NATURE

SATURDAY, JULY 14, 1934

No. 3376 Vol. 134

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

The Scientific Basis of Modern Life

THERE are few more distressing tokens of defective leadership than are to be found in the comparative failure of the Disarmament Conference and the obstacles with which the Conference has been continually beset. It is a significant piece of evidence of our incapacity to order our affairs in accordance with the demands of the new age—the machine power age—and to exercise the restraints inevitable in view of the immense powers now placed within our hands. It is true that the Disarmament Conference demanded a high order of political capacity—a breadth of vision, a length of foresight, a degree of detachment from our own interests, a sense of responsibility, a steadfastness of purpose, a sweep of imagination and a power of dealing with technical factors which are not easily acquired. Such qualities are largely the result of adequate training, and their absence at the Disarmament Conference is due less to the imperiousness of narrow nationalism than to our defective educational systems which fail to cultivate them, and on the contrary, often do more to suppress creativeness than to awaken it.

What is true of the sphere of disarmament is equally true of those many other difficult problems such as unemployment or disemployment or leisure with which the machine age has confronted us. Confusion of thought in the community has made followers scarce as it has impoverished leadership, and it is an urgent task to eliminate such confusion as an essential step towards world order and control.

The lecture which Prof. J. L. Myres delivered at the University of Liverpool last December on "The Man of Science and the Science of Man" is particularly worthy of the attention of scientific workers from this point of view, and not only assists materially in clarifying thought about these issues but also indicates certain definite contributions which the man of science himself must make. When we speak of the effects of scientific discoveries for good or for evil, we usually mean the effects of the use for some specific purpose of a particular application or invention based on a scientific discovery. The scientific worker concerned with the discovery itself is usually widely separated from the point at which the invention or application of his discovery for an industrial purpose is made. Very commonly this distinction is not made, and the confusion between discovery by the man of science who seeks to meet our need

for knowing more about the universe, and invention, which satisfies our desire to do, is paralleled by a possibly even more serious confusion between the inventor, who may of course be a scientific worker, and the employer or exploiter. The former knows how to produce the required effect in given conditions; the latter is concerned with the immediate solution for his own purpose of some particular problem in applied science.

The moral responsibility of the scientific worker —whether he be discoverer or inventor—for the full use of his specific gifts, has been generally recognised, but in these days some critics have overlooked the betrayal of his trust which would be involved in his failure to persist in his work of investigating Nature, and compliance with the suggestion to take a ten years' holiday. It is also sometimes rather obscured by professional habits and associations, which are apt to assume an unduly conservative attitude towards progress. The moral responsibilities of the employer or exploiter of scientific discoveries are, however, only coming to be recognised at a point at which the restraint of abuse has become extremely difficult and complicated.

While this is one reason for the difficulties which beset the elimination of warfare between civilised communities, it cannot absolve the scientific worker from his share of responsibility, both direct and indirect. Apart from his moral responsibility for endeavouring as a citizen to prevent the abuse of powers with which he ultimately provided the community, he must recognise his equally important direct responsibilities. As already hinted, one of the most serious dangers to public order at the present time is the absence of any wide diffusion of that accurate general scientific knowledge which can provide an adequate background for the life that rich and poor alike have now to live. The paucity of such knowledge in the general community in the face of the high level of technique, the necessity for accurate observation and rapid decisions demanded of us daily in crossing the streets or managing domestic appliances, etc., is a prime factor in the outbreak of economic nationalism in recent years, with its threat not merely to the collective system but also to all the finest elements in our civilisation.

This responsibility, to which Prof. Myres directs attention, is accentuated by the problems of leisure and unemployment, and inspires his eloquent appeal for expositors of science who are competent to undertake the education of the general community so as to impart something of the spirit and methods of science. It is only as an adequate general scientific background is acquired that we can expect the general citizen to form a considered judgment on political and economic affairs to-day, or to reject the addresses of those advocating mutually inconsistent policies or seeking to exploit his ignorance to their own advantage.

The gullibility of the public can only be eliminated with the help of the scientific worker, but there are several respects in which the latter must set his own house in order before he can hope for much success in the task of exposition and education. In the first place, he must recognise that he himself is not less a responsible citizen because he follows a responsible calling, and that he must exercise his powers of observing and interpreting facts, not merely professionally and technically, but also in the ordinary affairs of everyday life. If scientific workers have in the past been regarded as unfitted for high administrative positions, that view has largely been encouraged by their common indifference to such work and the attitude of superiority or aloofness they are prone to assume.

The deliberate eschewing of this attitude of aloofness would in time ensure that the scientific worker participated on equal terms in the general life of the community, making important contributions where scientific and technical factors were conspicuously involved. That scientific workers themselves would thus come to qualify in increasing numbers for leadership is, however, of less significance than the wider opportunities of education thereby opened to them. Prof. Myers is unquestionably right in urging that much current misapprehension about scientific matters, pure as well as applied, would be avoided if scientific workers were to relax reasonably and seasonably our national reluctance to 'preach' or to 'talk shop', and to put their several competences at the disposal of others.

There is implied in this, however, the deliberate break with the common tendency of professional organisations to constitute themselves a separate class with their own rites and shibboleths, and to weave a web of mystery round their doings. The sense of mystery or magic with which the man of science has often been surrounded—particularly through the medium of the daily Press—is a fatal obstacle to the development in the public mind of the attitude to science which is required in the present age. When a great man of science is

regarded rather as a great artist is regarded, with respect and admiration for his skill and ability, but not with a feeling that his work is mysterious or incomprehensible, we shall be within reach of our goal.

Prof. Myres, however, makes even more practical remarks which should be heeded by those who would be expositors of science in this way. There must not simply be the willingness to expound and the readiness to mix freely and simply with other men. If it is inevitable that the subjects of scientific articles or lectures should be abstruse or highly technical, the scientific worker might well make a much more determined effort to relate them to some purpose within the cognisance of a reasonably well-informed citizen. The neglect to make this effort has frequently exposed the man of science in the past to the charge that he is as void of a general social and cultural background as the general citizen is of a scientific background.

If the first need in such exposition is an understanding of the audience and of the range of experience and knowledge of that audience, the choice of appropriate terms for that exposition comes a close second. Few things have done more to hinder the spread of accurate scientific knowledge in this community than the widespread indifference of the man of science in this respect. It is no uncommon experience to encounter scientific papers in which the authors have made so little attempt to define their terms that their meaning is almost incomprehensible even to other specialists in that field.

What is required, however, is not the evasion of the real issue by use of more or less accurate analogies or elaborate circumlocution which we frequently find in popular writers on scientific and technical subjects. It is rather the setting of trained minds to the evaluation of the facts and their expression in terms understood by the general community. This is no impossible task. Its possibility was demonstrated by Faraday, Clerk Maxwell, Huxley and many others who wrote strong, simple and beautiful English. It does demand, however, much more accurate thinking and more precision in the choice of words than are commonly to be found among scientific workers.

The elimination of jargon, and the loose thinking which it connotes, from our scientific and technical journals would be a first step in furtherance of the work of exposition and education. The strange contrast between the precision of experimental work, and the slovenliness and ambiguity with which its results are sometimes expressed, is a stumbling block which must be removed before the education of the community in this way can proceed apace or the scientific worker discharge his responsibilities of leadership.

The points to which Prof. Myres has directed attention are concerned with the whole standard of scientific work as well as with its expression. In the long run, scientific work cannot be accurate and precise if its expression is vague and careless. Moreover, science can only continue to render its fullest service to the community as the relations between the scientific worker and the general citizen are harmonised and the purposes and methods of science are widely understood. In the establishment of such a sympathy, a nobler type of citizenship becomes possible, adequate to defend us against the dangers to which civilisation is exposed and to build a social order worthy of the limitless powers which the advance of science has put into the hands of man. The realisation of these ideals, with the widening fields of service and investigation which they offer, demands the best endeavours of all scientific workers both professionally and as citizens.

Proliferating Nomenclature of Foraminifera

A Manual of Foraminifera. By Prof. J. J. Galloway. (James Furman Kemp Memorial Series, Publication No. 1.) Pp. xiii+483. (Bloomington, Ind.: The Principia Press, Inc.; London: Williams and Norgate, Ltd., 1933.) 25*s*. net.

IT is a matter open to question whether protozoologists, who concern themselves with the bionomics of the Foraminifera, can pay very much attention to the publications of the modern and fundamentally American school of commercial protozoology. It was a *dies nefas* for the biological student of the group when American systematists formulated the theory that minute variations of the ectoskeleton revealed the presence in oil shales, at a given depth, of petroleum, and that these variations progressively indicated where petroleum wells might be sunk. This formulation was made in, approximately, 1917, since when a vast body of workers, numbering more than three hundred, has been banded together, for the most part in somewhat quarrelsome mood, into the Society of Petroleum Geologists of America, with rival laboratories and a journal of its own.

Between the two chief workers in this economic

field, Dr. Galloway, the author of the work under review, and Dr. J. A. Cushman, of Sharon, Mass., there would appear to have been a race for publication, in which, on Dr. Galloway's showing, Dr. Cushman has twice been successful, anticipating many of the ideas which Dr. Galloway had discussed in detail with him.

In the present volume, Dr. Galloway gives a well-selected history of the classifications of the Foraminifera from the time when, in 1826, d'Orbigny put forward ten families and sixty-four genera, to the appearance, in 1884, of Brady's "Report on the Foraminifera of the *Challenger* Expedition", which became at once the standard classification of the group, with ten families, twenty-nine sub-families and one hundred and fifty-three genera, and which remains, in spite of latter-day criticism, the firm basis upon which zoologists have worked ever since. Brady made an *ex cathedra* statement, which it would be well for the modern student to bear in mind. He said : (*Challenger* Report 1884, p. 58) "The study of the Foraminifera, as assemblages of forms grouped round a comparatively small number of central or typical species, as advocated by Carpenter and his colleagues, is, I am convinced, the only means of arriving at a correct understanding of the biological relations of the Group." This point of view, if it was ever held by the American school, has been lost sight of in recent years, since the structure of the Foraminifera has become of commercial importance. Since the founding by Dr. Cushman in 1925 of his quarterly "Contributions to the Cushman Laboratory of Foraminiferal Research" (the ninth volume of which will be completed by the end of the year), the floodgates of nomenclature have been opened and into these fathomless receptacles the rising spate of new genera and species has escaped ever since.

In 1928, Dr. Cushman published a classification of the Foraminifera comprising 45 families, 68 sub-families and 413 genera, a classification modified in the second edition of his book (1933) into 47 families, 79 sub-families, 558 genera and 8 sub-genera, while in Dr. Galloway's present work, 35 families, 61 sub-families, and 542 genera are given. To establish these portentous figures, a vast number of papers have emanated from the American school and its Continental disciples. During the period 1930–1933, no less than 267 papers have been published to my present knowledge, and I am continually hearing of others hitherto unknown to me.

In a like period, 1929–1932 (the "Zoological Record" for 1933 not having yet been published), 66 new genera and sub-genera, and 1,301 new species of Foraminifera have been tabulated. Unfortunately, most of these new genera have been carved out of genera, already established by time and authority, where in my opinion they should have appropriately remained. Thus in an article in Dr. Cushman's "Contributions"*, he points out that as a result of his researches into European collections "new generic names are necessary for a number of species", and he carves out of *Clavulina* three new genera, *Martinotiella*, *Listerella* and *Goësella* ; out of *Lituola*, *Liebusella* ; out of *Gaudryina*, *Marssonella* and *Karreriella* ; out of *Verneuilina*, *Eggerella* ; out of *Nubecularia*, *Sinzowella* ; out of *Planispirina*, *Wiesnerella* ; out of *Pavonina*, *Ammospirata*, and so on.

It was said of d'Orbigny, the father of the study of Foraminifera, that "when anyone sent him new species, it was his custom to dedicate one of them to the sender. People were glad to see their names perpetuated by that of one of Nature's products, and there was mingled with this feeling of innocent vanity, the noble desire to contribute to the progress of science"†. Dr. Cushman would appear to carry this genial custom to an exaggerated point.

To come nearer home, my old friend Frederick Chapman‡ has made a genus *Heronallenia*, out of two species, the genotype being one named by Earland and myself, *Discorbina wilsoni*, other included species being *Discorbis kempii* (HA and E) and three others, concerning which genus we were constrained to make some critical remarks in Part I of the report on the Foraminifera of the *Discovery* Collections (1932, p. 419).

It has even happened that new species have been named from a full plate of a highly variable species by a later author, who had never seen the specimens figured therein.

No more convincing proof than this is needed to indicate that 'variation within a species' has 'gone by the board'. When in doubt whether a specimen conforms to a recognised figure, it is obviously a labour-saving practice to give it a new name, though it may not be in accordance with scientific method. When I was working in 1892–93 with F. W. Millett (the last of the great workers on the group) on Prof. A. C. Haddon's gatherings from the Torres Straits, I voiced a plaint

* Contributions to the Cushman Laboratory of Foraminiferal Research, vol. 9, pt. 2, p. 32.
† Gaudry, *Révue des Deux Mondes*, **19**, 831, 1859.
‡ Chapman and Parr, *Proc. Roy. Soc. Victoria*, **42**, Pt. 2, 1–14, 1931.

upon this subject. Millett replied in a characteristic letter, which I have published* elsewhere for the comfort and instruction of beginners, and from which I shall quote again. He wrote: "When I first started I thought I should find them [the Foraminifera] like a well-shuffled pack of cards . . . what I really found was this. Somebody had taken a hundred packs of cards and chopped each card into half a dozen pieces, then shaken the whole up in a bag and taking out at random half a dozen pieces at a time, had pasted them down on plain cards. . . . Then two or three packs of unmutilated cards stirred up in this medley would represent the typical specimens, the rest being intermediate varieties, the nearest affinities of which the student must judge for himself by experience."

In my opinion (and in that of many workers in many groups), the rigid international rules of zoological nomenclature should have been suspended (as provided for by No. 74 of the Summaries of Opinions), so that when hundreds of papers have made the generic names of species of world-wide distribution familiar to every student for a hundred years, one should not be compelled to register *Lenticulina* for *Cristellaria*, *Cibicides* for *Truncatulina*, *Elphidium* for *Polystomella*, *Camerina* for *Nummulites*, to name only a few examples.

"Taxonomy as applied to the Foraminifera" is the best and most significant chapter in Dr. Galloway's book, and one for which there is nothing but unqualified praise. In it he himself sets forth most cogent arguments against the manners and morals of the 'new school'. As he pertinently remarks: "The personal philosophy of the taxonomist has a very important bearing on his classification. . . . Different taxonomists place different importance on the same structures . . . some authorities allow great variation within a group, and others allow very little, the 'lumpers' and the 'splitters'. Fads, the particular biologic or paleontologic view-point of the moment also affect classifications".

Dr. Galloway's paragraphs upon "Comparative Morphology" and his "Philosophic Considerations" are admirable, and the same may be said for his section on "Evolution and its Corollaries", although his term "Bradygenesis" for an unusual retardation of ancestral stages in a test is, in this connexion, rather unfortunate. The introductory sections of this book are not only learned but deeply interesting and suggestive. The section on "Reproduction" alone is meagre and incomplete, probably because of the author's systematic view-point. In fact, it is when we reach his "Systematic descriptions" that we must meet him in the gate. To discuss the inclusion of many fresh-water and chitinous forms, and the validity of many of the 'new' genera, would lead us beyond the limits of a review, but I may be allowed to take exception to the classification of parasites infesting some species (especially *Saccamina sphaerica*) as Foraminifera — *Rhynchogromia*, *Ophiotuba*, *Dactylosaccus* and so on, taken from Rhumbler's paper of 1894.

The frontispiece is one of the highly idealised portraits of d'Orbigny, and comes from a work of great rarity, the title of which, as quoted on the frontispiece, contains a bad typographical error. The outline figures which fill the forty-two plates cannot but be of immense value to students of the group, but it is difficult to understand why the "magnification of the figures is not given; sizes of specimens are included in the generic descriptions", in the form "up to—mm.", an indication completely useless, for example, in *Miliolina*, *Orbitolites* or *Cycloclypeus*. A nine-page glossary with an ample index form a useful termination to the book.

EDWARD HERON-ALLEN.

* "Prolegomena towards the Study of the Chalk Foraminifera", etc., p. 21, 1894. London.

Radio Technique

(1) *Short Wave Wireless Communication.* By A. W. Ladner and C. R. Stoner. Second edition, revised and enlarged. Pp. xiv+384+13 plates. (London: Chapman and Hall, Ltd., 1934.) 15*s*. net.

(2) *Handbook of Technical Instruction for Wireless Telegraphists.* By H. M. Dowsett. Fifth edition, revised and enlarged. Pp. xix+572. (London: Iliffe and Sons, Ltd., 1934.) 15*s*. net.

(3) *Principles of Radio.* By Keith Henney. Second edition. Pp. xii+491. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 21*s*. 6*d*. net.

THE first and third of these books are second editions, the other is the fifth edition of that firmly established work which began as "Hawkhead", and later became "Hawkhead & Dowsett". All of them have thus had the benefit of friendly aid from reviewers, and are better books because of that aid.

(1) Messrs. Ladner and Stoner make handsome acknowledgment in their new preface, and their

second edition is a notable advance on a highly commended first. The points least favourably commented on have been corrected, and the new edition contains excellent fresh material which will maintain and enhance the reputation of this book as the only satisfactory work yet available on short-wave communications. The additional material on aerial arrays and feeders, and on ultra-short wave working, is specially welcome.

The recognition of frequency stability as the key to the future scope of ultra-short waves may be specially mentioned; the closely related subject of frequency stability in the main short-wave band occupies a whole chapter, which might have been improved by statements of attainable performance, as, for example, in the Franklin master oscillator. The same chapter refers the reader to "the articles dealing with" the multi-vibrator method, but does not tell him where they may be found. The chapter on the propagation of short wireless waves is good, but might be much better if it were freed from some needless obscurities of exposition. The suggestions that there are "no air currents" in the upper atmosphere, that "the actual composition of air is not of particular importance to wireless communications", that "the *E* layer reflects all waves longer than the (*sic*) critical wavelength", that the *E* layer is "ionised by some corpuscular bombardment", that Appleton first "postulated" the separate existence of the *F* region, which, in fact, he demonstrated, are all singularly dangerous fractions of truth. On the personal side, Lord Kelvin can doubtless spare some of the laurels which the authors arbitrarily transfer to T. L. Eckersley, but another distinguished Cambridge observer should not be misspelt to simulate a distinguished Observer in the rival township.

(2) The author of this always valuable handbook knows exactly what he wants to do, and does it exactly. His aim is "to provide simple instruction for sea-going operators and others . . . a complete theoretical course for the P.M.G. Certificate". He tells them as much as he thinks good for them, and no more. He scarcely ever says anything that can mislead them, and the result is a thoroughly satisfactory book of its very special kind. This fifth edition contains new material which shows how the demands on the sea-going operator increase—beyond, indeed, the limits of wireless telegraphy. "Constant Frequency Oscillators", "Short Wave Marine Transmission and Reception" and "Marine Telephony" follow directly in the original succession, but "Echo Sounding Apparatus" and "Band Repeaters" are added benefactions. The book is well known to be quite indispensable to sea-going operators; it remains only to say that the "others" are a very large class indeed.

(3) This is a much less satisfactory book, partly, no doubt, because its aim is much less definite, partly because the author frequently lapses into a carelessness which is not excused by the fact that "those skilled in the art" can see quire clearly that he "knows all about it", and could have avoided the setting of booby traps. He may be forgiven for vacillating about what electricity really is, but he should make up his mind to have one story and stick to it, especially after raising false hopes of meticulous treatment by telling us that "the resistance per foot may be obtained . . . by dividing the resistance per thousand feet by one thousand". Contrast this with the harrowing picture of the next page:— "Scientists have approached to within a fraction of a degree of absolute zero". Brrrr! There are much better books of the same general scope, and Mr. Henney could have written one of them.

Soil Science in Hungary

Általános talajtan. By Dr. Elek 'Sigmond. Pp. xii+696+5 plates. (Budapest: The Author, Keleti Károly-utca 24, 1934.) n.p.

BEFORE the War, Hungary was predominantly an agricultural country with a girdle of forests; she possessed but few urban industries. The great consuming centres of Hungarian products were in Austria and in Bohemia, and for that reason Hungary was known as the granary of the Austrian Empire. In spite of efforts directed towards the attainment of self-sufficiency in manufactured products, Hungary now finds herself forced to rely more than ever upon cultivated products of her soil: even the forests lie largely outside political Hungary of to-day. Hungary's ability to weather the conditions imposed upon her has been due in no small measure to the excellence of her agricultural research and teaching.

It may seem, superficially, to be a curiosity that Hungary should have two experimental stations for the study of paprika, but in fact, every aspect of Hungarian agriculture is catered for by the agricultural research and experimental stations. Six soil laboratories have recently been

established at the instigation of Prof. Elek (Alexius) 'Sigmond. The largest of these is attached to the Central Chemical Institute in Budapest, of which institute Prof. 'Sigmond is director.

