+256+54 plates. (London: Chapman and Hall, Ltd., 1933.) 18*s.* net.

(2) *The Alloys of Iron and Molybdenum.* By J. L. Gregg. (Published for the Engineering Foundation.) Pp. xii+507. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 36*s.* net.

(3) *Special Steels: a Concise Treatise on the Constitution, Manufacture, Working, Heat Treatment and Applications of Alloy Steels; for Students, Operators and Users of Special Steels; chiefly founded on the Researches regarding Alloy Steels of Sir Robert Hadfield.* By T. H. Burnham. (The Specialists' Series.) Second edition. Pp. xviii+234. (London: Sir Isaac Pitman and Sons, Ltd., 1933.) 12*s.* 6*d.* net.

(4) *Elementary Metallurgy for Engineers.* By G. F. C. Gordon. Pp. ix+156+12 plates. (London: Constable and Co., Ltd., 1932.) 8*s.* 6*d.* net.

(5) *Foundrywork and Metallurgy: a Practical and Authoritative Guide for Moulders, Pattern Makers and Apprentices.* Edited by R. T. Rolfe. Vol. 1. Pp. vii+256. Vol. 2. Pp. viii+257–504. Vol. 3. Pp. viii+505–760. Vol. 4. Pp. viii+761–992. Vol. 5. Pp. viii+993–1216. Vol. 6. Pp. viii+1217–1464. (London: Sir Isaac Pitman and Sons, Ltd., 1931–1932.) 6*s.* net each volume.

(1) MESSRS. GREAVES and Wrighton's handbook of microscopical metallography has now reached a second edition, and has been considerably enlarged and improved. The descriptions of technique are full and practical, being based on a wide experience of both hard and soft metals, and the laboratory worker will usually find them a safe guide. The authors employ an ordinary table pattern of microscope, and more might have been said on the subject of microscope design, as many readers will be called upon to use the inverted type, especially in the compact form now so widely adopted in industrial laboratories. Macro-etching, sulphur printing and similar processes are well described, and the excellent photomicrographs, some 270 in number, will be found valuable for reference.

The theoretical aspects of metallography are only discussed so far as is necessary to indicate the meaning of structures as they present themselves in each system, but the equilibrium diagrams of the most important alloy systems are

included. Some familiarity on the part of the reader with the construction and interpretation of such diagrams is therefore desirable.

(2) The Battelle Institute of Columbus, Ohio, is rendering a great service to metallurgy by the publication of a series of exhaustive monographs of the alloys of iron, based on a critical survey of the whole available literature. The volume under notice, the third of the series to appear, deals with the alloys of molybdenum. Steels containing molybdenum have become increasingly important in recent years, but the data concerning them are scattered through many technical journals and trade publications. After eliminating second-hand accounts, 800 papers had to be abstracted for the purposes of this volume.

The simple alloys of iron and molybdenum are mainly of interest from the remarkable degree of precipitation-hardening which some of them can undergo, making them suitable for use as dies for drawing hard metals. When added to nickel chromium steels, molybdenum has the property of preventing the temper-brittleness to which such steels are liable, and this combination has proved particularly useful in engineering practice. Resistance to creep at high temperatures, and suitability to nitriding are other purposes for which the metal is added to steels. More recently, molybdenum cast irons have found application. The compilation has been well done, and there is a full and valuable bibliography.

(3) Mr. Burnham's book on special steels, mainly based on the work of Sir Robert Hadfield, has been enlarged on passing into a second edition. It contains an interesting account of the methods employed in making special steels, which often differ widely from those usual in works where structural steel is made. It is in this field that the high-frequency induction furnace, for example, finds its application.

The book contains much useful information, marred in some cases by the use of trade names in place of compositions. The author's references to literature, especially to foreign publications, are sparse and rather arbitrarily selected, but the book will be found most useful by the metallurgist familiar with common steels, who is imperfectly acquainted with these newer and more specialised developments.

(4) To present the main facts of metallurgy in such a way as to be intelligible to engineers is not an easy task, but it has been essayed by many writers. Mr. Gordon's book is elementary and clear in its presentation, but it suffers from a lack of first-hand knowledge, so that the descriptions of technical processes contain many minor errors, although the main outlines are satisfactory. The treatment of constitution and structure is weak. The long-discarded β-allotropic form of iron is re-introduced, and even employed to explain blue-brittleness, whilst the term "Ac_3" is introduced on p. 64 without explanation, and its meaning is only to be inferred from a diagram forty pages later. A reader having no previous knowledge of metallurgy will find this book useful as an introduction, but the ideal metallurgy for engineers remains to be written.

(5) This handbook for the foundryman, edited by Mr. Rolfe, makes its appearance in six handy and very well printed and illustrated volumes. It is actually the work of a number of authors, and covers, section by section, the subject of foundry practice and such matters as pyrometry and metallography so far as they are of direct value to the foundryman. The authors are all experts in their own branches, and tests applied at random have shown the descriptions to be up-to-date and correct. Such subjects as die-casting and centrifugal casting, information on which has usually to be sought in journals, are well treated, and the volumes will no doubt be frequently consulted in those foundries—fortunately an increasing number—where attention is paid to the scientific control of the making of castings.

Lorentz's Collected Papers

Collected Papers. By H. A. Lorentz. Vol. 7. Pp. vii+399. (The Hague : Martinus Nijhoff, 1934.) 10 guilders.

THIS volume is the first to be produced of the projected nine volumes of the collected papers of the late Prof. H. A. Lorentz. It contains a number of papers—nineteen in all, mainly printed addresses—otherwise accessible only in rather scattered places. The period covered is 1897–1927 and the subjects are spread over practically the whole wide range of the author's interests. There are lectures on hydrodynamics ; on the Zeeman and other magneto-optical effects ; on the rotation of the earth and its influence on optical phenomena ; on the old and new mechanics ; and on the partition of energy in radiation and the quantum theory.

The subjects dealt with show the broad interests of Lorentz, and the individual lectures themselves are typical examples of his characteristic genius, of his penetrating spirit in comprehending the physical essence of any new theory, and of his masterly power of exposition in writing of such theories. They are also typical in one other aspect, namely, in showing the part played by their author during his long life in the development and redevelopment of modern physical theory. At certain stages in the development of both the

theory of relativity and the theory of quanta, it seemed as though the classical theory of electricity, which owed so much in its early stages to Lorentz himself, would have to be thrown overboard completely, in consequence of the rapidly increasing difficulty in fitting it to the accumulating mass of experimental detail. Again and again, however, the influence of the master, who knew his classical theory better than the younger generation, and could therefore see how far and in what direction the inconsistencies lay, predominated and, in a new and generalised form perhaps, this theory now takes an honoured and essential part in the current explanation of physical phenomena. This moderating spirit is particularly predominant in a number of the critical lectures in the volume before us.

Lorentz rarely encumbered his work with the unnecessary hypothesis so frequently introduced in order to work out special cases in numerical detail, so that his discussions have always remained pertinent and readable longer than those of most writers; and in spite of the editor's description of the lectures in this volume as non-elementary, one would like, on this account alone, to commend them heartily to all students of mathematical physics who are not averse to reviewing in some detail the still close connexion between the complex physical theories of to-day and the rather less complex ones prevailing a quarter of a century ago.

The style and letterpress of the book are both very pleasing, and the editors and publishers are to be congratulated on the way in which it is produced. When complete, the nine volumes will certainly form a fitting monument to the memory of the great physicist whose name they bear.

G. H. L.

Short Reviews

Plant Chimaeras and Graft Hybrids. By Prof. W. Neilson Jones. (Methuen's Monographs on Biological Subjects.) Pp. viii+136. (London: Methuen and Co., Ltd., 1934.) 3*s*. 6*d*. net.

THIS excellent concise account of those peculiar combinations of plant tissues, belonging to two different varieties, species, or even genera, which are known as chimæras, will be welcomed by both students and teachers. A clear and useful distinction is drawn between chimæras and graft-hybrids, the latter term being retained for plants which (supposedly) arose from nuclear fusions between scion and stock. This conception is precise and there is nothing in it that is impossible on theoretical grounds. The author, however, is very distinctly in favour of the chimæral hypothesis for all those examples which have been relatively well investigated. This hypothesis was put forward by Baur as a result of his studies of *Pelargonium* varieties, though the name 'chimæra' was used by Winkler for a branch built up of two genetically distinct tissues. The 'chimæral hypothesis' assumes that the pattern found in the mature organ of a chimæric structure "is merely a development of the pattern already present at the growing point".

Prof. Neilson Jones discusses the well-known examples of chimæras in *Pelargonium*, *Solanum*, *Cytisus* (*Laburnum*), *Crataego-Mespilus* and *Hydrangea*, besides less-known instances. For the latter, some original interpretations are made, and these tend to bring the examples, in general, into line with Baur's hypothesis. A useful introduction presents some of the relevant facts connected with grafting and a general summary condenses the more important results derived from the study of chimæras and possible graft-hybrids into three and a half pages of print. Twenty-one figures illustrate the text and are mostly outline diagrams useful for blackboard reproduction. A bibliography and index are provided.

W. B. TURRILL.

Memoirs in Miniature: a Volume of Random Reminiscences. By Dr. G. C. Williamson. Pp. 273. (London: Grayson and Grayson, Ltd., 1933.) 10*s*. 6*d*. net.

MANY books have been described in their titles as containing the 'gems' and 'cameos' of their subject, but no author has greater claim to the description 'in miniature' than Dr. G. C. Williamson, who is known all the world over for his lifelong and intimate acquaintance with many forms of art, among which portrait miniatures take a high place. He tells us how his pursuits, partly undertaken for Mr. Pierpont Morgan, have taken him into good and high company: we now thank him for sharing his introductions to that exalted circle. But "the old slides which he has put into the magic lantern of his life" also cast welcome sidelights on Victorian science, and it could scarcely be otherwise, for he comes of a scientific stock. His father was an analytical chemist who won the approval of Faraday by the discovery of a new method of fractionating coal-tar. His grandfather, J. O. N. Rutter, is remembered for his success in the practical application of electricity when the names of his intimate friends, Faraday and Brunel, were less well-known than they are to-day. Wheatstone's first electrical signalling apparatus was used in his library at Brighton; and his work on "Human Electricity" is a classic. Another memoir recalls that wonderfully fascinating centre, the Regent Street Polytechnic, where the diving bell, Pepper's ghost, the great plate electric machine, the zoetrope, glass-spinning, etc., were in daily operation, giving to thousands of the youthful visitors of the 'seventies a vivid and enduring impression of the powers and marvels of science.

But Dr. Williamson's reminiscences teem with interest: one never knows what or whom one will meet next. Many deserve a larger canvas.

The Preservation of Antiquities. By Dr. H. J. Plenderleith. Pp. viii+71+2 plates. (London: The Museums Association, 1934.) To members, 2*s.*; to non-members, 2*s.* 6*d.*

THIS little volume is from the authoritative pen of the Assistant Keeper in the British Museum Laboratory. It is, in the first instance, a laboratory manual, containing concise instructions for the cleaning and preservation of a wide range of objects of antiquarian interest—leather and textiles; wood, bone and ivory; siliceous materials such as earthenware, glazes and enamels; and metals, notably copper, bronze and lead. The section on corrosion of metals is particularly fresh and illuminating and, above all, practical.

The book is, however, more than a mere technician's guide. It is easy, reading between the lines, to visualise the blend of scientific acumen, imagination, patience and keen artistic appreciation, which have gone to the formulating of the methods described, all of which are employed in the British Museum Laboratory. The antiquarian and the man of science are, in general, lacking in knowledge of that wide but little-known field where their common interests overlap. Here is a book which will interest both, and also their friend the layman: for though the antiquarian will doubtless be ignorant of the exact rôle played by moist common salt in metallic corrosion and the 'bronze disease', it will probably surprise the scientific worker to hear of the jealous care with which a healthy bronze patina is cherished, and the æsthetic value attaching thereto. The layman also may be less inclined to take for granted the bloom on the majority of our more ancient museum exhibits.

Dr. Plenderleith's book sets a high standard for the companion volumes which will follow it, "dealing with subjects of interest to the museum curator".

P. D. R.

Birth Control To-day: a Practical Handbook for those who want to be their Own Masters in this Vital Matter. By Dr. Marie Stopes. Pp. iv+237+4 plates. (London: John Bale, Sons and Danielsson, Ltd., 1934.) 5*s.* net.

THIS is a practical handbook dealing with methods of birth control, written in simple language so that it can be understood by the ordinary man and woman. Dr. Marie Stopes, for the same reason, writes somewhat dogmatically and gives practical advice based upon a unique experience. After a simple description of the sex-organs and the physiology of reproduction, so as to make clear what it is that has to be controlled, the methods by which pregnancy may be prevented are fully described. These range from domestic makeshift methods to obstructive appliances and chemical spermaticides, the surest of all, according to Dr. Stopes, being an occlusive rubber cap together with a simple grease suppository.

Various questions bearing upon birth control are asked and answered, and a chapter is devoted to birth control clinics. 'Positive' birth control is also referred to—when children are desired, but have failed to materialise. The subject of birth control is of such national, as well as individual, importance that a knowledge of what it aims at, and how it may be effected, should be accessible to all who desire it, and we believe that this book provides that knowledge and deserves to be widely read.

Chemische Unterrichtsversuche: Ausgewählte Beispiele für den Gebrauch an Hochschulen und Höheren Lehranstalten. Von Prof. Dr. H. Rheinboldt. Pp. xx+326. (Dresden und Leipzig: Theodor Steinkopff, 1934.) 10 gold marks.

PROF. RHEINBOLDT'S manual differs from the standard works on lecture experiments in several ways. It includes some experiments on organic chemistry and gives copious references to the literature of ordinary descriptive chemistry. A liking for unusual methods and complicated apparatus is also often apparent. It is difficult to say what purpose is served in a manual for the preparation room by the references which fill up much space, and the deviations from standard practice are sometimes almost grotesque. The usual method of sparking ammonia over mercury in order to show its decomposition is historically sound, since it is the method originally used; the experiment given uses a peculiar eudiometer and confines the gas over di-*n*-butyl phthalate coloured with Celliton Red R I.G.Farbenindustrie A.G. Instead of inverting a jar of hydrogen sulphide over one of sulphur dioxide, the author uses a quite unnecessarily complicated apparatus. Many striking experiments, such as the reaction between chlorine and hydrogen iodide, do not seem to be mentioned.

Although the book has many good points, it does not seem as though it is likely to become popular in England, since it does not appear to fit in with the usual lecture courses in universities, and makes use of apparatus and materials not commonly available in school laboratories.

The Hour of Decision. Part 1: *Germany and World-Historical Evolution.* By Oswald Spengler. Translated from the German for the first time by Charles Francis Atkinson. Pp. xvi+230+xiii. (London: George Allen and Unwin, Ltd., 1934.) 8*s.* 6*d.* net.

THE author of the "Decline of the West" has now found the solution of the world's ills. The economic crisis, unemployment and the political difficulties of the day could be eliminated by the application of cold-blooded "Prussianism", without which the world would indeed be overwhelmed by an uprising of the coloured races. Why "Prussianism"? Because "Germans are still young enough to experience world-historical problems, to form them and solve them; inwardly, while other nations have become too old and rigid to do more than raise defences". Many readers will undoubtedly resent this extraordinary thesis of Spengler's, and point out that the collection of historical facts piled up by him has not necessarily the unilateral interpretation he gives them. But however unconvincing these views, they need careful consideration, especially at a time when some kind of 'intellectual' defence of Hitlerism is becoming fashionable among German thinkers.

T. G.

Psychology and Social Problems*

By DR. SHEPHERD DAWSON

SOCIAL problems are partly material and partly mental. Every society consists of interdependent personalities whose harmonious co-operation is necessary for the general well-being, and the really serious problems of life concern this co-operation. Very great progress has been made in the solution of the material problems; but much less attention has been given to the study of the mental aspects of social welfare. Nevertheless, for a proper understanding of the numerous problems that arise from life in a community, such as those of supply and demand, labour and capital, law and order, hygiene, housing, transport, education, the conflict of traditions and ideals, and local and international rivalries, the study of mind is just as important as is that of matter. The solutions to these problems are to be found ultimately in the forces that move men to action, in their inherited tendencies, in their acquired habits, in the mentality of the groups to which they belong, and in their relationships to those groups.

Social problems can be approached either from the point of view of the individual or from that of the group to which he belongs. Neither approach can be consistently maintained to the exclusion of the other, for the problems of the individual are the problems of society and vice versa: a man is not independent of his fellows; his social environment is part of himself; his thoughts, feelings and desires vary with his environment; he is socially a chameleon, and any account of him which fails to consider his environment is as distorted as is an account of society itself which fails to consider the variety of aptitudes, motives, knowledge, manners and customs of its members. A social group is a complex structure which contains within itself other groups and sub-groups, professional, economic, linguistic, etc., whose harmonious co-operation is necessary for the welfare of the whole. The big social problem is the dual one of fitting the individual into the group and fitting the group to the individual. This is essentially an educational problem, one for education in the widest sense of the word; it concerns the home, the school, the university, the Press, and broadcasting and other publicity agencies. Its solution demands some knowledge of the natural endowment of the individual, his impulses and intellectual capacities, and of methods of making the most of them; and this in its turn implies the need for, and the use of, methods of assessing human endowment and achievement.

I wish to consider especially the scientific assessment of natural capacity and some of the problems connected with it; therefore, it is necessary to keep clearly in mind the distinction between ability and capacity. Ability is actual, capacity is potential. Ability is measured by what can be done here and now; capacity can usually be estimated by what can be done after a course of training. Knowledge and skill at games are forms of ability; they depend on certain natural capacities and on upbringing. All examinations are tests of ability.

The measurement of ability is difficult enough, but the estimation of the parts played by native capacity and upbringing respectively in determining such ability is very much more so. Innate qualities do not exist *in vacuo*: they exist with reference to certain external conditions and they must be diagnosed and measured in relation to these conditions. Every test is directly a test of ability, and can be a test of capacity only indirectly. Where training has no effect on the expression of a capacity, then a test of ability is a test of capacity; but few, if any, capacities are unaffected by training. If opportunities and incentives are so widely scattered that they are available for everybody, or if similar training has been given to all, then differences in performance indicate differences in capacity; but where the essential training and environmental conditions vary, inferences regarding capacity can be made with much less certainty. It is difficult to convince oneself regarding the uniformity of external conditions: for example, it is sometimes supposed that mental differences between children of the same parents are due solely to genetic differences, but some of them are certainly due to variations in the family environment: the health and age of the mother are not the same at the birth of each child (unless they be twins); families move from easy to difficult circumstances and vice versa; parents become more experienced, or more indulgent, in the management of their children; school-fellows vary; and the children themselves vary in their relationships to one another and to the rest of the world. The conditions of the experimental chemical laboratory cannot be exactly reproduced in the study of human and social phenomena; we have to be content with approximations to these conditions.

It is necessary to stress these considerations of method, for psychologists have hitherto been more concerned to distinguish and measure different kinds of ability which *seem* to be dependent on

* From the presidential address before Section J (Psychology) of the British Association, delivered at Aberdeen on September 7.

native capacity than to prove their innate basis. An example may make this clear. It is a common belief that people differ in respect of mechanical ability, that some have little difficulty in understanding the working of a motor-car, a dynamo, a clock or other piece of mechanism, and that others find these things unintelligible ; it is also commonly believed that these differences are due to differences in natural capacity. Now, the first thing that must be done is to find whether there is actually a positive correlation between ability to solve one kind of mechanical problem and ability to solve other kinds, for until such a correlation has been established, it is futile to talk about mechanical ability. This is the kind of problem on which much effort has been spent, especially in Great Britain : but after a correlation has been established, it is still necessary to find to what extent this ability is the expression of a specific inborn capacity. This more difficult problem is usually attacked by using test situations so novel that there is little probability of one examinee having any advantage over another through familiarity with the situation, or by using problems such as occur so often that it can be presumed that inability to solve them is due ultimately to innate incapacity. In practice, the difficulty, once it has been recognised, is probably not so great as may appear, for the opportunities of, and the need for, exercising most of one's native capacities are in fact numerous ; a person who fails to pass a properly designed and properly conducted test of colour-blindness is almost certainly colour-blind.

All kinds of capacities are being investigated with varying success, and it may be possible some day to evaluate mental characters with some approximation to the accuracy with which physical characters can be assessed. Most progress has been made in the evaluation of intellect by the so-called intelligence tests, largely under the pressure of educational needs.

Repeated application of mental tests to the same children suggests that mental development, as measured by the tests, proceeds along lines analogous to those of physical development and that it reaches its maturity about the age of adolescence, as do stature and other physical characters. The *rate* of development is expressed by the ratio of the level reached by the individual to that reached by the average of his age—for example, a boy of age ten years who has reached only the level of the average nine-year-old is said to have an intelligence ratio (mental ratio or intelligence quotient) of nine tenths or 90 per cent. This figure seems to measure some innate capacity or capacities, for, though it varies from one person to another, yet it remains fairly constant for each individual, and appears to be little affected by external circumstances. Even serious and long-continued spells of illness appear to affect it very little : it is only ailments producing progressive deterioration of the central nervous system, especially of the brain, such as encephalitis lethargica and some forms of epilepsy, that reduce it. Absence from school may interfere with a child's education and so promote social inefficiency without affecting his intelligence ratio.