It is remarkable that within such a comparatively small language group as is the Hungarian, a demand for a textbook on soil science should have led to the publication of the compendious work under review. Only one similar—but smaller—book has been published in Great Britain. *Általános talajtan* (freely, "The Comprehensive Study of Soil") is purely a pedological treatise; it devotes only seven pages to the soil as a medium for plant growth, whereas twenty pages are occupied with consideration of the rôle of plants in soil formation. These statements briefly give the key to the book's character.

The work is divided into four sections covering formation and genetics, properties, classification, and mapping of soils. The last two will need little introduction to those who are aware of the prominent part played by Prof. 'Sigmond in elucidating the constitution of soils, especially of 'alkali' soils. The treatment is excellent, and the folding coloured plate showing typical profiles with the appropriate vegetation, beautiful.

The section on the properties of soil has been contributed in part by colleagues, with varying success. Prof. 'Sigmond has written about inorganic constituents, and Dr. Kotzmann has added a distinctive monograph on organic matter in soil. Unfortunately, the treatment of physical properties is far from up to date. Dr. Telegdy Kováts contributes a condensed but knowledgable survey of soil microfauna, while the lesser microbiological life is dealt with by another author without much attempt at correlation, so that little of real value emerges from it.

In the section dealing with the formation of soil, Prof. 'Sigmond is thoroughly at home; he has made an extensive review of all possible factors, from the geological to the human. A number of minor errors disfigure the book, otherwise well printed and produced. These will be readily forgiven, since the author was a sick man when he was completing the work, and indeed his book is prefaced with a grace that he was spared to finish it.

Prof. 'Sigmond has now held the first Hungarian chair of agricultural chemistry for twenty-five years; during that time he has done very valuable work. Closely linked with Prof. 'Sigmond's name, soil science in Hungary is having attention paid to it to an extent relatively greater than in some other and richer countries. It was largely owing to methods devised by the author of this book that the reclamation of alkali soils in Hungary has been so brilliantly successful. The actual supervision of that reclamation devolved chiefly upon his pupils at one or other of the soil institutes. For them, and for those who will follow them, this textbook is intended. Hungary is fortunate in possessing such a standard of scientific and technical attainment as that to which the book stands witness. H. N.

The Rhesus Monkey

The Anatomy of the Rhesus Monkey (*Macaca mulatta*). By T. H. Bast, Kermit Christensen, Harold Cummins, Frederick D. Geist, Carl G. Hartman, Marion Hines, A. Brazier Howell, Ernst Huber, Albert Kuntz, S. L. Leonard, P. Lineback, John A. Marshall, Gerrit S. Miller, Jr., Ruth A. Miller, Adolph H. Schultz, T. D. Stewart, William L. Straus, Jr., W. E. Sullivan, Geo. B. Wislocki. Edited by Carl G. Hartman and William L. Straus, Jr. Pp. ix+383+7 plates. (London: Baillière, Tindall and Cox, 1933.) 27*s*.

WHAT was a very evident gap in the literature on Primates has recently been filled by the publication of the volume under notice on the structure of the rhesus macaque, the commonest of laboratory and menagerie monkeys. Up to the present, there have been no more than two readily available books to which English students could refer for information about the anatomy of monkeys and apes—Duckworth's "Morphology and Anthropology", originally published in 1904, and Sonntag's "The Morphology and Evolution of Apes and Man", published in 1924. Neither of these two provides as much detailed information about subhuman primate anatomy as does the new volume on the rhesus.

The book, which has been edited by Drs. C. G. Hartman and W. L. Straus, is divided into sections, each the work of some one or more authors familiar with that particular field. It opens with a short taxonomic note by Gerrit S. Miller, Jr., and this is followed by an account of the animal's growth and development. This section, the work of Dr. Adolph Schultz, is in many ways one of the more interesting and valuable parts of the book. The skin, the skeleton and joints, the muscular system,

immense amount of detailed and accurate work devoted to stratigraphical geology and palæontology by the geologists of large oil companies. As a result, much information, widely scattered in the literature and in private reports, is available for an adequate interpretation of the larger problems of regional and historical geology. Synthesis has lagged behind, and the author of this admirable book has rendered valuable service not only to the geologists of the State, but also to a wider circle, by furnishing a simple, well written and beautifully illustrated account of the present status of geological investigation in California.

The first four chapters deal with geological provinces, structural problems, and pre-Mesozoic and Triassic rocks, and chapters are then devoted to each of the succeeding systems in turn, post-Jurassic events receiving most attention. As chief geologist to an important oil company, the author writes with particular authority on the Miocene beds and the diastrophism which they reveal. The book should have a special value in stimulating research, since it directs attention to the many complex problems that remain to be solved before the full history of the coast ranges and other parts of California can be written.

In addition to a detailed index of authors and subjects, there is a useful appendix of geographical names and a locality index map; this feature might well be adopted in all similar works since it saves the unfamiliar reader much mental friction. The illustrations effectively portray a wide range of phenomena.

On a New Chemical Theory and Researches on Salicylic Acid. Papers by Archibald Scott Couper (1858). (Alembic Club Reprints, No. 21.) Pp. 45. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson, 1933.) 2*s.* 6*d.*

THE latest of the Alembic Club reprints gives us the papers of Archibald Scott Couper who, as is now recognised, shares equally with Kekulé the credit for enunciating the theoretical conception of the linking of carbon atoms in the molecules of organic compounds. Few conceptions have been more fruitful of results or had greater influence on the development of chemistry, and it is most desirable that the part played by Couper should be established beyond doubt. The studies of Anschütz published in 1909 have done much to make clear his achievements, showing in particular that there was a delay in the presentation of his first paper to the Paris Academy owing to the dilatory action of Wurtz. Following the sympathetic biography of Anschütz, the Scottish chemists combined in 1931 to place a memorial plaque at Townhead, Kirkintilloch, where Couper was born in 1831, the full circumstances being placed on record in the *Journal of the Society of Chemical Industry*, vol. 50.

The present reprint gives the short note on "A New Chemical Theory" presented to the Academy by M. Dumas, and the full English paper supplemented by certain additions from the later French version. Both the French and English versions of the paper "Researches on Salicylic Acid" are given, the former being apparently the earlier, as Couper made the change from C=6 to C=12 between their respective dates of publication.

No student of organic chemistry should fail to read these papers.

An Introduction to Thermodynamics for Chemists. By Dr. D. Johnston Martin. Pp. vii+343. (London: Edward Arnold and Co., 1933.) 16*s.* net.

THE object of the author of this textbook is to provide a work of a less advanced and detailed nature than the classic volume of Lewis and Randall, and at the same time to clarify certain fundamental principles with the view of making the subject one of real utility to the practical chemist. Thus, since most measurements refer to reactions at constant pressure, the advantage is urged of employing the criterion of zero free energy change at constant temperature, instead of zero maximum work of a process at constant volume and temperature, since the former is true of any reaction whatsoever.

A clear differentiation between free energy and maximum work is emphasised, and special attention is given to a proper appreciation of the concept of entropy. The rest of the text, apart from developing the laws of thermodynamics, deals with the application of thermodynamic principles to continuity of state, homogeneous systems, dilute solutions, electrochemistry of dilute solutions, the activity treatment of solutions, strong electrolytes, chemical affinity and heterogeneous systems. All these are well illustrated by tabulated data for an extensive range of substances and reactions.

The book should fill the needs of a wide circle of students and investigators; no advanced mathematics is introduced, printing and production are of a high order, and there is a really efficient author and subject index. N. M. B.

Commonwealth Bureau of Census and Statistics, Canberra. *Official Year Book of the Commonwealth of Australia.* No. 26, 1933. Prepared by E. T. McPhee. Pp. xxxii+942. (Canberra: Government Printer, 1934.) 5*s.*

THIS useful year-book may almost be regarded as a model of arrangement and condensation. The need for economy still restricts its growth and precludes the inclusion of the special articles for which earlier issues were noted. The essential statistical matter, however, has not suffered curtailment. A special index refers to longer articles in former issues. In this issue the vital statistics of the 1933 census have been included and analysed. Agricultural, pastoral and mining activities are fully treated and made more valuable by the inclusion of many comparative statistics for other countries. Full attention is paid to labour, wages and public finance, while an appendix gives the history of the financial crisis in Australia. A list of useful books on Australia is added.

Gyromagnetic Measurements and their Significance

By DR. L. F. BATES, University College, London

THERE have recently appeared a number of articles in foreign periodicals, and of footnotes in treatises on magnetism concerning gyromagnetic measurements, which, perhaps unintentionally, show three main tendencies. First, they tend to obscure the fact that credit is certainly due to O. W. Richardson, who was the first to show that, if the electron is responsible for ferromagnetism, then it ought to be possible to make quantitative measurements in gyromagnetism. Secondly, they tend to disregard much of the earlier work on the subject, to view certain results as merely approximate and to neglect much of the latest work on the subject. Thirdly, they suggest that important sources of error were entirely overlooked by some workers. Consequently, it seems desirable to examine the present position so far as is possible in a short article.

In practice it is necessary to consider only two gyromagnetic effects. One such effect is produced when we take a cylinder of any substance and rotate it rapidly about its long axis ; on account of the Larmor precession of the electrons, the cylinder becomes magnetised parallel to the axis of rotation. Actually, such magnetisations have been measured so far only in the case of ferromagnetic substances. Many experiments on this effect have been successfully made by Barnett in the United States since 1914. It is sometimes suggested that this effect is not strictly the converse of the other effect, with which the above publications are almost exclusively concerned. It will not be considered further here, although Barnett's results agree as well as can be expected with others described below.

The other effect may be described as the production of angular momentum by change in magnetisation. Richardson showed in 1908, as mentioned above, that if the magnetic moment of a freely suspended body be changed by an amount M, then the angular momentum about the same direction should be changed by an amount U, the ratio U/M, the gyromagnetic ratio, being equal to $2m/e$, on the assumption that the electron is a point charge moving in a closed orbit.

It was not until 1915 that the effect was even experimentally detected by Einstein and de Haas, and, consequently, on the Continent the effect is known as the Einstein-de Haas effect. Incidentally, when two English workers termed it the Richardson effect in a well-meant effort to credit Richardson with its prediction, Sir Oliver Lodge, in the course of a lecture, part of which was published as a supplement to NATURE of August 4, 1923, strongly deprecated the attachment of personal names to such effects. Einstein and de Haas stated that they found exact agreement between experiment and the theory, which they had independently re-discovered. Such agreement was not confirmed by later workers, for in 1918, J. Q. Stewart found the ratio for iron to be $0{\cdot}98\,m/e \pm 15$ per cent by a direct method, and in 1919 Beck found $1{\cdot}06\ m/e \pm 5$ per cent and Arvidsson $0{\cdot}94\ m/e \pm 4$ per cent by resonance methods.

At this stage the problem was attempted by Chattock and Bates, who used the direct method of observation. They suspended a thin iron or nickel wire from a fine quartz fibre so that its axis coincided with that of a vertical solenoid, and measured the angular momentum produced on reversing the magnetisation of the wire, by the deflection of the wire against the torsion of the fibre. The ratio was thus found to be exactly equal to m/e within the limits of experimental error, which were considered to be about 1 per cent. It was not thought necessary to neutralise the vertical component of the earth's magnetic field in these experiments, and this has been a source of criticism. Such criticism, however, takes no account of the fact that Chattock and Bates proved that U is strictly proportional to M for a wide range of values, which would have been impossible if the unneutralised component had produced a serious source of error. Since magnetostriction and electron inertia effects loom large in criticisms of later work, it is as well to state here that they could not have been sources of error in these direct experiments.

This result was confirmed by Sucksmith and Bates in 1923, using a null method of measurement designed by Chattock, with an error of about 1 per cent. Now, measurements more recently made by Barnett by a very similar method, in which lower magnetising fields and lower frequencies were employed, gave the values $1{\cdot}04\ m/e$ and $1{\cdot}05\ m/e \pm 0{\cdot}5$ per cent for iron and permalloy, and $1{\cdot}06\ m/e$ and $1{\cdot}08\ m/e$ for nickel and cobalt, respectively. It has been suggested that the differences between Barnett's results and those of Sucksmith and Bates arise because the latter did not attempt to neutralise the vertical component of the earth's field, or to eliminate the effects of magnetostriction and inequalities in the half cycles of the alternating current supplied to the magnetising solenoid. Against this suggestion, however, it must be stated that if such serious errors existed in their work, it is very surprising that of the thirty-eight results recorded for iron, nickel and Heusler alloy by Sucksmith and Bates, not one exceeds the value $1{\cdot}03\ m/e$.

Other workers, presumably aware of the discrepancy, have recently provided independent support for the value m/e, but their results have not received the attention they deserve. Thus Coeterier and Scherrer[1] give a provisional value of $0{\cdot}995\ m/e$ for iron, whilst in his 1933 Amsterdam thesis, Coeterier gives the final value $1{\cdot}01\ m/e$ for

iron in powder form. These values were obtained by a resonance method in which a special photo-electric relay reversed the direction of the magnetising field as the oscillating system passed through its zero position.

Again, Ray-Chaudhuri[2] has published the values 1·008, 1·016 and 1·022 m/e for Fe_3O_4, Fe_2O_3 and $NiO \cdot Fe_2O_3$, respectively, with a possible error of 2 per cent. These substances were used in powder form packed inside thin glass tubes. A resonance method with an apparatus similar to that used by Sucksmith in his measurements with paramagnetic substances was employed, the apparatus being evacuated to give large resonance oscillations.

It is, however, desirable to consider the theoretical grounds on which the ratio may conceivably be greater than m/e. For any electron system, the ratio is accurately given by the expression $\frac{1}{g} \cdot 2 \cdot \frac{m}{e}$, where g is the Landé splitting factor, which is equal to 1 for purely orbital motion and equal to 2 for spin motion alone. If ferromagnetism is due entirely to electron spin, then the ratio must be m/e, but if due to an electron system which is distorted by the fields of neighbouring atoms, it is suggested that g may lie between 1 and 2, the ratio being correspondingly increased. Again, van Vleck has suggested that two types of ion with g values of 3/2 and 2 may be simultaneously present in the iron lattice and thus give an effective value of g less than 2.

A measurement of great interest in this connexion is that of Coeterier on pyrrhotite, which shows well-known ferromagnetic peculiarities; this substance in powder form gave a value of 0·63 for g by the method outlined above. Inglis has shown, on the basis of a simple model in which the orbital momenta of the effective electrons are orientated antiparallel to their spins, that the theoretical value for g is 2/3. It is, perhaps, noteworthy that the experimental value of the ratio is thus somewhat higher than the theoretical value, so that perhaps Coeterier's value for iron is also a little too high, but incomplete orientation, as suggested by Inglis, would also account for this difference.

In the case of simple paramagnetic compounds of the rare earth and iron groups, we have fairly definite knowledge of the g values for the appropriate ions based on spectroscopic data. The direct determination of the gyromagnetic ratio for such substances is a matter of extreme difficulty, but such measurements have been successfully made by Sucksmith, who finds satisfactory agreement between the calculated and experimental values. The limits of experimental error were about 6 per cent, but, in view of the great experimental difficulties, Sucksmith was fortunate to get measurements at all. Therefore, the suggestion in a recent article by Barnett[3] that even these most skilful measurements are open to the serious errors supposed peculiar to English work on gyromagnetism is a little difficult to understand.

In conclusion, then, there appears to be no valid reason why theoretical physicists should consider the gyromagnetic ratio for simple ferromagnetic substances, and for simple paramagnetic substances, to be other than m/e and $\frac{1}{g}\ 2\ m/e$, respectively, in the present state of our knowledge.

[1] *Helvetica Physica Acta*, 1932.
[2] NATURE, **130**, 891, Dec. 10, 1932.
[3] *Phys. Z.*, March 1, 1934.

Research in Australia and New Zealand

WHEN the prices of wheat and wool fell calamitously four years ago, Australia found herself on the verge of economic collapse, and every State department was compelled to tighten its belt in order to avert a general disaster. Among them, the Commonwealth Council for Scientific and Industrial Research discovered some economic truths for which it had not been consciously seeking, and it is now both suffering from, and benefiting by, its discoveries*. It is an undoubted fact that under boom conditions, research is liable to become far more costly than it need be; a successful investigation may well yield a continuous profit of 1,000 per cent or more on the original capital outlay, and rapidly lead to the initiation of a host of superfluous and hopeless projects. These are the first to be weeded out when contributions to research are curtailed. The Australian Research Council deserves sympathy for the enforced curtailment of its activities, but congratulation for making immediate use of adversity by pressing forward existing schemes for inter-State co-ordination and imperial co-operation in agricultural research. Proposals for establishing a Commonwealth organisation in agricultural and pastoral research were put forward seven years ago, but in view of the wide divergence of interests between the different States and the great distances separating the chief research institutions, it is doubtful how far those proposals would have materialised in the absence of the pressure exerted by recent economic events. In making grateful acknowledgment of the assistance of the now defunct Empire Marketing Board, the Council emphasises the inestimable services performed by the Board in bringing research institutions in different parts of the Empire into close touch with one another.

The report of the Council for the past year, although not recording any outstanding new results of research, gives some very striking figures illustrating the cash returns that have been, and

* Seventh Annual Report of the Council for Scientific and Industrial Research for the year ended 30th June. (Canberra: Commonwealth Government Printer, 1933.) 3*s.* 8*d.*

may be obtained from the application of scientific research to agriculture in Australia. Thus the complete solution of the problem of 'bitter pit' in apples—a disease found to be associated with immaturity at picking time—has resulted in a saving of £100,000 per annum to the Australian export trade. Root rots and smut of wheat cause losses of more than £1,000,000 a year, and already considerable progress has been made in controlling these diseases. Great strides have in the past been made in the field of plant breeding, and have enabled Australia to become one of the chief wheat producing countries of the world, and it is pointed out that further work which might result in an average increase in quality equal to a penny a bushel would now bring an annual return of £1,000,000. Even at the present low price of wheat, an increased yield of a bushel an acre would mean more than £3,000,000 added to the value of the Australian crop. It is true that many of these savings have yet to be made, but it is already obvious that the Council is paying very satisfactory dividends on its annual expenditure of about £100,000.

Australia's greatest problem is the shortage of water, which limits the natural expansion of both her great industries—wheat and wool production. Progress in the past has depended on the conquest of drought; plant breeding has enabled farmers to produce a bushel instead of half a bushel of wheat for every inch of rain, and animal breeding has enormously increased the yield of wool per sheep from the specially bred merino strains. Progress in the immediate future will involve the consolidation of the position already won, by improving the quality and hardiness of drought-resistant wheats and by maintaining, on dry pasture lands often of indifferent quality, the high wool yield of which the modern merino is capable.

This presents problems of great interest. Apart from the question of drought, there is the greater demand made on soil minerals to produce increasing quantities of wool, and areas once regarded as fertile are incapable of producing the maximum yields that are now possible, and economically essential. In particular, the question of the sulphur metabolism of sheep has come into prominence. Wool consists of keratin, which contains a high proportion of sulphur, and it has so far been assumed that the sulphur needed for the growth of wool must be supplied as cystine. Since the amount of cystine produced by pastures is limited, investigations have been made on the effects on wool production of adding sulphur in other forms to the diet, but without any significant result. The importance of the problem, however, is apparent, and emphasises the imperative need of co-ordinating research on animal breeding and nutrition. It is useless to breed for still higher yields of wool, if the sheep cannot procure the necessary materials for making the wool.

Drought is also being combated by large-scale irrigation schemes, of which the Murray River scheme is perhaps the best known. Its object is to develop a dried fruit industry and involves problems of adjusting a human community to a new environment besides those bearing on irrigation engineering and costs, soil properties, fruit culture and processing, and the control of old and new pests. From its comprehensive nature, the work can only yield results gradually, but it deserves special notice as illustrative of the modern trend of agricultural research programmes—to consider each problem in its intimate relation to all others, biological, chemical, economic and social.

Australian research, under the influence of the slump, is recovering from the first flush of its early triumphs, and one can read between the lines of the Council's report the unexpressed conviction that future progress, although certain, will demand patience, and the realisation by all concerned that the science of the land is one the secrets of which are too deep and complex to be solved except by the corporate action of its many branches.

A striking feature of the work of the New Zealand Department of Scientific and Industrial Research* is that much of it is directed towards the more efficient application of science as a weapon in the struggle to preserve a distant market. As might be expected, most of its activities are connected with agriculture, and one of its first tasks is to keep constantly informed of the changing food fashions of industrial England. The Department works in close co-operation with research organisations such as the Low Temperature Research Station, the Imperial Mycological Institute and the Imperial Agricultural Bureaux in England, and several of its branches maintain liaison officers in London to advise and to secure expert opinion on new lines of produce shipped from the Dominion. Reports received from Britain often determine the lines of research followed in New Zealand.

For example, it was learnt—what is perhaps not realised in Britain itself—that people here are showing an increasing preference for butter with a distinct lactic flavour, and consequently the attention of the Dairy Research Institute was directed towards discovering how this flavour can be obtained—not so much in fresh butter as in butter that has travelled for six weeks in cold storage. The investigation has shown that the required flavour can be obtained by using the highest quality cream. It is interesting to read that "overseas buyers showed themselves remarkably sensitive to salt. . . . It is well known that certain districts in Britain vary in their preferences for degree of saltiness in butter, hence it is incumbent on local buttermakers to study the needs of their special markets before adding salt". We wonder if the British farmer is advised to study the respective idiosyncrasies of London and

* N.Z. Department of Scientific and Industrial Research. Seventh Annual Report for the year 1932–33. (Wellington: Government Printer, 1933.) 2*s*. 6*d*.

Manchester with the same care as the New Zealander!

Again with an eye to the British market, a considerable amount of new work has been carried out on the refrigerated transport of fruit, and it has now been found possible to deliver New Zealand plums in London in excellent condition; attempts to transport lettuces, tomatoes and passion-fruit, however, have been unsuccessful. An investigation which showed that two varieties of apple—Cox's Orange and Jonathan—travel much better at a carrying temperature of 2° F. above that hitherto used (33°–35°) indicates the enormous scope for detailed research that still remains in the realm of cold storage. It is stated that the present inadequate understanding of the meaning of maturity is one of the greatest obstacles to the progress of refrigerated fruit transport.

In 1932, New Zealand exported about 12,000,000 pickled pelts—an important by-product of the frozen meat industry. The pelt market is very difficult to accommodate, as different buyers have very different views on what are the most desirable qualities in pelts. Since it is impossible to manufacture economically and at the same time satisfy every buyer, research has been directed along the eminently practical lines of making experimental shipments of pelts and discovering their relative values through reports prepared by the New Zealand Pelt Committee in London. Such research is bound to be costly, but it affords a good illustration of the direct way in which New Zealand is attacking practical problems with the closest co-operation between the buying and selling sides of industry. The programme of the Leather Research Association is largely based on the reports received from the Committee in London.

Active research, in collaboration with the English parasite farm at Farnham Royal, and with the help of the Empire Marketing Board, has been carried out on the elimination of noxious weeds. Particular attention has been paid to the ragwort seed-fly and to the piripiri saw-fly, and the value of both parasites—especially the former—in checking the spread of the weeds has been established. The gorse-seed weevil has been effective in the south only, as the flowering season of gorse in the north does not coincide with the weevil's period of activity. The use of the Buprestid beetle against blackberry has had to be abandoned, as it was beginning to attack apple trees, while the blackberries sometimes survived. New Zealand is thus discovering both the possibilities and pitfalls of this modern method of biological control.

The unglamorous but, for the future of agriculture, fundamentally important task of soil survey is continually being extended. In recent years much valuable information has been obtained on the cause and cure of bush-sickness, a disease closely related to the soil type of the pastures grazed by affected animals. The interesting fact has emerged that this iron-deficiency disease is caused by a lack of available iron in the soil itself, rather than in the vegetation, the animals obtaining an essential part of their iron by ingesting soil along with the grass. The diseases can be controlled by giving limonite licks, but the most complete cure has been obtained with drenches prepared from the soil of a healthy pasture, suggesting that iron deficiency is not the only cause of the ailment. Other cattle ailments have been traced to deficiencies in pastures of magnesium, iodine, calcium and phosphorus.

The work of the Department covers other branches of agriculture, concerned mainly with export produce, as well as geological survey, meteorology and astronomy. In a world abounding in international obstacles to the spread of applied science, it is satisfactory to find that New Zealand and Great Britain at least are co-operating freely to secure the widest application of the results of research to problems affecting the welfare of both. The achievement of that co-operation is perhaps the greatest of the Department's successes.

G. V. JACKS.

Scientific Aspects of Cooking

ANALYSES of even common foodstuffs are frequently incomplete, especially in the case of the mineral constituents. Moreover, most of the existing figures refer to uncooked food, although there are practical reasons why most diets can only be weighed or measured after the food has been prepared and cooked. It was with the object of bridging this gap that McCance and Shipp undertook a systematic analysis of cooked flesh foods; the results of their study have recently been published.*

A comprehensive analytical scheme was worked out for total, purine, non-protein and extractive nitrogen, fat, carbohydrate, chloride, total and inorganic phosphorus, sodium, potassium, calcium, magnesium and iron. The chief error was found to lie in the variations of composition of different samples of the same foodstuff: errors of sampling and fortuitous analytical errors were only small. Hence several specimens of each food were analysed whenever possible, but the analyses were not carried out in duplicate. The methods used are described in detail in the report and the analytical figures obtained are set forth in a series of tables and comprise the results of the analyses of 64 samples of fresh fish, 8 of preserved fish, 11 of shellfish, 20 of fresh meat, 8 of preserved meats, 11 of poultry and game, 12 of different animal organs and a few of raw foods. Each figure represents the

* Medical Research Council. Special Report Series, No. 187: The Chemistry of Flesh Foods and their Losses on Cooking. By R. A. McCance and H. L. Shipp. (London: H.M. Stationery Office, 1933.) 2*s*. 6*d*. net.

mean of at least two analyses, which were generally made on a mixed sample consisting of several specimens.

Only a few points can be referred to here. In the analytical procedures it is of interest to note that the authors used bromine to deproteinise their aqueous extracts. Examination of the figures obtained showed that the percentage deviation from the mean in the case of protein was 6–10, in the case of fat 30–45 and in the case of the salts 7–20. The dangerous errors in working with food tables, however, are first the systematic analytical ones and secondly the use of inappropriate tables, for example, those showing raw composition when the food is actually eaten cooked.

All the fish commonly eaten in Great Britain have been analysed: it was found that the white fish have on the whole a uniform composition. The purine content of whitebait was found to be high and only surpassed by that of soft roes and sweet-breads. Smelts, herring and whiting are also rich in purines. Sprats, sardines and whitebait may be a valuable source of calcium, since the bones are small and usually eaten. The winkle is peculiar in containing a very large amount of magnesium. The phosphorus content of foodstuffs depends largely on the amount of edible bone or nuclear material present.

The third section of the report is devoted to an experimental study of the losses brought about by cooking: the losses were determined at intervals after the beginning of cooking, so that the results can be expressed simply in graphical form. Beef and fish were chiefly studied, but there is no reason to suppose that other meats will behave differently. It was found that beef, when fully cooked, loses the same amount of weight, water and salts, whether the cooking is commenced in hot or cold water. When the temperature is raised to 60° C. all flesh foods shrink, owing to shrinkage of their proteins and the expression of juices. This is the only cause of salt loss when meat is heated in steam or air; in water, some salts are also lost by diffusion into the water. The extent of the shrinkage of beef, fish, kidney and liver proteins is little affected by raising the temperature from 80° to 100° C., but is slightly increased by a further rise to 120° C. Brain does not shrink below 80° C.; tripe shrinks when the temperature is raised from 80° to 100° C. Fish muscle loses weight in watery solutions below about *p*H 5·6 and gains weight at higher *p*H. Beef tends to gain weight at all *p*H values, especially below 4·5 and above 6·5. Acids and alkalis inhibit the heat shrinkage of muscle proteins. In fish, shrinkage is greatest at *p*H 4·0–4·5 at which loss of weight on soaking is greatest; in meat, shrinkage is greatest at about *p*H 6·0. It is suggested that the chief protein in fish has a more acid isoelectric point than that of beef. Shrinkage on heating is not so rapid nor so extreme just after death as it is 40 hours later. In heating by steam, 50 per cent of the water and salts of beef may be lost and a still higher percentage in kidneys. On lowering the *p*H of the cooking medium, meat and fish tend to lose more of their cations and less of their anions; fish juices are more alkaline than those of beef, and fish lose relatively more of their anions than meat on cooking in water.

In roasting, the loss of water is nearly all due to evaporation; the loss of salts is small, because when the juices are expressed and the water evaporated, the salts are left on the surface. Frying in deep fat leads to such rapid evaporation of water that the loss of salts is at a minimum. Loss of fat is due to liquefaction of the fat by the heat so that it runs off the meat; shrinkage of the proteins has little influence on the loss of fat.

The authors' experiments have led them to conclude that 'pressure cooking' has no advantage over steaming at 100° C., however economical it may be in time and fuel. Compared with heating in water, both methods have the advantage that all loss due to leaching out of soluble constituents is avoided. Salt losses in fish are greatly reduced by steaming, but with larger pieces of meat the losses are similar whether the meat is cooked in water or steam. No evidence was found that a pellicle forms on the outside of a joint when cooking is commenced at a high temperature; this procedure can only be supported on grounds of palatability or digestibility. Undercooked meat is probably not more nutritious than overcooked meat; in any event the latter is a more concentrated food, since the greater part of the weight lost in cooking is water.

News and Views

The Lost Fragrance of Musk

THE total disappearance within recent years of the scent of musk, *Mimulus moschatus* Dougl., is one of the most puzzling of plant phenomena. A native of North America, it was introduced into Great Britain from British Columbia in 1826 by the botanist David Douglas. It quickly became a garden favourite, and the yellow, rather insignificant flowers are still a familiar sight in cottage windows. The plant has become naturalised in certain parts of the British Isles and in New Zealand, where it was taken by the early settlers. At the beginning of the present century, the sweet-smelling musk was hawked from door to door in London suburbs. So far as records are available, it appears that the loss of fragrance was first noticed in Britain in 1909, when a well-known nurseryman asked: "Is there such a thing now as a common Musk with the old Musk perfume? Many friends of mine contend that there is not, and I myself am sceptical." Vilmorin, however, in "Les Plantes de Pleine Terre" (fifth edition, 1909), describes the musk as a "petite plante poilue et visqueuse, exhalant une forte odeur musquée, qui se sent à une grande distance", which suggests that

the 'mutation' had not been noticed in France at that date, and there is evidence that in some localities the failure to produce the characteristic perfume was not generally apparent until after 1916.

DURING the years that followed, it was believed that this failure to produce the 'musk' smell might be ascribed to some adverse condition of cultivation, and it was not known how world-wide was the phenomenon until Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, in his presidential address before Section K (Botany) of the British Association in 1930 at Bristol, stated that, as a result of exhaustive inquiries in Great Britain and in western North America, it had been established that plants of musk with the old-fashioned and distinct fragrance were no longer to be found, even in their native habitat. Correspondence with New Zealand shows that the same thing has happened in all the stations where the plant was previously known to have been scented. Periodically reports reach Kew that the old scented musk has been rediscovered; unfortunately, the statements cannot be substantiated, and seeds submitted produce scentless plants or fail to germinate. Many ingenious suggestions have been made to account for the disappearance of the odour of *Mimulus moschatus* Dougl., but, so far, no conclusive theory has been offered.

Cancer Research

THE eleventh annual report of the British Empire Cancer Campaign, presented at the annual general meeting on July 9, contains summaries of a great variety of researches of different kinds, carried on in a number of laboratories and hospitals. Two of them are of particularly general interest. At the Middlesex Hospital, Prof. J. McIntosh has shown that tumours produced in fowls by the action of tar may be filtrable, that is, they may be transmitted from bird to bird by an ultramicroscopic agent which has many of the characters of a virus. In this way, the artificial tumours resemble those which spontaneously occur in birds, and filtrability seems to be a general property of bird tumours, irrespective of their mode of origin. The common-sense interpretation of this is that the virus-like agent arises in the tumour and does not come into the body from outside. At the Cancer Hospital, Prof. E. L. Kennaway, Dr. J. W. Cook and their colleagues have carried their brilliant work on carcinogenic chemicals a good deal further. Having at last identified at least one of the effective substances in tar, they have studied allied compounds and derivatives and have established what may be called a carcinogenic constitution, so that the probable action of any substance may to some extent be predicted from its structural formula. All this helps to rationalise the overwhelming hygienic case against tar and soot as causes of external cancers: it seems possible also that it may explain the origin of some internal cases, for some of the active substances are related to the sterols, bile acids and œstrin, which are normal components of the body. Conversely, as Prof. E. C. Dodds has shown, some substances which produce tumours are also effective in causing œstrus and sex changes in the plumage of birds.

A New Radioactive Element beyond Uranium

THE Czechoslovak newspapers reported on July 5 that an element of higher atomic weight than uranium has been discovered in Joachimsthal pitchblende by Dr. O. Koblic. The element has been assigned the atomic number 93 and its atomic weight has been found to be 240 from an analysis of the silver salt, $Ag(93)O_4$. The new element would be a congener of manganese and of rhenium, which was discovered in 1925. It should thus form an acid analogous to $HReO_4$ and also salts similar to the permanganates and perrhenates. Acting upon the supposition that the sodium salt of $H(93)O_4$ would be very soluble, Dr. Koblic concentrated the mother liquor from the alkali treatment of pitchblende in the extraction of uranium and radium compounds, and the acidified filtrate was precipitated first with silver nitrate and finally with thallium nitrate. This gave the expected $Tl(93)O_4$ as a red crystalline precipitate. It was re-converted into the more soluble yellow silver salt, 115 milligrams of which were obtained. The discoverer has suggested the name "Bohemium" for the new element, which he considers is probably the parent element of protactinium and the disintegration products of the actinium series. It is estimated that crude pitchblende contains about one per cent of the new element. It will be recalled that Prof. E. Fermi, of Rome, who is investigating the products of neutron bombardment of various elements, recently reported the discovery of an element of atomic weight exceeding that of uranium (see NATURE, June 16, p. 898).

Low Temperature Exhibition in the Science Museum

THE Science Museum—the National Museum of Science and Industry at South Kensington—has made for itself an enviable reputation by the special temporary exhibitions held in the past few years to illustrate the progress which has been made in various branches of science and technical industry. The most recent exhibition, which comes to an end on August 31, shows the public the principles and applications of refrigeration. In the original scheme, it was intended to include a few exhibits to show the progress which has been made in very low temperature work from the days when Faraday demonstrated that certain gases could be liquefied. It was soon realised, however, that the subject was too big and too important to be included merely as a branch of the present exhibition, and it was decided to devote to it an independent exhibition. As the result of a meeting arranged by Col. E. E. B. Mackintosh, director of the Science Museum, of scientific workers, industrialists and representatives of Government institutions interested, to consider the proposal, a small committee has been appointed to decide upon suitable exhibits. The exhibition will commence in March 1935 and will be on view for two months. The arrangements will be in charge of Mr. T. C. Crawhall, the officer of the Museum who was responsible for arranging the present refrigeration exhibition.

THE two laboratories in Great Britain which specialise in low temperature work, namely, the Clarendon Laboratory at Oxford, under Prof. F. A. Lindemann, and the Royal Society Mond Laboratory at Cambridge, under Prof. P. Kapitza, have offered the Museum their advice and assistance, and the Committee, under the chairmanship of Mr. H. T. Tizard, includes other well-known scientific workers and representatives of industrial organisations. The exhibition is primarily intended to show the properties of substances in the following low temperature regions :—solid carbon dioxide, liquid air, liquid hydrogen and liquid helium. As the use of these gases involves the liquefaction of gases obtained from the air, there will be exhibits to illustrate how the liquefaction and separation of these gases is performed in the laboratory and on an industrial scale, while the properties and uses of the gases and liquids will also come within the scope of the exhibition. The scheme is an ambitious one and there is no doubt that, with the support which the Science Museum has already received, it should result in an exhibition of great importance and interest. Col. Mackintosh desires that it should be comprehensive and he will welcome suggestions from anyone who has not so far been approached.

The Radcliffe Observatory

WHEN in the Court of Chancery on July 2 Mr. Justice Bennett approved in principle the application of the Radcliffe Trustees for permission to remove their observatory from Oxford to a site on the high veld near Pretoria, this project, which has been the subject of discussion for several years, reached a further and important stage in its development. Although the judge has reserved his final sanction of the scheme until he is satisfied as to certain details of law and finance, it is not anticipated that these will give rise to any serious difficulty. The Radcliffe Trustees have from the outset wished for some system of close co-operation between the observatory in South Africa and the University of Oxford, and it is intended that the scheme submitted to the judge for his final sanction shall set forth plans for such co-operation in a more concrete form than has hitherto been possible. The present buildings of the Radcliffe Observatory have to be vacated in the summer of next year, when they will be taken over by the Oxford Medical School, but several years must clearly elapse before the new observatory with its 72-inch telescope will be able to commence operations on the site on the hills outside Pretoria most generously presented by the municipality of that city. When it does, it will find waiting for it a vast field of nebulæ and faint stars yet unexplored with the spectroscope.

Heavy Hydrogen

THE intensive research on the new hydrogen isotope, 'heavy hydrogen', of mass 2, and on its oxygen compound, 'heavy water', some aspects of which have been summarised in NATURE (**132**, 536, 1933 ; **133**, 197, 881, 1934), has given rise to an extensive literature. It was to be expected, therefore, that a monograph on the subject would be written, and two such have recently appeared. In that of Prof. E. Darmois ("Un Nouveau corps simple : le Deuterium ou Hydrogène Lourd", *Actualités Scientifiques et Industrielles*, No. 121. Paris, Hermann et Cie, 1934, pp. 24)—to consider them in alphabetical order of authors—a brief account of the course of discovery, the methods of separation, and the properties of heavy hydrogen and heavy water are reviewed, with useful numerical data. There is a short account of the utilisation of the deuterium (heavy hydrogen) nucleus in atomic disintegration, and of the compounds of deuterium apart from the oxide. The monograph of Prof. H. Mark ("Das Schwere Wasser". Leipzig and Vienna, F. Deuticke, 1934, pp. 32) covers much the same ground, but is rather fuller in some parts than that of Prof. Darmois, and the converse is also true, so that both monographs are necessary in obtaining information on the whole range of the subject up to the date when they were written. Readers of NATURE who desire information on the subject of heavy water will find these monographs very convenient and useful : it is noteworthy that many of the communications listed in the bibliographies have appeared in our columns.

Chlorination of Water Supplies

AT the recent annual meeting of the British Waterworks Association, Prof. P. S. Lelean dealt with the history and present state of the methods of chlorination of water supplies. The process was used in 1897 after an enteric outbreak at Maidstone, and its application on a large scale began in 1900 at Ostend ; but the modern process, in which much smaller amounts of chlorine are used, was first put into operation in connexion with the London supplies on the initiative of the late Sir Alexander Houston. The method was extensively used during the War, when perfectly safe drinking water was procured in large amounts from canals and other sources of highly polluted water. In modern practice, bleaching powder has been replaced by chlorine from liquid chlorine. One part of chlorine in ten millions can reduce *Bacillus coli* from 1,000 to 2 per c.c. in ten minutes. The chloramines formed by the action of chlorine on ammoniated water, however, are much more effective than chlorine alone. In the case of Thames water, an addition of 0·1 parts per million of ammonia, filtration, and addition of 0·25 parts per million of chlorine resulted in the absence of *B. coli* from 98 per cent of the samples of 100 c.c. Growth from spores is also considerably retarded. The process causes neither taste nor odour. Prof. Lelean dealt with many aspects of water chlorination in detail, and his lecture emphasised the very great service rendered to public health by the use of scientific methods by the authorities responsible for water supplies : in London, 280 million gallons per day are treated.

Water Supplies in Rural Districts

THE British Electrical Development Association, Inc., has recently issued a report on water supplies and sewage disposal in rural and small urban districts in Great Britain. The report is one which should be

of use to many authorities who to-day are faced with the problem of improving water supplies. The extension of the electricity grid will naturally lead to the installation of electrical pumping plant in preference to steam and oil-driven plant on account of the possibility of automatic control. Many facts and figures as to cost and maintenance of plants and examples of installations are given, ranging from those suitable for a single house to those for large rural areas. In one district with a population of 17,000 spread over an area of 23,000 acres, a scheme was carried out for supplying 12½ gall. per head, the charge for which was approximately two shillings in the pound on the net annual value of the premises. The amount of water used will, of course, depend largely on the sewage system, but it is generally accepted that 25 gall. per head is a safe figure in planning a rural scheme.

Guide Books and Museums

Two guides to the palæontological collections of the British Museum (Natural History) have recently been issued. One of them, the "Guide to the Fossil Birds, Reptiles and Amphibians", claims to be "rather the first edition of a new Guide than a new edition of the old", while the other, the "Guide to the Fossil Mammals", is a reprint "altered and corrected where necessary" (London: British Museum (Natural History), 1*s*. each). Both guides call for criticism. In the first place it is a little difficult to know to what class of reader they are addressed. If for the serious student of palæontology, they are not sufficiently full and contain some rather serious errors, while to the visitor who only wishes to take an intelligent interest and have a little of the veil lifted, they are likely to be wellnigh unintelligible. This difficulty might perhaps be overcome by the use of material already to hand. In 1923 there was published a guide to the exhibition galleries of geology and palæontology, which, rewritten if necessary and with a few well-chosen illustrations, would serve the general public admirably and might be of use to the more elementary of the students. It may also be suggested that a series of separate guides, or guide leaflets, such as are to be found issued by the American Museum of Natural History, would serve a useful purpose. In fact, this plan is already partially in operation in the Natural History Museum. There is a "Guide to the Fossil Remains of Man", published in 1915 at a price of fourpence and a guide to the "Elephants (Recent and Fossil)" published as a second edition in 1922 for a shilling, both very satisfactory. Detailed criticism of the two guides under notice is out of place here, but it may be remarked that neither gives a clear idea of the evolution or classification of groups, while the purpose of some of the illustrations is obscure. It is to be hoped that the authorities will consider not a republication from time to time of matter which has served its purpose and has in course of time become obsolete, but an entire replanning and rewriting of guides to the national collections to meet the two distinct calls made on them, by the student and by the general public.