Changes in social and physical environment have very little effect in modifying this ratio unless they be very great. Residence in an institution does not appear to make the ratios more alike than they were on admission, and children who have never seen their parents, but have been reared in the same homes, show the same differences of intellect as do their parents. It is very hard to find the necessary data to decide this question of the effect of environment. In Glasgow about 300 children were tested at the time of their removal from slum houses to a rehousing area, and again about eighteen months later. It had been intended to allow an interval of two or three years to elapse between the examinations, but so many of the children—about 20 per cent—left their new homes, that the interval had to be shortened. The ages of the children varied from five to nine years, an age at which they might be expected to react quickly to the new and improved environment. At the second test they did on the whole show a just appreciable improvement—their average ratio was raised from 90·6 to 92·1. A control group that did not move from their slum homes showed no such improvement. The result of this investigation is cheering for those who are trying to improve the external amenities of life ; but the improvement is so small that it suggests that any improvement in the social virtues that is to attend the initiation of social welfare schemes may have to rely on the formation of new habits of thought, feeling and action, habits that will have to be learned, rather than on any improvement in intelligence.

Here, in the interest of scientific accuracy, a word of caution is necessary. While the constancy of the intelligence ratio raises a presumption that this ratio is determined by genetic constitution, it may, however, to some extent be partly determined by other conditions, ante-natal, natal or post-natal : birth accidents are certainly responsible for some cases of dullness and defect. There are, however, several considerations which suggest that in most cases the ratio does measure something that is innate.

As might have been expected, the average intelligence of the children of men engaged in professional and skilled occupations is higher than

that of the children of unskilled workers; but more interesting and more significant for social problems is the fact that the variability within the different occupations is so great that there is much overlapping; in other words, high-grade intellect is not the exclusive property of any social class or professional grade.

Perhaps more important still is the information regarding the distribution of intellect through the whole population. An investigation was conducted in June 1932 by the Scottish Council for Research in Education with the assistance of education officers, teachers and others, in which a group test was given to practically the whole of the school population in Scotland born in the year 1921 and so of age $10\frac{1}{2}$–$11\frac{1}{2}$ years, 87,498 in all. The result agreed with previous estimates, but the dispersion proved to be greater than had previously been supposed—in other words, there were more who were dull and more who were bright. About half the population examined had mental ratios between 89 and 111 (instead of between 91 and 109, as was previously supposed), and it was estimated that, in the whole population, between $1\frac{1}{2}$ and 3 per cent fell below the 70 line, that is, below the line which is commonly supposed to mark the boundary between mental defect and normality. The average of the boys was the same as that of the girls, but their dispersion was greater, that is, there were amongst them more who were very bright and more who were dull. This distribution has important implications, of which I shall consider only one, and that very briefly—namely, its bearing on the rate at which boys and girls leave school after completing the work of the primary school.

In Scotland about 44 per cent of the children of age twelve embark on a secondary school course; of these 70 per cent begin the second year work, 43 per cent the third, 22 per cent the fourth, 15 per cent the fifth, and 9 per cent the sixth. Of those who pass to the 'Advanced Divisions' only 14 per cent enter on a third-year course. These educational casualties are due to many causes; some fall out for economic reasons, others find—or think they find—a better preparation for the serious business of life elsewhere (and these include some of the brightest), but probably most drop out because school seems to be a testing-ground rather than a training-ground, a means of picking out the brightest. This suggestion finds some support in the fact that it is the duller pupils who drop out first, the very pupils who are most in need of training. It has been estimated that a boy or girl must have an intelligence ratio of 115 or above to profit without undue strain from a secondary school education; this may be an over-estimate, but there can be little doubt that the average secondary school curriculum is unsuitable for the boys and girls whose ratios fall below the mean, that is, for half the school population. The bulk of the population are of average or nearly average intelligence—about 68 per cent have mental ratios between 84 and 116—and it seems reasonable to ask whether a national system of post-primary education should not give first consideration to these rather than to the 16 per cent at the upper end of the scale who have the intellect and temperament that fit them for professional and administrative work.

It may be suggested that the mental development of the duller elements of the population ceases at the age of twelve or thirteen and that, therefore, they have learned all they can learn by that age, whereas the mental development of their more brilliant fellows continues for several years longer. This suggestion is probably incorrect. We know that intellect develops more slowly in the dull, so that they fall farther and farther behind, but there is some ground for thinking that it reaches its maturity at about the same age. Further, the suggestion that the dull child has learned all he can learn by the age of twelve or thirteen implies a certain confusion of thought. Whatever may be the age at which maturity of intellect is reached, and whatever may be the level of development reached, it is certain that learning does not cease at that age: it can continue until senile decay sets in. The age at which maturity is reached has little or nothing to do with the age at which training must cease.

The 'open school door' is a well-established tradition in Scotland: here the gifted child has ample opportunities of developing his talents; but the practice of pushing all children along the same scholastic course, studded with hurdles which must be jumped, under penalty of being left behind, is one which could be improved upon. As the intelligence ratio seems largely to determine scholastic success, and as it remains approximately constant, at any rate during school life, and can be determined early, it should be possible to organise education on a basis of natural capacity.

The study of mental inheritance has suffered sadly from a readiness to take over the crude concepts of everyday life: it has been concerned mainly with marked abnormalities—mental defect and insanity—and this, too, has hampered the study of the subject, for there is widespread opinion that these deficiencies and ailments are morally reprehensible—an opinion which is rarely expressed openly, but is enshrined in everyday speech and conduct.

One serious difficulty in the study of mental inheritance has been that of defining and measuring

accurately the characters under investigation : for example, mental defect can be, and is, defined in several ways, legally, clinically, psychologically, etc. In the legal sense it is a social concept, for according to the law the feeble-minded are "persons in whose case there exists from birth or from an early age mental defectiveness so pronounced that they require care, supervision, and control for their own protection or for the protection of others ; or, in the case of children, that they, by reason of such defectiveness, appear to be permanently incapable of receiving proper benefit from the instruction in ordinary schools". However satisfactory this may be as a legal definition, it is useless both biologically and psychologically, for in the absence of any definition of mental defectiveness or arrested mental development, it means just inability to look after oneself and one's affairs without proper supervision. If social environment becomes more complex and makes higher and higher demands on natural capacity, then, unless that capacity improves, the proportion of feeble-minded must increase. Some think that feeble-mindedness *is* increasing, and that this is due to differential birth-rate, but it is equally possible that the cause lies in the increasing complexity of civilised life : intellects that could live happily in a simpler environment may be finding the complexities of modern civilisation too much for them : there can be little doubt that to-day bigger demands are being made on children in the 'ordinary schools' than were made on them fifty years ago.

The clinical varieties of mental deficiency which medical men meet—mongolism, cretinism, microcephaly, hydrocephaly, etc.—are distinguished by anatomical rather than by either social or psychological characters. Psychologically, mental deficiency is usually defined in relation to performance at intelligence tests : the legal mental defective usually has an intelligence ratio below seventy, so this figure is often taken as marking the line that separates the mental defective from the normal. This is an arbitrary method of defining mental deficiency ; it has the merit of precision, but it is a precision which may be misleading when we begin to investigate its genetic basis, for it is possible that feeble-mindedness may be due to one or more of a large number of genetic factors ; there may be different forms of feeble-mindedness which are not distinguishable by means of intelligence ratios.

From Log Cabin to Royal Observatory

By PROF. ALLAN FERGUSON

THE British Association has seen many excursions and occasions, but few can compare, in real romantic interest, with the excursion which set out from the Marischal College in Aberdeen on Monday, September 10, to attend the unveiling of the Lamont memorial above Braemar. Most of us had a vague notion, based mainly on the 'A' appearing on our excursion ticket, that Lamont had some connexion with physical science, possibly with astronomy. A few said, "Why Braemar ? Wasn't Lamont a German ?" ; and, did one seek information concerning Lamont's life and labours from an eminent astronomer, invariably he

> "Dallied with his golden chain,
> And, smiling, put the question by."

The setting was perfect. The road through Braemar climbs along a precipitous hillside and looks down on the Dee falling ever farther and farther below. Four or five miles past the spot where, as tradition tells, the Standard on the Braes o' Mar was up and streaming rarely on a September day in 1715, is the clachan of Corriemulzie where Lamont was born on December 13, 1805, and a couple of miles farther on is the village of Inverey where he had his schooling. Here, on a natural platform a few yards above the road, stands a severe obelisk of grey granite bearing, below a cross of St. Andrew carved on its face, the inscription

THIS STONE
COMMEMORATES
JOHN LAMONT
1805–1879
WHO WAS BORN AT
CORRIEMULZIE.
HIS NAME IS WRITTEN
IN THE HISTORY OF SCIENCE
AS
JOHANN VON LAMONT
ASTRONOMER ROYAL OF BAVARIA.

On the back of the stone, below a representation of the constellation of Orion, is the text, "Day unto day uttereth speech, and night unto night showeth knowledge", which text is repeated on the west and on the east sides in Gaelic and in German.

The memorial was as yet hidden under a canvas covering, and at four o'clock Prince and Princess Arthur of Connaught arrived and were escorted to the memorial, the pipes playing the Lamont march. The president of the British Association,

Sir James Jeans, explained the occasion in a few fitting words, Princess Arthur unveiled the memorial, and words of thanks concluded the simple ceremony.

What is the link that binds the story of the village lad of Corriemulzie to that of the Bavarian astronomer of world-wide reputation? This, that at Ratisbon in Bavaria existed a college of Scottish Benedictine monks which from time to time took charge of youngsters from Scotland in order to educate them for the priesthood. John Lamont was so chosen, and on an October morning of 1817 we may picture the twelve-year-old wood forester's son setting out in a farm cart for what was then a toilsome three days' journey to Aberdeen—a road which our motor coaches covered in less than three hours. Arrived at Aberdeen, the travellers set sail for Rotterdam, and thence made their way up the Rhine to their destination. Followed eleven years of hard study, and at the end of that period Lamont, who had discovered a capacity for mathematics, decided that astronomy rather than the priesthood was his vocation. Accordingly, in March 1828 he was appointed assistant astronomer in the Royal Observatory at Bogenhausen, near Munich, of which observatory at that time Prof. Soldner was conservator. In 1835, two years after the death of Soldner, Lamont succeeded to the position of conservator, and in 1852, the year of his election as a foreign member of the Royal Society, he was appointed to the chair of astronomy at Munich*. On August 6, 1879, he died at Munich at seventy-four years of age. The John Làmont of Braemar merged his identity very completely in that of Johann von Lamònt, the Bavarian astronomer; indeed, the late Earl of Crawford, who consulted Lamont in 1873 concerning the equipment of an expedition to observe the transit of Venus, furbished up his German for the interview, and was not a little surprised to find his introductory speech answered in good Aberdeen Scots.

What were Lamont's principal contributions to astronomical science? His observatory provided him with a refracting telescope of $10\frac{1}{2}$ inches aperture and 15 feet focal length, and with this instrument he made observations of Titania and Oberon—two satellites of Uranus—and hence deduced a value for the mass of Uranus in terms of that of the sun. Reduced to its simplest form, the calculation is, of course, simple. One writes down the force between the planet (P) and the satellite (M) as $G.PM/r^2$ and equates it to the mass-acceleration (Mv^2/r) of the satellite. A similar equation holds for the planet (P) and the sun (S) in terms of the velocity (V) of the planet and the radius (R) of its orbit. Hence, by dividing the two equations, we have the numerical value of the ratio P/S if we know the speeds and orbits of satellite and planet. Lamont's value for this ratio was 1/24905. Of the determinations made during his lifetime the most important are those of Bouvard who, in 1821, obtained the value 1/17918 from a consideration of the perturbations of Jupiter and of Saturn; of von Asten, who in 1871, working on observations of the two exterior satellites made by Struve, Lassell and Marth as well as those of Lamont, deduced the value 1/22020; of Copeland, in 1875, who, using Lord Rosse's telescope, found a value of 1/24000; and of Holden, in 1878, who, from observations made in 1875–76, obtained a mean value of 1/22600. Taking from modern tables the mass of Uranus as $87{\cdot}7 \times 10^{24}$ kilograms, and that of the sun as $1{\cdot}984 \times 10^{30}$ kilograms, the ratio is 1/22620.

In 1835 Lamont made a long series of observations on Halley's comet, and in 1836 he carried out observations on the second and third satellites of Saturn and deduced the elements of their orbits. He observed several total eclipses of the sun, and subscribed to the view that the red prominences were produced by clouds or other vapours in the earth's atmosphere.

Lamont has many claims to be regarded as a pioneer in the science of terrestrial magnetism, taking, as he did, a leading part in establishing that concerted system of magnetic observations which was inaugurated about 1840. The bent of his work is indicated by the title of the first paper which he devoted to this subject—"Bestimmung der Horizontal-Intensität des Erdmagnetismus nach absolutem Maase" and he followed this up by a long series of papers devoted to observations and instruments.

Lamont's most massive contribution to astronomical science is contained in a six-volume catalogue of telescopic stars, mainly of the eighth and ninth magnitudes. His labours were confined to a broad belt round the celestial sphere, extending from 27° N. to 33° S. of the equator of that sphere, although most attention was paid to stars on the belt extending from 15° N. to 15° S. of the equator. In this region no fewer than 34,764 stars were observed, their positions being mapped out in ten catalogues, each extending over a belt about six degrees in breadth. It may be remarked that on two occasions he unwittingly observed the planet Neptune—on October 25, 1845, and September 7, 1846. Galle's identification of the planet was made on September 23, 1846.

That, in brief, is the story of quiet achievement which the granite stone on Deeside will commemorate for centuries to come.

* I have not noticed, in the official obituaries which I have consulted, the title "Astronomer Royal of Bavaria" as representing Lamont's official position, which seems to have been that of "Conservator of the Royal Observatory".

Aluminium-Surfaced Mirrors in Astronomy

By Dr. H. SPENCER JONES, F.R.S., Astronomer Royal

IT appears probable that aluminium-surfaced mirrors will in time entirely displace silvered mirrors for investigations in the ultra-violet region of the spectrum and for astronomical purposes generally. The evaporation process dates back to the time of Edison who, in 1890, obtained patents in connexion with it. It was not until about 1928 that the advantages of the evaporation method for various scientific applications began to receive attention. At about this time, Hochheim, in Germany, evaporated an ultra-violet reflecting alloy consisting of 88 per cent of aluminium and 12 per cent of silver.

The process was perfected by R. Ritschl at the Reichsanstalt, particularly with the view of coating two interferometer mirrors simultaneously and equally to give the same reflecting power. The firm of Messrs. Adam Hilger, Ltd., was later instructed by Ritschl in the production of reflecting surfaces by the evaporation process. In the United States, the process was used in 1931 for small interferometer mirrors and filters by Dr. J. Strong, then of the University of Michigan, and Dr. P. G. Kruger, at Cornell University. Pure aluminium seems to have been first evaporated by Dr. Kruger. Dr. R. C. Williams suggested in June 1931 that the method be applied to large astronomical mirrors and tried chromium, which he found to give a hard, untarnishable film with fair ultra-violet reflectivity. The first astronomical application of the process was at the total solar eclipse of August 31, 1932, when a chromium-surfaced 15-inch mirror of the Lowell Observatory was used to obtain the spectrum of the corona.

Dr. H. Cartwright and Dr. J. Strong found that the evaporation process could be applied to many metals, including aluminium, antimony, beryllium, bismuth, calcium, chromium, cobalt, copper, gold, iron, lead, magnesium, nickel, selenium, silver, tellurium, tin and zinc; also to speculum metal and to substances such as quartz and fluorite. They protected a silvered surface with quartz, less than one wave-length in thickness, and found that it was quite immune from tarnishing when exposed to sulphuretted hydrogen. The coating of astronomical mirrors with aluminium was undertaken independently by Dr. Strong and by Dr. Williams in the autumn of 1932.

Some results obtained with these aluminium-coated mirrors have recently been published. With the 36-inch Crossley reflector, Dr. W. H. Wright has investigated the ultra-violet spectra of certain planetary nebulæ. The principal lines present can be divided into two groups, namely: λλ 3346, 3426 and λλ 3133, 3312, 3341 and 3445. In some nebulæ the first of these groups is relatively strong; in others, the second group is strong. The two lines of the first group have been identified independently by Swings and Edlén and by Bowen, from theoretical considerations, as forbidden lines in the spectrum of Ne V. The slitless images of these lines are the smallest in the whole nebular spectrum, indicating a high degree of ionisation. The lines of the second group are permitted lines in the O III spectrum; other O III permitted lines which might be expected to be present are not shown. Bowen has remarked that all the permitted O III lines which appear in the nebular spectra represent either a transition from the $3d\,^3P_2$ term or a transition from a term to which an electron can jump directly from this $3d\,^3P_2$ level. As the intensity variation of these lines from nebula to nebula follows the behaviour of the H II λ 4686 line more closely than that of the forbidden O III λλ 4959, 5007 lines, and as they are never observed when the λ 4686 line is missing, Bowen suggests that they are produced by fluorescent excitation. The $(2p)^2\,^3P_2 - 2p3d\,^3P_2$ transition of O III coincides closely with the resonance line of He II at λ 303·78. A quantum of this He II line can therefore disappear by excitation of an O III atom to the $3d^3P_2$ state.

The 15-inch mirror of the Lowell Observatory was aluminised by Williams and Sabine in August 1933, and the ultra-violet spectra of 97 stars, to the ultra-violet limit of atmospheric transmission, were photographed at the mountain station of the Observatory on San Francisco Peak at a height of 11,500 feet. The Huggins bands of ozone and additional bands to the ultra-violet were prominent. The microphotometer energy curves have been used for the derivation of the temperatures of the stars.

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Obituary

SIR EDGEWORTH DAVID, K.B.E., C.M.G., F.R.S.

BY the death of Tannatt William Edgeworth David, emeritus professor of geology at the University of Sydney, Australasia has been deprived of an outstanding personality among her men of science. Although a brilliant geologist, the very breadth of his interests to some extent reduced his output of purely geological work, while the intensity of his enthusiasms sometimes led him to conclusions that his colleagues could not accept. But his reputation rests upon a broader and surer basis than his contributions to geological science, considerable as they were.

The outstanding feature of David's early work with the Geological Survey of New South Wales was the exploration and mapping of the northern coalfield, which has since become one of the main assets of the State. In 1891, he left the Survey to become the head of the new Department of Geology in the University of Sydney. In his new post his genius as a teacher was soon made manifest, and the glamour of his personality attracted an ever-increasing number of men and women students to what rapidly developed into one of the most vigorous and flourishing schools of a progressive university.

It is from 1907, however, when Ernest Shackleton passed through Australia on his way to Antarctica on his *Nimrod* Expedition, that the imperial and international reputation of David dates. One of the characteristics of the Permo-Carboniferous rocks that contain the main Australian coal measures is the evidence of a glaciation which may be said to be comparable in extent and intensity with that of the antarctic continent to-day. This fact captured David's imagination, and with characteristic foresight and energy he seized the first opportunity of studying a continental ice-sheet at first hand. Shackleton was not a man of science, but he was himself an intelligent and imaginative man, and saw the value of such a recruit to an expedition that was not too well-equipped on the scientific side. David obtained leave from his University Council to accompany the expedition as far as its base. When the *Nimrod* sailed for New Zealand again she bore with her—not Prof. David—but letters explaining his absence and asking for an extension of leave the granting of which he had already anticipated. South Victoria Land remained his home for twelve more months, and the scientific success of the Expedition was assured from the day his decision was taken.

David's part in the Expedition is well known. He led the first party to climb Mount Erebus, the successful ascent being undertaken when winter temperatures were already setting in. He carried through a detailed survey of what has proved to be the most interesting of all the winter quarters occupied by the expeditions to East Antarctica. He planned and executed as comprehensive a programme of scientific work as the equipment at his disposal allowed. Where equipment was lacking he often improvised with success means of observing and measuring accurately those factors of the antarctic environment which he thought would best repay investigation. He crowned his work by undertaking at the age of fifty-one years the first sledge journey to the South Magnetic Pole, a journey which involved more than a thousand miles of man-hauling, and might well have taxed to the uttermost the fittest of men in the prime of life. That he was exceptionally fortunate in the physique and determination of his two companions does not in any way detract from his own share in planning and executing perhaps the second greatest man-hauling journey that has ever been performed.

Beyond all this, David's contribution to the expedition must be measured, not by his physical or mental feats, or even by his scientific discoveries, but by the influence of his character and personality upon his leader and his comrades. In name and fact he was Shackleton's chief of scientific staff, but he became his chief adviser in other things as well. To the rest of us he brought a new conception of what loyalty and friendship might mean. None of our problems was too small to merit his attention : none so difficult that he could not make a contribution towards its solution. Whether he was assisting with a plane table survey, freezing his rather shaggy eyebrows to the telescope of a brass alidade in a gale at − 30° F. ; washing up after dinner with an inadequate ration of water ; planning and installing a novel tide-gauge, adjusting the same gauge in a blizzard, or helping to rescue it from a sudden break-up of sea-ice ; giving Dickens readings into the small hours in the winter night ; or talking over with Shackleton the plans for the attack on the South Pole, the "Professor" was always equal to the occasion and always had some useful and original contribution to make. His courtesy and patience were only equalled by his good humour. Nearly all the good stories of the Expedition centre around one or other of these attributes, which were sometimes not without their trials to lesser men.

After the Expedition, Shackleton was cramped for money, and the publication of reasonably adequate scientific memoirs was almost wholly dependent on David's activities. He lectured all over Australia in search of funds, and he devoted a great deal too much of his own slender resources to the same end. Funds proved difficult to raise, and the memoir which was David's chief published contribution to geology did not appear until 1914. It still remains the chief authority on general antarctic geology, and that aspect of the work is David's alone.

When the War broke out, Prof. David was fifty-six years of age, but he threw all his energy into the recruitment and training of an Australian mining unit and, when the time was ripe, repeated his exploit of 1908 by accompanying the expedition overseas. In France he spent some busy months in congenial geological work on the Western Front, until in 1917 occurred the accident from which he never wholly recovered, although he was still to carry out many

years' useful work. When descending a well shaft to examine the rocks through which it had been dug, he fell some 70 feet and was very seriously injured. The two remarks he is reported to have made when he recovered consciousness are perhaps as characteristic as anything he ever said. His first was: "It was, I assure you, solely my own fault. No one else is to blame." Then, turning to the unfortunate officer in charge of the winch: "You let me down so fast that I was unable to make out the sequence of the strata as I went past."

After his recovery, David was attached as chief geologist to General Headquarters and there he remained until the Armistice, one of his duties, which caused him a deal of quiet amusement, being the location of underground workings to protect the General Staff from bombs. He returned to Australia in 1919, and the next news his friends in Europe had of him was that he had departed on camel-back on an expedition to Central Australia in company with another veteran geologist, Howchin, of the University of Adelaide, who must then have been more than seventy years of age.

The last years of David's life were shadowed to some extent by illness, by the controversy that arose over his claim to have discovered pre-Cambrian fossils, and by his failure to complete his last self-imposed task, the preparation and publication of a comprehensive account of Australian geology, which was the main preoccupation of the years after his retirement from the headship of his Department in 1924. In 1932 he fortunately published a geological map of Australia with a volume of notes as an instalment of the great work, which he was himself beginning by then to fear he had commenced too late. Two days before the announcement of his death, the present writer received a letter concerning a projected visit to Cambridge in the winter, when he hoped to spend some months at Clare, the college of his adoption there, completing his book, so that he was, as he would have wished, in harness to the very last. His country, the scientific world and a host of friends are the poorer by his death.

R. E. P.

Prof. C. O. Jensen

Prof. Carl Oluf Jensen, who died on September 3 at the age of seventy years, was professor of pathology and director of the Serum Laboratory of the Danish Agricultural and Veterinary School, Copenhagen. He was chiefly honoured, and will be best remembered, as the author of two classical papers in cancer research—the first in 1903 on the experimental propagation of an alveolar carcinoma of the mouse, and the second in 1909 on transmissible rat tumours.

Although the transmission of rodent new growths had previously been achieved by Moreau, Hanau, and L. Loeb, Jensen's researches are rightly regarded as the beginning of modern experimental cancer research. He showed that the new tumours arose from the intact cells inoculated, and not by a transformation of the tissues of the new host. He further investigated the conditions for survival of tumour cells outside the body, proving that successful transmission could be obtained with tumour material after three weeks' sojourn in the ice-chest. The prompt and complete confirmation of his results by Bashford and myself no doubt assisted the general recognition of the advance made by Jensen, but its fundamental nature was really established by Jensen's own work and by his free and wide distribution of tumour material. The award of the Walker Prize of the Royal College of Surgeons in 1906 was made in recognition of the value of these researches.

The transmissible rat sarcomas which formed the subject of Jensen's second paper are better known and have been propagated and used for investigation in every cancer laboratory in the world, but the remarkable circumstances of their origin have either been forgotten or ignored. They arose in two rats inoculated intraperitoneally with cultures of an acid-fast bacillus, a remarkable and unexplained observation which has never been repeated.

Jensen's only other contribution to tumour problems dealt with the transmissible tumours of the turnip and beet, later shown by Erwin Smith to be due to a microbe (*B. tumefaciens*) and now familiar as crown-gall.

In later years, administrative duties in connexion with Denmark's paramount agricultural industry absorbed so much of Jensen's time and energies that cancer research was perforce relegated to the background. His fame is secure and his memory will be cherished as long as men busy themselves with the fascinating problems of cancer.

J. A. Murray.

We regret to record the death on September 24, at the age of seventy-seven years, of Mr. C. Carus-Wilson, who will be remembered for his investigation of the phenomenon of 'singing sands'. So long ago as 1888, Mr. Carus-Wilson read a paper before the Bournemouth Natural Science Society in which he ascribed the production of sound by certain sands to the rubbing together of myriads of very smooth grains of quartz. In Nature of August 6, 1891, he described further experiments in which he succeeded in producing musical notes from appropriate sands in vessels of various shapes and sizes. He was able to show that Eigg sand in particular is musical in any vessel, whereas other 'singing sands', such as those of Studland Bay, emit sound only in highly glazed vessels of particular shape. A process of sifting, washing and boiling was also used to improve the emitting power of poorly musical sand. Mr. Carus-Wilson was a successful lecturer and writer on geological and other science subjects.

We regret to announce the following deaths:

Sir John Adams, from 1902 until 1922 professor of education in the University of London and principal of the London Day Training College, on September 30, aged seventy-seven years.

Prof. Adalbert Fernau, director of the Institute for Radium Technology at Vienna, on August 30, aged fifty-six years.

News and Views

Inventions and Patents

THE development of dormant and new inventions as a stimulus to economic recovery was the subject of a paper read by Sir James Henderson before Section G (Engineering) of the British Association at Aberdeen. The recent action of the Institution of Mechanical Engineers in appointing a committee to act as an advisory link between inventors and capitalists is a step in this direction which might well be followed by other similar societies and by the industries themselves, while the State should realise the important bearing that the industrial application of inventions might have on the problems of unemployment and future prosperity. The Government deserves the greatest credit for the encouragement it has given to the promotion of scientific research through the Department of Scientific and Industrial Research and the various research associations, but it is necessary also that at least as much practical encouragement should be given to promote the technical research needed to develop an invention to the commercial stage after its discovery in the laboratory. While it is not easy under present conditions to define what kind of stimulus the Government could or should give to attract the capitalist, or to assist an engineering firm to meet the cost and time involved in the transition of an invention from the laboratory to the factory, Sir James Henderson suggested that a good deal might be achieved if the Government would secure that the expenditure incurred by a firm, not only on its research laboratory but also on the technical development of an invention as far as the manufacturing stage, should be reckoned as working costs and be exempted from income tax. The risk that the resultant loss of revenue might not be completely balanced by additional receipts due to an improved industrial position might well be taken.

ON the other hand, Dr. Herbert Levinstein, in an article which appeared in the jubilee number of the *Journal of the Society of Dyers and Colourists* and now available separately, urges that for the protection and advancement of British industry a reform in our Patent law is necessary, under which the Patent Office would have the power to refuse an application for a patent on the ground of insufficient subject-matter or want of inventive step, from which decision there would be no appeal, and a patent once granted would be immune from subsequent attacks on those grounds. Dr. Levinstein pleads that the only reason for granting patent monopolies is the introduction of new industries into the country, and a state of affairs under which a very large number of the patents sealed by the Patent Office prove to be valueless and only serve to block the way can be remedied by giving to the Comptroller the extended powers that are now exercised only by the Courts when the validity of a patent is called in question, so that the decision as to whether in fact there is invention or merely an alleged invention would be made before the grant of the patent and not after. The elaborate and expensive investigation usually deemed necessary in the Courts before the question of subject-matter of a patent can be decided will lead many to doubt whether Dr. Levinstein's suggestion would not introduce serious complications at a stage when the commercial value of a patent was quite unknown. The matter was, it will be remembered, ventilated before the Board of Trade Departmental Committee on the Patents and Designs Acts which reported in 1931, and received no encouragement from the Committee.

Drainage of the Fen District

A SIGNIFICANT event in the long history, covering a period of 300 years, of the struggle to master the problem of the drainage of the Fens, took place on September 28, when Mr. Walter Elliot, Minister of Agriculture, inaugurated the new sluice and pumping station at St. Germans, Norfolk, which, by its ability to discharge up to 3,000 tons of water per minute, will materially relieve the difficulties which have hitherto attended the drainage of the Middle Level, an area of 173,000 acres lying between the Rivers Nene and Ouse. The greater part of the Fen District consists of peat and, by reason of its reclamation and adaptation to agriculture, the soil has dried and shrunk, causing settlement averaging half an inch per annum, but attaining as much as 6 feet in some places during the last fifty years. Simultaneously, the River Ouse has been gradually silting up, making it impossible in times of flood for inland water to gravitate to the sea, and necessitating the employment of pumps to raise the water to enable it to escape. The new sluice is the third which has been installed, its predecessors, the first of which dates back to 1848, having proved insufficient to cope with the volume of tidal water to be excluded. Advocated after the disastrous flood of 1912, the present scheme, which has cost about £224,000, did not take shape until 1929, when, on the advice of their chief engineer, Major R. G. Clark, the Middle Level Commissioners decided to proceed with the work to his design, which incorporated a pumping system of three units. Mr. Elliot described the pumping machinery as "the biggest in the world—more powerful than anything in Holland, the great land of dams, engineers, and water pumps". The four sluice gates provided are designed to withstand and operate against a maximum difference of head of 30 ft. from the Ouse side and of 17 ft. from the drain side. The weight of each gate is approximately 28 tons.

A Suggested Locomotive Testing Station

ON many occasions, proposals have been put forward for the erection in Great Britain of a national testing station for locomotives, similar to those in the United States, France and Germany, and the

matter was discussed by a committee of inquiry appointed by the Department of Scientific and Industrial Research. The latest of the testing stations built abroad is that at Vitry-sur-Seine, near Paris. A description of this station appeared in *Engineering* of August 4, 1933, and it was the subject of special notice in Mr. H. N. Gresley's presidential address to the Institution of Locomotive Engineers delivered on September 27, in which he made a vigorous plea for a similar plant in England. Of the usefulness of such a station, he said, there can be no doubt. The requirements of the export trade in locomotives and the conditions of railway transport at the present day indicate the need for better facilities for the scientific study of the locomotive than are generally available in Great Britain in order that improvements in design, resulting in a higher standard of thermal efficiency and economies in fuel consumption, might be effected. Mr. Gresley described the station at Vitry as the most perfectly equipped in the world. The plant is designed to test locomotives having an axle load up to 30 tons running at all speeds up to 100 miles per hour. The hydraulic brakes for the testing bench, which were made by Messrs. Heenan and Froude, Worcester, can absorb up to 7,200 horse-power. The total cost of the station was £120,000. Mr. Gresley advocated a similar station for Great Britain, to be financed by Government, which might set up an organisation under the Department of Scientific and Industrial Research for its control, with power to levy fees for its use.

Photoelectricity in the Theatre and on the Road

A PAPER read by Dr. N. R. Campbell and Mr. C. C. Paterson to Section A (Physical and Mathematical Sciences) of the British Association meeting at Aberdeen on September 11 described the vicissitudes of the photoelectric cell during the sixty years since it was invented. The development of the cells was almost complete forty years ago, but, with the exception of a few men of science, no one took much interest in them until ten years ago. Apparently photoelectricity had arrived before the world was ready for it. The invention of the sound film created a great demand for photoelectric cells. Formerly, they were made in ones and twos by laboratory workers. Now they are demanded in thousands, and it is well worth the while of large industrial firms to manufacture them and develop them further. The obstacle to their extension that had to be overcome was, not lack of technical power, but simply ignorance on the part of those that might use them. Engineers had not yet recognised the many important purposes to which they could be put. The great rapidity of their action made them most useful for timing races. If a speed limit were imposed by the new Traffic Act, photoelectric cells could be used to make it effective. There is no difficulty in timing a car over 15–20 feet without any possibility of human error.

Classification of Stone Age Cultures

WE have received a communication from Messrs. J. Reid Moir and J. P. T. Burchell in which they criticise the methods of classification adopted in the arrangement of the special exhibit, now on view at the British Museum, illustrating the cultures of the Old Stone Age. The system, which, in their opinion, clearly has a geological basis, in the main is that recently put forward by Dr. L. S. B. Leakey, and the points to which criticism are directed relate to the differentiation and arrangement of the earlier stages of that schematisation. The writers maintain that the tripartite division of the sub-crag implements, one division being named 'Icenian', a name suggested by Sir E. Ray Lankester for the whole group of pre-crag artefacts, has no relation to the facts as disclosed by recent investigation, but not yet published. Further, exception is taken to the equation of 'evolved Clactonian' (that is, High Lodge) with implements of Lower-Middle Acheulean antiquity, when the latter are demonstrably, on geological evidence, prior in date ; while it is pointed out that no mention is made of recent work showing that Coombe Rock was immediately followed by the Middle Mousterian cultures of Crayford and Northfleet. Again, it is said, certain specimens from below the sand of unknown origin at Ivry Street, Ipswich, are erroneously labelled "flakes from the English Brown Boulder Clay". More generally, the whole classification of the earlier cultures into 'hand-axe' and 'flake' industries is regarded as invalid, as here in Great Britain, at least, these often occur on undisturbed floors in intimate association and are beyond doubt contemporaneous. Moreover, it is common knowledge that large numbers of hand-axes are themselves made from flakes.

MESSRS. REID MOIR and Burchell pay a well-deserved tribute to the character of the exhibit, for which they credit the chief responsibility to Dr. Leakey. This special exhibit of stone age cultures, however, is intended to bring before the public new views and to stimulate discussion ; and although Dr. Leakey helped to prepare a scheme of classification of stone age cultures for submission to the recent International Congress of Anthropological and Ethnological Sciences, his views are not all peculiar to himself. It must also be pointed out that while the writers' main criticisms of the classification attempted have a chronological basis, the principle of classification is cultural. The chronological relation of members in two parallel, but independent, developmental series is irrelevant for this purpose, even though specific types equated as occupying analogous positions in the series can be shown to be, and admittedly are, widely separated in chronological succession. On the other hand, the criticism of the distinction drawn between the 'hand-axe' and 'flake' industries on the ground of their intimate association and contemporaneity argues neither for nor against the validity of the interesting hypothesis of two cultures of independent origin and lines of development ; but neither does it preclude its possibility. In default of published evidence, the weaknesses of the tripartite division of the pre-crag industries have still to be demonstrated ; but Mr. Reid Moir himself has argued on several occasions for the cultural

differentiation of these implements, and from this has inferred a difference in racial origin.

The Cable Repair Ship H.M.T.S. *Monarch*

In connexion with 'Telephone Week' (October 1–6), members of the general public had an opportunity of inspecting the Post Office cable repair ship *Monarch*, which was lying in the Thames off the Tower. This ship is fitted out with the special gear necessary for carrying out all the operations required in cable laying and repair, on which service she is at sea for most of the year attending to cables such as those laid between Great Britain and the Continent. The positions of cables are charted so that a faulty section or broken cable may be located and raised by means of grappling gear, of which there are various types provided. The ship's testing laboratory contains apparatus for the measurement of conductor resistance, insulation resistance, localisation of faults and other tests applied to the end of a cable which has been hauled on board. Sections of defective cables are replaced by lengths of new cable, a supply of which is carried in the ship, and the repaired cable relaid and charted, a somewhat noticeable feature of the cross Channel cables being the large number of repairs marked on the charts. The ship is provided with wireless equipment including a valve transmitter and, in reserve, a quenched-spark transmitter. In addition to an ordinary receiver there are a directional receiver and an emergency automatic call which rings an alarm bell, when the operator is not on watch, as soon as it responds to three 'longs', of four seconds duration, out of the twelve sent for the S O S signal. The chart house contains an echo sounding device. The ship's complement is 14 officers and 50 ratings, this large number being required on account of the technical duties, in addition to ordinary duties, carried out on board.

Telephone Statistics of the World

In *Electrical Communication* of July the telephone and telegraph statistics of the world have been published up to January 1933. The United States have now 53 per cent of the total number of telephones in use in the world, Canada has 4 per cent, Germany 9 per cent, Great Britain 6·5 per cent, France 4 per cent, the remaining European countries 14 per cent and all other countries 9 per cent. In January 1928, the United States had 60 per cent and Europe 28 per cent as compared with 33·5 per cent now. Whilst the number of telephones in Europe has increased by about 20 per cent during those five years, the number in the United States has diminished by 12 per cent. San Francisco leads the world with 36·5 telephones per 100 of the population and Washington comes next with 33·3. Stockholm is third with 31·8. In Canada, Toronto has 25·6 and Vancouver 28·1. Paris has 15, Berlin 11·1 and Munich 10. London heads the cities in Great Britain with 8·8 and Edinburgh comes next with 6·9. Honolulu, with a population of 138,000, has 11·7 telephones per 100. Whilst the United States have 70 miles of telephone wire per 100 of the population, Canada has 48, Australia and New Zealand 39, Sweden has 32·7 and Denmark 31·5. Germany has 23·2, Great Britain and Northern Ireland 22·6 and France 10·7. India and China have only 0·11 miles of telephone wire per 100 of the population. Czechoslovakia, the United States and New Zealand use their telephones more than other countries. The telephone conversations per capita in these three countries in 1932 were 224·5, 204·6 and 205·8 respectively. This compares with 33 in Britain and Germany and 20·5 in France. The number of conversations by telephone now averages about 100 times as many as of communications sent by telegraph.

Social Sciences in the United States

The social sciences and, especially, applied social science or civics, figure prominently in discussions of current educational policies in the United States, as witness the monthly Educational Review published as a supplement to *School and Society* of July 7. An advanced school of thought has lately found an exponent in Richard Welling, whose "Civics as it should be taught" has provoked discussion about the courage needed by teachers to teach "the real facts about distorted democracy", and led to a proposal to form a union to teach civic truth and to protect anyone who does it. A new monthly journal of educational criticism and reconstruction is to appear this month under the name of the *Social Frontier* (2 dollars annually, 66 West 88th Street, New York) to be devoted to "serving the emerging consciousness among American teachers that they must participate fully in social processes reshaping the American order". The report of the American Historical Association's commission on the social studies has, after repeated revisions, reached its final form, a compromise between conflicting views (New York: Charles Scribner's Sons. 170 pp., 1.25 dollars). It calls for increased emphasis on social instruction from the kindergarten upward and extending to the adult population, and it stresses the need for a more realistic approach with frequent interpolation of the question: How is it in your own town, city, country? The principal article in the same issue, entitled "Cultural Objectives of Health Education" by the professor of public health, Yale School of Medicine, urges that teachers should bear in mind that they are educating citizens and not merely doctors or lawyers or farmers, or stenographers or salesmen or bank presidents.

Research in Industrial Health

The fourteenth annual report of the Industrial Health Research Board up to June 30 emphasises, as have previous reports, that, "the study of the physiology and psychology of the worker is to reveal as many problems as are solved: to the fundamental problems becomes added that of overcoming difficulties in methods of approach and in technique". Trustworthy data about the incidence and kind of ill-health from which the workers in different occupations suffer are a pressing need. In the introduction to the report is a discussion of some of the difficulties in the way of obtaining data. An account of the chief problems now being investigated is given in outline.

Among the environmental conditions are lighting, noise, dust, heating and ventilation, the relation of warmth to comfort, and a special study of infra-red rays and comfort. Under the main heading of the physiology and psychology of work are mentioned an extensive survey of the physique of men in different industrial occupations, a study of incentives in repetition processes, sickness absenteeism and labour wastage, vocational suitability with special reference to accident proneness, and a study undertaken in co-operation with the Ministry of Labour dealing with the factors involved in employability among boys. In the conclusion it is pointed out that while there are signs of the practical application of much of the knowledge obtained by the Board, yet much more use could be made of the available knowledge, and also that many more problems remain to be investigated.

The Educational Machine

DR. JOHN MURRAY, in an article in the *Hibbert Journal* (32, No. 4), suggests that education is nowadays disliked not by children or teachers but by an increasing number of people outside the schools. The most dangerous of these are the materialists who think that education is too expensive, and in any event of doubtful value. Then there are the people in a hurry, who either want the children to start earning early or to learn their craft at school. Dr. Murray thinks that technical training is given better in the workshop than in the school, and that it is unfair to blame our present academic system until the generation it is training has reached middle age. Education to-day is unpopular also with those who dislike the educational machine—which is certainly cumbrous and in need of criticism—and with those who value character more highly than intelligence, and deplore the modern emphasis on interest rather than discipline. Finally, education is blamed for all those qualities which old people dislike in the young: but, as Dr. Murray points out, the 'bright young people' have existed in all ages and their energy is the motive power of society. Earlier marriage, rather than less education, would remedy their stability.

Reproduction of Graphs

FROM time to time, reference has been made to the fact that section paper ruled black is not a stock article, and that such paper would be advantageous for the preparation of graphs for reproduction as lantern slides or by printing. Mr. W. A. Young, who discussed the preparation of illustrations for a paper (*Proc. Inst. Heat. and Vent. Eng.*, 8, 79 and 127; 1907), records that as black was unobtainable he procured—not without difficulty—some paper ruled in red, but he found that it did not reproduce properly and concluded that the only satisfactory method was to trace a plotted curve, squares and all, in Indian ink. Mr. M. E. J. Gheury de Bray, First Avenue House, High Holborn, London, W.C.1, informs us that, being unable to obtain black ruled section paper, he has undertaken its production himself and can now supply it on paper and on card. Mr. A. F. Dufton, Greenbank, Garston, Hertfordshire, referring to this question, points out that "section paper ruled *yellow* is admirably suitable for reproduction. When photographed on a process plate, yellow reproduces like a full black. Paper ruled yellow, moreover, can be obtained without difficulty. It may perhaps be pointed out that an ordinary graph is not usually suitable for reproduction as it stands. The co-ordinate grille, printed in yellow, blue or green, appears as a mere background upon which black lines stand out boldly, but when reproduced in black it becomes unduly prominent. For reproduction, therefore, a graph should be drawn upon a grille of as coarse a mesh as practicable".