Average Temperatures in the British Isles

THE number of persons requiring information about the temperature normally experienced in different parts of the British Isles, for one purpose or another, has for many years been large enough to make it an important part of the work of the Meteorological Office to secure so far as possible that standard methods of obtaining air temperature shall be followed both at official and private meteorological stations, and that summaries of these records in comparable form shall be available for inquirers. In a recent handbook ("Averages of Temperatures for the British Isles." H.M. Stationery Office. 9*d*., postage extra) monthly and annual averages of the daily maximum and minimum temperature are given, so far as possible, for the years 1901–1930. As there are, however, many stations for which the averages can refer to only a portion of that period, the inquirer has to be warned against indiscriminate comparisons; for example, differences between a pair of stations for which the period of years referred to is not the same may be due more to peculiarities of the two periods than to real climatic differences; there is the further pitfall of possible differences in times of setting of the maximum and minimum thermometers at the two places. These matters are dealt with in the introduction and the necessary information is shown against each set of figures. It may be observed that the precise meaning of the 'normal' or 'average' maximum or minimum temperature for a given season and a given place is not easily defined. In Table I of the "Book of Normals", which the tables under review supersede, the mean temperature at Kew in January (or rather the mid-point between the mean daily maximum and mean daily minimum) is given as 38·9° F., whereas in the new tables it appears as 40·4° F. The relatively low figure in the "Book of Normals" is due partly to the fact that in the period covered therein (1881–1915) there was a notable run of cold winters, those of the early 'nineties, while the winters of 1901–30 have mostly been mild; there is no means of knowing whether the next 30 years will give an average or 'normal' near to 38·9° F. or one nearer to 40·4°.

British Empire Broadcasting

SOME of the difficulties overcome by the British Broadcasting Corporation in establishing a broadcast service between Great Britain and distant regions of the Empire are well described in a paper in *Electrical Communication* of April by C. M. Benham and P. H. Spagnoletti. Except in special cases, long distance radio communication is practical only when short wave-lengths are used. It was necessary therefore to use radio equipment of the short wave type. Fortunately, the colonies and dominions are so distributed longitudinally that they can be conveniently divided into time zones, that is, areas which have approximately the same local time. There are four main zones: Australia, which has a time displacement relative to London of 'eight hours early'; India, 'four hours early'; Africa, the same time; and Canada, 'six hours late'. In the case

of Australia, the farthest away, transmission must travel through twilight conditions whichever path round the world is used. It was not expected therefore that wave-lengths of 15 metres, using the daylight path, or 37 metres using the dark path, would give trustworthy service. Both can be used for short periods but their useful duration is limited and uncertain. The twilight band (25–29 metres) has been found to be the best. In the Indian zone it has been found that 17 metre transmissions are very satisfactory. In the case of Africa, as it lies almost due south, shorter wave-lengths are used during the day, intermediate wave-lengths at dusk and at night-time 32 metre wave-lengths or even longer can be used. It is found better to divide Africa into two zones. The great circle path to Canada passes very near to the north pole and even in summer it is not a true daylight path. A satisfactory day wave for Canada is of the order of 19 metres, but night waves of 31 and 50 and sometimes as high as 70 or 80 metres have been used. The B.B.C. deserves great credit for having overcome so successfully many of the difficulties connected with the most ambitious project ever attempted in broadcasting.

Standardisation of Electricity Supply

IN a paper read on May 31 to a meeting of the Incorporated Municipal Electrical Association (the I.M.E.A.), which was held in Liverpool, L. Romero discussed the standardisation of methods for distributing electricity and for its sale. He recently addressed a questionnaire to sixty of the largest municipal supply undertakings in Great Britain, and nearly all had replied explaining the systems they used and in particular the voltages which they adopted to supply their consumers. It was decided officially some years ago that the standard system of supply should be the alternating current system and that the standard pressure for domestic supply should be 230 volts. The replies received show that about a third of the municipal undertakings are maintaining voltages which are not standard and that the number of consumers using these voltages is rapidly increasing. The reason given for not adopting the standard is that the change would be expensive. This is a short-sighted policy, as it causes expense to consumers and is a definite obstacle in the way of cheapening electrical lamps and appliances. Several countries abroad also suffer from this lack of standardisation. Luckily, in Great Britain, the progress made in changing from D.C. to A.C. supply is much more satisfactory. Many people think that the supply of electricity should be managed on a national basis, their principal argument being the lack of standardisation that otherwise ensues. Presumably local authorities desire to manage their own electricity supply. Some of them would therefore do well to regard standardisation from a broader point of view.

Electrification of Collieries

ALTHOUGH great progress has been made during recent years in the electrification of collieries, about one third of the total power utilised is still generated mechanically. According to the *Electrical Review* of June 29, the total horse-power of the motors in use in collieries is now about 1,900,000. This is equivalent to more than ten per cent of the capacity of all the plant connected to the public supply mains in Great Britain. Of the electricity used, only about thirty per cent is supplied by statutory authorities. Doubtless this percentage will rapidly increase, as power can be produced more cheaply at points away from the pithead where a more abundant water supply is available for condensing purposes. It is satisfactory to notice that, despite the increase in the use of electricity, the number of electrical accidents is steadily decreasing. This is due to the design of flame-proof structures and flame-proof apparatus. Owing to the high standards adopted by the Association of Mining Engineers, the costs of maintenance have also rapidly diminished. The fixing of minimum standards for illumination for portable lamps is a notable advance. We think that inventors ought to turn their attention to the development of a fixed lighting system which would be safe to use at all parts of the coal face.

Interference with Radio Supply by Electric Lighting

IT is well known that when direct current supply is used for electric lighting, the contacts of the switches and fuses often get badly corroded after a few years' operation. This usually causes little, if any, inconvenience in the lighting of the house or in the use of electric appliances, but if a radio receiver be installed the loud speaker produces most unpleasant noises. This is often attributed quite wrongly to some fault in the set. In many cases the noises are got rid of by having the electric wiring overhauled. According to a paper in the *Electrical Review* of June 1 by V. Z. de Ferranti, many domestic electrical appliances also cause bad radio reception. As examples he gives electric bells operated from the mains, children's electric toy trains, a bad contact in an electric fire and, worst of all, any piece of equipment driven by a motor. He points out that it is far easier to supply equipment which can be trusted to cause no interference than to eliminate by special devices the interference caused by equipment already installed. The special devices are often expensive. He estimates that there are now two and a half million mains-operated radio sets in Great Britain. Collectively, they take about 150,000 kilowatts and the average demand is about two hours a day. In addition, the demand for this load is outside the busy hour of supply and it is therefore desirable to the electricity companies. There is quite an appreciable number of small house-holders who have availed themselves of electric supply primarily in order to be able to use it for radio receiving sets.

Secret Radio-telephony

A SCIENCE SERVICE Mail Report dated May 28 states that Dr. S. Chiba, of the Tokyo Electric Co., has developed a secret method of radio-telephonic communication. According to the description, the

sending installation employs a microphone so constructed that the speech current is inverted with respect to frequency, so that it is unintelligible to the listener on an ordinary receiver. At the receiving end of the communication channel an equipment is used to turn the speech back to normal. From these brief details, it would appear that the system is similar to the inverted-speech method employed by the British Post Office for securing secrecy, as an alternative to the speech-scrambling method which has also been developed and used by the Post Office in long-distance radio-telephonic communication.

Research on Lawns

IT is gratifying to learn that the British Board of Greenkeeping Research will be enabled to maintain its Research Station at St. Ives, Bingley, Yorks, for a further period of five years. Vol. 10, No. 3 of the Board's *Journal* contains a review by the Director of the past four and a half years' work at the Station. There is also a continuation of the series of articles by Mr. I. G. Lewis, describing common grasses. Redtop (*Agrostis stolonifera*, L., var. *gigantea*, Koch) and velvet bent (*A. canina*) are considered in the present volume. The former is somewhat coarse for fine lawns, but the latter is the queen of putting green grasses. Mr. Arthur Hill describes his experiments on lawns at Craibstone, whilst the Director of the Bingley Station, Mr. R. B. Dawson, continues his articles on "Common Weeds of Turf". Dr. T. W. Evans also contributes a paper on phosphatic fertilisers in relation to greenkeeping, and Mr. R. Gordon, of Prestwick Golf Club, writes on "A Golf Course under Seaside Conditions".

Royal Society of New Zealand

THE inaugural meeting of the newly formed Royal Society of New Zealand (hitherto called the New Zealand Institute) was held at Wellington on May 16, when the presidential address was delivered by Prof. R. Speight, professor of geology at Canterbury College, Christchurch, New Zealand. Lord Bledisloe, the Governor-General of New Zealand, in a written address to the Society, intimated His Majesty's approval of the new designation of the Dominion's chief organisation for the promotion of science. The New Zealand Institute was founded in 1867 and the fellowship of the new Society is held by forty-eight men of science. In his address, Lord Bledisloe emphasised the importance of science in solving the world's economic and social problems. Only by the further application of science in all its ramifications and a more enlightened recognition of its beneficent potentialities by the world's rulers will effective remedies for current human disorders be found. The New Zealand Institute has achieved a high prestige in a land of immeasurable opportunities for industrial and cultural expansion. It is therefore to be hoped that under its new appellation it will enjoy to an ever-increasing extent the confidence and respect of the community at large.

Dorothy Temple Cross Fellowships in Tuberculosis

THE Medical Research Council has made the following awards of Dorothy Temple Cross Fellowships for 1934–35, under the terms of the benefaction in that name for research fellowships in tuberculosis: Mr. W. S. Creer, Lady Jones Orthopædic research fellow, University of Liverpool; Mr. A. W. Franklin, chief assistant to Children's Department, St. Bartholomew's Hospital, London; Dr. P. D'A. Hart, assistant physician, University College Hospital, London; Mr. A. Landau, house physician, Brompton Hospital, London: Mr. A. H. T. Robb-Smith, senior demonstrator of morbid anatomy, St. Bartholomew's Hospital, London. Mr. Robb-Smith's fellowship is tenable in Germany, the others at centres in the United States. In addition, the fellowship awarded last year to Dr. G. G. Kayne for work at centres in Europe has been renewed for a further period of six months.

Books on Social History and Early Travel

MESSRS. FRANCIS EDWARDS'S Catalogue No. 572 of new and second-hand books on "History throughout the Ages" contains items of even more extended interest than the title suggests. Not only does it include source books, but also in its extra-European sections there are a number of early travel books and other works of value for their early records of ethnographical material. Among items of particular interest to the social historian is a remarkable run of the *London Gazette*, Nos. 1–4825, dating from November, 1665 to March 24, 1710, in thirteen folio volumes, in contemporary calf. The early numbers include notices of the Plague, indicating the rapid decrease then showing in the figures. The accounts of the Fire of London are followed by schemes for rebuilding the city. Another item of similar interest is Higden's "Polychronicon" in the Rolls Series, now partly out of print. Among official papers is a complete set of the reports of the Historical Manuscripts Commission to 1926. An *editio princeps* of the Nuremburg Chronicle in Gothic letter of 1493 contains 1800 woodcuts, among which appears a portrait of Pope Joan. Early travel books include Hakluyt in black letter, the "Relations" of the Jesuits in Canada (1858), Burney's South Seas, Callander's Australian voyages, Fornander's "Account of the Polynesian Race", Dalrymple's voyages in the South Pacific and Kæmpfer's history of Japan.

Percival Collection of Seeds of British Plants

THE Department of Agricultural Botany of the University of Reading has acquired the Percival Collection of seeds of British plants. This collection, which took about forty years to put together, contains mounted and named seeds of more than a thousand species. Although the British flora is not completely represented, the collection is by far the most adequate in Great Britain and is invaluable for reference purposes. Prof. W. B. Brierley, professor of botany at Reading, hopes that field botanists will

assist him in completing this collection and states that he will be glad to supply lists of the species still unrepresented.

Royal Society of Medicine of Ghent

THE centenary of the foundation of the Royal Society of Medicine of Ghent was celebrated on May 26 in the presence of some three hundred medical men from all parts of Belgium and France under the presidency of Dr. Van Cauwenberghe. The inaugural meeting, in which the history of the Society was related by the secretary, M. de Bersaques, was followed by a scientific gathering at which papers were read by Profs. Leriche of Strasbourg, Polak Daniels of Gröningen and Dr. Ragin of Lausanne.

Announcements

WE much regret to announce the death, at the age of seventy-nine years, of Dr. L. Cockayne, F.R.S., honorary botanist of the State Forest Service of New Zealand; and also of Dr. N. L. Britton, emeritus director of the New York Botanic Garden, on June 25, at the age of seventy-five years.

THE Rogers Field Gold Medal of the Royal Sanitary Institute has been awarded to Imperial Chemical Industries Ltd., for an exhibit of Chloros at the Bristol Congress of the Institute just concluding. The medal is given for an exhibit of outstanding merit from the point of view of hygiene. The special features of the Chloros exhibit at Bristol were its uses in connexion with the sterilisation of rural water supplies and swimming pools.

THE Secretary of State for the Colonies has appointed Mr. A. C. Miles, provincial superintendent of agriculture, to be deputy director of agriculture, Gold Coast.

DR. R. C. BOWDEN, chemical engineer under the Director of Ordnance Factories, has been appointed by the War Office to be Superintendent, Royal Gunpowder Factory, Waltham Abbey, in succession to Lieut.-Col. P. H. Evans, Royal Artillery, who retires on July 12.

THE trustees of the Bernhard Baron Charitable Trust have made a grant of £10,000 to the British Empire Cancer Campaign in response to its Empire Day appeal. The money will be put in a special fund to be called the "Bernhard Baron Cancer Fund".

THE annual Autumn Meeting of the Institute of Metals will be held at Manchester on September 3–6, under the chairmanship of Dr. Harold Moore, president of the Institute. On September 3, Dr. J. L. Haughton will deliver the thirteenth Autumn Lecture entitled: "The Work of Walter Rosenhain". Further information can be obtained from the secretary of the Institute, 36 Victoria Street, London, S.W.1.

IN 1920, Miss L. Jones-Bateman, of Cae Glass, Abergele, presented to the Royal Horticultural Society a valuable silver-gilt replica of the Warwick vase to be used for the encouragement of fruit production. It has accordingly been decided to offer it triennially for researches in the growing of hardy fruits, figs, grapes and peaches in the open or under glass, and it is available for award in 1934. Candidates should submit accounts of their work by October 31. The work dealt with must have been carried out by the candidate in the United Kingdom mainly during the past five years.

MESSRS. LONGMANS, GREEN AND CO., LTD. announce for publication in September a work by Mr. G. C. Robson, deputy keeper of zoology at the British Museum (Natural History), and Mr. O. W. Richards, lecturer in entomology at the Imperial College of Science and Technology, entitled "Variations of Animals in Nature". In this work the authors have summarised the evidence on the subject in an attempt to decide what evolutionary theory is in best agreement with the facts.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A part-time assistant in statistics at the London School of Economics and Political Science, Houghton Street, Aldwych, W.C.2—The Secretary (July 17). An assistant lecturer in electrical engineering at the York Technical Institute—The Secretary for Education, Education Offices, Clifford Street, York (July 18). An assistant lecturer in the Department of Zoology, preferably a vertebrate morphologist, at University College, London, W.C.1—The Secretary (July 18). A head of the Department of Geology, Mineralogy and Geography at the Chelsea Polytechnic, London, S.W.3—The Principal (July 21). A lecturer (man) to take charge of the Post-Graduate Training Department of University College, Leicester—The Registrar (July 21). A lecturer in engineering at the Denbighshire Technical Institute, Wrexham—The Principal (July 21). A teacher of engineering at Leigh Municipal College—The Director of Education, Town Hall, Leigh (July 21). An assistant lecturer in geography at University College, Exeter—The Registrar (July 28). A deputy director and bacteriologist at Adelaide Hospital, who will also be lecturer in bacteriology in the University—The Agent General for South Australia, Australia House, Strand, London, W.C.2 (Aug. 15). A biochemist or chemist, preferably with knowledge of physical chemistry and biology, for an investigation into the effect of oil upon mosquito larvæ, at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1—The Secretary (Sept. 7). A professor of mathematics in Victoria University College, Wellington, New Zealand—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, London, W.C.1. Demonstrators in mechanical engineering, electrical engineering and communications, and physics, at Woolwich Polytechnic, London, S.E.18—The Secretary. A teacher of mining and engineering in East Kent—The Acting Principal, Technical Institute, Ladywell, Dover.

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.*]

An Early Record of the Sycamore Maple in Britain

THE sycamore maple, *Acer pseudoplatanus* L., is one of the hardiest of British trees, sometimes suppressing the elm by the vigour and rapidity of its growth. According to Henry[1] it thrives in almost any dry soil, and seems to reach its greatest size and perfection in the colder hilly parts of England and Scotland, "where nearly all the finest specimens are found". It is unaffected by the severest frosts, at any season, and is rarely attacked seriously by insects, or by fungi except *Rhytisma acerinum* (Pers.) Fries, which produces noticeable black blotches on the leaves. The sycamore maple ripens seed profusely and reproduces itself almost everywhere on clean ground, though the seedlings are easily suppressed by coarse grass. Bean[2] notes that its seedlings spring up in the wilder parts of Kew Gardens in such a way that in course of time the place, if left to run wild, would probably become a sycamore forest. He points out that this is one of the few trees that will stand the full force of salt-laden winds in exposed places near the sea. Last year I found it growing on the coast of Caithness exposed to the full fury of the north wind.

It seems strange that such a hardy and adaptable species should not be indigenous to Great Britain, yet Henry[1] states that it is not a native of the British Isles, nor of north-west France, Belgium, Holland, the North German plain, Denmark, Scandinavia, or the greater part of Russia. In these countries, however, it "flourishes and is extensively cultivated". Its centre of distribution appears to be the great central chain of the Pyrenees, Alps and Carpathians, with the mountains and hills radiating from them; it occurs wild also in Asia Minor, Armenia and the Caucasus[1]. Smith[3] refers to it as occurring "In sepibus, et ad domos, vix indigena". Ray[4] states that in his time it was planted in cemeteries and about the houses of the nobility, and that it was nowhere wild in England: "In coemiteriis & circa nobilium aedes: nullibi tamen, quod sciam, in Anglia sponte oritur" (3rd ed., p. 470, 1724). Turner, 1551[5] and Gerarde, 1597[6] refer to it as a stranger, or introduced tree: "The great Maple is a stranger in England, only it groweth in the walkes and places of pleasure of nobelmen, where it especially is planted for the shadow sake, and under the name of Sycomore tree" (6, p. 1300). Hyde[7] observes that the sycamore maple is "not a native of Wales, or indeed of Great Britain, but was introduced from the Continent of Europe, probably during the sixteenth century". The late Clement Reid[8] writes of the sycamore as "undoubtedly introduced", and suggests the possibility of its having been planted by Roman officers around their villas, for shade and beauty, along with the Spanish chestnut.

Examining recently some beautiful stone carvings in the Cathedral of Christ Church, Oxford, I was impressed by the fact that one of them represents, quite clearly and unquestionably, *Acer pseudoplatanus*, although they date from the end of the thirteenth (or early fourteenth) century. Ten species are depicted, seven of which are native British plants, and the others cultivated. They represent: *Acer campestre* L., *Quercus robur* L. (*sensu stricto*, that is, *Q. pedunculata* Ehrh.), *Crataegus monogyna* Jacq., *Hedera helix* L., *Aquilegia vulgaris* L., *Chelidonium majus* L., *Bryonia dioica* L., *Vitis vinifera* L., *Ficus carica* L. (?), and *Acer pseudoplatanus* L. The grape-vine and the fig-tree, both perhaps introduced by the Romans, were much grown in English gardens in the sixteenth century. Gerarde[6] says: "The Fig trees do growe plentifully . . . in England, where they beare fruite." They were valued as medicinal plants: according to Culpepper[9], fig-trees "prosper very well in our English gardens, yet are fitter for medicine than for any other profit which is gotten by the fruit of them".

FIG. 1. The sycamore maple, *Acer pseudoplatanus* L., on the canopy of the tomb of St. Frideswyde in the Cathedral of Christ Church, Oxford.

The carvings referred to are on the canopy of the shrine of St. Frideswyde. This shrine was erected in the year 1289; the carving is attributed to the period 1290–1320. The late Dr. Wells[10], Warden of Wadham College, wrote of it as "the earliest known instance in England of natural foliage in architectural decoration".

A list of species is given on a card placed on the shrine for the information of visitors. The only one about which there seems to be any possible doubt is *Ficus carica*.

As seven of the ten species represented are native British plants, and the other three were commonly cultivated in Britain, and as the carvings are remarkably true to Nature, there seems no reason to doubt that they were designed from living specimens grown in or near Oxford. If this be so, it places the introduction of *Acer pseudoplatanus* into England about a quarter of a century earlier than the approximate

date generally assigned to it, and the St. Frideswyde carving appears to be the earliest known illustration of the sycamore maple in Great Britain.

I am indebted to the Very Rev. the Dean of Christ Church for courteous permission to take the photograph here reproduced (Fig. 1).

J. BURTT DAVY.

Imperial Forestry Institute,
Oxford.
June 14.

[1] Henry, A., in Elwes and Henry, "Trees of Great Britain", vol. 3, pp. 645–646; 1908.
[2] Bean, W. J., "Trees and Shrubs Hardy in the British Isles", (2nd ed.), vol. 1, p. 155; 1919.
[3] Smith, Sir J. E., "Flora Britannica", vol. 1, p. 422; 1804.
[4] Ray, John, "Synopsis Methodica Stirpium Britannicarum", p. 230; 1690.
[5] Turner, William, "A Newe Herball . . .", Part 1; 1551.
[6] Gerarde, J., "The Herball", 1597; and edit. 2, enlarged and amended by Thomas Johnson, 1633.
[7] Hyde, H. A., "Welsh Timber Trees", p. 86; 1931.
[8] Reid, Clement, "The Origin of the British Flora", p. 16; 1899.
[9] Culpepper, N., "The English Physitian", enlarged. London, 1653. Many subsequent editions appeared; Dr. Daydon Jackson mentions one in Welsh, issued in Caermarthen in 1818; my own copy was published at Halifax, but bears no date.
[10] Wells, J., "Oxford and its Colleges", 13th ed., p. 21; 1926.

Effect of Temperature on Diffraction of Slow Electrons and its Application

WE have investigated the influence of temperature on the intensity (I_T) maxima due to the diffraction of slow electrons from a cleavage plane of Ceylon graphite, using the method of constant Bragg angle ($\theta = 65°$). The apparatus used in these experiments is described in detail elsewhere[1].

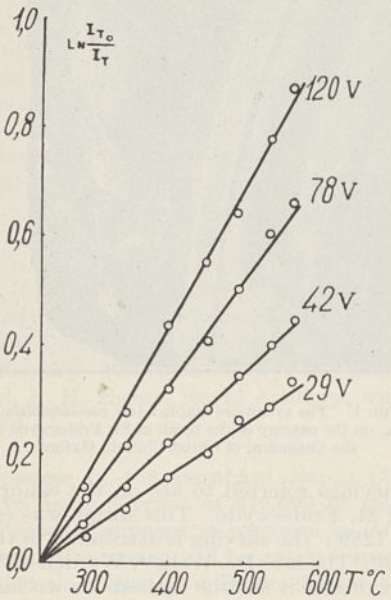

FIG. 1.

Fig. 1 gives graphs of $\ln I_{T_0}/I_T$ against T, the temperature of the experiment. Every straight line corresponds to a definite maximum the value of which in volts is indicated. In Fig. 2 voltages of the maxima are plotted against the values of $1/(T-T_0)$ $\ln I_{T_0}/I_T$. The empirical relation between the intensity of the maxima and temperature is then:

$$I_T = I_{T_0} e^{-q(V+\psi)(T-T_0)} \qquad (1)$$

where the constants have respectively the values

$q = 2{\cdot}0 \times 10^{-5}$ grad^{-1} volt^{-1}, $\psi = 22$ volts.

It is known that the Debye thermal factor for X-rays has the following form

$$I_T = I_{T_0} e^{-a\frac{\sin^2\theta}{\lambda^2}(T-T_0)} \qquad (2)$$

Moreover, if the refraction of electronic waves is taken into account, the introduction of the value φ of inner potential permits the following transcription of equation (2):

$$I_T = I_{T_0} e^{-a\frac{\sin^2\theta}{150}\left(V+\frac{\varphi}{\sin^2\theta}\right)(T-T_0)} \qquad (3)$$

where V is measured in volts.

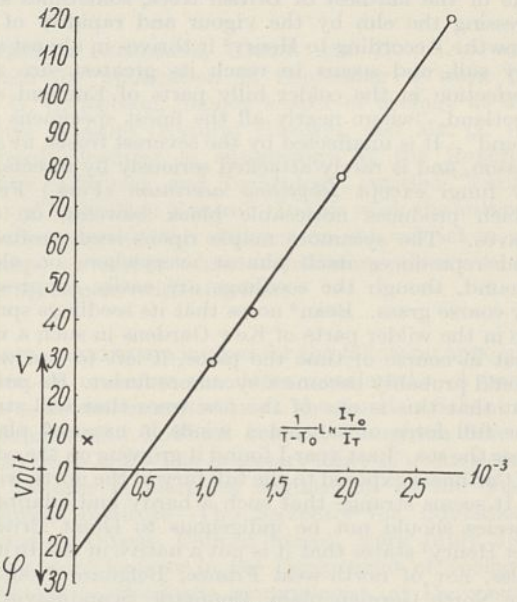

FIG. 2.

The constant a (for X-rays) may be computed for graphite from Bakhurst's data[2], which give the value $a = 0{\cdot}0038$ A.^{2} grad.$^{-1}$. The use of our value for q, obtained from experiments on electronic diffraction, leads to very nearly the same result: $a = 0{\cdot}0036$ A.^{2} grad.$^{-1}$. The constant ψ, multiplied by $\sin^2\theta$, may be easily identified with inner potential, a result which follows from the comparison of formulæ (1) and (3); thus we obtain $\varphi = 18$ volts in good agreement with the value (20 volts) found earlier[2].

We wish to point out that in order to obtain the value of φ by this procedure, a knowledge of the Millerian indices of the maxima is no longer necessary. We may thus propose a method of controlling the correctness of determination of plane indices. The maximum observed at 8 volts (marked by the cross in Fig. 2) has shown an almost negligible temperature effect, in striking contrast with the general results. This fact forced upon us the conviction that this maximum does not arise from the space lattice. In fact, special investigation has shown that this maximum is due to a selective change of the coefficient of reflection on the surface layer of graphite and does not belong to the diffraction maxima.

The detailed account of our research will be published in *Phys. Z.S.U.*

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[1] W. E. Laschkarew, E. W. Bärengarten and G. A. Kuzmin, *Z. Phys.*, **85**, 631; 1933.
[2] I. Bakhurst, *Proc. Roy. Soc.*, A, **102**, 340; 1923.

The Chlorine–Chlorine Distance in Carbon Tetrachloride

THE chlorine–chlorine separation in carbon tetrachloride has been given as $2{\cdot}99 \pm 0{\cdot}03$ A. by Bewilogua[1], from X-ray diffraction measurements, and as $2{\cdot}98 \pm 0{\cdot}02$ A. by Wierl[2], from electron diffraction experiments. Recently Dornte[3], and Hendricks, Maxwell, Jefferson and Mosley[4], have mentioned confirmation of these values, but Braune and Knoke[5], and Brockway and Pauling[6] have obtained smaller values, all using the electron diffraction method.

In the course of further work with this method, carried on independently in our respective laboratories, we have effected considerable improvements in the experimental technique, so that we are now able to measure up to the seventh order with accuracy. Our results with carbon tetrachloride prove to be much lower than those previously reported. The mutual agreement of our independent results almost eliminates the possibility of a consistent experimental error. At the same time, the case has been thoroughly investigated as regards possible sources of error; the voltmeters used were calibrated against diffraction photographs of gold foil. We have recalculated the complete theoretical scattering curve for carbon tetrachloride with respect to electrons, taking account of the atomic scattering factor and incoherent scattering corrections. The resulting curve differs very slightly from that given by Wierl[2].

The accompanying sets of results represent the mean of numerous readings, both direct and photometric, from the positives and negatives of twelve good plates:

Maxima	1	2	3	4	5	6	7	
$L_{Cl.-Cl.}$	2·71	2·74	2·87	2·83	2·85	2·83	2·85 A.	(V. E. C.)
	2·69	2·74	2·84	2·84	2·87	2·88	2·84 A.	(H. de L.)

The first two maxima yield very low results, due to uncertainty in measurement, or more probably to the position of the apparent intensity maxima being influenced, in this region of high density, by the rapid change in slope of the intensity-blackening curve for the plate[7]. One of us (V. E. C.) has developed a method for the compensation of the continuous background scattering, which gives values of 2·84, 2·79 and 2·86 A. for the first three maxima respectively. This indicates that the initial error in the first and second maxima lies in the measurement, and not in the experimental method or the theoretical scattering curve.

Taking these results into consideration, we get a mean value for the chlorine–chlorine separation in carbon tetrachloride of $2{\cdot}86 \pm 0{\cdot}03$ A.

This work will be published in full elsewhere.

V. E. COSSLETT.

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H. G. DE LASZLO.

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May 29.

[1] *Phys. Z.*, **32**, 270; 1931.
[2] *Ann. Phys.*, **8**, 521; 1931.
[3] *J. Chem. Phys.*, **1**, 566; 1933.
[4] *ibid.*, **1**, 549; 1933.
[5] *Z. phys. Chem.*, (B), **21**, 297; 1933.
[6] *Proc. Nat. Acad. Sci.*, **19**, 68; 1933.
[7] Cf. Becker and Kipphan, *Ann. Phys.*, **10**, 15; 1931.

A New Band System of Aluminium Hydride

IN a recent paper[1] we reported on a new band system of aluminium hydride lying at 3380 A. We have now succeeded in photographing this band system in the second order of a 6·5 m. concave grating. As light-source we used an aluminium arc burning in a hydrogen atmosphere at a pressure of 15 mm. with high current (15 amp.).

The band system has been analysed and is shown to belong to a $^1\pi^* \rightarrow {}^1\pi$ transition. It consists of four branches (P_1, P_2 and R_1, R_2), with no Q branches, in agreement with theory. From the analysis it is evident that the lower $^1\pi$ term is identical with the upper $^1\pi$ term of the well-known $^1\pi \rightarrow {}^1\Sigma$ system. The following constants have been found:

	B_0	D_0	J_0	r_0	ω_0
$^1\pi^*$	5·60	$-9{\cdot}7 \times 10^{-4}$	$4{\cdot}95 \times 10^{-40}$	1·76 A.	851·7 cm.$^{-1}$
$^1\pi$	6·026	$-6{\cdot}66 \times 10^{-4}$	$4{\cdot}60 \times 10^{-40}$	1·70 A.	1146·5 cm.$^{-1}$

The upper term $^1\pi^*$ shows a remarkable predissociation at $j = 12$ for $^1\pi_c$ and $j = 11$ for $^1\pi_d$.

The Λ-doubling has been measured and is given by the following equation:

$$\Delta\nu = 1{\cdot}29(j+\tfrac{1}{2})^2 - 0{\cdot}0163(j+\tfrac{1}{2})^4 - 0{\cdot}867 \times 10^{-4}(j+\tfrac{1}{2})^6$$

The intensity distribution among the branches is of some interest, while the P_1 (R_1) branches, in disagreement with theory, is far more intense than the P_2 (R_2) branches.

A detailed report will be given elsewhere.

W. HOLST.

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June 14.

[1] *Z. Phys.*, **89**, 40; 1934.

Wireless Echoes from Regions above the *F* Layers

DURING recent years, we have obtained a large number of fixed-frequency continuous automatic records of the cyclic changes of effective layer-heights which constantly occur in the ionosphere, and our record files now cover a period of approximately 11,000 hours. Our most interesting results have been obtained at the frequency of 3,492·5 kilocycles, although we have also made a number of experiments on the simultaneous reception of 4,095 and 2,398 kilocycles. Some of the 3,492·5 kilocycle transmissions have been recorded simultaneously at three different geographical points. The receiving and recording apparatus is compact and reliable, and it can operate at a distant point for at least two weeks without any attention. An accurate time scale is automatically marked on all records by the transmitter.

In addition to the usual stratified multiple *F* layer echoes, and occasional abnormal *E* layers, we have frequently observed first-order echoes which appear to come from regions of considerably greater effective height. We have delayed the announcement of these results as we wished to be reasonably certain that the effects were not due to the low group velocities ordinarily encountered in the *E* and *F* regions when the electron density is near a critical value. With improved sensitivity and resolving power we have recently obtained a series of consistent records which apparently rule out this explanation. We have used four different mechanical designs in constructing

automatic recorders for various types of service. The gaseous discharge lamp[1] gives a positive indication of very weak echoes which are far below the static level. When used under such extreme conditions, the photographic trace shows a series of black echo lines on a dark grey mottled background.

Although it is not yet certain that the refracting regions are directly overhead, it is convenient to describe the experimental results by a tentative classification into '*G* reflections' and '*H* reflections'.

The *G* reflections are much weaker than the *F* reflections. They produce a broad diffuse turbulent trace with a sharply defined lower boundary which normally remains relatively constant from midnight to sunrise. At this geographical location the boundary commonly has an effective height of approximately 600 km. It is ordinarily observed whenever the *F* region is completely penetrable, but it is also frequently present in combination with the various *F* components.

On different occasions the *H* reflections have returned from various effective heights ranging from 1,100 km. to 1,800 km. During a single observation the reflection often remains comparatively steady in signal strength and position for a period of six hours or more. The signals are weak but sharply defined, and the photographic traces are quite different in appearance from those produced by the *G* reflections. A slow steady downward drift has sometimes been observed from midnight to sunrise. On a number of occasions the '*H* layer' has been recorded in the evening hours while lower layers have been present. *G* and *H* layers may be observed at points very close to the transmitter as well as at a distance. The seasonal variation is not yet certain.

The early experiments were made in collaboration with Dr. Pao H. Wang. Mr. Paul B. King has obtained a large part of the recent data.

HARRY ROWE MIMNO.

Harvard University,
Cambridge, Massachusetts.
May 14.

[1] H. R. Mimno and P. H. Wang, *Proc. Institute of Radio Engineers*, 21, 529; 1933.

Induced Radioactivity and Transmutation

WITH reference to Fermi's work[1] on the bombardment of elements with neutrons and the production of β-rays, we suggest that the bombardment produces unstable and missing isotopes containing α-particles, a diplon and neutrons. Thus with aluminium the transmutation would be as follows:

$$_{13}Al^{27}\ [6\alpha + D + n]\ (\text{stable}) + n \rightarrow\ _{13}Al^{28}.$$

The missing isotope $_{13}Al^{28}$ is unstable, disintegrating thus:

$$_{13}Al^{28}\ [6\alpha + D + 2n] \rightarrow\ _{14}Si^{28}\ [7\alpha] + \beta$$

to form the next stable α-particle configuration $_{14}Si^{28}$ [7α]. Similarly for chlorine:

$$_{17}Cl^{35}\ [8\alpha + D + n]\ (\text{stable}) + n \rightarrow\ _{17}Cl^{36}\ [8\alpha + D + 2n];$$

and the latter being unstable and a missing isotope, we have:

$$_{17}Cl^{36}\ [8\alpha + D + 2n] \rightarrow\ _{18}Ar^{36}\ [9\alpha] + \beta$$

as observed by Fermi. In addition $_{17}Cl^{37}$ may be spontaneously radioactive:

$$_{17}Cl^{37}\ [8\alpha + D + 3n] \rightarrow\ _{18}Ar^{37}\ [9\alpha + n] + \beta;$$

and although such spontaneous radioactivity has not yet been observed, it does occur with potassium. In the case of magnesium—an isotope of even atomic number—

$$_{12}Mg^{26}\ [6\alpha + 2n] + n \rightarrow\ _{12}Mg^{27}\ [6\alpha + 3n]$$
$$_{12}Mg^{27}\ [6\alpha + 3n]\ (\text{unstable}) \rightarrow\ _{13}Al^{27}\ [6\alpha + D + n] + \beta;$$

so that β-rays would be emitted as found by Fermi.

Similarly, with silicon,

$$_{14}Si^{30}\ [7\alpha + 2n] + n \rightarrow\ _{14}Si^{31}\ [7\alpha + 3n]\ (\text{unstable})$$
and $_{14}Si^{31}\ [7\alpha + 3n] \rightarrow\ _{15}P^{31}\ [7\alpha + D + n] + \beta.$

Then with phosphorus $_{15}P^{31}\ [7\alpha + D + n] + n \rightarrow\ _{14}Si^{31}\ [7\alpha + 3n]$ + proton and $_{14}Si^{31}\ [7\alpha + 3n]$ (unstable) $\rightarrow\ _{15}P^{31}\ [7\alpha + D + n] + \beta$. These transmutations agree with Fermi's observation that phosphorus bombarded with neutrons emits protons and electrons, the unstable silicon isotope returning to the original isotope $_{15}P^{31}$.

According to our theory of nuclear structure, a full account of which will be published shortly, missing isotopes are unstable, emitting either an electron or a positron. The theory also predicts stable but at present missing isotopes such as $_{18}Ar^{37}$ and $_{18}Ar^{38}$.

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

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June 8.

[1] NATURE, 133, 757, May 19, 1934.

Induced Radioactivity of Potassium

I HAVE bombarded potassium chloride with the α-rays of radium C′ of 55 mm. effective range and found that it acquires a greater radioactivity than that due to the natural activity of potassium. The effect is due to potassium, because no similar effect was exhibited by sodium chloride irradiated in the same conditions. In order to measure exactly the amount of induced radioactivity, all counting experiments were done by taking the difference between the number of impulses due to two identical samples of potassium chloride, one of which has been irradiated.

Irradiating potassium chloride for 12 hours with 30 millicuries of radon, I have found that the corrected initial activity amounts to about 50 impulses per minute, while the non-irradiated sample gave an effect of 17 impulses per minute. The induced activity decays exponentially with a half-period of 3 hours. I have found that the radiation consists of positrons and is completely absorbed by a sheet of lead of 0·27 gm./cm.^{2}. No positron emission takes place when the range of α-rays is reduced to 45 mm.

The probable reactions are:

(1) $_{19}K^{41} + {}_2He^4 = {}_{21}Sc^{44} + \text{neutron}$;

(2) $_{21}Sc^{44} = {}_{20}Ca^{44} + \text{positron}$

or analogous reactions due to the 39 potassium isotope.

In order to test this possibility, I have tried to separate chemically the assumed scandium isotope, with the help of Mr. A. Wroncberg, to whom my best thanks are due. Irradiated potassium chloride was

dissolved in slightly acidulated water, a few milligrams of scandium chloride ($ScCl_3$) added to the solution and precipitated by an excess of ammonia. The precipitate exhibited an activity of the same character and comparable in amount with that emitted by irradiated potassium chloride.

M. ŻYW.

Mirosław Kernbaum Radiological Laboratory,
Warsaw Society of Sciences.
June 14.

Carotenoids and the Vitamin A Cycle in Vision

SINCE reporting the occurrence of vitamin A in the eye tissues of the frog and several mammals[1], I have examined the carotenoids of the frog's eye in detail.

The combined pigment and choroid layers of *R. esculenta* and *pipiens* (dry weight about 2·2 mgm.) contain about 4γ per eye of vitamin A. There is also about 1γ of another carotenoid in these tissues possessing the spectroscopic and solution properties of xanthophyll. These quantities are not altered appreciably by light or dark adaptation.

In the retinas of dark adapted animals, no xanthophyll and only a trace of vitamin A occurs. Instead, their chloroform extracts contain a third carotenoid with novel properties. I have named this substance retinene.

Retinene in chloroform solution possesses no absorption bands in the visible spectrum. It is faintly yellow, due to an ascending absorption from 500 mμ into the ultra-violet. The crude retinal extract shows a small absorption maximum at about 410 mμ and larger ones at 310 and 280 mμ. Retinene exhibits a strong blue colour with antimony trichloride, due to a sharp band at 655 mμ.

Though present in quantity in the extracts of dark adapted retinas, retinene has completely vanished from light adapted ones. In these it has been replaced by about 0·3γ per retina (dry weight about 3 mgm.) of newly formed vitamin A.

The process which generates the vitamin is easily demonstrated in the isolated retina. Dark adapted retinas 'bleach' instantly in intense light to a bright orange colour (visual yellow). When such bleached retinas are immediately extracted with chloroform, they yield the same quantity of retinene as do dark adapted tissues, and no vitamin A. If, however, they are left at room temperature, the orange colour fades and within an hour has vanished. Extracts of such colourless retinas contain about 0·8γ per retina of vitamin A, and no retinene. Partially faded retinas yield intermediate quantities of both substances.

The fading of visual yellow proceeds equally well in light or in darkness, though in the latter instance some visual purple is regenerated. At 0° C. the process is delayed indefinitely, even in brilliant sunlight. The photochemical conversion of visual purple to visual yellow thus is followed by a thermal decomposition of the latter substance to colourless products, among them vitamin A.

Isolated retinas which have been bleached and have completely faded contain much more vitamin A than retinas from light adapted animals. Some vitamin A is therefore lost in the visual process.

Retinene is no more than a useful artefact in this system. It does not occur in the retina as a free substance. Benzine and carbon disulphide, though they dissolve both compounds easily, extract the vitamin A from dark adapted retinas, but no retinene. Subsequent extraction with chloroform yields retinene in the usual quantities. Neither carbon disulphide nor benzine affects visual purple or visual yellow, whereas chloroform rapidly decolourises both. Clearly vitamin A is bound in visual purple and yellow to some colourless molecule, insoluble in fat solvents. Chloroform breaks this complex to yield retinene. The thermal fading of visual yellow in the bleached retina dissociates the complex in another manner, liberating the vitamin.