Forestry in Italy

IN *Forestry* of June 1934 is an article entitled "The Fascist Government and the Restoration of Italian Forests" by Prof. Aldo Pavari, director of the Royal Experimental Station for Sylviculture, Florence. Prof. Pavari deals with the forest problems in Italy, Italian forestry policy from 1887 to the march on Rome in 1922, Fascist forest legislation, the National Trust militia and instruction and experimental work in forestry. Of the total area of Italy, 31 million hectares, only a little more than 2½ million hectares are unproductive, that is, water, roads, buildings, sterile mountain slopes and crests, etc. Of the remainder, about 53·8 per cent is under agriculture, 26·7 per cent is pasture land of varying quality and 19·5 per cent, or 5½ million hectares, is covered by forest. These area totals are of importance in a mountainous country like Italy, which has vast areas subject to erosion as a result of the geological formation, whilst having at the same time an irregularly distributed rainfall. A general survey of soil conditions in Italy shows that, while the plains are intensively cultivated and the hills fertile, with vineyards, olives and other tree crops, the mountains have scarcely any woods and are generally in a low state of productivity. The so-called 'productive mountain pastures' are often nothing more than coppices, where constant grazing leads to progressive degradation and erosion of the soil, and thus the importance of erosion and floods increases from year to year with tragic consequences for the mountains themselves as well as for the hills below, leading to a constant destruction of the nation's resources and wealth. The measures by which the Duce proposes to improve the existing state of affairs are explained by the following three clauses of the Fascist Forest Legislation: "(*a*) To secure and defend the stability of the soil and the regularity of the water supply. (*b*) To aid the development of a rural economy in the mountain districts by encouraging sylviculture and the improvement of mountain fields and pastures. (*c*) To co-ordinate the whole complex action of the amelioration of the mountain districts with the reclamation of the hills and the plains".

The 'Isolated Basins' Electricity Scheme, Upper Egypt

EGYPT has a population of about 15 millions, and for the most part they are dependent on the land for their livelihood. The intensive development of the

comparatively small area of fertile land is of great importance. Since the rainfall is almost negligible, the irrigation of the country depends on the Nile. The Delta provides part of Egypt with a complete system of natural canals, and so it is possible to irrigate this part of Egypt at any time of the year and thus two or three crops can be grown annually. Along the banks of the Nile are situated a number of fertile areas called 'isolated basins' separated from one another by desert patches extending to the river's edge. The Nile is low for three months every year. It begins its rise of approximately 20 feet in May and from August to October all the isolated basins are flooded. When it subsides, one crop can be raised. Further irrigation is provided by primitive native water elevators, the water being elevated from wells and discharged into channels leading to the fields. The Egyptian Government has decided on an electrification scheme which will enable the land to be irrigated and drained in an adequate way. The contract for the supply and erection of the necessary overhead transmission lines, some of which are carried by towers across the Nile, others in underwater cables, has been given to the General Electric Co. by the Egyptian Government. In the *G.E.C. Journal* of August, a full description is given of the scheme by C. S. Ickringill and H. Peters. Power is generated at 3,300 volts, stepped up to 33,000 volts and transmitted to the pumping stations. A photograph is shown of the two lattice towers supporting the power cables across the Nile at Idfu.

Increasing the Speed of Atlantic Liners

FIVE years ago, four of the turbine vessels of the Hamburg-Amerika line were equipped with new turbines and water-tube boilers, so as to increase their output from 15,000 to 28,000 horse-power. This effected an increase in the speed of the vessels from 16 to 19·2 knots and reduced the time taken from Cherbourg to New York from 8 to 6½ days. The results of experiments and tug tests carried out with a model of the ships by the Hamburg Shipbuilding Testing Federation showed that considerable economies could be effected in the fuel consumption by altering the shape of the vessels. It was decided to increase their length by about forty feet and reinforce the hull structure so as to make it similar to the *Europa*. It is computed that the saving thus effected will in three years' time compensate for the total cost of the reconstruction, which was carried out by Messrs. Blohm and Voss of Hamburg. During last winter, the vessels were withdrawn from service one after the other and new bows were fitted. As these bows had been previously constructed, the time that each vessel remained in the dockyard did not exceed 60 days. The old bow was burned away from the hull by oxy-acetylene blowpipes and the new bow was drawn towards the hull and kept in position by grappling irons. All the shell plates were electrically welded together and also nearly all the other connexions, including the floor plates, pillars and girders. Interesting illustrations of electric-welded ship construction by Messrs. Blohm and Voss are shown in *Electric Welding* of August.

'Dry Ice' in the Machine Shop

BY means of solid carbon dioxide, often called 'dry ice', it is easy to lower the temperature of a piece of metal to 100 degrees below zero Fahrenheit. At this temperature, the metal contracts considerably and so the workman can obtain a good 'shrink fit'. It is analogous to the riveting of boiler plates by red hot rivets, which on cooling draw the plates so tightly together as to form a joint impervious to high pressure steam. According to Science Service of Washington, W. H. Swanger of the U.S. Bureau of Standards, who has been conducting experiments with solid carbon dioxide, reports that machine shop practice may come to accept this new method of shrinking metals. When a metal band has to be slipped round a shaft it is necessary to heat it, and as it cools it contracts to a tight fit. Instead of doing this we can refrigerate the shaft causing it to contract, and thus enabling the band to be slipped in place. When the shaft warms to room temperature a tight fit is secured. As the domestic production of frozen carbon dioxide has in recent years exceeded 40,000 tons it is commercially available. Mr. Swanger concludes that the shrinking of metals with very low temperatures is commercially feasible.

Speculative Borings in the Earth's Crust

THE heat generated in the interior of the earth's crust has puzzled men of science for centuries. In recent years, radical changes have been made in the theory of what causes this heat. A modern theory is that there is no heat from radioactive materials at greater depths than 12 miles. Heat is also due to the oxidation of iron and friction of slipping rocks. The present high price of gold has turned the attention of South African engineers to the possibility of boring their mines deeper. In the *Heaton Works Journal* of June an interesting account is given of the work done by Sir Charles Parsons in this connexion, and on the proposals he made for sinking a bore hole 12 miles deep. He proposed an arrangement of brine-cooling by large steel pipes connected at the top and bottom of each half mile section by a closed ring. There would be air-locks also every two or three miles so as to prevent the air pressure from becoming excessive. The real difficulty in the way of boring a hole to a great depth lies in the cost of the undertaking, and in the fact that a financial return cannot be guaranteed. Practically the only inducement to business men to explore the depths of the earth by sinking a deep hole is the chance of finding rich deposits of precious metals. If this is ever done it would put the speculations of men of science to the acid test of practice.

Rabbits and Steel Traps

ONCE again the R.S.P.C.A. rabbit week in Great Britain (October 6–13) is being made the occasion of an effort to obtain support for the Bill promoted by the University of London Animal Welfare Society to prohibit the import, manufacture, sale, exposure for sale, possession, custody or use of steel traps or gins. This Bill has now reached the final stages of drafting, and

will be introduced early in the new session. Viscount Tredegar will introduce it in the House of Lords, while Mr. Linton Thorp has consented to take charge of it when it reaches the House of Commons. Apart from the humanitarian aspect of the steel trap problem, there is another which assumes national importance, inasmuch as it has a vital bearing on agriculture. To agriculturists, the rabbit is a pest, and its extermination would be of great benefit to farmers. Paradoxical as it may seem, the steel trap is beginning to be suspect as an exterminator—and this in districts which have hitherto been wedded to its use. In certain portions of Carmarthenshire and in Pembrokeshire, traps were not used before the War, and rabbits were kept down by other means; since the introduction of the steel trap, these districts are overrun with rabbits.

New Uses for Bone Glue

THE results of the competition organised by the International Association of Bone Glue Manufacturers ("Epidos"), with the object of extending the uses of bone glue, have recently been announced, and the sum of 30,000 Swiss francs has been distributed among thirty competitors representing ten Continental countries; the fact that this is 10,000 francs in excess of the amount to be distributed under the rules of the competition may be taken as an indication of the high standard of the contributions. It is remarkable that few of the winning memoranda refer to what is usually regarded as the obvious and most common use for glue, namely, as an adhesive. They are, indeed, characterised by the diversity of their interests, and include processes in which glue is used as a stabiliser for colloids (for example, in latex preparations, polishes and ceramic products); as a source of nitrogen in the production of yeast; to enhance resistance (for example, of rubber) to oils and spirits; and as a catalyst, for example, to inhibit the action of acid pickle-liquor. There also appears to be a wide range of uses for glue as an ingredient of plastics, moulding and insulating materials and lacquers, and as a dressing for textiles. Full particulars of each process are obtainable from the General Secretariat of Epidos, 40, Rue du Colisée, Paris. International competitions of this kind suggest a novel method of obtaining technical information which doubtless will prove popular with prospective inventors. In the present instance, the experiment certainly appears to have justified itself, since it is announced that a further competition will be organised in the near future.

B.D.H. Products

THE British Drug Houses Ltd., London, N.1, have issued a handy brochure entitled "B.D.H. Injections for Parenteral Medication". It contains a list of drugs which are commonly given by injection, a brief note of their use and the range of dosage recommended, together with the packings obtainable and their cost. It is stated that the preparation of the solutions is carried out in a specially designed room, provided with double doors and supplied with filtered air at a pressure slightly in excess of atmospheric. The ampoules and bottles used are made of standard alkali-free amber glass and are sterilised after filling by an approved method, the actual process adopted being one which exerts no deleterious action on the medicament. Where containers designed to permit the withdrawal of successive doses on different occasions are employed, a small quantity of antiseptic is added to the solution. "Glucotest Solution" B.D.H. provides a simple and rapid method for determining the amount of sugar in urine. 2 c.c. of the solution is boiled in a test tube with a small amount of Glucotest powder to prevent bumping and the urine is added drop by drop from a pipette. The addition of urine is continued until the blue colour of the liquid has completely disappeared and a white or yellow colour free from any suggestion of green remains. The amount of glucose in the urine is inversely proportional to the number of drops required, and is ascertained directly from a table supplied with the solution.

Cosmic Radiation

No. 4 of the *Annals of the Observatory of Lund*, 1934, is devoted to a memoir in English, entitled "Cosmic Ultra-Radiation in Northern Sweden (an Academical Dissertation)" by Axel Corlin. It is an admirably printed quarto volume containing 113 pages of text and 80 pages of tables and bibliography. The author made measurements of the cosmic radiation in the far north of Sweden, using a Kolhörster apparatus in 1929–30 and a Steinke apparatus in 1932–34. A careful study is made of the relation between the radiation measured, and the air pressure, air temperature and humidity, using the method of multiple correlation. No direct influence of air temperature and humidity was found. Likewise no positive relation was established, after exhaustive investigation, between the cosmic radiation and magnetic storms and auroræ. The transition effect in iron was observed in a lake near Abisko, with results similar to those found by Steinke at Königsberg. The ionisation by cosmic radiation was measured in the Kirunavaara iron mine, and was detected down to 700 metres water-equivalent. The volume contains two chapters of great general interest, one giving a historical summary of the experimental and theoretical development of cosmic ray investigation, while the other discusses the origin of the radiation; the present situation of this problem being described as "quite desperate".

Measurement of Geological Time

IN 1931, H. V. Ellsworth analysed a specimen of uraninite from Manitoba and obtained a lead-ratio with the surprisingly high value of 0·260, corresponding to an age of about 1,750 million years. Although Ellsworth gave adequate evidence that the mineral was of first class quality, there has naturally been some hesitation in accepting this great extension of geological time. Confirmation of the most convincing kind is now, however, forthcoming. It is announced by Prof. A. C. Lane through Science Service, Washington, D.C., that Miss Edith Kroupa (working in the laboratory of Dr. F. Hecht in Vienna) has

analysed a sample of monazite which occurred with the Manitoba uraninite. The age turns out to be 1,725 million years. The significance of this high figure may be realised when it is remembered that the 'Middle' Pre-Cambrian rocks of Ontario, Norway and India have an age of about 950–1,050 million years. Clearly there was time enough before this for at least three major cycles of mountain-building and igneous intrusion, of which only one has hitherto been generally recognised.

Fur-Farming in U.S.A.

ECONOMIC stringency in the United States of America threatened to put a stop to the experimental fur-farming carried on by the Bureau of Biological Survey of the Department of Agriculture, but the restoration by the committee of appropriations of a grant of 51,717 dollars which had been eliminated will enable the experiments to be continued (Science Service, Washington, D.C.). Fur-farming is perhaps the only live-stock industry which has been profitable in the United States during the past three years. In 1933, there were harvested 150,000 silver fox and 50,000 mink pelts, but the great difficulty has been found to be the over-all improvement of the quality of the skins, too many still being of inferior grade. Some thirty to thirty-five million dollars is invested in the industry.

Report of the Ordnance Survey

THE report of the progress of the Ordnance Survey for the year 1933 (H.M. Stationery Office. 3*s*. net) directs attention to the slow rate of revision in the field of the large-scale plans which is at present possible. During the last three years, revision has been largely confined to the area of Greater London, adjoining counties, Devon, Cornwall, parts of the West Riding and Manchester areas. But the greater part of England has not been revised for more than ten years and much is more than twenty years out of date. Wales and Scotland have been largely unrevised for at least twenty years. Progress is reported in the preparation of the new fifth or relief edition of the one-inch map, and six more sheets were published during the year. Archæological maps of the Trent Basin and the Old Sarum district were published. Other publications included the magnetic edition of the physical maps of England and Scotland.

Announcements

LORD MACMILLAN has been appointed a trustee of the Beit Memorial Fellowships for Medical Research in succession to the late Sir James Kingston Fowler. The other trustees are: Sir Alfred Beit, Mr. Wm. Ormsby Gore, Lord Onslow, Lord Rayleigh, Dr. Edwin Deller (principal of the University of London) and Sir John Rose Bradford.

PROF. A. J. CLARK, professor of materia medica in the University of Edinburgh, and Prof. J. C. G. Ledingham, director of the Lister Institute of Preventive Medicine and professor of bacteriology in the University of London, have been appointed members of the Medical Research Council in succession to Sir Charles Sherrington and Dr. A. J. Arkwright, who retired in rotation on September 30.

THE Lord President of the Council has appointed Sir John Cadman and Sir James Jeans to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Sir Arthur Balfour, Sir William Bragg and Lord Rayleigh have retired from the Council on the completion of their terms of office.

SIR HARRY LINDSAY has been appointed director of the Imperial Institute, South Kensington, London, to succeed Sir William Furse, who retired on September 30. Sir Harry Lindsay was formerly Director-General of Commercial Intelligence, India, and since 1923 has been Indian Trade Commissioner.

A SYMPOSIUM on "Technical Aspects of Emulsions" is being arranged by the International Society of Leather Trades' Chemists (British Section) to be held at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, on December 7 at 10 a.m.–6 p.m. The morning session will be devoted to papers on the making of emulsions, and the afternoon session to papers on the breaking of emulsions. The symposium is open to the public. Further information can be obtained from the Organising Secretary, International Society of Leather Trades' Chemists, 17 Market Street, London, S.E.1.

THE Irish Radium Committee has published its report for the year 1933 (*Sci. Proc. Roy. Dublin Soc.*, 21, No. 7. July, 1934. Separate Issue). Radium therapy is carried out by means of radon tubes, of which 306 batches, containing 12,996 millicuries radon, were issued during the year. Reports upon 466 cases treated at four hospitals are included, but no conclusions respecting the results obtained are given.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A principal of the Belfast Municipal College of Technology—The Director of Education, Education Offices, Victoria Street, Belfast (Oct. 12). An inspector for the purposes of the Diseases of Animals Acts, 1894–1927, in the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (Oct. 15). A head of the Science Department, Blackburn Municipal Technical College—The Director of Education, Education Offices, Library Street, Blackburn (Oct. 15). A professor of social science, and a lecturer in anatomy in the University of Cape Town—The Secretary to the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (Nov. 7). A teacher of domestic subjects at the Technical Institute, Tunbridge Wells—Dr. J. Lister, Technical Institute, Tunbridge Wells. A micro-analyst in the Department of Organic Chemistry, University of Manchester—Prof. I. M. Heilbron. An assistant keeper in charge of the Oceanographical Collection in the British Museum (Natural History)—The Secretary, British Museum (Natural History), London, S.W.7.

Letters to the Editor

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

Air Waves of Unknown Origin

WITH the object of investigating the passage of waves through the atmosphere to great distances, sets of hot wire microphones are maintained at a number of stations and operated when it is announced that heavy guns are to be fired. Most of the firing which can be utilised for the purpose takes place at Woolwich, but by the courtesy of the Admiralty it is sometimes possible to take advantage of firing by H.M. ships.

During May last, there were three occasions when firing in West Bay near Portland was anticipated and microphones were in operation at the recording stations. On the last occasion, May 29, the firing which was arranged to take place between 10 and 10.30 B.S.T. had been postponed for several hours but this was not known to the operators. No air waves were recorded at any of the stations except Nottingham, but there, in an interval of less than two minutes, from 10.59.35 to 11.1.19 B.S.T. nine distinct air waves were recorded. The spacing of these was rather irregular and there was a decrease in intensity from the first to the last (Fig. 1).

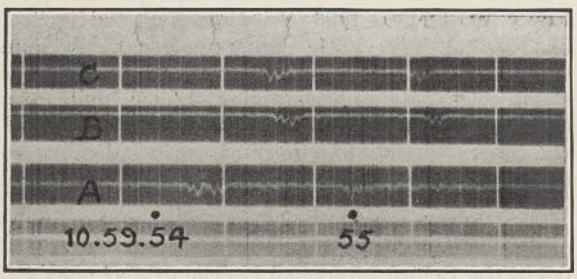

FIG. 1. Microphone records of air waves at Nottingham on May 29, 1934. Receptions 3 and 4. Microphone *B* is 243 m. 35° east of north of *A*; microphone C is 311 m. 14° west of north of *A*.

The station at Cefn Mably (Cardiff) was in operation up to 11.0.18. The records at Birmingham and Bristol had stopped at 10.49 and 10.40 respectively.

There are three microphones at Nottingham, so that, from estimates of the intervals between the receptions of waves, the bearing of the source of the waves and the inclination of the trajectory to the horizon can be determined. In this case the bearing of the source was 36° west of south and the angle of descent was 51°. Such a large angle of descent has never been recorded before and therefore the identification of the source is much to be desired.

A line through Nottingham on the correct bearing would pass through Plymouth and near Finisterre. It has been ascertained that there was no naval gun practice near Plymouth. Possibly there was firing near the French coast or blasting at quarries in Cornwall or in Brittany. It is likely that the waves passed over Cefn Mably at a great height. The extraordinary angle of descent of the waves implies that they must have attained a height at which the velocity of sound relative to the ground was about 550 metres per second. This is the velocity of sound in still air at about 1000° A. The alternatives are therefore offered. Was the temperature on May 29 at a certain height of the order 1000° A. (700° C.); was there a wind of the order 200 metres per second (400 miles per hour)? Did very high temperature and very strong wind co-operate?

If we knew where the explosions were produced and the exact times, we could determine approximately the height at which these remarkable conditions prevailed; it is therefore hoped that such information as to the explosions will be obtained. We should be grateful for any assistance.

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Supraconductivity and Fermi-Dirac Statistics

IT is an established fact[1] that the specific heat of some elements in the non-supraconductive state (zinc, silver) does not follow Debye's T^3-law at low temperatures. The deviations seem to be caused by a gas of free electrons, which follow the Fermi-Dirac statistics. So the specific heat of a non-supraconductive elementary substance is:

$$c_n = c\,T^3 + \gamma\,T, \qquad (1)$$

$\gamma\,T$ being the specific heat of the free electrons according to Sommerfeld[2]. Now it is possible to derive thermodynamically the difference[3] between the specific heat of the supraconductive state (c_s) and c_n:

$$\Delta c = c_s - c_n = \frac{V\,T}{4\pi}\left\{\left(\frac{dH}{dT}\right)^2 + H\,\frac{d^2H}{dT^2}\right\}, \qquad (2)$$

H being the threshold value and V the atomic volume at the temperature considered, or, by assuming the curve of the threshold values to be a parabola[4] ($H = -aT^2 + b$)

$$c_s = \left(c + \frac{3\,a^2\,V}{2\,\pi}\right) T^3 + \left(\gamma - \frac{a\,b\,V}{2\,\pi}\right) T. \qquad (3)$$

Now experiments suggest that in the case of tin and thallium, c_s follows a T^3-law[5]. So the second term of the second member of equation (3) has no appreciable value:

$$\frac{a\,b\,V}{2\,\pi} = \gamma. \qquad (4)$$

This relation can be verified (Table I). In the calculation of γ we assumed the number of the electrons per atom (n) to be equal to their valency. (If n does not equal the valency, the agreement is not so good, but n has only a relatively small influence, as γ is proportional to its cube root.)

TABLE I.

Element	a (gauss/°K²)	b (gauss)	V (cm.³)	$\frac{abV}{2\pi} \times 10^4$ (cal./°K²)	n	$\gamma \times 10^4$ (cal./°K²)
Tl	29·11	163·5	16·9	3·06	3	3·10
Sn	20·35	280·7	14·2	3·08	4	3·03
In	20·86	237·0	15·8	2·96	3	2·97

The agreement is surprising.

After substituting the formula $H=-aT^2+b$ into Rutgers' formula[6] ($\triangle c=\frac{V T_s}{4\pi}\left(\frac{dH}{dT}\right)^2$), we have:

$$\triangle c=\frac{a b V}{\pi} T_s = 2\gamma T_s \qquad (5),$$

(T_s being the transition point).

So it is possible to calculate $\triangle c$ without the aid of the curve of the threshold values. Again the agreement between experiment and calculations is striking in the case of thallium, tin and indium (see Table II).

TABLE II.

Element	$\triangle c$ observed (cal./°K)	$\triangle c$ Rutgers (cal./°K)	$\triangle c$ equation (5) (cal./°K)
Tl	0·00148	0·00144	0·00146
Sn	0·0024	0·00229	0·00225
In	—	0·00202	0·00203

From equation (4) we obtain: $ab=8\cdot58\times10^3\ (n/V)^{\frac{1}{3}}$ gauss^2/°K^2.

The curves of the threshold values of mercury and lead are not parabolas, so in these cases our considerations break down.

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Photographic Intensity Measurements of Lines of the Paschen Series of Hydrogen in the Infra-Red Solar Spectrum

THE photographic photometric methods used in the Utrecht Physical Laboratory were applied to some important lines of the infra-red solar spectrum. For the nearer infra-red at about 10000 A., the Agfa plates "Rapid 960" were used, for the farther region at about 11000 A. the new Agfa plates with a maximum of sensitivity at 10600 A. The dispersion of the first order spectrum was 4 A./mm.

The lines of the Paschen series P_6 (transition $3\rightarrow6$) at 10938 A. and $P_7(3\rightarrow7)$ at 10049 A. are directly visible on the plates as hazy absorption lines. This is not the case with the lines $P_8(3\rightarrow8)$ at 9546 A. nor with the helium lines 2^3S-2^3P at 10830 A. As these latter lines fall between strong lines (probably of atmospheric origin), only an upper limit for their central absorption can be given. It was found that in the Fraunhofer spectrum the central absorption of P_8 (9546 A.) is less than 6 per cent, that of the helium lines 2^3S-2^3P (10830 A.) less than 5 per cent of the intensity of the continuous background.

Concerning the Paschen lines P_6 and P_7, the wings of the first are blended by weak lines whilst its centre is free from blends and corresponds exactly with the calculated place on the registrogram. The profile of the line can be easily determined by connecting the peaks between the blends. The line P_7, already identified in the "Revision of Rowland's Preliminary Table"[1], is free from blends, so that its profile can be determined in detail with greater exactness than that of P_6. It shows a slight asymmetry, namely, a stronger absorption at the red side. The profiles of both lines show the characteristic contours of pressure effect (Y-shape), as found by Unsöld[2] for the higher members of the Balmer series.

In these circumstances, if the re-emission of the light absorbed in the line can be neglected, it is possible, as Unsöld[3] has shown, to determine a lower limit for the number of atoms in the lower state from the total absorption of the lines by the equation

$$\int_0^\infty \log\frac{I_0}{I}\,d\lambda = \frac{\pi e^2\lambda^2}{mc^2}\cdot f.N_3$$

where I and I_0 are the intensities of the line and of the continuous background, and N_3 is the number of atoms in the third level above 1 cm.^{2} of the sun's surface. The f-values are taken from Sugiura[4]. The value found for N_3 from the line P_6 is $0\cdot028\times10^{15}$, and from the line P_7 $0\cdot064\times10^{15}$ atoms. The difference is caused by the fact that re-emission plays a greater rôle for P_6 than for P_7. Also the value from P_7 will be too small, but it should be near to the true value, for the values of N_2 calculated by Unsöld[3] from the Balmer lines, which converge for the higher lines to the true value, differ from it for the upper levels 6 and 8 only by factors of 10 and 2 respectively. There is another interesting fact. The Balmer line $H\varepsilon$ falls in the strong absorption region of the line H of Ca^+. From the plausible assumption that the higher hydrogen levels are filled essentially by absorption of the Balmer lines, it follows that by the coincidence of $H\varepsilon$ with the strong line H, the number of atoms in the seventh level and accordingly the re-emission from this level will be smaller than without this coincidence.

These considerations show that the conditions for the calculation of N_3 by the simple absorption scheme are fairly well fulfilled for the line P_7, so that the value of $N_3=0\cdot064\times10^{15}$ may be expected to be nearly correct. (Under simplified assumptions for the equilibrium of the levels, one can take into account quantitatively the re-emission and the influence of the close coincidence of the two lines $H\varepsilon$ and H. This calculation gives a corrected value $N_3=0\cdot073\times10^{15}$).

From $N_3=0\cdot064\times10^{15}$ and $N_2=5\times10^{15}$ (Unsöld[3]) it follows that $N_3/N_2=1/78$ (for $N_3=0\cdot073\times10^{15}$: $N_3/N_2=1/68$). The assumption of thermal equilibrium of 5,000° K. for the sun's atmosphere gives with the Boltzmann formula $N_3/N_2=1/35$. Thus with respect to the degree of exactness of the values of N_2 and N_3, it can be said that the proportion of the numbers of atoms in the second and in the third levels is in good accord with a Boltzmann distribution of 5,000°. A similar fact was found by Merrill and Wilson[5] for stars of types B and A. The above result is remarkable because in the sun the proportion of the numbers of atoms in the second level and in the ground-level

(Unsöld[3]) differs from the Boltzmann distribution by the factor 10^3. A full account of this work will appear elsewhere.

I wish to express my thanks to the "Academisch Steunfonds" in Amsterdam for a financial grant and to both Prof. L. S. Ornstein and Dr. M. Minnaert for the facilities provided and many helpful suggestions. I wish also to thank the firm of Agfa for placing their excellent infra-red plates to the disposal of the laboratory.

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Effects of Polarisation in the Spectrum of β Lyræ

IT was suggested by me in a brief paper in 1929[1] that such polarisation effects as appear in connexion with resonance radiation may be present in some celestial sources of light. Comets and high prominences were mentioned by me as promising objects in this respect. As a matter of fact, observations made recently by B. Lyot[2] seem to give a proof of the existence of polarisation in the case of prominences.

Also, in the case of starlight, it seems possible that polarisation sometimes may appear, and notably for stars not having a spherical shape. Take, for example, a very much flattened, rapidly rotating star. If such a body is observed edgewise, we must expect the resonance radiation originating from the very edge to be partly polarised in the case of certain spectral lines. The theoretical value for the maximum degree of polarisation for resonance light from such an edge is found to be 33 per cent. This amount is, however, only to be expected for spectral lines giving complete polarisation when excited by parallel light. If the body is extremely flattened at the edge, there may also appear an accumulative effect in the production of polarised light.

Similar polarisation effects may appear in very elongated stars if they are so orientated that their longest axis is nearly perpendicular to the line of sight.

A star which appeared to me to be of special interest in this connexion is β Lyræ. It has been observed by me with the 40-inch reflecting telescope of the Stockholm Observatory since May 7 of this year for the purpose of trying to find polarisation effects. The instrumental arrangement is the same as that described in *Meddelande*, No. 12, of the Stockholm Observatory. The observations have been made in such a way that the spectrograph equipped with double image prism has been turned round the optical axis of the telescope, and a series of exposures have been made corresponding to different position angles of the slit. The star has been observed on 18 nights, and the total number of spectrograms which have been analysed is 117. Some of these are extraordinary images. Three different dispersions have been used corresponding to 9, 23 and 27 A./mm. at $H\gamma$. The spectrograms have all been analysed with a self-recording microphotometer.

A preliminary examination of the microphotometer tracings has given some interesting and rather puzzling results. *Faint effects of polarisation have been found to be present in the $H\gamma$ line*, but as to other spectral lines no clear effect has so far been found. The polarisation effects which have been observed appear in the *absorption contour* of $H\gamma$. That wing of this absorption line, which is situated on that side of the line centre which is opposite to the $H\gamma$ emission line, is somewhat deeper and broader for images corresponding to a certain position of the slit than it is for images taken in other position angles of the spectrograph. No polarisation effects are present in or near the principal minimum, but otherwise the effects have been followed during nearly all the period and also close to the secondary minimum.

It may seem surprising that the effects appear in an absorption contour and not in an emission line. The fact that the absorption wing is well developed in certain images but fainter in others can be explained in this way, however, that the contour is to some extent filled out by polarised light. As regards strong emission lines, the conditions are surely not very favourable for the production of polarisation if, as is generally believed, such lines result as emission by steps after absorption of light in the far ultra-violet. We have probably in such a case very little resonance radiation.

The observations give a determination of the plane of polarisation with an accuracy of about 10°; and they give a very remarkable result as to the orientation of this plane. They show that *the plane is not fixed in space but seems to be subject to oscillations*. The observations indicate a periodical variation with a total range of about 66° and a period of about 103 days. As yet the observations only cover one such period and the figures must therefore be considered approximate.

The real meaning of the observed effects is not very clear from the present material. It seems evident, however, that the polarisation originates in the primary *cB*9 star revolving around the secondary *B*2*e* star because the effects appear in the oscillating asymmetric absorption wing.

A determination of the plane of polarisation would mean a determination of the equatorial plane in the case of polarisation effects at the edge of a very flattened or elongated body. But if the plane of polarisation is subject to a regular oscillation with respect to its orientation, this would lead us to rather phantastic conclusions; namely, either that the polar axis of the star has a very rapid precessional motion, or that the star shows a physical libration, or that the orbit itself is subject to disturbances from a third body. But this is difficult to understand when considering the regularity in the eclipsing phenomena. Maybe the effects are caused by gigantic prominences leaving the star at different zones at different times. We must content ourselves with speculations until much more extensive material is available.

The star is still observed regularly by me. Also some other similar objects and rapidly rotating stars have been put on the observing programme.

YNGVE ÖHMAN.

Stockholm Observatory.
Aug. 25.

[1] *Monthly Notices, R.A.S.*, **89**, 479; Uppsala Observatory, *Meddelande*, No. 43.
[2] *C.R.*, **198**, 249; 1934.

Light of Very Short Wave-Length (2100 A.) in the Solar Spectrum

FABRY and Buisson[1] have shown that the short wave-length limit of the spectrum of the sun near 2900 A. is due to the absorption by ozone in the atmosphere of the earth. This absorption of the ultra-violet Hartley band of ozone begins at the wave-length 3100 A. and reaches a maximum at 2540 A. (Läuchli[2]). It is important to notice that the absorption falls rapidly on the short wave-length side of the band. Edgar Meyer[3] first pointed out that this property of ozone gives an opportunity of observing sunlight in the region of 2100 A. Several investigators searched for this short wave-length radiation, but without any success[4]. The reason for this is mainly given by the fact that below 2600 A., the atmospheric oxygen is strongly absorbing over long distances[5], so that it is necessary to use extremely sensitive apparatus to detect any radiation of this wave-length.

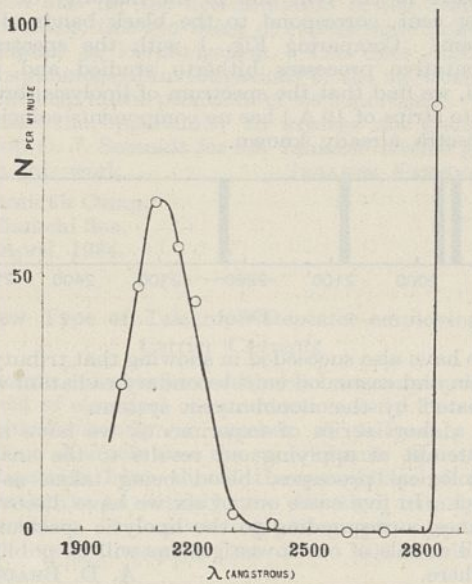

FIG. 1.

The researches of Schein and Stoll[6] show that it is possible to build extremely sensitive light counters for the ultra-violet, which enable very weak radiations to be measured. Such counters have been used to search for the above-mentioned radiation of the sun. On account of the absorption by oxygen in this spectral region the main experiments were carried out at great heights; at first in Arosa (1860 m.), afterwards at the Jungfraujoch (3460 m.).

A quartz monochromator was directed to the sun, and the radiation measured by a sensitive photon counter. The number of photons, which are proportional to the intensity of the radiation, were registered. A full description of the experiments will be given later in a more detailed paper.

The curve shown (Fig. 1) was obtained at the Jungfraujoch and shows the ultra-violet spectrum of the sun from 2000 A. to 2850 A. For these measurements a photon counter was used with a sensitive layer of platinum sputtered in an atmosphere of hydrogen. In the curve the number of registered photons is plotted against the wave-length in angstroms.

The curve obtained shows distinctly that in the short wave-length region of the ultra-violet a certain amount of sunlight reaches the earth's surface. The maximum intensity of this radiation lies at a point where the combined absorption of ozone and oxygen gives the greatest relative transparency of the atmosphere.

The following facts are characteristic of the intensity of this new radiation:

(1) It falls rapidly as the sun moves from the meridian to lower altitudes.

(2) It increases very much with the height above sea-level; at the Jungfraujoch we measured an intensity about a thousand times greater than at Arosa.

The more detailed discussion of these problems will shortly be published in a paper by M. Schein and B. Stoll in the *Helvetica Physica Acta*.

EDGAR MEYER.
Physical Institute, M. SCHEIN.
University, Zurich. B. STOLL.
Aug. 18.

[1] Ch. Fabry and H. Buisson, *Astrophys. J.*, **54**, 297; 1921.
[2] A. Läuchli, *Helv. Phys. Acta*, **1**, 208; 1928. *Z. Phys.*, **53**, 92; 1929.
[3] Edgar Meyer, *Ann. Phys.*, **12**, 859; 1903.
[4] Edgar Meyer, *Ann. Phys.*, **12**, 859; 1903. Edgar Meyer, *Verh. d. klimat. Tagung in Davos*, 1925. P. Lambert, G. Déjardin and D. Chalonge, *J. Phys. et le Rad.*, **4**, 536; 1923.
[5] H. Buisson, G. Jausseran and P. Rouard, *C.R.*, **190**, 808; 1930. **194**, 1477; 1932. F. W. P. Götz and H. Maier-Leibnitz, *Z. Geophys.*, **9**, 253; 1933.
[6] M. Schein and B. Stoll, *Helv. Phys. Acta*, **7**, 485; 1934.

Steric Hindrance and Geometrical Isomerism

IT is not often that evidence in the form of steric hindrance is available for confirming the configurations of geometrical isomers among ethylenic compounds. The following observations are thus of interest. *cis*-αβ-Dibromocinnamic acid[1] (m.p. 100°) esterifies to the extent of only 6 per cent in one hour, and 33 per cent in 16 hours, by the Fischer-Speier method, whereas the *trans*-acid[1] (m.p. 136°) is esterified completely in one hour. This is in conformity with my earlier observation[2] in regard to the different modes of addition of bromine to β-phenylpropiolic acid and its methyl ester.

cis-*o*-Nitro-α-bromocinnamic acid (m.p. 159°) has recently been prepared for the first time, in these laboratories, by Mr. J. D. Vasavada and me, as dense yellow rhombic tablets, by crystallising from benzene the unesterified portion of the acid product of the direct nitration of *cis*-α-bromocinnamic acid[3] (m.p. 120°). It has also been made from *o*-nitrocinnamic acid dibromide by the action of alcoholic potash and pyridine. In ten per cent choroform solution with a trace of free bromine, it is transformed with remarkable ease, by a few minutes exposure to direct sunlight, into the insoluble needle-shaped crystals of the *trans*-isomer[4] (m.p. 212°), which is capable of complete esterification in 1 hour. This and further work in this series will shortly be published elsewhere.

P. RAMASWAMI AYYAR.
Indian Institute of Science,
Bangalore.
July 20.

[1] *Annalen*, **247**, 139.
[2] Ind. Sci. Congr. Chem. Abstr., No. 75, 1934.
[3] *J. Chem. Soc.*, **83**, 668.
[4] *Ber.*, **24**, 251.

Effect of Light on the Reducing Substance (Vitamin C ?) in Milk

IT has been reported in a previous letter[1] that milk which originally gives a positive vitamin C titration when the method of Birch, Harris and Ray[2] is applied fails to reduce the indophenol reagent after a short exposure to light (direct sunlight being excluded).

We have found at present that the property to reduce the reagent may be restored to about 90 per cent of the original value after short exposure to light (not more than 1 hour under our experimental conditions) by treating the milk with hydrogen sulphide and removing the latter from the trichloracetic acid filtrate in a way similar to that used by Tillmans, Hirsch and Dick[3] and Johnson[4] for the regeneration of reversibly oxidised lemon juice.

Longer exposures to light entail greater irreversible losses. Thus, after six hours, the hydrogen sulphide treatment restores only little more than half of the original value.

R. G. BOOTH.
S. K. KON.

National Institute for Research in Dairying, University of Reading.
Sept. 3.

[1] Mattick and Kon, NATURE, **132**, 446, Sept. 16, 1933.
[2] Birch, Harris and Ray, *Chem. Ind.*, **52**, 159; 1933. *Biochem J.*, **27**, 59; 1933.
[3] Tillmans, Hirsch and Dick, *Z. Unters. Lebensmitt.*, **63**, 267; 1932.
[4] Johnson, *Biochem. J.*, **27**, 1287; 1933.

The Ridge in the Indian Ocean between Chagos Is. and Socotra

IN NATURE of July 7, p. 29, Dr. Hans Pettersson proposes that the submarine ridge running across the north-east Indian Ocean should be named after the late Prof. Johannes Schmidt. It should be pointed out, however, that the ridge in question has been baptised by Schmidt himself *Carlsbergryggen* (Carlsberg Ridge), the name taken from the Carlsberg Foundation, which fund made it possible for Prof. Schmidt to carry out the circumnavigation with the *Dana* (*vide* "Dana's Togt omkring Jorden 1928–1930", Copenhagen 1932, p. 255, fig. 198 B).

Å. VEDEL TÅNING.

Marinbiologisk Laboratorium, København V.

THE main reason why the name of "Johannes Schmidt Ridge" is preferable to that of "Carlsberg Ridge" appears to me to be that the former name conforms better with the traditions of oceanographical science than the latter. Ridges or depressions of the ocean floor have so far, where a geographical name already existing has not been used, almost exclusively been named, either after the ship from which they were discovered, or after some famous seafarer or investigator. There are, it is true, instances where geographical discoveries have been named after individuals or institutions in recognition of financial support. But in the present case, dealing as we are with one of the main features of the earth's crust, the name of its discoverer appears most appropriate, a name which Dr. Schmidt's modesty would, needless to say, have precluded him from putting forward himself.

Oceanografiska Institutet, Göteborgs Högskola. HANS PETTERSSON.

Lipolysis as a Source of Mitogenetic Radiation

AMONG the fermentative systems studied mitogenetically, the processes of glyceride hydrolysis, an important and widespread reaction in organisms, have hitherto not been examined. I have therefore examined lipolysis as a source of radiation. The methods of investigation are fully described in Prof. Gurwitsch's recently published monograph[1].

The following systems have been investigated: (1) tributyrin and monobutyrin from serum or pancreatic lipase; (2) triolein and lipase (pancreatic); (3) castor oil and ricinase (from *Ricinus* beans).

The spectral analysis has been carried out of the splitting of monobutyrin by pancreatic lipase. The diagram of the spectrum reproduced (Fig. 1) is based on more than two hundred experiments. The spaces, that is, the absence of radiation, correspond to differences between the induced reaction and the control and on an average do not exceed 3 per cent. The induction effects, where the average values have exceeded 15 per cent and in the majority of cases 20 per cent, correspond to the black bands of the diagram. Comparing Fig. 1 with the spectra of fermentative processes hitherto studied and published, we find that the spectrum of lipolysis (broken up into strips of 10 A.) has no components coincident to spectra already known.

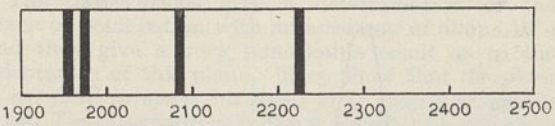

FIG. 1.

We have also succeeded in showing that tributyrin, triolein and castor oil emit secondary radiation when irradiated by the monobutyrin system.

In a short series of experiments, we have made an attempt at applying our results to the analysis of biological processes, blood being taken as the subject. In five cases out of six we have discovered the lines corresponding to the lipolytic spectrum.

Full details of our investigations will be published elsewhere.

A. D. BRAUN.

Institute for Experimental Medicine, Leningrad.
Aug. 20.

[1] "L'Analyse mitogénétique spectrale". Paris: Hermann et Cie, 1934.

Vibrations of the Ice-Cap of Polar Seas

IN the course of the Polar expedition on the S.S. *Cheluskin* in the Chukchi Sea, 1933–34, I noted a very interesting phenomenon, concerning which I have been unable to find any descriptions in the literature available to me.

The solid ice-cap of the sea, which represents, as it were, an immense elastic plate on a liquid foundation, is in a state of perpetual vibration. Though I had no special seismic apparatus at my disposal, I was nevertheless able, by means of very primitive hand-made instruments, to detect and roughly to measure these vibrations. They proved for the most part to be caused by the wind, and the direction of the greatest amplitudes tallied with the direction of the prevailing wind. A few cases of considerable

vibrations running in a determined direction were observed on a windless day. Some hours later (up to eight hours) the wind blew in that same direction; evidently it did not keep pace with the sound oscillations it had created in the ice. We call those vibrations 'wind vibrations', but we admit that they may consist in a periodic warping of the ice-plate.

Besides these strictly directed 'wind vibrations' there may be observed 'disturbance vibrations' in the ice, spreading equally from the centre—the spot of the breaking up of the ice in different directions. A systematic investigation of the 'wind vibrations' would evidently greatly assist arctic synoptics. The study of the 'disturbance vibrations' will obviously permit periodicities in the dynamics of the ice-covered sea to be determined.

At present it is proposed to take observations of both types of vibrations by means of special ice seismographs, which will be set up on the shore-ice. There could be created, by means of blastings, artificial vibrations in the ice, and this method could be used also for the determination of the limits of the ice-fields, this too being of considerable practical importance in ice-navigation. The data obtained from seismological investigations of the ice would be of great help in the prognosis of ice conditions.

I take the opportunity to express my gratitude to Prof. O. J. Schmidt for his valuable advice given me in this work.

IBRAHIM FAKIDOV.

Schmidt's Camp,
Chukchi Sea.
April, 1934.

New Type of Telegraph Repeater employing Carrier Currents

CARRIER currents have hitherto been employed, in the field of electrical communication, only for working simultaneously a number of telegraph and telephone channels over the same circuit. My recent investigations have shown the possibility of their application in an entirely new direction, namely, in the problem of 'repeatering' telegraph signals of various speeds, ranging from 25 to 400 words per minute.