Visual purple is non-diffusible[2] and may be salted quantitatively from solution with half-saturated ammonium sulphate. Its sensitivity to warming[2] and to deproteinating agents of all sorts adds a protein character to these general colloidal properties. The visual pigment seems, therefore, to be a carotenoid protein like that recently found by Kuhn and Lederer in lobster shells[3]. The lobster pigment and visual purple are similar in many properties; both are insoluble in water and organic solvents, and both are fundamentally altered by warming, acids, alkalis, alcohol and acetone. It is probable, therefore, that visual purple is a conjugated protein, in which vitamin A is the prosthetic group.

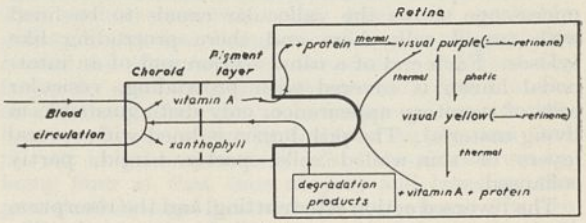

FIG. 1.

In isolated retinas which have been bleached and replaced in darkness, visual yellow reverts in part to visual purple; the remainder decomposes as described to colourless products. The latter substances never re-form visual purple in the isolated retina. In the intact eye this type of reversion does occur freely; it requires the co-operation of the pigment epithelium[2].

The pigment epithelium is necessary also as a source of vitamin A, quantities of which are lost during vision. These must be restored from the reserves in the pigment layer, since the frog retina contains no blood supply[4]. However, the ultimate source of vitamin A in any vertebrate is in the diet, and this is, at least in part, the reason for the failure of the visual purple mechanism (night blindness) in avitaminosis-A.

All these relations can be indicated in a single diagram (Fig. 1), which is tentatively proposed to represent the elements of visual purple-vision in the frog.

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[1] Wald, G., NATURE, **132**, 316, August 26, 1933.
[2] Kühne, W., "Hermanns Hdbch. der Physiol.", **3/1**, 235; Leipzig, 1879.
[3] Kuhn, R. and Lederer, E., *Ber.*, **66**, 488; 1933.
[4] Hyrtl, *Sitzber. Akad. Wien*, **43**, Abt. 1, 207; 1861.

Transpiration Current in Horsetails

THE xylem system of *Equisetum* appears so inadequate for the vigorous transpiration maintained, which may be twice as great as in the sunflower[1], that the suggestion has been made that water travels in the canal-system of the stem[2].

The following observations support this idea. I have constantly found, in the fertile shoots of *E. maximum*, that both carinal and vallecular canals and the large central lumen of the stem are filled with water under pressure. If an incision is made at the top of an internode a strong spurt of water escapes.

This liquid has the following characteristics: *p*H 6·6, optically inactive, no reducing sugar present, no nitrate or nitrite, no amino acids, a trace of sulphate and a considerable amount of phosphate present. Evaporation leaves a fine, amorphous deposit, insoluble in ether.

When sporophore shoots are cut and left in water, even in a covered vessel, the upper internodes collapse laterally. On making an incision now there is a sharp intake of air, and the walls of the stem again expand. Transpirational loss being excluded by the conditions and direct leakage barred by the Casparian bands, there would seem to be a reversible secretion into these cavities from the surrounding parenchyma.

Similar observations have been made on *E. hiemale*. In both species observation with the binocular microscope shows the vallecular canals to be lined with turgid cells, here and there protruding like tyloses. Each end of a canal section and of an internodal lumen is covered with protruding, vesicular cells of secretory appearance, only distinguishable in living material. The pith lumen is lined with several layers of thin-walled cells, partly turgid, partly collapsed.

The reversed action after cutting, and the resorption of the secreted water, can only be due to the disappearance of the exudation pressure which originated from the roots. The phenomenon is an interesting complement to the development of a centripetal secretion pressure in normal roots and illustrates the upward extension of physiological root conditions in pteridophytic stems with typical secondary endodermis.

R. C. McLEAN.

University College,
Cardiff.
June 6.

[1] Dosdall, *Plant World*, **22**, 1, 29; 1919.
[2] Westermaier, *Sitzber. Akad. Wissenschaften*, 1105; 1884.

Hatching Experiments on the Potato Eelworm (*Heterodera schachtii*)

DURING the course of our research on the potato eelworm (*H. schachtii*) we have established the fact that the root excretion of potatoes growing in recently sterilised soil does not possess the power of inducing hatching of eelworm eggs in the normal manner. In other words, we have found that when eelworm cysts are added to sterilised soil, the hatching of the eggs in these cysts does not commence for a considerable time afterwards although potatoes are growing in the soil. The period elapsing before hatching commences is greatest in very recently sterilised soil and gradually becomes less according as the interval between sterilisation and planting time is increased. This has been proved in the laboratory by hatching experiments (with large numbers of cysts) in which leachings from soil sterilised at different times and growing potatoes have been used. The effect of this delayed hatching is showing up very markedly in pot experiments. From our research it is obvious that, where hatching is delayed, the plants get a chance of making some growth and establishing a good root system before attack by the newly hatched larvæ. The onset of eelworm attack only when a good root system has been established does not seem to have much effect on the further growth or productivity of the plants.

In view of what we have found with sterilised soil, it appears reasonable to suggest that a somewhat similar condition of affairs may sometimes obtain in the field, where, due to one cause or another, plants make some growth and establish a good root system before the onset of eelworm attack. It appears that if hatching is delayed for even a short period after the plants commence to grow, the obvious symptoms of potato sickness do not develop to any extent.

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June 7.

Second Occurrence of the Whale-Shark (*Rhineodon typus*) in South Africa

IN April 1828 the first known specimen of the whale-shark was harpooned in Table Bay, and was described by Dr. Andrew Smith. Since then no other specimen had been reported from South African waters until one came ashore at Easter this year. It was found stranded on the sands at Kommetje Bay (on the west side of the Cape Peninsula) on April 2, but unfortunately was not reported to the Museum until three weeks later. The total length was 20 feet. Most of the skin of the upper half of the body, and also the head and fins were saved, from which it will be possible to investigate certain anatomical features which hitherto have been unknown or in need of verification. A description of these will appear later in the *Annals* of this Museum.

K. H. BARNARD.

South African Museum,
Cape Town.
May 16.

The Australian Oyster

IN an abstract of my paper entitled "The Life History of the Australian Oyster, *Ostrea commercialis*"[1] an error was made in referring to the temperature of the water when oysters spawned at Port Macquarie, New South Wales. The temperature of 72°–76° F., given in the abstract as the spawning temperature, refers to that which prevailed for the most part during the six weeks prior to spawning. When the oysters actually spawned, the temperature of the water in contact with them was 68° F.; the water was two feet deep and the surface temperature was 70° F.

T. C. ROUGHLEY.

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Harris Street, Sydney.
April 27.

[1] NATURE, **133**, 332, March 3, 1934.

Research Items

Yurok Marriage. From an analysis of a large number of genealogies of the Yurok of the lower Klamath River, north-west California, Messrs. T. T. Waterman and A. L. Kroeber have compiled a marriage census, which reveals some interesting facts relating to their marriage system and incidentally affords an example of a mechanism by which a patrilineal culture might become converted to a matrilineal (*Univ. California, Pub. Amer. Archæol. and Ethnol.*, **35**, No. 1). Two types of marriage are recognised, 'full marriage' and 'half-marriage'. In the former the man 'pays' for his wife and takes her to live in his town and his house. In 'half-marriage', the man pays less, normally about half the value of his bride, and goes to live with his bride, either in her father's house or nearby. He is more or less under his father-in-law's direction and the children belong to his wife's family, their bride-price or any blood money going to his father-in-law, or in the event of his decease, to his wife's brothers. In 'full marriage' the children belong to the husband, and he retains them in the event of divorce, if he refuses to accept the refund of the marriage payment. 'Half-marriage' is perfectly legitimate and carries no disapprobation; but it indicates a lack of wealth and connotes a relatively low social standing in a society which equates wealth and rank. The census count shows about 23 per cent of marriages of the half-type, suggesting that either the plebs was small or that only part of it 'half-married'. In fact, it is clear that 'full marriage' was of greater frequency than the incidence of aristocracy. It is also evident that the influence of social status was sufficiently strong to lead to the avoidance of 'half-marriage' except from necessity. Mere economy was no adequate motive. In certain cases, however, wealthy parents without male children might persuade a son-in-law to live with them on condition that he became the heir, and a declaration making this clear accompanied the acceptance of the half-payment.

Some American Gobies. Mr. Isaac Ginsburg gives a detailed account of certain gobies, very common on the east coast of the United States as well as on the coast of the Gulf of Mexico, which are important members of the littoral marine fauna (*Bull. Bingham Ocean. Coll.*, **4**, Dec. 1933). In the genus *Gobiosoma* there are no scales (except for two scales at the base of the caudal fin in two sub-genera) and hitherto the common species have been separated into two only, according to the geographical range, one from the Atlantic coast of the United States and one from the Gulf Coast. It is here shown that several species are represented, three of which are common on the east coast of the United States, and their ranges overlap freely: *Gobiosoma ginsburgi* from Massachusetts to South Carolina, *G. bosci* (including *molestum*) from Long Island to Mexico, and *G. robustum* from Florida to Brazil. Closely related genera show a complete transition to the scaleless forms. Thus in *Aboma* the body is entirely covered with scales; in *Garmannia paradoxa*, the genotype, the scales are present only on the posterior half, from a line somewhat behind the origin of the second dorsal; in *Tigrigobius* (established originally as a sub-genus of *Gobiosoma*) the scales are still further reduced to a small patch on the caudal peduncle, and four scales on the caudal fin at its base (the four scales being also present in *Garmannia*); in *Gerhardinus* as well as *Dilepidion*, here regarded as sub-genera of *Gobiosoma*, the scales are reduced to two on the caudal fin at its base. A study of sex ratio in the commonest species shows that there is a preponderance of males in the catches, but, as is explained in the text, this may be due to the smaller size of the females.

Variation in American Fresh-water Gastropods. An intensive study of variation in *Goniobasis virginica* and *Ancula carinata* under natural conditions by Joshua L. Bailey, Jr., Raymond Pearl and Charles P. Winsor is published in three parts in *Biologia Generalis* (Band 8, Lief. 2 (Schlusslief.), 1932; Band 9, Lief. 2, 1933 and Band 9, 2 Hälfte (Verslugs–Festschrift), 1933). For this elaborate work two North American molluscs, closely related but belonging to distinct species, are chosen, both of which vary greatly under normal conditions in their natural habitats. The problem was to find the extent or degree of variation in both species in different defined localities within a small defined geographical region, and the relation between any local differences which may be discovered in these forms and measurable factors in the narrowly delimited local environment. The authors conclude that erosion is probably primarily physical, being caused by the silt particles carried by suspension in the water, and that the larger the snail the greater the erosion. Also that the size of the shells seems to be influenced by chlorine, but to a larger extent by the food supply, and that the silt in autumn tends to affect the size adversely, being finer at that time of year and lessening the growth of the algal food and also not being so effective a triturating agent in the stomach of the snail as are the larger sand particles deposited in the earlier part of the year.

Recent and Fossil Foraminifera. Both recent and fossil Foraminifera are dealt with in two of the latest parts of the "Discovery" reports (vol. 3, 1933, "Fossil Foraminifera from the Burdwood Bank and their Geological Significance" by W. A. Macfadgen and "Foraminifera, Part 2, South Georgia" by Arthur Earland). Mr. Earland continues the account of the recent forms. The first part having described the bottom deposits from the Falkland Islands and adjacent area, the present part is on those of the islands of South Georgia and the outlying Shag Rocks, situated some 800 miles to the eastward of the Falklands in the Southern Ocean. He finds the two areas very different although there is no great difference in latitude. South Georgia, lying outside the influence of the Pacific warm water and surrounded by the cold antarctic current flowing northwards, is within the region of the pack-ice, and rises more or less abruptly from deep water, the coastal deposits and bottom faunas being quite unlike those of the Falkland Islands. Many of the species in the coastal fauna are of a distinct type and several are new, while in the deeper water they are more or less identical with those at similar depths in all seas. The existence of really siliceous Foraminifera, except fossil forms, has always been a matter of uncertainty but is shown by Mr. Earland to be a fact, the author defining the term 'siliceous' as meaning "capable of resisting the action of strong acids

without structural change". Three of these acid resisting species have been found in the South Georgian material.

Guinea Worm in China. The occurrence of guinea worm, *Dracunculus medinensis*, in China, has apparently been reported only once, namely, in the tarsus of a horse in Tientsin in 1888, but as the horse had been brought from India it was uncertain where the worm had been acquired. In a recent issue of the *Chinese Medical Journal* (**47**, No. 11–12, 1933), dedicated to the memory of the late Prof. Fülleborn, H. F. Hsü and J. Y. C. Watt record observations on two dogs, both born in Peiping, which were found respectively in August and September 1933 to be harbouring guinea worm. In the first dog, which was one year old, four female worms were present, their anterior ends being observed respectively in the lower jaw, between the toes of the left fore foot, between the toes of the right fore foot and in the lower part of the left hind leg. The first of these worms was discharging larvæ. In the second dog, one year and one month old, one female worm, discharging larvæ, was present in the lower part of the left fore-leg. In Peiping the water of ponds and lakes is frozen from December until March and the authors therefore conclude that the development of sexual maturity in the worm requires at a minimum eight months and at a maximum one year. Four species of *Cyclops* were placed in dishes with actively moving larvæ from the female worms; the larvæ entered all four species. The authors had the intention of keeping the infected *Cyclops* alive for more than five weeks to permit the full development of the larvæ and to feed the infected *Cyclops* to dogs and in this way to complete the life-cycle, but the *Cyclops* died in less than five weeks.

Distribution of *Zostera*. R. W. Butcher has summarised (*J. Con. Internat. l'Explor. Mer.*, **9**, 1934) the present condition and distribution of the various forms of *Zostera* on the English coast. Marked diminution of *Zostera* beds has been noticed for many years in certain localities and more particularly since 1918, that is, for many years before the disease was recorded in America. While in some places the plant has disappeared altogether, in others it is the large-leaved type-form of *Zostera marina*, L., which has suffered, and this has been replaced by narrow-leaved forms usually referred to as *Zostera marina*, var. *angustifolia*, Hornem. This form is sometimes considered to be *Zostera marina* × *nana*, but the author states there is no evidence of any of the chief taxonomic characters of *Z. nana* in such plants. In several places, where an epidemic was noticed in 1931 or 1932, the plants now seem to be recovering and healthy. No evidence of the cause of the disappearance of *Zostera* is produced, though the author suggests that a change in the nature of the substratum is one of the chief contributory factors.

Coal from the Lancashire Coalfield. The Fuel Research Board has just published No. 32 of its Survey Papers, containing a detailed report upon nineteen samples from seven distinct coal seams of the Lancashire coalfield. The seams are for the most part thin but variable, and all of them appear to consist of coking coals. It may be noted that considerable attention has been paid by the Research Board to the Lancashire coalfield, no less than seven reports on this field having been already published. The seams dealt with in this report have been in part dealt with in Report No. 19, which discusses the same seams in a different area of the coalfield. The work, as usual, has been done most carefully. The samples taken are in practically every case pillar samples cut from the seam *in situ* and representing it from the floor to the roof, and the report gives, in addition to the approximate and ultimate analyses of the coal, the amount of sulphur present, the calorific value, the melting point of the ash, the caking index and carbonisation assays, generally as obtained by means of the Gray-King apparatus. It may be pointed out that the seams dealt with in this report are all seams in the Lower Coal Measures and one even in the Millstone Grit. It is stated repeatedly in the report that the correlation of the seams offers considerable difficulty, but the method of using spores for correlation, although referred to in Paper No. 17 and recently applied advantageously by Dr. Raistrick in the Northumberland and Durham area, does not appear to have been employed in this report.

Map Projections. The presidential address of Dr. G. S. Adams, retiring president of the Philosophical Society of Washington, appears in the *Journal of the Washington Academy of Sciences* (**24**, No. 5, May 15, 1934). The principal map projections in common use are reviewed in this address and Dr. Adams describes a series of his own solutions to the problem of providing more accurate graticules for geodetic work. They are derived by projecting from the ellipsoid of revolution on to a sphere of equal surface and thence to a plane. The plane conformal projection is developed by means of the properties of the *sm w* elliptic function to give seven conformal graticules in various polygons. Cahill's butterfly map and its gnomonic variant are mentioned. The address ends with a brief account of the various co-ordinate systems devised and computed by the U.S.A. Geodetic Survey for linking cadastral surveys in the various States; these are based either on Lambert's conformal with two standard parallels or the transverse Mercator.

Wind Tunnel Interference Effects. A comprehensive survey of the interference effects of either the rigid walls of a closed tunnel, or the free surface of an open jet, upon models of aircraft wings, bodies, or airscrews has recently been published (Aeronautical Research Committee R. and M. No. 1566; "Wind Tunnel Interference on Wings, Bodies and Airscrews". By H. Glauert. Pp. 75+34 diagrams. London: H.M. Stationery Office, 1933. 4*s*. 6*d*. net). The effects are not only discussed but also the basis of the theoretical treatment is examined critically. Experimental results are quoted when necessary to justify formulæ used, or as a derivation of empirical values which sometimes have to serve to complete theoretical analysis. These are finally summed up in tables and figures which should be invaluable to users of wind tunnels for practical application of the correction formulæ. The limited extent of the artificial stream of a wind tunnel of either type inevitably leads to some constraint of the flow and to some interference with the behaviour of a model tested. This interference could be minimised by using very small models, but it is desirable for many reasons that the model should be as large as possible. One of the most important of these is the impossibility of faithful reproduction of detail construction to very small scales. The study of wind tunnel

interference is therefore of great importance. The application of the knowledge collected and collated in this report should extend the field of investigation available to all existing wind tunnels, and it must appeal to everyone concerned with the use of this particular instrument of aeronautical research. An extensive bibliography of relevant literature is included with references to the text as necessary.

Nuclear Transmutations with Heavy Hydrogen. Two papers on nuclear reactions produced by high-speed ions of heavy hydrogen have recently appeared (*Proc. Roy. Soc.*, A, May). In the paper by M. L. E. Oliphant, P. Harteck and Lord Rutherford, diplons (H^2 nuclei) are made to collide with diplogen nuclei (used as ND_4Cl and D_3PO_4), the velocities corresponding to a maximum of 400 kv. Experiment has revealed no action when D is bombarded with α-particles or protons. With the D bombardment, there was a large emission of particles falling equally into groups of ranges 14·3 cm. and 1·6 cm. The reaction assumed for this is

$$_1D^2 + {}_1D^2 \rightarrow {}_2He^4 \rightarrow {}_1H^1 + {}_1H^3,$$

the $_1H^1$ and $_1H^3$ particles forming the two groups. There is furthermore a large emission of neutrons, apparently homogeneous in velocity, and ascribed to the reaction

$$_1D^2 + {}_1D^2 \rightarrow {}_2He^4 \rightarrow {}_2He^3 + {}_0n^1.$$

The *Physical Review* for May 1 contains a letter from G. P. Harnwell, H. D. Smyth, S. N. Van Voorhis and J. B. H. Kuper in which the production of a hydrogen isotope of mass 3 by the first of these reactions has been confirmed by a mass-spectrograph analysis of a heavy hydrogen sample which had been exposed to a heavy discharge in a 50–80 kv. canal ray tube. (See also NATURE, **133**, 413, March 17; and **133**, 564, April 14, 1934.) J. D. Cockcroft and E. T. S. Walton (*Proc. Roy. Soc.*, A, May) describe the result of diplon bombardment of lithium, boron and carbon at voltages up to 700 kv. Lithium gives a proton group of 30·5 cm. range, which is ascribed to the reaction

$$_3Li^6 + {}_1D^2 \rightarrow {}_3Li^7 + {}_1H^1$$

the energy changes being roughly consistent with the known masses of the nuclei. Carbon gives protons with range 14 cm. (and probably γ-rays). Boron gives particles and several proton groups with ranges up to 92 cm., these being probably due to the conversion of B^{16} into B^{11}. Investigations on a number of heavy elements gave proton groups which were probably due to adsorbed layers of impurity.

Aluminosilicate Framework Structures. W. H. Taylor has recently given an account of the aluminosilicate framework structures which include the felspars, zeolites and other crystals (*Proc. Roy. Soc.*, A, June). In these structures the silicon and aluminium atoms lie at the centres of tetrahedra of oxygen atoms, and all the corner oxygen atoms are shared between tetrahedra. All the frameworks contain as a secondary unit a ring of four tetrahedra; most of the frameworks are three-dimensionally infinite, but in some zeolites it is probable that the framework is two-dimensionally infinite but of finite thickness. The framework constitutes an extended anion, and cations fitting into the framework may undergo isomorphous replacement of two types represented by $KSi \rightleftarrows BaAl$ and $Ba \rightleftarrows K_2$ respectively. The latter type of replacement is only possible when there are cavities within the structure to accommodate the increased number of potassium ions. The zeolites have peculiar properties of easy dehydration and rehydration—the tetrahedral framework is not dependent on the water molecules, but the latter fit beautifully into the framework if they are assumed to have the tetrahedral arrangement of bonds suggested by Bernal and Fowler.