The incoming telegraph signals are made to modulate a carrier wave of 5 kc./s. supplied at the repeater station. The modulated wave is then passed through a band pass filter to pass both the side bands, which are amplified by a power amplifier. The amplifier output is demodulated, passed through a low pass filter, amplified again by a single stage power amplifier and passed on to the next line section.

This type of telegraph repeater appears to possess many advantages over a mechanical telegraph repeater, which requires adjustment of polarised and neutral relays, automatic switches, etc. The overall current magnification is about 100 decibels and the wave-form of the amplified signals shows practically no distortion at all speeds of working. Further, the same power amplifier may be utilised for a number of telegraph channels passing through the same repeater station. Further investigations to develop this type of repeater are in progress.

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Aug. 10.

Induced Radioactivity

WHEN elements are bombarded with neutrons, we suggest that three types of reaction are possible, namely, simple neutron capture, disintegration with proton emission and disintegration with α-particle emission, the particular type of reaction depending upon the energy of the incident neutrons. Experimental evidence is now being published by various workers which seems to confirm these proposed reactions and also our hypothesis[1] that under neutron bombardment stable isotopes transmute to missing, unstable ones which are spontaneously radioactive, disintegrating with the emission of β-rays. For example:

$$_{13}Al^{28}\ (\text{unstable}) \rightarrow {}_{14}Si^{28}\ (\text{stable}) + \overrightarrow{\beta},$$

the Al^{28} being produced by the following reactions:

$$(a)\quad {}_{13}Al^{27} + n \rightarrow {}_{13}Al^{28},$$
$$(b)\quad {}_{14}Si^{28} + n \rightarrow {}_{13}Al^{28} + \overrightarrow{p},$$
$$(c)\quad {}_{15}P^{31} + n \rightarrow {}_{13}Al^{28} + \overrightarrow{\alpha}.$$

Of these the second has been observed by Fermi, while Bjerge and Westcott[2] state that phosphorus under neutron bombardment gives rise to two radioactive isotopes, one of which decays with a period of 2·5 minutes. Since the period of radioactive aluminium, due to proton emission from silicon, is also 2·5 minutes, we conclude that both reactions (*b*) and (*c*) have been verified experimentally, the active product of short life from phosphorus being $_{13}Al^{28}$. Reaction (*a*) has not yet been confirmed.

Bombardment of phosphorus with neutrons of appropriate energy should give the following reactions, according to our theory of induced radioactivity:

$$(a)\quad {}_{15}P^{31} + n \rightarrow {}_{15}P^{32}\ (\text{unstable}) \rightarrow {}_{16}S^{32} + \overrightarrow{\beta},$$
$$(b)\quad \begin{cases} {}_{15}P^{31} + n \rightarrow {}_{14}Si^{31}\ (\text{unstable}) + \overrightarrow{p} \\ {}_{14}Si^{31} \rightarrow {}_{15}P^{31} + \overrightarrow{\beta}, \end{cases}$$
$$(c)\quad {}_{15}P^{31} + n \rightarrow {}_{13}Al^{28}\ (\text{unstable}) + \overrightarrow{\alpha}.$$

Reaction (*a*) has not yet been observed experimentally, but we suggest that (*b*) and (*c*) explain the two decay periods obtained by Bjerge and Westcott with phosphorus bombarded by neutrons of various energies.

Additional confirmation of our hypothesis is given by the most recent work of these experimenters[3], namely, the formation of $_{11}Na^{24}$ by neutron capture. Fermi had previously produced sodium from magnesium and aluminium, so that all three reactions, by means of which Na^{24} (unstable and missing) can be formed, have been verified, namely:

$$(a)\quad {}_{11}Na^{23} + n \rightarrow {}_{11}Na^{24},$$
$$(b)\quad {}_{12}Mg^{24} + n \rightarrow {}_{11}Na^{24} + \overrightarrow{p},$$
$$(c)\quad {}_{13}Al^{27} + n \rightarrow {}_{11}Na^{24} + \overrightarrow{\alpha}.$$

A full account of induced β-radioactivity, arising from these three types of reactions, for all elements will be published later.

F. H. NEWMAN.
H. J. WALKE.

Physics Department,
University College,
Exeter.
Sept. 5.

[1] NATURE, **134**, 64, July 14, 1934.
[2] *ibid*, **134**. 177, Aug. 4, 1934.
[3] *ibid*, **134**, 286, Aug. 25, 1934.

Photographic Desensitisers and Oxygen

In the course of experiments on the tracks on photographic plates due to protons set in motion by neutrons, we have made some observations of more general interest. We found that the rows of silver grains marking the tracks of swift particles only appeared after development when the plate had been treated with pinacryptol-yellow or some similar substance and when the exposure to the particles was carried out in air at reduced pressure or in nitrogen. We therefore investigated the effect of light on photographic emulsions similarly treated and exposed in air at different pressures or in different gases. Our results may be summarised thus:

(1) The desensitisation is much reduced by (*a*) reduction of the air pressure; (*b*) by substituting pure nitrogen for air.
(2) This effect is not so marked when the plate is moist.
(3) The effect is apparent with pinacryptol-yellow, densitol, indulin-scarlet, phenosafranin, a mixture of pinacryptol-yellow and indulin-scarlet, antilumin and pinacryptol, but not with pinaflavol.
(4) A reduced pressure has no influence on plates not desensitised by one of the substances before mentioned.

That this effect has not been noticed by Mr. Shivonen[1] in silver bromide sols is probably due to essential differences in the experimental conditions.

From our experiments we feel entitled to draw the conclusion that the dye itself only plays an auxiliary part, probably that of a catalyser, in the desensitisation process, the major part being played by the oxygen of the air. These results, therefore, appear to us to support the well-known oxidation theory of desensitisation due to Lüppo-Cramer.

The details of our investigation will be published in the *Sitzungsberichte der Akademie der Wissenschaften*.

Marietta Blau.
Hertha Wambacher.

Institut für Radiumforschung
und
II Physikalisches Institut der Universität,
Wien.

[1] *Z. wiss. Phot.*, 24; 1926.

Energy of the C–OH Bond and Molecular Structure in Alcohols

A continuous absorption spectrum in the ultra-violet region which corresponds to the immediate dissociation of the molecule into its constituents was investigated for a number of alcohols in the vapour state. The radical OH is generally considered as pseudohalogen, and the dissociation products are considered to be the excited OH radical and the normal alkyl residue, analogous to a halogen-alkyl. So the dissociation energy in the accompanying Tables I and II, estimated from the absorption edge, must be modified, if the energy necessary to excite the OH radical is known. The data are not so accurate as the absolute values, but they seem to have a definite physical meaning as relative values and to be of sufficient interest to warrant publication.

A comparison of the results obtained with the series of alcohols reveals certain interesting features on the relationship between the dissociation energy of the bond and the structure of the molecule.

Table I

Alcohols	Diss. Energy (kcal./mol.)	Raman Lines $\Delta\nu$ (cm.$^{-1}$)
CH_3OH	133·6	1225
C_2H_5OH	137·5	1272
n- C_3H_7OH	140·9	1282
n- C_4H_9OH	141·9	1286
n- $C_5H_{11}OH$	142·3	
n- $C_6H_{13}OH$	142·7	
n- $C_7H_{15}OH$	143·4	
n- $C_8H_{17}OH$	144·5	
n- $C_{10}H_{21}OH$	150·2	
n- $C_{12}H_{25}OH$	152·2	

Table II

Alcohols	Diss. Energy (kcal./mol.)	Raman Lines $\Delta\nu$ (cm.$^{-1}$)
n- C_4H_9OH	141·9	1286
iso- C_4H_9OH	141·2	1264
sec.- C_4H_9OH	140·2	—
tert.- C_4H_9OH	141·2	1202

(1) The energy of the C–OH bond increases successively as we go up the series of normal alcohols.
(2) In the isomers, no regularity appears among the energies of the C–OH bonds. It seems to assume the maximum value for the corresponding normal alcohols.

In connexion with the study of absorption in the ultra-violet region, it may be also worth while to compare the preceding results with the investigations of the Raman spectra of the corresponding alcohols. According to S. Venkateswaran and S. Bhagavantan[1], precisely the same relationships hold good in the series of alcohols as shown in Tables I and II.

Y. Hukumoto.

Physical Institute,
Imperial University,
Sendai, Japan.
July 20.

[1] S. Venkateswaran and S. Bhagavantan, *Ind. J. Phys.*, **5**, 129; 1930.

A New Band System in Nitrogen

I have recently directed attention in a letter which has been sent to the *Physical Review* for publication to some new nitrogen bands. Three of these bands degrading to the violet and having wave-lengths 2536, 2635 and 2740 A., have been found to increase in intensity as the pressure is lowered. This is true also of the new Appleyard–van der Ziel bands recently discussed by van der Ziel, and of the new system that is reported by me in the above-mentioned letter. The three bands have been identified as (0, 1), (0, 2) and (0, 3) bands of a new system, and their frequency differences agree well with those of the lower electronic state of the Appleyard–van der Ziel bands.

Further work is in progress in an attempt to obtain bands arising on higher vibrational states. Photographs taken at lower pressure may bring out such bands.

Joseph Kaplan.

University of California at Los Angeles.
Aug. 24.

Research Items

Blood-Groups of British Columbian Indians. Prof. Ruggles Gates and Dr. Geo. E. Darby have carried out an investigation of the blood-groups of the Indians of the coastal region of British Columbia (*J. R. Anthrop. Inst.*, 64, Pt. 1). Special significance seemed likely to attach to the investigation of these tribes, in view of the fact that anthropologists consider that these Indians are more Mongoloid in appearance than other American Indians, and hold that they represent a later wave of immigration from the Asiatic continent. Hence it might be expected that here would be found evidence of the *B* group characteristic in eastern Asia, which previous investigation has shown to be practically absent in the American Indian. In the event, it was found that in two individuals only among 300 tested was the *B* group found, when it was probably due to European crossing. The results of the test were : 86·7 per cent showed *O*, 12·7 showed *A* and 0·6 showed *B*. A comparison with later results taken by Dr. Darby, in company with two other observers, showed an increase to 23·6 in the *A* group ; but the earlier observations were almost confined to subjects of an older generation, while the later included a larger number of the younger. The results indicate an increase in white blood in the younger generation. An explanation is offered for the apparent disagreement of the blood-groups of the American Indian with the anthropologist's hypothesis that the Indian population of the American continent represents a relatively late migration from the north-east of Asia. The peoples of north-east Asia, through lack of isolation, have become infected with the *A* and *B* blood-groups : but the peoples of the islands and archipelagos stretching down the Asiatic coast from Saghalien to the Philippines and Borneo, and at one time possibly more widely dispersed from Tibet to the coast, have been more isolated. The blood groups of only a few have been taken at present ; but in certain instances, such as the Gilyak and the purer Ainu, they are consistent with this view.

Art and Race in India. A lecture on "Art in Orissa", delivered before the Royal Society of Arts by Rai Bahadur Ramprasad Chanda on July 25 (*Roy. Soc. Arts*, 72, Aug. 17), in describing the figure sculptures and images decorating medieval temples of Orissa, mostly on little-known sites, dwells upon certain characteristics which appear to mark a racial difference in the provinces of Indian art. In the fifth century A.D., Buddhist art reached its culmination in northern India, and Indian sculptors began to carve Brahmanic images at about the same time. The most typical of the Gupta period are three panels (c. A.D. 600) at Deogarh in the United Provinces. In these, while the bodies of the two principal figures incline to one another as if in conversation, the eyes and faces show that they are lost in contemplation. The same incongruity in the pose of the body and the expression of the face is even more marked in the minor figures. The Brahmanic figures of the south, however, differ widely from those of the north in spirit. They show frank participation in dramatic action with open eyes. The difference may be illustrated by comparing the Deogarh figure of Vishnu reclining under the hood of a serpent with that of a relief from Badami in the Bijapur District of the Bombay Presidency, in which Vishnu is watching with open eyes and the eyes of all the attendants are fixed upon him. Therefore we have to distinguish the Brahmanic images of the Aryan-speaking northern India and Mahārāshtra on one hand and of the Dravidian-speaking areas of the south on the other as the products of two different schools of sculpture. Fergusson long ago pointed out the differences between the Dravidian and the Indo-Aryan in architecture, and Sir John Marshall has suggested that India was indebted to the earlier Dravidian or pre-Aryan people for her natural and inborn love of ornamental design.

Hypotrochanteric Fossa in the Primate Femur. A study of the hypotrochanteric fossa in the human and anthropoid femur has been made by Dr. Aleš Hrdlička (*Smithsonian Miscell. Collect.*, 92, No. 1), in which for the first time in anatomy and anthropology it has been possible to view the whole ontogeny of a definite feature of human morphology. This study leads to the conclusion that it may be that every separate organ of the human body may have a like history of advance and either regression or other line of development, bearing on human derivations and antiquity. The hypotrochanteric fossa has some peculiar relationships. It appears in man, gorilla, chimpanzee and orang. It is not found in the old-world monkeys, but there is an occasional trace of it in the gibbon and the new-world monkeys. In the great apes it serves the definite purpose as the place of attachment for one of the large thigh muscles. It shows a progressive development in size until full growth is reached, but it is often missing in the young. In man, on the other hand, it appears in the fourth month before birth. Sometimes, however, it may appear at any stage in child and sub-adult life. It attains its greatest development before maturity, and then it begins to disappear. It may undergo its entire development and regression during childhood. While the fossa has a specific and necessary function in the ape, in man it has no function, or only a very minor one. Apparently the fossa in man and the apes is derived from a common ancestry, but while it remained an essential feature in the ape throughout life, in man, if it served any useful purpose, it was only in the early years. In early man and the precursors of man, *Pithecanthropus*, Neanderthal man, etc., the conditions do not differ substantially from those in man of to-day. The incidence of the fossa differs in various human races and other groups ; but these differences are neither great nor conformable to general racial affinities.

Incubation of Alligators. In a careful study of the egg-laying of alligators, E. A. McIlhenny found that the building of a nest, 3 ft. 9 in. high, with a 7-ft. base, occupied four days (*Copeia*, p. 80 ; 1934). On the sixth day, 34 eggs were laid in a hollow in the centre and covered with weeds and mud. A double registering thermometer was placed in the egg-mass, and daily readings showed a wonderfully stable temperature which was generally a few degrees higher than the maximum shade temperature outside, although occasionally the nest temperature was slightly lower than the outside temperature. This particular nest of eggs took sixty-six days to hatch, several days longer than the average, which is 62–64 days, but this may have been due to the daily interference

in making the thermometer readings. Another point of great interest is that the alligator which laid the eggs had been marked by McIlhenny when it hatched on August 22, 1921, so that its first nesting occurred when it was nine years and ten months old, and had reached a length of seven feet three inches.

Nephridia of *Amphioxus*. Prof. E. S. Goodrich (*Quart. J. Micro. Sci.*, **76**, 499–510 and 655–674, 1934) gives an account of the development of the unpaired anterior nephridium (Hatschek's) and of the paired nephridia of *Amphioxus*. At an early stage, before the buccal diverticulum has even appeared, the rudiment of the unpaired nephridium can be first identified as one or two cells between the posterior wall of segment 2 and the anterior wall of segment 3. By the time the mouth has been pierced, the rudiment appears as a group of cells between these two segments. At first solid, it later acquires a lumen and opens into the pharynx through the endoderm. Cells grow from the blind end of this rudiment towards the cavity of segment 2, the cœlomic epithelium being now broken through. The canal of the nephridium and the solenocytes are derived from the same rudiment. At no stage could an open funnel be found. The author states that in studying the development of the paired nephridia he could find no evidence for the view of Legros that the nephridium is developed from a fold of cœlomic epithelium giving rise to the canal, open to the cœlom at first by a funnel which closes later, and that the cells of the cœlomic epithelium are converted into solenocytes. The nephridium actually arises as a group of cells between the endodermal wall of the pharynx and the cœlomic epithelium lateral thereto. The cells increase, forming a plate over which the cœlomic epithelium is stretched and then ruptured, so that the growing solenocytes formed from the more dorsal cells of the plate become exposed to the cœlomic fluid. The more ventral cells of the plate form the canal of the nephridium and remain covered by the cœlomic epithelium. The canal fuses with the dorsal wall of the gill pouch at a point where the nephridiopore comes to open. At no stage is there an internal opening. The author's conclusions are in agreement with the view that the nephridia of *Amphioxus* are true protonephridia, homologous with the protonephridia of the invertebrates, but not homologous with the excretory tubules of the Craniata, which are derived from cœlomoducts.

Systematics of Pulmonates. Mr. Henry A. Pilsbury has recently reviewed the Planorbidæ of Florida, with notes on other members of the family (*Proc. Acad. Nat. Sci. Philadelphia*, **86**, 1934), and in the same volume of that journal he describes the molluscs from the Dolan West China Expedition of 1931. The first paper is a valuable contribution to the systematics of the Planorbidæ, including much that is based on the internal anatomy. It is often difficult to find differences in the shells when the animals show distinct and important specific characters. This is especially the case with the reproductive system, and many careful dissections have been made. There is a large range of variation in the Planorbidæ of Florida, and forms which by themselves would be viewed as quite distinct species seem to run together in continuous series. It is very interesting to follow the different forms of *Helisoma durgi* of the sub-genus *Seminola*, where six races recognised and described vary from a true *Planorbis* shape to a turreted shell differing only slightly from the closely related species *Helisoma scalare*. No barriers to the migration of these snails exist, so that the geographical limits of such races are only vaguely defined. In the second paper, a collection of Chinese land snails from Szechwan Province is described. Sinistral forms appear to be common in these districts, which are very rich in land molluscs.

The Termites of Java and Celebes. In *Kungl. Svenska Vetens.-akad. Handl.*, **13**, 1, No. 4, 1934, Mr. N. A. Kemner contributes an important memoir on the above subject. While this work is mainly systematic in character, the biology of a number of species is also described, and their nest features are figured in the accompanying plates. The author follows recent taxonomists in regarding the Rhinotermitidæ as a separate family. As might be expected from its greater size, the island of Java with Madura has a richer termite fauna than Celebes and its neighbouring small islands. Of the new species described, 26 are from the former region and 13 from Celebes. One new genus (*Pseudocapritermes*) is described with a single species (*silvaticus*), also from Java. The work is accompanied by a full bibliography, and will prove indispensable to students of termites.

South American Potatoes. Data and material collected by Bukasov and Juzepczukii during expeditions of the Institute of Plant Industry, U.S.S.R., to Central and South America, in 1925–28, are appearing in the *Bulletin of Applied Botany, Genetics and Plant Breeding*, Leningrad. The first part, by Juzepczukii, was the "Systematics of the Potato"; the second part, by S. M. Bukasov, is entitled "The Potatoes of S. America, and their Breeding Possibilities" (*Bull. Applied Bot., Gen. and Plant Breed.*, Supp. 58. In Russian, with summary and explanations of illustrations and tables in English). The originators of the expeditions were amply justified in their belief that the home of the wild and cultivated potato had been inadequately explored. As a result of these surveys, collections and subsequent work, the primary material at the disposal of the potato breeder has been much enriched, fourteen new cultivated species, for example, having been added. The possibility of building up frost and disease resistant varieties is brought much nearer by this work; thirteen of the new species are indigenous to high mountainous regions. An interesting sidelight on the difficulties encountered in such work is the poor tuber formation and consequent loss which occurred when many samples were grown near Leningrad, where the days are long. Were it not for recent work on photoperiodism, a species like *Solanum demissum* might have received little attention there, owing to the poor tuber formation.

Sulphuric Acid Spraying against Weeds. The recognition of sulphuric acid spraying as a means of destroying surface weeds in cereal crops is rapidly becoming general, and the acreage treated in 1934 was more than five times that in 1932. The work is generally carried out by contract, as there is a natural prejudice amongst farmers against handling and diluting the strong acid preparatory to the spraying operations. Any simple means of reducing the hazards will, therefore, be welcome, and with this object in view an illustrated leaflet by R. K. Macdowall entitled "An Improved Method for the Handling and Dilution of Sulphuric Acid for Spraying

Weeds" has been issued by the Institute for Research in Agricultural Engineering (Oxford: University Press, 1*s*.). The method recommended is to prepare the spray fluid on a specific gravity basis, thereby avoiding the dilution of the acid in open tubs. The concentrated sulphuric is pumped directly into the spraying machine and mixed there 'under cover', the correct strength being adjusted by means of a hydrometer. A thorough mixing of the fluid before spraying is essential, and a hand paddle has been found to serve this purpose very efficiently. The method proved entirely satisfactory when tested out on 100 acres of corn land, and the full working details provided in this leaflet should enable many farmers to extend their spraying operations with greatly reduced risks and at the same time considerable advantage to their crops.

Electron Scattering by Atomic Electrons. A. L. Hughes and R. G. Hergensother (*Phys. Rev.*, Aug. 1) have investigated the scattering of electrons by helium under such conditions that the effect of the electrons of the helium atom was prominent. Electrons of about 1,000 volts energy were fired into helium at about 0·001 mm. pressure, and the electrons scattered at any desired angle were analysed with respect to velocity by a magnetic refocusing method, differential pumping being used to keep the pressure low in the analysing chamber. At any angle, the analysed velocities show a maximum corresponding to the elastic scattering of the electrons by the helium nucleus and a broader 'inelastic' peak which agrees approximately with the velocity $v = v_0 \cos \theta$ which would be retained by an electron of velocity v_0 after deflection through θ with another free electron. The spread in velocity of these electrons may be ascribed to the initial 'orbital' velocity of the struck electron, as in Jauncey's theory of the broadening of the Compton scattered line.