Electrolytic Conductivity of Alkaline Earth Chlorides. Accurate measurements of the conductivities of some uni-univalent electrolytes have confirmed the Onsager conductance formula as a limiting equation. T. Shedlovsky and A. S. Brown (*J. Amer. Chem. Soc.*, May) describe experiments with the chlorides of magnesium, calcium, strontium and barium at concentrations (C) up to 0·1 normal. The results were considered in relation to the equation $\Lambda_0 = (\Lambda + \beta\sqrt{C})/(1 - \alpha\sqrt{C}) - BC$, where B, α and β are constants and Λ, Λ_0 are the equivalent conductances at concentration C and zero concentration, respectively. This equation reduces to Onsager's equation as a limiting form ($C \rightarrow 0$). The plot of the first term on the right (called Λ'_0) against C did not give perfectly straight lines, although the systematic deviations were not large, and the values of Λ_0 extrapolated agreed with those found by linear extrapolation from plots of Λ against $\sqrt{C}$ for measurements on the very dilute solutions. The data show that the equation for finite concentrations should be $\Lambda'_0 = \Lambda_0 + BC + DC \log C - EC^2$, in which D and E are constants. This result had been predicted theoretically by Onsager as the next approximation to the limiting law. The results thus confirm the Onsager equation as a limiting law for these electrolytes (bi-univalent). A relation with the sizes of the ions is also found.

Analysis of Stellar Variations. A new method of analysing stellar variability has been suggested by Prof. E. A. Milne (*Mon. Not. Roy. Astro. Soc.*, **94**, 418; 1934). Although intended originally to apply to pulsating variables of the Cepheid type, it promises to be of great value in the case of variable stars of all types. It is based on the theoretical relationship between radius (r), luminosity (L) and mass (M). In the case of any individual star, M is obviously constant, and if simultaneous observations of r and L are made, a characteristic curve may be plotted showing the relative variations of these quantities. Actually r and L are not observed directly, but r may be deduced from observed radial velocities by integrating with respect to time (after allowing for the velocity of the centre of gravity of the star and for the differing velocities of approach of different regions of the disc) if an approximate mean value of r is assumed. L is derived simply from radiometric observations. It is suggested that log r be plotted against log L, giving a characteristic curve which (in the case of regular periodic variables) will be a closed curve approaching the elliptical in form. Such curves give considerable insight into phase relations and the period-luminosity law. They also illustrate in a striking way certain features in pulsating variables, such as the coincidence of maximum L with maximum surface velocity. Some preliminary applications are made by the author, sufficient to show its possibilities in increasing our understanding of the nature and origin of stellar variation.

Position of Caste in India

AN instructive review of a situation difficult to gauge with detachment was prepared by Sir Claude Hill for the Friday evening discourse on "Society and Caste in the India of To-day" which was to have been delivered at the Royal Institution on March 9. The discourse was never delivered, for Sir Claude was taken ill and died on April 20, but it is now available in the *Proceedings of the Royal Institution*, vol. 28, pt. 2, p. 251. It is generally admitted that the present reaction of Hinduism to the introduction of Western conditions and ideas and its effect on the future of the caste system is one of the most important, and at the same time obscure, factors in the Indian political situation.

Sir Claude, in his preliminary account of the origin and characteristic features of caste, lays stress on the fact that this system, imposed for the preservation of the racial purity of the invading Aryans—a function which he aptly compares with that of the restrictions laid by Moses on the Israelites—notwithstanding efforts at reform such as Buddhism, Brahmo Samaj and other movements which he mentions, has adhered rigidly to its main purpose in the demarcation of the grades of society and the regulation of their intercourse. He refers more particularly to two examples which show the strength of caste feeling as against considerations which in other circumstances might be expected to carry preponderant weight. Of these, one is the remarkable position of the Chitpávan Brahmins, who, although they are said to have originated from castaways on the west coast, a tradition supported by their physical characters, have attained a dominant position in Brahminism on the strength of their claim to have sprung from the head of Brahma. The second instance is that of Mr. Gandhi, who, not being a Brahmin, but a Banya by caste, after attaining a position of pre-eminence in leadership such as has not been known for centuries, lost influence entirely when he took up the cause of the Untouchables, not as a political measure, but as an attack on the caste system.

There is, Sir Claude goes on to point out, a curious paradox in modern India. Young India, the intelligentsia class, has imbibed the democratic ideas of John Stuart Mill and Marx, yet clings with an almost fantastic tenacity to the ancient garment of Hindu social philosophy. Superficially, the West has made its mark on the face of Indian society. Sir Claude, in common with other observers, noted the marriages into higher and lower castes or even outside the pale of caste, the ignoring of caste in travel on railways and other like unwelcome departures from 'the ordained path'; but he holds that it would be a mistake to regard these incidents as portending any fundamental change of outlook on the part of the overwhelming mass of the people.

Sir Claude very rightly points to the unchanged position of the village Brahmin, upon whom in the rural community, who form 90 per cent of the population, Hindus of every caste depend for the ceremonial observances which accompany every stage of their life from the cradle to the grave. The undoubted revolt against Brahminical dominance is, he maintains, entirely confined to the political arena, but in the social field the situation remains substantially the same.

On the other hand, while emphasising the extent to which the Indian political problem during the past four years has been complicated by the caste system, Sir Claude also stresses the fact that many highly cultured Brahmins in various parts of India are making noble efforts for social reform by endeavouring to modernise traditional prejudices. Social reform is being advocated by all grades of Indian society, but the leaven is working slowly, especially when compared with the rate of political change. In summing up the position, Sir Claude was of opinion that contact with the outside world will in course of time produce a transformation, but that in so far as we of the Western world are concerned, our help will best be given by an attitude of sympathetic understanding.

International Universities Conference at Oxford

THE Association of University Teachers took the initiative in convening an International Conference of university representatives which took place at University College, Oxford, on June 29–July 2. The conference was called for the discussion of general problems of university organisation and development in the light of the experience of different countries and it was, so far as is known, the first definite effort to establish some measure of international association between universities for the specific purpose of considering university affairs.

Forty universities abroad and in the Dominions appointed delegates to attend the Conference, as well as certain university associations, while British universities were represented by the Council members of the Association of University Teachers and by delegates from Oxford, Scotland and the British Federation of University Women. It was gratifying to observe that among the foreign representatives were included the presidents of both the French and the German University Federations and the vice-president of the Association of American Professors.

The proceedings began with a dinner in University College on June 29, at which the foreign delegates and those of Oxford, Sir Michael Sadler and Mr. George Smith with the Warden of All Souls College, were the guests of the Council of the Association of University Teachers.

The first day of the Conference was devoted to a series of accounts of the origin, constitution and aims of the university associations which already exist, given by representatives of each association. These included associations in England, Scotland, France, Germany, the United States, Hungary, Switzerland and Mysore; but the Swedish and Italian associations unfortunately could not be represented.

It is evident that the principle of association between teachers in universities is of recent origin and has not yet spread far, but in each of the cases mentioned the existing associations are flourishing and useful institutions, keenly appreciated by their members. It is to be hoped that the publication of this series of reports may do something to encourage the foundation of similar associations elsewhere.

On the second day the Conference divided into four commissions, dealing respectively with: (1) overcrowding in universities; (2) vocational training in universities; (3) co-ordination of the machinery

of interchange of teachers; (4) adult education in the universities. Reports from these sections were presented by the sectional leaders to the Conference for discussion on the last morning.

In general, it may be said that there was abundant evidence of interest in the very varied experiences and opinions revealed in these informal discussions. At a first conference the procedure must obviously be exploratory, but nevertheless there was a movement to set on foot international committees to deal with both of the questions, overcrowding and exchange, in which concerted action seems to be specially indicated.

These committees were not actually instituted by the present Conference, which felt that the ground should be explored further with fuller material in hand before action is taken. In order to prepare for this, the Conference resolved that an International Conference Committee should be instituted and that the university associations in each country, or single national universities where such exist, or *ad hoc* committees in other countries, be invited to nominate an officer to act as a member of this committee, the duty of which will be to maintain international contacts and prepare material for future conferences. Prof. R. C. McLean of University College, Cardiff, was appointed by the Conference to act as secretary of this committee.

The Conference then agreed to accept provisional invitations from France for 1935 and from Germany for 1936 as the scenes of the next two Conferences.

The Warden and fellows of All Souls gave an evening reception at which the Vice-Chancellor, who was unavoidably absent from Oxford, was represented by the Right Hon. H. A. L. Fisher, the Master of New College. The Conference was concluded by an address from Prof. Gilbert Murray, in which he emphasised the duty of university people to uphold ethical standards and freedom in the pursuit of truth.

The movement thus initiated promises well for the future co-operation between universities in different lands, and it is greatly to be hoped that these periodical conferences will establish themselves as a permanent and valuable feature of international organisation.

Sixteenth International Congress of Agriculture

THE sixteenth International Congress of Agriculture was held at Budapest on June 13–20 under the presidency of the Marquis de Vogué, president of the International Commission of Agriculture, and was attended by about 1,100 members. The fifteenth Congress had taken place at Prague in June 1931 and the fourteenth at Bucharest in 1929, it having been the intention up to the present to convene such gatherings every two years. Actually ten meetings took place prior to the War, and a further six have taken place since. The seat of the international organising committee is at Paris where the inaugural meeting was held in 1895, to be followed by a second (which actually, however, must rank as the first proper) meeting at Budapest in 1896, which year marked the thousandth anniversary of the existence of Hungary as a nation.

Consequently, after an interval of thirty-eight years, Budapest has been once more chosen as the venue for the Congress. At the preceding one, held at Prague, attention was focused on the then most pressing problem of the moment, namely, the agricultural crisis and methods to be recommended for combating it and minimising its evil effects. The programme of work at the recent Congress was subdivided into eight sections, namely, (1) agricultural economics, (2) rural education, (3) co-operation, (4) crop production, (5) viticulture, (6) live-stock production, (7) agricultural industries and (8) consideration of the part played by women in the farming community and in farming life.

The principal paper in section 1 was that by Prof. Ernest Laur, director of the Union suisse des paysans, on the reorganisation of present-day agriculture and, in view of the persistence of the agricultural depression in almost all countries of the world as well as the severity of its incidence, the subject of his contribution must be considered as the principal and most important topic discussed at this Congress. Prof. Laur, at the conclusion of his paper, put forward various recommendations, forming part of a proposed agricultural policy, amongst which were that the consumption of fats of animal origin, and especially butter, should be encouraged by private or State measures in order to combat the growing consumption of vegetable fats, which in turn has restricted the consumption of cereals and been one of the principal causes of the accumulation of cereal stocks with resulting price debasement.

The other papers in section 1 dealt with the influence of mechanisation on agriculture and with the organisation of a proposed international live-stock market.

At the Prague Congress the attendance was about 1,200, including 563 participants from European countries other than Czecho-Slovakia and from non-European countries, and this total represented the highest attendance reached at any meeting held up to date. The Budapest Congress showed an attendance of 72 official delegates of various Governments, 19 delegates representing international organisations, and about 1,028 individual members. Great Britain was only represented by some fifteen of the latter and such a poor representation is, in the opinion of the writer of this article, very much to be regretted, the more especially as the same state of affairs prevailed at the two previous congresses at Bucharest and Prague.

Most of the countries taking part in these congresses are, in the main, agricultural exporting countries, whereas England is, as is well known, a heavy importer of agricultural produce. In order therefore that her views and difficulties as such should be properly stated and justified, it is essential that she should be adequately represented at these international congresses, which assume more and more importance as time goes on. Failure to do so is liable to result in judgment going by default.

At the termination of the Congress a choice of agricultural excursions was offered to all members, that to the Hungarian university town of Szeged and to the Government stud farm at Mezöhegyes being of especial interest.

At the closing session the Congress resolved that from now onwards meetings should be held at intervals of three instead of two years, as previously intended, and that the venue for the next congress should not be decided until next year.

Association of Technical Institutions

PAPERS read before the annual summer meeting of the Association of Technical Institutions, held at Brighton on June 22–23, included "Apprenticeship and the Irish Apprenticeship Act", by Mr. R. R. Butler, of the Aston Technical College; "National Scheme of Foundry Education", by Mr. J. G. Pearce, director of the British Cast Iron Research Association; and "The Function and Operation of Junior Instruction Centres", by Mr. Valentine A. Bell. Mr. Bell's paper insisted that the work of the Juvenile Instruction Centres has consistently followed the general purpose of preventing "demoralisation likely to result from unemployment" and "facilitating the absorption of boys and girls into employment as soon as opportunity may occur". Mr. Bell, who has visited these centres in various parts of the country, dealt with criticism levelled against them. He did not fail to stress difficulties such as those of staff recruitment (since "there was no guarantee as to how long the centres would remain open, it was difficult to find men who had permanent jobs to take up this new work"), but his answer to the criticism so often made, namely, little good can be done where the average length of stay per student is only three weeks, is to the point: "Those who merely study statistics are easily inveigled into making rash statements. . . . I may have had 10,000 through my Centre during the past four years. Thousands may have found work within a week, but hundreds have stayed with me for six months or more, yet the average may work out at only four weeks."

Very closely allied to Mr. Bell's paper was an address given by Mr. F. N. Tribe, of the Ministry of Labour, who dealt with the educational provisions of the Unemployment Bill. He pointed out that the Royal Commission on Unemployment Insurance recommended that the gap between the school-leaving age and the age of entry into insurance should be bridged by lowering the age of entry into unemployment insurance to correspond with the statutory school-leaving age. The recommendation avoided any stereotyping of age fourteen years as the proper age for leaving and suggested that contributions should be credited in respect of voluntary full-time education, and that attendance at a course of instruction should be a normal condition for the receipt of benefit by anyone less than eighteen years of age. These conditions have been accepted by the Government.

Mr. R. R. Butler indicated that while laws governing apprenticeship are in operation in Germany, Denmark, Hungary, South Africa, New Zealand, Ontario and the Irish Free State, no similar national system has been considered desirable in England. It is clear that, under rationalised conditions in industry, it is no longer possible for a master craftsman to educate his apprentice. Under conditions of mechanisation, the duties of apprenticeship fall increasingly on technical colleges. He urged an increase in full- and part-time day technical colleges and an extension of the junior trade schools on a national basis. These steps become the more necessary if, in England, we are not prepared, like the Irish Free State (Act of 1931) to adopt a legal system of apprenticeship. In any scheme, however, training for specialised jobs will be of less importance than training for adaptability to changing processes.

Mr. J. G. Pearce also underlined the importance of adaptability of mind and the power to reason correctly about the new facts and circumstances which are continually arising. The old distinction between the man of theory and the man of practice, he said, is fast disappearing. He went on to describe a national scheme of education for the founding industry. A school for training those who have already experience in the industry to be managers, foundry engineers, chemists and metallurgists is to be opened at Birmingham Central Technical College in October 1935 if sufficient students are forthcoming.

Annual Conference of the Museums Association

THE forty-fifth annual Conference of the Museums Association was held at Bristol on July 2–7, by invitation of the Lord Mayor and Corporation. The meetings were held in the Museum and Art Gallery, but the University authorities very kindly granted the delegates additional facilities. The Conference was very well attended and some two hundred and thirty members of the Association met under the presidency of Dr. Cyril Fox, director of the National Museum of Wales.

In his presidential address, Dr. Fox, in the first place, dealt with the progress of the Association during the year and the great developments at home and in the Dominions due to the generosity of the Carnegie Corporation of New York and the Carnegie Trust in Great Britain. He commented also on the firm and practical basis upon which the diploma scheme and the educational policy of the Association now rest. The main part of his address, however, was occupied by a plea for a National Folk Museum in Great Britain. After describing a typical Continental open-air museum (that of Skansen, Stockholm) he emphasised its advantages and cultural effect. Dr. Fox also stressed the additional establishment of regional open-air museums to illustrate local aspects of general culture. He urged provincial curators to collect in the meantime the fast-disappearing furnishings and implements of local interest.

Following the presidential address, Dr. R. E. M. Wheeler opened a discussion on folk museums, in which he divulged that the Departmental Committee, set up according to the recommendations of the Royal Commission on National Museums and Galleries, has come to the conclusion that the National Folk Museum should be in London, about 10–15 acres in size, and should consist of a museum containing folk-material and an open-air coherent village-group illustrative of English country life before the Industrial Revolution.

In the afternoon Mr. J. E. Barton interested and amused the delegates with a paper on "The Education of Public Taste" and Mr. H. W. Maxwell described the steps that have been taken during his directorship to modernise the Bristol Museum and Art Gallery.

The whole of Wednesday morning was devoted to more scientific subjects. Dr. F. S. Wallis, speaking on "The Popularisation of Geology", suggested simpler labelling, more life-reconstructions of extinct animals, and less truly systematic arrangement of specimens. Dr. F. J. North gave an excellent account of map making and the importance of map collections, especially those of the middle and later part of last century. Prof. A. E. Trueman, of Bristol, wound up the morning with a paper on "Science and the Public Museum" in which he urged a greater curatorial interest in working things illustrating the physical sciences, especially astronomy. This paper was much appreciated and evoked a good discussion which seemed to indicate that quite a number of delegates have little knowledge of recent improvements in science museums.

Thursday morning was occupied by the annual general meeting, but afterwards seven members of a delegation of the Association to the recent American Museums Conference at Toronto gave their impressions gained upon the tour. They were informative and entertaining, and showed a respect for much American museum technique and even for such diverse things as American petrol stations and cemeteries. In the afternoon the delegates were conducted round the various University departmental museums by their honorary curators.

The morning of the last day was devoted to short papers by Prof. L. P. W. Renouf, of Cork, on "Stamps as Educational Exhibits", by Mr. Percy Grimshaw, of the Royal Scottish Museum, on the newly-arranged Children's Gallery in that Museum, and by an excellent demonstration by the Gaumont British Film Company of the uses of the cinema in the museum. All the meetings were well attended though there was probably less general discussion this year than is usual. It only needs to be added that there was a full trade exhibition staged in the Royal West of England Academy. Dr. Cyril Fox was re-elected president of the Association, and it was decided to accept the Belgian Government's kind invitation to hold the next conference in Brussels.

University and Educational Intelligence

LONDON.—The Court has accepted a tender of £362,579 from Messrs. Holland and Hannen and Cubitts, Ltd., for the superstructure of the first of the buildings to be erected on the University's site in Bloomsbury. A condition of the contract will be the use throughout of materials obtained from sources within the British Empire. The date for completion is March 25, 1936.

ST. ANDREWS.—The Court has appointed Dr. A. M. Taylor to be lecturer in natural philosophy, and Mr. R. Jackson to be lecturer in philosophy, in the United College.

The Sir Henry Jones Memorial Committee has offered to the University a sum of about £100 to provide annual prizes in the Department of Moral and Political Philosophy. Prof. Henry Jones held the chair of logic and metaphysics from 1891 until 1894.

The degree of D.Sc has been conferred upon R. C. Menzies for a thesis on the application of thallium compounds in organic chemistry, and upon James Stirling for a thesis entitled "A Study of Flowering in Heterostyled and Allied Species".

THE following awards for the year 1934–35 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Salters' Company :—Fellowships have been renewed to :—J. D. Rose, of Jesus College, Oxford ; C. W. Woolgar, of King's College, London. Fellowships have been awarded to :—G. Broughton, of East London College ; D. E. Wheeler, of the University of Bristol ; L. R. Barrett, of Lincoln College, Oxford. The Salters' Institute has also awarded one hundred and thirty-six grants-in-aid to young men and women employed in chemical works to facilitate their further studies.

THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 has made the following appointments to Overseas Scholarships for 1934 on the recommendation of the institutions named : *Canada*. McGill University, Montreal : Dr. E. Solomon, for research in physical chemistry at the University of Manchester, and Dr. A. H. Snell, for research in physics at the University of California. Queen's University, Kingston : Mr. W. E. Bennett, for research in physics at the University of Cambridge. University of Toronto : Dr. L. B. Pett, for research in biochemistry at the National Institute for Medical Research, London. *Australia*. University of Adelaide : Mr. L. A. T. Ballard, for research in plant physiology at the University of Cambridge. University of Melbourne : Mr. L. H. Smith, for research in organic chemistry at the University of Oxford, and Mr. D. P. R. Petrie, for research in physics at the University of Cambridge. *New Zealand*. University of New Zealand : Mr. H. Service, for research in geology at the Imperial College of Science and Technology, London. *Irish Free State*. University of Dublin : Joyce C. Hill, for research in zoology at the Strangeways Research Laboratory, Cambridge.

Science News a Century Ago

The Obelisk of Luxor

In the *Mechanics Magazine* of July 12 and 19, 1834, is an interesting account of the arrangements made for the transport to France from Egypt, a country "once great and flourishing, but now desolate and forsaken", of the famous Obelisk of Luxor. The plans for its transport were entrusted to the distinguished naval engineer, Jean Baptiste Lebas (1797–1873), who had been a student at the Ecole Polytechnique. Under his direction a special vessel was built at Toulon, the crew of which consisted of 120 seamen and 12 artisans. Commanded by Lieut. Vernniac, the vessel sailed from Toulon on April 15, 1831, arrived at Alexandria on May 3 and proceeding up the Nile, reached Luxor on July 12, when her rigging and fittings were removed. With her stern ashore, as the waters subsided she settled in the sand and sand was piled high around her sides. A section of the stern was then removed and an inclined plane was constructed to the Temple 1,500 ft. away. The obelisk was then encased in a wooden shell, one side of which was worked smooth and greased, and by means of a number of tackles and capstans the obelisk, weighing about 240 tons, was slowly lowered and drawn down the inclined plane and placed in the ship. These operations were completed by December 19, when the vessel was released from the sand and re-rigged, and on December 25 proceeded down the river. The obelisk was set up in the Place de la Concorde, Paris, by Lebas in 1836.