Measurement of Current in a Lightning Flash. A Mail Report from Science Service, Washington, D.C., states that since 1926, Dr. Heinrich Gruenewald and his associates of the Berlin-Charlottenburg Society for the Study of High Tension Installations have been engaged in investigating the magnitude and direction of the electric currents produced by lightning in conductors, such as the steel mast of a high tension line. The measurements were made by inserting in the path of the lightning short rods of a special substance which becomes magnetised on the passage of a current. The degree of magnetisation showed the strength of the current, and the polarity showed its direction. The largest current measured in this way was 60,000 amperes, while currents of half this value were found to be a frequent occurrence in lightning flashes. It was found that the current usually passed upward from the ground, indicating that the base of a thunder cloud is generally charged negatively.

Dissociation Constant of Boric Acid. Although boric acid and borax are important standards in the preparation of buffer solutions, the numerous determinations of the dissociation constant of boric acid are in poor agreement. A new series of values, at temperatures of 10°–50°, has been obtained by B. B. Owen (*J. Amer. Chem. Soc.*, **56**, 1695; 1934) by an electromotive method. One electrode was a hydrogen electrode in a solution containing the acid, borax, and sodium or potassium chloride, and the other electrode was silver and silver chloride. Account was taken of the hydrolysis of the borax. The values of pK extrapolated to zero ionic strength, K representing the dissociation constant of metaboric acid HBO_2, or the first dissociation constant of orthoboric acid, H_3BO_3, are found to be represented by the equation $pK = 9{\cdot}023 + 8 \times 10^{-5}(76{\cdot}7 - t^\circ\,\text{C.})^2$, a form known to be characteristic of a variety of weak electrolytes, although the usual factor in the temperature term is 5 instead of 8. This gives the following values of $K \times 10^{10}$:

t° C.	10	15	20	25	30	35
$K \times 10^{10}$	4·17	4·70	5·25	5·80	6·35	6·89
	40	45	50			
	7·39	7·89	8·33			

At finite concentrations there will be some ambiguity owing to the formation of the ion of tetraboric acid.

Heats of Combustion of Hydrocarbons. The calorimetric heats of combustion of the saturated paraffin hydrocarbons ethane (C_2H_6), propane (C_3H_8), normal butane (C_4H_{10}) and normal pentane (C_5H_{12}) have been determined by F. D. Rossini (*Bur. Stand. J. Res.*, June 1934). The values, which are given in international kilojoules per mol for 25° C. and 1 atm. to form gaseous carbon dioxide and liquid water, are 1,559·57, 2,219·57, 2,877·88, 3,536·00, respectively, which are all about 1 per cent larger than existing values except for normal butane, for which there are no existing data. The heats of combustion of these hydrocarbons are of industrial importance, and in view of the precautions taken to ensure the purity of the materials and the accurate experimental technique, the new values are probably more correct, the differences from the existing values being 30–50 times the estimated uncertainties in the new figures. The international joule is taken as 1·00032 absolute joules and the 15° gm. cal. as 4·1850 absolute joules. The experimental method consisted in finding the amount of electrical energy which furnished heat equivalent to the heat evolved in a combustion calorimeter, the amount of reaction being determined from the mass of water formed, and small corrections were applied for a slight incompleteness in the combustion of the carbon.

Heaviside's Operational Calculus. In Oliver Heaviside's electrical work, many mathematical results were obtained by methods of his own, of which he refused to give any justification except that they worked well. "Am I to refuse to eat because I do not fully understand the mechanism of digestion?" However, the subject was placed on a logical basis by J. R. Carson and T. J. I'A. Bromwich. A good account of some modern developments is given in a 27-page tract by P. Humbert ("Le Calcul Symbolique", Paris: Hermann, 1934). Given any function, another (usually much simpler) called its *symbolic image* can be found, and to any properties of the symbolic image correspond properties of the original function. By this process, Van der Pol proved a theorem concerning Bessel functions which is very difficult to obtain by ordinary methods. Extensions have been made to differential and integro-differential equations, and to functions of two variables. In the opinion of E. T. Whitaker, we should now place the operational calculus with Poincaré's discovery of automorphic functions and Ricci's discovery of the tensor calculus as the three most important mathematical advances of the last quarter of the nineteenth century.

Association of Special Libraries and Information Bureaux

ANNUAL CONFERENCE

THE eleventh annual conference of the Association of Special Libraries and Information Bureaux held at Somerville College, Oxford, on September 21–24 presented several features of special interest to scientific workers. Sir Richard Gregory's presidential address on "Science in the Public Press" was discussed in a leading article in NATURE of September 29.

The ensuing discussion made it manifest that there is a widespread desire for reliable scientific information in a form intelligible to the general reader, and the idea of a British Science Press Service on the lines of the Science Service inaugurated in the United States in 1921 was warmly supported. The same need was expressed in a discussion on the following day on book selection. This discussion, which centred round a group of papers dealing with methods used by the Bodleian Library, contributed by Mr. S. G. Wright, by the general library, by Mr. J. E. Walker, and by the special library, by Mr. A. F. Ridley, was probably the most important technical discussion at the Conference, and the selection of scientific literature was its most prominent feature. Under present conditions, both the general library and the special library encounter much the same difficulty in the selection of reliable general and specialist books on scientific subjects, particularly foreign books, and specialist advice is not always available or as helpful as it might be. The value of some critical review of scientific books was clearly stressed and it was suggested that attempts should be made to secure the co-operation of members of A.S.L.I.B. and of the Library Association to secure the publication of such notes or reviews.

At the afternoon session on September 22, Mr. C. Nowell described the new Central Library in Manchester opened by H.M. the King on July 17, and Mr. H. F. Alexander gave an account of the new extension of the Radcliffe Science Library which is to be opened early in November.

The annual report of the Council presented to the annual meeting showed that the Association is now holding its own, although a marked increase in membership and in income is desirable if the work is to be developed adequately. A membership campaign has already been inaugurated. The report referred also to the inquiry concerning the costs of printing and publishing scientific abstracts which is proceeding and to the preparation of a "Business Man's Directory to Sources of Information" for the whole field of commerce and industry.

A feature of the conference was the admirable address on "The Idea of Planning" delivered by Major L. R. Urwick on the Saturday evening. After pointing out the dangers which attend the careless use of such words as 'rationalisation', 'scientific management' and 'planning' as a charm or panacea without reference to their real meaning, Major Urwick stressed the importance of clear thinking based on scientific knowledge in every domain of our affairs to-day. Planning is essentially an attempt to substitute censorious control for individual self-interest. It recognises no limits to human knowledge or in the organising powers of the human mind when the right principles are discovered and followed. Major Urwick thus touched on the same point of the relation of knowledge and power which was previously emphasised by Sir Richard Gregory; and he alluded to the growing influence exerted by the professional man in the management of industry, which is steadily making for direction based on technical knowledge and not political prejudice. Major Urwick stressed the necessity for a study of organisation as a technical problem as an essential part of sound planning. Planning is intimately linked with the questions of authority, control and management, and we have as yet little knowledge of what authority is required to enforce a plan if those in control are kept really informed of the factors concerned and their reactions.

Major Urwick's emphasis on the social and human elements in planning was reiterated in a later address by Mr. K. M. Lindsay, M.P., on "Public Efforts at Planning in Great Britain", in which particular stress was laid on the necessity of planning so as to preserve liberty and flexibility. The value of a public relations service as a part of the machinery of government was emphasised. The unplanned adjustments of the period 1924–34 well illustrate the fields in which planning is required, and the planning of social environment is as essential as the technical side in determining the location of new industries. Wise planning involves attention to psychological and social principles, and it is an essential condition in successful planning that it should lead to an increase in purchasing power.

As in Major Urwick's address, the field for scientific investigation which is offered here in the study of the structure of planning, if an adequate technique in which personal prejudices have been replaced by organic principles is to be developed, was again emphasised, and in particular the necessity of a pure science upon which to base the so-called applied science of market research was pointed out. On the question of information, Mr. O. W. Roskill contributed a valuable survey of the sources and supply of industrial information in Great Britain with reference to planning. Once again the necessity for a central national authority for statistics was emphasised and the necessity for much more up-to-date statistics. Frequently much time is lost in ensuring an accuracy which is of no practical value in relation to the purposes for which the figures are required when it is much more important to have the figures promptly. Users might also determine to a much larger extent the form and type in which the statistics are presented. The importance of closer co-operation between industrial organisations and university departments engaged in statistical and economic research was also emphasised, as well as the need for a different type of training for the university economist. This question of linking effectively the statistical and technical elements in industry is another special aspect of the relations between knowledge and power with which the conference was repeatedly faced, and throughout it was clear that there are many ways in which A.S.L.I.B., through its work as a clearing house of information, can contribute materially to establish those relations on a sound basis.

Currents and Fisheries of the North Sea

DURING recent years the study of marine biology has been prosecuted with great vigour by most of the maritime countries of the world, with the result that remarkable progress has been made in the elucidation of the habits and life-histories of marine organisms. Much knowledge has now been accumulated concerning those great fluctuations in the stocks of economic fishes which from time immemorial have disconcerted the fishing industries of this and every other country in which fishing activities are carried on. Such outstanding progress has in fact been made in this direction that, for some fishes at least, notably the haddock and the herring, it is now possible to make reasonably accurate forecasts concerning the magnitude of the fish stocks—and therefore of the prospects of the respective fisheries—a year or even two years in advance.

These forecasts have in the past been based largely, if not entirely, upon purely biological and biometrical studies of the fish stocks themselves and of the changes taking place within them.

But although these population fluctuations can now be followed in great detail, the question of what are the causes underlying them still remains unanswered. With the progress of marine research, however, it becomes increasingly evident that the further elucidation of this problem must be sought in a more intensive study of the environment—that is to say, of the physical and chemical properties of the sea itself.

Now one of the most outstanding and most important characteristics of the sea is its constant and more or less complex motion. It is particularly noteworthy, therefore, that the entire afternoon session of Tuesday, September 11, was devoted by Section D (Zoology) of the British Association at Aberdeen, to a very full discussion of "The Currents of the Sea and their Biological Importance" in which the following took part: Dr. J. B. Tait, Fishery Board Laboratory, Aberdeen; Dr. J. N. Carruthers, Fisheries Laboratory, Lowestoft; Prof. A. C. Hardy, University College, Hull; and Dr. E. R. Gunther, of the scientific staff of the "Discovery" Committee. In the course of this discussion, it was pointed out that, from the biological point of view of the environmental relationship of fishes, the importance of the sea's constant movement lies in the fact that the physical conditions of almost every region are thereby subject to continuous change. Moreover, fishes are dependent upon certain movements in the sea for the conveyance of much of their food to the regions they inhabit. These same movements further control the passive migrations of the eggs of most fishes and of their young stages before their swimming powers have developed. The movements of the sea have thus a double effect from the biological point of view, first because of their purely mechanical effects and secondly as governing the physical and chemical conditions of any given region. In both these respects, it is the horizontal movements or currents, especially those of the upper water layers, which are generally of most importance; although Dr. Gunther pointed out that in some regions at least—notably on the west coast of South America—*vertical* currents are of fundamental biological importance.

The measurement of horizontal currents in the sea presents numerous practical difficulties. In the northern North Sea these difficulties have been mainly overcome by the use of drift-bottles of suitable design. Recent analyses of elaborate drift-bottle experiments confirm the presence of extensive drift-currents in the northern North Sea. These currents can, and do, often possess chemical and physical properties very different from those of the adjacent waters on either side. Such great variations in the properties of the water as are occasionally noted within a short interval of time at the same hydrographical station may therefore well be due to alteration in the direction of flow of a stream current and not, as is usually implied, to such radical hydrographical changes as betoken large and rapid hydrodynamical variations; for it can be taken as a general rule that modifications in the physical phenomena of the sea in which time is an essential factor do not take place with marked suddenness. The drift-bottle and hydrographical records further show that the main stream current affecting the northern North Sea is that which brings in Atlantic water around the north of Shetland through the Faroë-Shetland Channel.

In the southern North Sea, the hydrographical conditions are governed largely by the flow of water through the Straits of Dover. By means of a current meter attached to the Varne Lightship, data concerning the strength and direction of this current have been collected continuously over the last eight years. The varying water movements observed, when balanced out over a term of years, have effected the same overall transport of water as would have been accomplished by a very slow river flowing at the rate of about 3·2 miles a day from the English Channel into the North Sea. In certain circumstances the current flows the other way. Following winds quicken it and head winds impede it. A play of such wind conditions over the North Sea at large, as would be expected to pool up the Southern Bight (and north-westerly wind conditions are well known to do this), can most effectively hold up and reverse the current.

The results of the last three years are of especial interest, for, instead of the residual current heading boldly into the North Sea (as it most frequently had done in the previous three years) it has displayed less and less easting with the passage of time. During 1933, the current headed about half a point west of north.

Such long-enduring modifications of the current are held to be analogous in a way to the short-lived modifications produced by wind influence. The inferred cause, in their case, however, is an oceanic pulse—an accession of strength on the part of the parent supply stream which flows in from the ocean round the north of Scotland. This causes an extra strong southward urge of waters through the North Sea—with the results observed in 1933 particularly.

The Dover Straits current attains its strongest and weakest rates of flow a half year later than does the current entering the North Sea round the north of Scotland, but a quarter year later than the current in the Cromer Knoll region.

These facts are interpreted to indicate that the Dover Straits current waxes and wanes through the year in a sort of buffer relationship with the current from the North—that there exists a sort of see-saw conflict between the two. The vagaries of the Dover Straits currents are, on the strength of the findings mentioned, held to serve as pointers to

major modifications of the currents in the northern and middle reaches of the North Sea half a year earlier.

The results obtained from the current measurements in question have been applied to various problems of fishery interest. Amongst those of immediate local concern, that is, germane to the southern North Sea, there are the questions of good and bad survival years for the plaice and for the herring of the great East Anglian autumn fishery. The latter originate from vast annual spawnings in the eastern end of the Channel. It seems that good fortune has attended the broods of both fish when, during the egg and/or fry stages, the current issuing from Dover Straits has been most average in point both of strength and direction. This accords with the supposition that good augury for a plaice brood exists when the products of the spawning are transported to the Continental coastal shallows—the so-called young plaice nursery grounds.

Other problems calling for the application of the Varne lightvessel current data in their local rôle are concerned with the intermingling of two types of herring through the Straits, and with the outcome of the Belgian spent herring fishery. This latter is carried out upon fish supposedly enfeebled by the operation of spawning in the eastern channel.

Applied at a distance as it were, on the strength of the facts set out above, the Dover Straits current data enable something to be said about good and poor haddock years. The haddock fluctuates very closely (though oppositely) with the herring, and seems, when in the egg and fry stage, to have experienced the best survival conditions when we should judge the waters to have been most strongly urged towards the south.

The year-class fluctuations of the cod have been studied side by side with meteorological data, and it appears that the best augury for a brood obtains in those spawning seasons during which winds from the half-compass centred on north-east have been at a maximum—a finding which accords well with what is inferred in the case of the haddock from the Varne current data. G. A. S.

Translocation in the Cotton Plant

THE cotton plant continues to be a fruitful source of information regarding the movement of materials in plants. Phillis and Mason[1], in a paper which deals more particularly with the transport of carbohydrate out of the leaves into the vascular tissue, have re-examined the evidence which led Mason and Maskell[2] to the conclusion that carbohydrate was exported from the mesophyll as reducing sugar and condensed to sucrose in the phloem of the transporting tissue, and that carbohydrate is translocated in the form of sucrose along concentration gradients in the phloem.

The results of Phillis and Mason, derived from an elaborate series of ringing experiments and determinations of diurnal fluctuations in the concentration of sugars in the lamina and petiole, indicate that sucrose, and not reducing sugar, is the form in which carbohydrate is moved from the mesophyll to the veins as well as longitudinally down the petiolar phloem. They find further that the concentration of sucrose is greater in the vein and petiole than in the mesophyll, suggesting that sucrose is accumulated against a concentration gradient. By subdividing the petiole into wood and inner and outer bark, they concluded that this accumulation occurred in the phloem region, and an examination of the distribution of sieve-tubes and companion cells indicated the localisation of the process in the large companion cells and undivided phloem mother cells of the fine veins. These 'transition cells' thus remove sucrose from the leaf parenchyma and liberate it to the sieve tubes of the veins, whence it is transported by a diffusion process down concentration gradients. The problem of translocation is thus further complicated by the additional problem of accumulation against a concentration gradient, a mechanism which is far from being completely understood even in the case of much simpler substances than sucrose.

No. 5 of the Memoirs of the Cotton Research Station, Trinidad, 1934, contains two further papers by Mason and Maskell. The first[3] deals with the transport of phosphorus, potassium, calcium and nitrogen. The results indicate that these elements move upward in the xylem, and with the exception of calcium, are re-exported from the leaf and move downwards in the phloem. Estimations of the ratios of nitrogen, phosphorus and potassium to carbohydrate moving downwards from the leaves indicate that these elements are probably in excess of the amounts required for growth of the lower tissues. It is suggested that mineral elements ascend the stem from the roots with the transpiration current, passing with the bulk of the water to the leaves, where accumulation occurs together with the synthesis of organic compounds. Downward movement of these mineral substances is accompanied by leakage laterally, not only to the growing and storage tissues but also into the tracheæ, in which they may be moved upward again by the transpiration stream. Calcium was not appreciably re-exported from the leaf and seems incapable of moving in the phloem, facts which the authors suggest may be correlated with the combination of this element with cell contents, or the relative impermeability of the cell membranes.

The other paper[4] consists of the examination of changes in the concentrations and vertical gradients of mineral elements and carbohydrates in relation to ontogeny, the object being to derive evidence to show whether transport occurs by a diffusion mechanism determined by individual concentration gradients for each substance moved or by "a mass flow of sap containing all the mobile materials" from a region of higher to one of lower turgor pressure. Negative gradients from the foliage region downwards were found for nitrogen, phosphorus, potassium and calcium, but it is suggested that the "dynamic gradient of mobile material was being masked by a static gradient of storage or immobile material".

In the case of nitrogen, a positive gradient of residual nitrogen is shown to be almost completely masked by the storage of asparagine, which results in a steep negative gradient of crystalloid nitrogen. Except in the case of potassium, the evidence for

positive gradients of the mineral elements is not conclusive, the ontogeny showing storage of calcium, initial storage of phosphorus followed by depletion, and no storage of potassium. The gradients are consequently negative in the two former cases and positive for potassium. The observed positive gradient of total osmotic pressure in the bark would seem to lend support either to a diffusion or a mass flow mechanism. The authors claim, however, that the data in general support the view that "movement of materials along the phloem is determined independently for each material by the concentration gradient of its mobile form in the channel of transport". W. E. B.

[1] *Ann. Bot.*, **47**, 585; 1933.
[2] *Ann. Bot.*, **42**, 189; 1928. **42**, 571; 1928.
[3] *Ann. Bot.*, **45**, 125; 1931.
[4] *Ann. Bot.*, **48**, 119; 1934.

University and Educational Intelligence

WALES.—The Council of University College, Cardiff, has made the following appointments: Mr. E. E. Edwards, adviser in agricultural zoology; Dr. Dorothy Strangeways, assistant lecturer in histology; Dr. R. W. Haines, assistant lecturer in anatomy; Mr. C. W. Startup, assistant lecturer in physiology.

The Council has awarded the Dr. Price prize in anatomy to Mr. Henry Vernon Jones.

CHARLES W. ELIOT, the Harvard president who did so much during his forty years of office to make his University famous, has been the subject of many addresses and articles commemorating his birth a hundred years ago. One of these, by the present head of the University, Dr. J. B. Conant, published in *School and Society* of April 7, emphasises the unusual combination exhibited in his character of rigid principles and invincible faith and courage with a power of mental growth persisting through a great part of his career. This power was exemplified in the reshaping of his original conception of the function of a university as primarily "regular and assiduous class teaching". Influenced in part by the ideas which guided his friend Gilman in inaugurating advanced study and research work at Johns Hopkins University in 1876, he came to recognise graduate work as essential to the idea of a university. There is an element of irony in the juxtaposition in another issue of the same journal of a quotation from one of Eliot's latest pronouncements on education and a paper read before the Association of American Universities at its last annual conference on the "alarming growth" of graduate work in institutions not designed and equipped for it and in many instances not even fully qualified for work of the college grade. It appears that some 20,000 awards of the master's degree are now made annually and it becomes increasingly difficult to protect even the Ph.D. against inflation. Recent investigations show that, without counting teacher-training departments of universities, there are 233 graduate schools, of which no more than 27 have been deemed eligible to membership of the Association of American Universities, while, to make matters worse, additional institutions of undergraduate calibre are constantly breaking into the graduate field, and the aggregate enrolment in these pseudo-graduate schools, some of which have the effrontery to offer a doctorate, is mounting at an amazing rate.

Science News a Century Ago

Halley's Comet

A century ago, much interest was shown in the approaching reappearance of Halley's comet, which had last been seen in 1759. Damoiseau in Italy, Pontecoulant in France and Lehmann and Rosenberger in Germany had all made calculations regarding it, and had shown that it would be visible again in the latter part of 1835. An American paper, however—the *New York Commercial Advertiser*—announced in the late summer of 1834 that Halley's comet was visible in the east, near the constellation Taurus, and that its distance from the earth was 40,000,000 miles. It also said that on September 13 the comet would be only 22,000,000 miles distant and that on October 6 it would be nearest the earth, being then only three and a half million miles distant. The announcement was reprinted in the *Times* of October 6, 1834, and it was followed a few days later by a note from an Irish paper in which a correspondent pointed out that the comet would not be seen until a year later. As a matter of fact, the comet was first observed from the Jesuit Observatory in Rome on August 5, 1835.

Invention of a Sphygmometer

In the *Times* of October 6, 1834, it is recorded that at a meeting of the Paris Academy of Sciences, Dr. Magendie made a report upon an instrument invented by Dr. Hérisson called the 'sphygonemètre' which shows the rate of the pulse, its rhythms and anomalies. In pursuance of the conclusion of the reporter, the Academy passed a vote of thanks to the author of this most useful and ingenious discovery. Dr. Hérisson published a memoir, showing the results of his several applications of this instrument in studying the diseases of the heart. After six years of clinical researches supported by numerous anatomical proofs, he claimed that it was capable of distinguishing organic affections from cases which only assume the appearance of such affections. As the sphygmometer gave the numerical force of the pulse, it was possible, according to the observations of Dr. Hérisson, to prevent such attacks of apoplexy as arise from a too great determination of the blood towards the head.

The Dublin and Kingstown Railway

The first railway in Ireland was that from Dublin to Kingstown constructed by C. B. Vignoles (1793–1875) and the first train ran on October 9, 1834. The following comments are from *Saunder's Dublin News Letter* (Oct. 10, 1834). "Yesterday, Oct. 9, a train of carriages proceeded for the first time from the station house at Westland Row to Salt-hill. A great number of ladies and gentlemen, invited by the directors, enjoyed this so novel a treat in this country." Two trips were made, the train being drawn in the first instance by the locomotive *Hibernia* built by Sharp, Roberts and Co., of Manchester, and in the second by the locomotive *Vauxhall* built by Messrs. Forester and Co., of the Vauxhall Foundry, Liverpool. Among other remarks it was said that, "nothing could surpass the admirable manner in which the spiral springs which are attached to the buffers ward off the concussion when the train is stopped. . . . Every person who joined in the trip was delighted with the perfect ease to themselves.

. . . We sincerely trust the general completion of the works will admit our fellow citizens at large to enjoy the pleasure of a steam trip such as we have had yesterday. All apprehensions of fear will soon vanish, when they experience the great comfort and accommodation with which railway conveyances will present them." The line was officially opened on December 17, 1834.

The Zoological Gardens

On October 11, 1834, the *Times* announced that "The Zoological Society have succeeded in obtaining a most abundant supply of water at the depth of 192 feet from the surface. The well was sunk 184 feet, and at a further depth of 8 feet, which was effected by boring, the water came in so rapidly as to rise 26 feet in 20 minutes in a well of 9 feet diameter. This water will be distributed over their beautiful gardens by means of a steam engine, and thus an additional attraction added to this amusing and fashionable resort. The Society will by these means be delivered from the West Middlesex Waterworks Company to whom they have formerly paid 200£ per annum, but who have demanded and received for the last quarter the sum of 250£, or at the rate of 1000£ per annum."

Rare Orchid in Bloom

Among the most interesting accounts in the 1835 volume of *Curtis' Botanical Magazine* is the description of Deppe's *Maxillaria*, which first flowered in Earl Fitzwilliam's orchid house in October 1834. This orchid, *Maxillaria Deppii*, was received from Mr. Deppe, who gathered it in New Spain, the description relates, and it first flowered under the care of James Cooper, the well-known orchid expert of Wentworth Gardens. Another flowering of October 1834 at Wentworth Gardens, described in the same issue of the *Botanical Magazine*, was that of the halberd-leaved clerodendron, *Clerodendron hastatum*, one of the Verbenaceæ. This vervain was introduced into Great Britain from the Botanical Gardens of Calcutta by Dr. Wallich. It was first discovered by Mr. Smith, the collector, at Sylhet, and he sent it to Dr. Roxburgh in 1811. The clerodendrons, however, were climbers that became increasingly cultivated in the latter half of the last century, and thirty years later, *Clerodendron Balfouri* was widely cultivated, doing fairly well when trained on low walls in light sunny positions, grown in pots and well pruned annually. An issue of "The Garden" for 1878 described this species as blooming freely in a London garden.

Societies and Academies

PARIS

Academy of Sciences, August 20 (*C.R.*, **199**, 469–500). MAURICE D'OCAGNE : An indeterminate equation of any order whatever. CAMILLE GUTTON, JEAN GALLE and HENRI JOIGNY : The reflection of radio waves in the upper atmosphere. GEORGES GIRAUD : New results relating to principal integrals of any order. GH. TH. GHEORGHIU : Metaspherical functions. MLLE. M. PERNOT : The system mercuric chloride, potassium chloride and ethyl alcohol. VASILESCO KARPEN : The passage of current in electrolytes without electrolysis. A solution of iodine in aqueous potassium iodide permits the passage of a permanent current without electrolysis : the concentration of iodine is increased at the anode and diminished at the cathode. RAYMOND QUELET : A new method of synthesis of the alkoxy(α-hydroxyethyl)benzenes and the corresponding ether oxides. P. LAVIALLE and P. JAEGER : The cytology and nuclear peculiarities of the pollen grain of the Dipsaceæ. HENRI HERMANN, GEORGES MORIN and JOANNY VIAL : Modifications of arterial pressure in the course of, and after, the progressive destruction of the spinal marrow in the dog. GEORGES BOURGUIGNON : The variation of the chronaxy of a muscle during the voluntary contraction of its antagonistic muscles in normal man. ROBERT RANJARD : Contribution to the physiology of the development of hearing by the fundamental sounds of the vowels. MARCEL BAUDOUIN : A very rare double monstrosity, a thoradelph cat. TCHIJEVSKY and VOYNARD : The ageing of the organism retarded by the inspiration of negatively ionised air.

LENINGRAD

Academy of Sciences (*C.R.*, 2, No. 5). P. S. NOVIKOV : On a property of analytic complexes. A. A. LIAPUNOV : The separability of analytic complexes. N. N. LUZIN : Some notes on multiple separability. A. G. ANJOUR : A new type of movement of a solid body which can be squared. M. S. EIGENSON : The central forces of attraction and repulsion in a gravitational problem of two bodies of variable mass. A. I. SERBINOV and M. B. NEUMAN : The effect of nitrogen peroxide on the kinetics of ethane oxidation. The velocity of oxidation is increased several times by adding small quantities of NO_2 to the mixture. The probability that this is due to a selective transfer of energy from NO_2 molecules to O_2 or C_2H_6 is discussed on theoretical grounds. M. V. KRAUSE, M. S. NEMCOV and E. A. SOSKINA : The kinetics of ethylene polymerisation. M. E. LOBASHEV and F. A. SMIRNOV : The nature of the action of chemical agents on mutation in *Drosophila melanogaster* (1). The action of acetic acid on non-disjunction and translocation. B. V. KEDROVSKII : New data on the morphology of protein metabolism in a living cell. R. I. BELKIN : The influence of the substance of the posterior lobe of the hypophysis on regeneration in axolotls. A. I. POTAPOV : Plant growth in subtropical soil as a function of mineral nutrition. Aluminium in the soils of humid subtropics is often toxic to plants, but this effect can be neutralised by introducing large quantities of superphosphate. N. V. NASONOV : Structures produced in the axolotl by the subcutaneous insertion of a desiccated regeneration bud. I. I. SCHMALHAUSEN : On the phenogenetics of some morphological characters in poultry.

SYDNEY

Royal Society of New South Wales, June 6. A. R. PENFOLD, G. R. RAMAGE and J. L. SIMONSEN : The identity of darwinol with *d*-myrtenol. The authors show that the alcohol, darwinol (*J. Proc. Roy. Soc. N.S.W.*, **57**, 237 ; 1923. **60**, 8 and 331 ; 1926) is identical with myrtenol, isolated by Semmler (*Ber.*, **40**, 1363 ; 1907) from myrtle oil. The identity of the alcohols was confirmed by the preparation of the acid phthalate, m.pt, 111°–112°, phenylurethane, 58°–59°, and α-naphthylurethane, 92°–93°.

VIENNA

Academy of Sciences, June 28. J. KISSER and L. PORTHEIM: Experiments on the applicability of hydrogen peroxide to the treatment of seed. Certain seeds, but not all, can be completely disinfected without injury to their germinating properties, by treatment with 30 per cent hydrogen peroxide solution. JOVAN JURIŠIĆ: The gland-hairs on the roots of *Bryophyllum*. ROBERT JANOSCHEK: The age of the Moldavite scree in Moravia. KARL JEŽEK: Supporting power of a column of an ideal plastic steel. HERMANN WENDELIN: The R-integrability of compound functions, and a generalisation of a law of H. B. Fine. EDGAR SCHALLY: Results of experiments undertaken to establish the cause of D-streaming. This streaming must be attributed mainly to diffusion processes. ADOLF BACHOFEN: Occurrence of *Megaceros* in historical time. Evidence is advanced to show that *Megaceros* occurred about 500 B.C. in the steppes of South Russia or in the Caucasus. E. HEINRICHER: The greening of *Primula* blooms. HERMANN TERTSCH: Directed abrasion tests.

July 5. PAUL LUDWIK and JOSEF KRYSTOF: Determination of the tensile strength of cast-iron by the wedge-pressure test. STEFAN MEYER: Relation between the initial velocity and range of α-particles. ELISABETH KARA-MICHAILOVA and HANS PETTERSSON: Experiments on the detection of a γ-radiation from excited xenon nuclei. With a Geiger-Müller tube it has not been found possible to detect γ-radiation from xenon irradiated with polonium α-particles. FRIEDRICH HERNEGGER: Direct determination of the degradation constant of ionium from the number of α-particles emitted. By this means the following values are found for the radioactive constants of ionium: $\lambda = 8{\cdot}096 \times 10^{-6}\, a^{-1} \pm 1{\cdot}0$ per cent, $t = 124{,}000$ years, T = 85,600 years. BERTA KARLIK and HANS PETTERSSON: The spectrum of polonium. A method of investigating the optical spectra of difficultly volatile substances in highly-heated quartz spectrum tubes, excited with short waves, is described. Using platinum foil coated with polonium, two intense lines at 2450 and 2558·1 A., and a questionable one at 3005 A., were observed. HANS PETTERSSON and JOSEF SCHINTLMEISTER: Atomic fragments of short range from heavy noble gases. MARIETTA BLAU and HERTHA WAMBACHER: Experiments, by the photographic method, on the disintegration of the aluminium nucleus. GUSTAV ORTNER and JOSEF SCHINTLMEISTER: Radioactivity of samarium. GEORG WALTER and ERNST STORFER: Complex metallic salts of thio-urea (2, 3 and 4). GEORG WALTER, MAX ADLER and GEORG REIMER: Complex metallic salts of thio-urea (5): Electrochemical behaviour. ERNST BEUTEL and ARTUR KUTZELNIGG: Colorations appearing in the systems cupric chloride-halogen hydracid-water-alcohol (ether, aldehyde, ketone, acid, ester). GEORG KOLLER and ADOLF KLEIN: Saxatilic acid. This acid, from *Parmelia saxatilis*, is identical with the salazinic acid of Asahina. ATMA MALABOTTI: Transformations of insects (*Tenebris molitor*, L., *Vanessa io*, L. and *V. urticae*, L., *Dixippus morosus*, Br. et Redt.) with replanted heads. W. SCHMIDT: Temperature measurements of 17 Austrian Alpine lakes during 12 months. HANNS TOLLNER, with F. KOPF: Measurements of the nocturnal radiation of heat during the polar night 1932–33 on the island of Jan Mayen. The radiation Q and the extent of cloud B, expressed as a decimal of the surface of the sky, are connected by the simple relation, $Q = 0{\cdot}08 - 0{\cdot}006\, B$. The total loss of heat from the island during the three months December–February corresponded with a loss of 4·8 Cal. per sq. cm. per minute. KASIMIR GRAFF: The visual colour law of the Præsepe stars. W. E. BERNHEIMER and J. P. REIMER: Investigation of the galactic star cluster N.G.C. 2632 (Præsepe). ROBERT SCHWINNER: Geology of Eastern Styria (2): structure of the mountains north of Birkfeld. PAUL SOLOMONICA: The border region between Flysch and Kalkalpen from Traisen to Mank. F. E. SUESS: Comparative orogenetic studies. MAX PESTEMER: Ultra-violet absorption of binary liquid mixtures (5). The system acetone-hexane. MAX PESTEMER and OTTO GÜBITZ: Ultra-violet absorption of certain aromatic hydrocarbons (2). Mono-n-alkylbenzenes. K. W. F. KOHLRAUSCH and A. PONGRATZ: The Raman effect (36). Raman spectrum of polysubstituted benzenes. FRANZ KAHLER: (1) Occurrence of fusulinides in the Carbonaceous and Permian of the Carinthian Alps; (2) Comparison of the American and Carinthian stratigraphy of the Carbonaceous and Permian with the help of *Fusulina* species. K. HÖFLER: Specific permeability series. Experiments on the permeability of the cells of various plants to different substances are described.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 323–402, June 15, 1934). FREDERICK D. ROSSINI: The energies of the atomic linkages in the normal paraffin hydrocarbons. The latest data on the heats of combustion indicate that the energy of dissociation of gaseous molecules of C_nH_{2n+2} into gaseous carbon and hydrogen atoms is a linear function of n when $n > 6$. Deviations are in the direction of increased stability of the molecule, suggesting that the various C–H and C–C bonds are not alike. J. D. H. DONNAY and J. MÉLON: Ammonium and potassium molybdotellurates, two homeomorphous orthorhombic substances. LINUS PAULING and L. O. BROCKWAY: The structure of the carboxyl group (1). The investigation of formic acid by the diffraction of electrons. Resonance of the double bond between the two oxygen atoms has been verified; and in the double molecule the two parts are joined together by hydrogen bonds between the oxygen atoms of the carboxyl group. LINUS PAULING and J. SHERMAN: The structure of the carboxyl group (2). The crystal structure of basic beryllium acetate. It is concluded that the molecule contains four BeO_4 tetrahedra with one common corner; the remaining corners being occupied by oxygen atoms of the acetate groups. The distance Be–O is 1·65 A. X-ray data are used, with assumptions as to certain atomic distances. E. T. ALLEN: Neglected factors in the development of thermal springs. All seem to be due to the same fundamental causes: circulating ground water, heated by magmatic steam, deriving mineral matter from adjacent rock and magmatic sources. The great differences in individual springs are due to local causes; for example, character of outlet channel of a bicarbonate spring determines whether carbon dioxide is readily liberated and hence the deposition of travertine. In absence of limestone, topography, by control of depth to which water sinks, determines type of spring. CHESTER STOCK: Microsyopsinæ and Hyopsodontidæ in the

Sespe Upper Eocene, California. M. DEMEREC: Biological action of small deficiencies of *X*-chromosome of *Drosophila melanogaster*. Deficiencies were generally induced by X-rays and in most cases it was found that the regions affected are cell-lethal, as shown by the absence, in homozygous conditions, of the mosaic spots used for testing. CHAS. B. DAVENPORT: Ontogeny and phylogeny of man's appendages. The human fœtus starts with an intermembral index (arm-length/leg-length) like that of the young of the gibbon or chimpanzee and is gradually changing to the form of the relatively short-armed man during intra-uterine life. The human brachial index (lower arm/upper arm) shows a sharp break at birth whereby the lower arm falls behind in relative length until adolescence; during prenatal life it follows the general primate trend, deviating from plan more and more from birth onwards. E. M. EAST: The reaction of the stigmatic tissue against pollen-tube growth in selfed self-sterile plants. Seeds are sometimes obtained from such plants, by pollination in the flower buds before opening, and also at the end of the flowering season. Growth curves of pollen-tubes suggest the presence in the stigmatic tissue of the mature flower of substances which check pollen-tube growth. They appear normally just before the flower opens, while at the end of the flowering season they may fail to appear through lack of nutrient. The growth curves of pollen-tubes in bud fertilisation are peculiar in that they show no accumulation of depressive factors. EINAR HILLE and J. D. TAMARKIN: On the summability of Fourier series (5). G. A. MILLER: Groups of order 2^n whose squared elements constitute a cyclic subgroup. J. L. DOOB: Stochastic processes and statistics. RICHARD C. TOLMAN: Remarks on the possible failure of energy conservation. The continuous β-ray spectrum emitted in natural radioactive processes seems to be such a case for an individual elementary process. Statistical conservation is not necessarily violated, assuming that nuclei have a finite probability of forming only when the total energy available is equal to the average energy which will be made available by their later decomposition. A. H. TAUB, O. VEBLEN and J. VON NEUMANN: The Dirac equation in projective relativity. FRANCIS G. BENEDICT and HOWARD F. ROOT: The potentialities of extreme old age. A general statement of some of the physiological and psychological attributes of old age, with special reference to a Mr. Seth W. Lincoln, of Worcester, Mass., aged ninety-one years. JAMES BONNER: Studies on the growth hormone of plants. (5) The relation of cell elongation to cell wall formation. Sections about 3·7 mm. long cut from behind the tip of oat coleoptiles and placed in growth substance solution show that elongation is not necessarily accompanied by corresponding wall formation (cellulose); at 2° C. practically no new wall is laid down, while with addition of fructose more than normal is formed. FRANCIS B. SUMNER: A test of the possible effects of visual stimuli upon the hair colour of mammals. In view of the susceptibility of fishes and amphibia to colour changes of surroundings due to chromatophore changes, the author thought it worth while to consider the possibility that colour changes in higher animals might be related to some similar causes. Mice of known origin were reared and bred in coloured cages, but no evidence of any change of coat colour was obtained. The experiment was of short duration and the material was not treated statistically.

Forthcoming Events

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

Monday, October 8

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Capt. Guy Dollman: "The Evolution of the Horse".

Tuesday, October 9

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. G. Gamow: "The Recent Development of Nuclear Physics and its Astrophysical Applications" (succeeding lectures on October 12 and 16)*.

Friday, October 12

SCHOOL NATURE STUDY UNION, at 6.—(at the Institute of Education, Southampton Row, London, W.C.1. In conjunction with the London School Gardening Association).—Dr. Hugh Nicol: "The Microbes in your Soil".

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Irish Academy. Vol. 42, Section A. 1: The Wave-Equation corresponding to a given Hamiltonian. By P. G. Gormley. 2: On the Stability and Oscillations of Certain Permanent Arrangements of Parallel Vortices. By W. B. Morton. Pp. 14. Vol. 42, Section B, No. 4: Further Contributions to the Fungus Flora of Ulster. By A. E. Muskett, H. Cairns and E. N. Carrothers. Pp. 41–54. 1*s.* (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1571 (Strut. 139): Distortion of a Stripped Two-Spar Metal Wing under Torsional Loading. By D. Williams and H. F. Vessey. Pp. 17+12 plates. 1*s.* net. No. 1583 (S. and C. 561): Wind Tunnel Tests on Junker Type Ailerons. By F. B. Bradfield and W. E. Wood. Pp. 6+7 plates. 6*d.* net. No. 1586 (Strut. 111B): Stressing of a Fuselage under combined Bending and Torsion. By A. G. Pugsley. Pp. 11+2 plates. 9*d.* net. (London: H.M. Stationery Office.)

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. 53: Metallurgical Abstracts and Index to Volumes 51, 52 and 53 of the Journal. Pp. v+887. 80*s.* net, inclusive of 2 preceding "Proceedings" vols. Vol. 54. Edited by G. Shaw Scott. Pp. 326+22 plates. 31*s.* 6*d.* net. (London: Institute of Metals.)

Brighton Technical College. Calendar, Session 1934–35. Pp. 115+8 plates. (Brighton.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1581 (G. 33, 65): Stresses in the Fuselage induced by Gusts. By H. R. Fisher. Pp. 18+6 plates. 1*s.* net. No. 1589 (T. 3489): A Modified Chattock Gauge of High Sensitivity. By V. M. Falkner. Pp. 7+1 plate. 6*d.* net. No. 1592 (T. 3498): Heavy Flexible Cable for Towing a Heavy Body below an Aeroplane. By H. Glauert. Pp. 8+9 plates. 1*s.* net. (London: H.M. Stationery Office.)

OTHER COUNTRIES

U.S. Department of Agriculture. Circular No. 317: Protection of Orchard and Shade Trees and Ornamental Shrubs from Injury by the Japanese Beetle. By W. E. Fleming, F. W. Metzger and M. R. Osburn. Pp. 8. 5 cents. Miscellaneous Publication No. 201: Traps for the Japanese Beetle, and how to use Them. By F. W. Metzger. Pp. 12. 5 cents. (Washington, D.C.: Government Printing Office.)

Cornell University: Agricultural Experiment Station. Memoir 154: A Study of some Ecological Factors influencing Seed-Stalk Development in Beets (*Beta vulgaris* L.). By Emil Chroboczek. Pp. 84. Memoir 155: Studies in the Biology of *Phytophthora infestans* (Mont.) de Barry. By Willard Crosier. Pp. 40. Memoir 156: Relation of Nitrate Nitrogen to the Carbohydrate and Nitrogen Content of Onions. By A. L. Wilson. Pp. 30. (Ithaca, N.Y.)

Smithsonian Miscellaneous Collections. Vol. 92, No. 1: The Hypotrochanteric Fossa of the Femur. By Aleš Hrdlička. (Publication 3250.) Pp. ii+49+14 plates. Vol. 92, No. 2: New Fresh-Water Mollusks from Northern Asia. By Alan Mozley. Pp. ii+7+1 plate. Vol. 92, No. 3: Lethal Response of the Alga *Chlorella vulgaris* to Ultraviolet Rays. By Florence E. Meier. Pp. ii+12+3 plates. Vol. 92, No. 8: Samuel Pierpont Langley. By C. G. Abbot. Pp. ii+57+6 plates. (Washington, D.C.: Smithsonian Institution.)

Ministry of Finance, Egypt: Survey of Egypt. Geology of Egypt. Vol. 2: The Fundamental Pre-Cambrian Rocks of Egypt and the Sudan: their Distribution, Age and Character. Part 1: The Metamorphic Rocks. By Dr. W. F. Hume. Pp. lxv+300+124+96 plates. (Cairo: Government Press.) 300 P.T.

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