Karl Ludwig Harding, 1775–1834

On July 15, 1834, at Göttingen, the death occurred of Karl Ludwig Harding, whose name will always be remembered in connexion with the search for a planet between Mars and Jupiter, which led to the discovery of the asteroids. Born at Bremen in 1775, Harding was working under Schröter, "the Herschel of Germany", at Lilienthal when through the efforts of von Zach an association of twenty-four astronomers, mostly German, was formed for the search for the unknown planet. The honour of finding the first asteroid, Ceres, fell to Piazzi at Palermo on January 1, 1801, while the second, Pallas, was first seen by Olbers at Bremen on March 28, 1802. Two and a half years later, on September 2, 1804, the third, Juno, was discovered by Harding. The finding of these small planets aroused immense interest and Harding was awarded the Lalande Medal by the Paris Academy of Sciences. About the same time he was appointed professor of astronomy and director of the observatory in the University of Göttingen, where for many years Gauss was his colleague. An interesting episode in his career was recalled in NATURE of July 19, 1877, p. 237, in a reference to letters which had passed between Gauss and Laplace in 1807 when the professors at Göttingen had had to make contributions to the French Army occupying the town.

Prout and the Atomic Theory

When Francis Henry Egerton, eighth Earl of Bridgewater (1756–1829), died, he left £8,000 to be given to the author or authors, appointed by the president of the Royal Society, who should write an essay "On the Power, Wisdom, and Goodness of God, as manifested in the Creation". The writing of the essays was entrusted respectively to Sir Charles Bell, Drs. Chalmers, Kidd, Buckland, Roget and Prout and the Revs. William Whewell and William Kirby. The essays were published in 1833–35. In some cases they led to much controversy, and that by Dr. William Prout (1783–1850) on chemistry led Dr. W. C. Henry to criticise his views in the *Philosophical Magazine*. In reply to these remarks, Prout, writing from his house in Sackville Street, Piccadilly, on July 18, 1834, to the editor of the *Magazine*, said that he anticipated his opinions would provoke discussion, but that he had no time or inclination to enter into a controversy. "I have always," he said, "adopted the fundamental principle of atomic weights, or definite proportions, established by Dr. Dalton, and have always reflected with pride that this most important doctrine was first taught by an Englishman; but that I never did adopt, and I fear, never shall be able to adopt, some of the details of his atomic theory. Indeed I have always considered the atomic theory, as explained by Dr. Dalton, far less satisfactory and complete, as a whole, than his theory of gaseous bodies and of vapours; which had he done nothing else, would have placed him at the head of modern physical inquirers in this, and in every other country."

Chimneys and Chimney-Sweeping

Among the many social questions engaging attention a century ago was the wretched condition of young children employed on sweeping chimneys. In a Bill for the Better Regulation of Chimney-Sweepers and the Safer Construction of Chimneys and Flues discussed in Parliament in 1834, it was laid down that chimneys not being circular of 12 in. diameter should be not less than 14 in. by 9 in. with no angles less obtuse than 120°, and that partitions in chimneys and flues should be at least half a brick thick with joints well filled with mortar or cement. Commenting on this Bill, the *Mechanics Magazine* of July 19 said: "Should the bill, with these enactments pass into a law, something will certainly be gained to the cause of humanity, but it seems to us, notwithstanding, to be conceived altogether in a very petty spirit of legislation. The shortest, and at the same time, the only effectual way to put an end to the stifling and burning of infants in chimneys, is to prohibit absolutely and entirely the sweeping of chimneys by infants." Some years, however, passed until the age of chimney-sweepers' apprentices was raised to sixteen years, and after 1842 no one of less than twenty-one years of age was allowed to be employed on this work. The invention of the chimney-sweeping machine, which did away with the need of a person climbing the chimney, was the work of the philanthropist, Joseph Glass (1791 ?–1867), and was never patented.

Societies and Academies

LONDON

Physical Society, June 15. R. L. SMITH-ROSE and J. S. MCPETRIE: Measurement of the electrical constants of soil by a Lecher-wire method at a wave-length of 1·5 m. A parallel Lecher-wire system was set up and coupled to a source of oscillations of the desired frequency. The length of the stationary waves set up on the wires in air was measured and compared with the corresponding wave-length when the wires were immersed in the sample of soil under examination. The ratio of these wave-lengths gives directly a quantity involving both the conductivity and the dielectric constant of the soil. For conditions of normal moisture content the dielectric constant is 10 or 12, while the conductivity lies within the range $10–28 \times 10^8$ E.S.U. J. S. MCPETRIE: A determination of the electrical constants of the earth's surface at wave-lengths of 1·5 and 0·46 m. The most sensitive condition for finding the electrical constants of a substance from a study of its reflecting properties for electromagnetic waves is obtained when the radiation is incident normally on the reflector. The experiments described show that in this case the reflection coefficient of copper gauze is practically unity at both wave-lengths. There appears to be little difference in the reflecting properties of ordinary soil and soil covered by grass, probably because the bulk of the reflection takes place at a small distance below the surface. O. DARBYSHIRE: (1) A spectrometer determination of the metrical thickness and dispersive power of a thin film. By counting the numbers of Edser–Butler and Talbot bands produced within the same spectral range by a thin film of glass and a prism spectrometer, the metrical thickness of the film can be determined. The refractive index of the film for light of any standard wave-length can then be calculated from a count of the number of Talbot bands passing the position of the corresponding line in the spectrum as the Talbot echelon is rotated about the vertical edge of the film through an accurately measured angle. Two spectrometers are used in conjunction as a double-table spectrometer, and the other apparatus required is of the usual student-laboratory type. (2) Application of the theory of

the transmitting echelon to the explanation of Talbot's and Powell's bands. On the basis of the theory of the transmitting echelon, the formation and the asymmetrical character of Talbot's bands, which are produced when a plate and aperture are placed in certain positions in the beam of a prism spectroscope, are explained analytically and represented diagrammatically. R. W. POWELL : The thermal and electrical conductivity of metals and alloys : (1) Iron from 0° to 800° C. A longitudinal-flow method has been used to determine the thermal conductivity, at mean temperatures ranging from 30° to 800° C., of a nickel-plated rod of Armco iron containing approximately 99·92 per cent of iron. After allowance for the effect of the nickel plating, and extrapolation to 0° C., a value of 0·177 C.G.S. units is obtained for the thermal conductivity of the iron. This value is higher than that usually attributed to iron, but a chemically prepared iron of greater purity has been examined also and found to have a thermal conductivity of 0·194 C.G.S. units at 0° C.

DUBLIN

Royal Irish Academy, May 28. A. FARRINGTON : Glaciation of the Wicklow Mountains. Two local glaciations occurred in the area. The first was an ice cap and was earlier than the last Ivernian ice-sheet, while the second was a valley glaciation and was later than the last Ivernian maximum. Modifications in the accepted edge of the Ivernian ice sheet are suggested ; and, from the distribution of the local ice of the last phase, it is inferred that the direction of the prevailing wind was about the same as at present. The height of the snow-line of late glacial times was discussed.

PARIS

Academy of Sciences, May 23 (*C.R.*, 198, 1821–1888). P. A. DANGEARD : Notice on the work of the late Robert Chodat. GABRIEL BERTRAND and R. C. BHATTACHERJEE : The combined action of zinc and vitamins in the nutrition of animals. Results of experiments showing that vitamins cannot exert their normal action in the absence of zinc. JEAN BAPTISTE SENDERENS : The action of sulphuric acid, cold or at a moderate temperature, on the aromatic esters. From the point of view of sulphonation, sulphuric acid acts upon aromatic esters and acids similarly. E. GUYÉNOT, MLLES. K. PONSE and I. TROLLIET : The masculinising action of urine from the pregnant woman. LÉON POMEY : Unicursal involutions of the fourth order. ELISHA NETANJAHU : The term and the maximum modulus of Dirichlet's series. R. SAN JUAN : The problem of moments. EDMOND LAHAYE : A method of resolution of a category of transcendental equations. B. EDLÉN and P. SWINGS : The prohibited transitions of atoms with electronic configurations $2s^2 2p^2$, $2s^2 2p^3$, $2s^2 2p^4$, and on the interpretation of the lines of nebulæ and novæ. GEORGES POIVILLIERS : The perspective property of certain surfaces and its application to aerial phototopographic surveys. Discussion of certain cases in which distortion may arise in the course of stereotopographic surveys. AUREL POTOP : Natural convection is a very well defined phenomenon. Study of the heat loss from a small electric furnace. In the case of a furnace dissipating 0·5 watt, experiments can be repeated with an accuracy of one in five thousand. JEAN BECQUEREL, W. J. DE HAAS and J. VAN DEN HANDEL : The paramagnetic rotatory power of dysprosium ethylsulphate at very low temperatures. The experiments described represent the first case known of paramagnetic saturation. ALBERT LAMBRECHTS : The spectrographic study of phlorhizine and its derivatives. The ultra-violet spectrum of phloretine, phlorine and phloroglucinol. MLLE. SUZANNE VEIL : The systematic examination of the periodicities of precipitation by the two drop method. MLLE. M. QUINTIN : The heat of dilution of salts. The heat of dilution of copper sulphate solution has been determined by measurements of E.M.F. and application of the Gibbs-Helmholtz formula. JACQUES LEFOL : Hydrated calcium sulphoaluminate and calcium chloroaluminate. PIERRE VALLET : A recording apparatus for the study of reactions with regularly varying temperatures. This apparatus records simultaneously the variations of mass of a substance as a function of its temperature and the variations of its temperature as a function of the time on the same plate. R. SUTRA : The degradation of starch under the action of phosphoric acid, of glycerol and of acetic anhydride in the presence of sulphuric acid (acetolysis). JOSEPH HOCH : The action of organomagnesium compounds on ketoxims. L. ROYER : The structural relations which should exist between two substances *A* and *B* for *B* to modify the facies of crystals of *A*. New examples. PAUL LEMOINE, R. HUMERY and R. SOYER : The impoverishment of the stratum of green sand of the Paris region. The effects of the increase in the number of wells drawing water from the green sand. In ninety-three years the water level has been lowered 93 metres in the Seine synclinal. MIECZYSLAW PRONER : Researches on the idioblasts in the family Crassulaceæ. MAX VACHON : The act of nutrition of a pseudoscorpionid, *Chelifer cancroides*. PAUL CHABANAUD : The basisphenoidian complex and the nadiral orbital septum of the heterosome fishes. EMILE HAAS : A method for locating the retinal impressions with respect to the fovea. Application to the study of acuteness of vision at low illuminations. R. BONNET : The neuro-muscular action of amides and cyanic derivatives. From a pharmacodynamical point of view, urea behaves as an amide and not as a cyanic derivative : this is not in agreement with the Werner formula for urea. JACQUES MONOD : Galvanotropism and physiological age. MAURICE DOLADILHE : New observations on the physical properties of blood serum.

SYDNEY

Royal Society of New South Wales, December 6. A. R. PENFOLD and F. R. MORRISON : The essential oils of the genus *Calythrix*. (1) *Calythrix virgata*. The essential oils from various consignments were obtained in a yield of 0·5 per cent and possessed a very pleasant Tea Rose odour. The essential oil was found to contain *d*-*a*-pinene, citronellol and geraniol both free and combined as acetic, formic, citronellic and dehydrocitronellic acid esters. The range of chemical and physical constants of the essential oil was determined. M. B. WELCH : Some mechanical properties of Alpine ash. (1) *Eucalyptus Delegatensis*, R.T.B. (1) There is no uniform increase in strength towards the top of the tree, and in some instances the wood is decidedly weaker in the uppermost log than in the lowest. The weight per cubic foot varies from 32 lb. to 46 lb. and except for wood of low density it possesses considerable strength with a high modulus of elasticity, whilst the toughness, as indicated by the work to the maximum load, and also the elastic resilience, is

very satisfactory. The fibre stress at the proportional limit, modulus of rupture and modulus of elasticity increase comparatively regularly with the density, but the effect of density is more irregular on the work to the proportional limit and to the maximum load. J. C. EARL and A. W. MACKNEY: The action of nitrous acids on dimethylaniline (2). The substance described previously (*J. Proc. Roy. Soc. N.S.W.*, 67, 231; 1933) as the principal product from the reaction in the absence of strong acids, has now been identified as *p*-nitroso-dimethylaniline nitrate. It is difficult to obtain correct values in the estimation of nitrogen in this compound. F. P. DWYER and D. P. MELLOR: X-ray diffraction studies of the crystallisation of amorphous silica. X-ray powder photographs show that, as a result of the crystallisation of amorphous silica or opal in the presence of molten potassium chloride below 870° C., cristobalite is the first crystalline modification of silica produced. The occurrence of cristobalite as a form intermediate between amorphous silica and tridymite thus brings these transformations into line with Ostwald's principle. Cristobalite produced by heating silica gel and opal with potassium chloride at 810° C. was found to persist in the (β) high form for several months and eventually appeared to invert to (α) low tridymite. The formation of cristobalite from vitreous silica is consistent with the crystallite theory of the glassy state put forward by Randall and Rooksby. ADOLPH BOLLIGER: Volumetric micro-determination of perchlorates with methylene blue and picric acid. Perchlorates form, with methylene blue, a methylene blue perchlorate which is only slightly water soluble. By adding a known excessive amount of methylene blue the excess can be determined by titration against standardised picric acid. Complete removal of the methylene blue perchlorate formed is necessary with small amounts of perchlorate exceeding 1 mgm. A double precipitation method may be used whereby the excess of the methylene blue added is precipitated with an excess of picric acid. After filtering off the combined precipitates the remaining excess of picric acid is determined by titration with methylene blue. R. J. NOBLE: Note on the longevity of spores of the fungus *Urocystis tritici*, Koern. Chlamydospores were exposed to a series of relative humidities at 13°–31° C. for ten years. During the first two years, germination was first observed on the 50 and 64 per cent relative humidity series. No germinations were recorded at 72 per cent or 89 per cent at any time. Viability was lost at 64 per cent relative humidity after 2 years and at 50 per cent after 6 years. More than 50 per cent germination has been recorded in the 0–33·5 per cent relative humidity series each year.

Forthcoming Events

BRITISH PHARMACEUTICAL CONFERENCE, July 16–20. To be held at Leeds.

SOCIETY OF CHEMICAL INDUSTRY, July 16–20. Annual Meeting to be held at Cardiff.

July 17, Dr. J. T. Dunn: "Science and Industry—the Fertility of Ideas" (Presidential Address).

July 19, Prof. H. Freundlich: "Plasticity the Servant of Industry". Sir Harry McGowan: "The Uneven Front of Research".

July 20, Col. C. H. Bressey: "British Roads Development during the past Fifteen Years".

BRITISH MEDICAL ASSOCIATION, July 20–23. Annual General Meeting to be held at Bournemouth.

Official Publications Received

GREAT BRITAIN AND IRELAND

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 1, No. 1: Studies on the Physiology of Reproduction in the Ewe. Part 1: The Symptoms, Periodicity and Duration of Œstrus; Part 2: Changes in the Vagina and Cervix; Part 3: Gross Changes in the Ovaries. By Dr. R. Grant. Pp. 47 + 2 plates. 6*s*. 6*d*. Vol. 58, Part 1, No. 2: Notes on the Kidston Collection of Fossil Plant Slides. No. iii: Some Points in the Anatomy of *Sigillaria elegans* Brongniart; No. iv: On the Nature of the Corona and its Relationship to the Leaf-Traces in the Lepidodendreæ and Sigillariæ, with special reference to certain "Diploxyloid" Specimens in the Kidston Collection. By Dr. Mary G. Calder. Pp. 49–62+1 plate. 2*s*. Vol. 58, Part 1, No. 3: The Spermatogenesis of the Axolotl (*Amblystoma triginum*). By Robert Carrick. Pp. 63–74+3 plates. 3*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Proceedings of the Royal Society of Edinburgh, Session 1933–1934. Vol. 54, Part 1, No. 7: Spermatogenesis in *Drosophila pseudo-obscura* Frolowa. 2: The Cytological Basis of Sterility in Hybrid Males of Races A and B. By Dr. P. Ch. Koller. Pp. 67–87. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1*s*. 9*d*.

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1933. Part 1, with Report of the Geological Survey Board and Report of the Director. Pp. iii+93. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

OTHER COUNTRIES

Royal Observatory, Hong Kong. Meteorological Results, 1933. Prepared under the direction of C. W. Jeffries. Pp. iv+120. (Hong Kong: Government Printers.) 3 dollars.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 77: Studies on the Phosphorus Requirements of Sheep. 1: The Effect of a Diet deficient in Phosphorus but containing Digestible Proteins and Vitamins. By Sir Charles J. Martin and A. W. Peirce. Pp. 44+2 plates. (Melbourne: Government Printer.)

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1933. Pp. lxii+215. (Bern: Paul Haupt.)

Comparative Psychology Monographs. Vol. 10, No. 1: Modes of Behavioral Adaptation in Chimpanzee to Multiple-Choice Problems. By Robert M. Yerkes. (Serial No. 47.) Pp. 108. (Baltimore, Md.: Johns Hopkins Press.) 1.50 dollars.

Department of Science and Agriculture, Jamaica. Entomological Circular No. 14: Pests of Banana in Jamaica; Lecture delivered on the occasion of the Agricultural Open Week, held at Hope by the Department of Science and Agriculture, in July 1933. By W. H. Edwards. Pp. 20+11 plates. (Jamaica: Government Printing Office.)

Transactions of the San Diego Society of Natural History. Vol. 7, No. 30: Notes on some Types of North American Birds. By A. J. van Rossem. Pp. 347–362+plate 27. Vol. 7, No. 31: Two New Races of the Black Chachalaca from Central America. By A. J. van Rossem. Pp. 363–366. Vol. 7, No. 32: A New Race of Piranga bidentata from Central America. By A. J. van Rossem. Pp. 367–368. Vol. 7, No. 33: A Northwestern Race of the Varied Bunting. By A. J. van Rossem. Pp. 369–370. Vol. 7, No. 34: A Subspecies of the Brown Towhee from South-Central Texas. By A. J. van Rossem. Pp. 371–372. Vol. 7, No. 35: A New Form of Pocket Gopher from Southern Mons County, California. By Laurence M. Huey. Pp. 373–374. Vol. 7, No. 36: The Mammals of Southern Nevada. By William Henry Burt. Pp. 375–428. Vol. 7, No. 37: West American Species of the Genus Liotia. By A. M. Strong. Pp. 429–452+plates 28–31. Vol. 7, No. 38: Some Corrections needed in Recent Carcinological Literature. By Steve A. Glassell. Pp. 453–454. Vol. 7, No. 39: A Review of the Races of Geococcyx velox. By Robert T. Moore. Pp. 455–470. (San Diego, Calif.).

Boston Society for Psychic Research. Bulletin 22: The "Walter"–"Kerwin" Thumb Prints. Pp. 85+8 plates. (Boston, Mass.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 85. Pp. iii+438+17 plates. (Philadelphia.) 6.25 dollars.

State of Connecticut. Public Document No. 24: Fifty-sixth Report of the Connecticut Agricultural Experiment Station, New Haven, for the Year 1932. Pp. xii+832+57. (New Haven, Conn.)

Kungl. Sjokarteverket. Jordmagnetiska Publikationer Nr. 9: A Magnetic Survey of Sweden made by the Hydrographic Service in the Years 1928–1930. By Gustav S. Ljungdahl. Pp. 37+6 plates. (Stockholm.)

Smithsonian Miscellaneous Collections. Vol. 90: World Weather Records, 1921–1930. Collected from Official Sources by Dr. G. C. Simpson, Robert G. Mossman, Sir Gilbert Walker, Frances L. Clayton. Assembled and arranged for publication by H. Helm Clayton. (Publication 3218.) Pp. viii+616. (Washington, D.C.: Smithsonian Institution.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 23. (New York City.)

CATALOGUES

Alloy Steels: an Historical Survey. By Prof. Sir Harold Carpenter. (Nickel, A21.) Pp. 8. (London: The Mond Nickel Co., Ltd.)

A List of Books on all branches of Natural History. Pp. 20. (Sunninghill: Sunninghill Book Co.)

Absorptiometer for Liquids designed by Moll, Burger and Reichert. (Aso 34.) Pp. 4. Standard Thermopile of Moll and Burger. (Bolo 34.) Pp. 4. Non-Recording Microphotometer. (Nomi 34.) Pp. 2. (Delft: P. J. Kipp en Zonen.)

The Wild-Barfield Heat-Treatment Journal. Vol. 1, No. 1, June. Pp. iv+14. (London: Wild-Barfield Electric Furnaces, Ltd.)

The National Park of the Gran Paradiso. Pp. 20. The National Park of Abruzzo. Pp. 20. (London: Italian State Tourist Department.)