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Milk Supply and National Health

A FEATURE of the present-day interest in nutrition is the number of unofficial organizations which have sprung up with the object, by propaganda and other means, of directing attention to what is naturally and properly considered to be a matter of immediate public concern, and of stimulating the Government to take action on recommendations regarding nutritional needs which have been made by expert committees of the League of Nations, the Ministry of Health and other authoritative bodies.

Active among these organizations is the Children's Minimum Council—a non-party body the aim of which is to secure that no child shall, by reason of the poverty of its parents, be deprived of at least the minimum of food and other requirements necessary for full health. Undeniably, widespread damage is caused to our national health by malnutrition during pregnancy and lactation and in the early years of childhood. Undeniably, also, inadequate family means among a large section of our population is the chief contributory factor to the existence of this state of affairs. Such is proved by the recent surveys of Orr, M'Gonigle, Rowntree and others.

There is much that is still controversial regarding the right nutrition of our people ; but for those who seek an early improvement in existing conditions there is one guiding principle which may be followed without fear of contradiction or misdirection. It is the indisputable value of milk for nursing mothers and children.

In a recent memorandum on "Milk for Mothers and Children under Five", the Children's Minimum Council stresses the case for cheap milk. Expert Government committees have now unanimously declared that the desirable daily amount of milk for children is from one to two pints, for expectant and nursing mothers about two pints, and for other adult members of the community half a pint. At the present average prices, a family in which there are three children taking, say, one and a half pints a day each, an expectant mother taking two pints, and a father taking half a pint, would have an average milk bill of 13*s*. 3*d*. a week. Such an expenditure is, of course, quite beyond the means of working-class families with dependent children.

Consumption of milk in working-class households is far below the amounts regarded as desirable. Statistics from all over the country show how consumption drops with falling income and with an increasing number of children in the household. Many children get little or no fresh milk. For example, a survey of more than thirteen thousand school children in the Glasgow area showed that 57·7 per cent did not drink milk at all.

The proposal of the Children's Minimum Council is that milk should be made available at 1½*d*. a pint for expectant and nursing mothers and children under school age in families covered by National Health Insurance or of equivalent economic status. Both producers and distributors should be asked to make some concession in their prices for milk supplied under the scheme, and whatever subsidy is thereafter needed to bring the price down to 1½*d*. a pint should be paid by the national Exchequer. It is estimated that there are in Great Britain about three and a half million expectant and nursing mothers and children under five. The Council argues that a yearly Government subsidy of just over one and a half million pounds would suffice to provide for an annual distribution of eighty million gallons of cheap milk among that number. This is

on the assumption that their orders for the milk would average half a pint per head per day.

Any scheme which attempts to break down the price barrier preventing an adequate consumption of milk by those who most stand in need of it deserves our attention. Nevertheless, however laudable in itself, this new scheme is but another expedient (of which there are already three in existence) to remedy an evil the root cause of which lies much deeper than the mere inability of people to pay for milk. Various State-aided schemes for the provision of cheap milk to mothers and children are already in operation under the Public Health Act of 1936, the Education Act of 1921 and the Milk Act of 1934. Admittedly there are defects and anomalies in these schemes ; but another will only bring confusion to an already complicated position and further increase the administrative difficulties of our already overburdened public health services.

The case requires more drastic handling, and demands a fundamental change in the whole statutory position which at present governs the production and marketing of milk. In the past, the Government has tended to serve the economic interests of producers at the expense of the health interests of consumers. While no one will deny a fair return to the producer, it is out of all proportion that the interests of 175,000 producers should come before those of the ten million children on whose health the future of the country depends. The time has come when the Government must take a comprehensive view, and, without fear or favour, design a unified milk policy to meet the needs of the whole community.

Genetics and Plant Breeding in the U.S.S.R.

THE fourth session of the Lenin Academy of Agricultural Sciences, held in Moscow at the end of 1936, witnessed a determined campaign against genetics as the main basis of scientific plant breeding[1]. It is only now, however, that detailed reports of some of the speeches made at the session are available, while further light is thrown upon the controversy by recent Soviet publications.

The attack was opened by a group of plant-breeding experts headed by T. D. Lysenko, a member of the Odessa Institute for Selection and Genetics. The main ideas of Lysenko do not appear to have been published in a scientific form, but they are expressed in a popular pamphlet[2] and in his speech at the session of the Academy of Agricultural Sciences[3]. They are based on no lesser, and no later, authority than that of Charles Darwin, whose teachings according to Lysenko "were unable to blossom out properly in bourgeois countries. The best Darwinists in capitalistic countries, as for example Burbank in America, as well as our revolutionaries-biologists K. A. Timiriazev and I. V. Michurin in the Czar's Russia, were lone fighters." The works and theories of de Vries, Johannsen, Bateson, Morgan, are dismissed on the strength of a few quotations from their writings, suggesting their critical attitude to some of Darwin's ideas, all of which are held by Lysenko to be the last word in biology.

The actual controversy is centred around two points of practical plant breeding. One concerns the problem of crossing and selection of self-fertilizing pure line plants. According to Lysenko, pure lines if cultivated for a long time are liable to degeneration. This can be prevented, and the line even improved, by artificial cross-fertilization within the variety. "Small field experiments" made at Odessa with some varieties of wheat have shown an increase in the yield from cross-fertilized seeds, and this was taken to be sufficient to consider the method ready for immediate introduction into practice. About 10,000 farmers on 2,000 collective farms were instructed to sterilize wheat plants by cutting stamens to prevent self-fertilization. As a result, 500–1,000 gm. of cross-fertilized seeds were obtained on each farm. "If it happens that the seeds from intra-varietal crossing should be of higher quality, should produce plants with greater yield . . . , there will be no obstacle to a rapid transformation of a kilogram of seeds on each farm into tens of tons". Since Lysenko is also practically certain (although without apparent data) that the improved plants will be more resistant to winter frosts, he urged the Academy to pay serious attention to the question of the immediate necessity of introducing the method of cross-fertilization on "at least 50–70 thousands of collective farms".

It does not appear to be safe to criticize such enthusiastic plans, containing a promise of enormous and immediate progress towards the fulfilment of Stalin's recent order for increased agricultural production. N. I. Vavilov[4], in his reply to Lysenko, merely pointed out that many pure varieties of wheat, barley, etc., have existed without any "degeneration" for centuries, and there is no need to seek to improve them by intra-varietal cross-fertilization. Even if such crossing should produce an improvement (due to heterosis), it remains to be shown that the improvement will be lasting, since usually heterosis disappears in a few generations. G. Meister[5], who summed up the discussion, very cautiously suggested that it would be premature to develop extensive practical programmes while the method is still being studied experimentally.

While this first point of the discussion was mainly concerned with a practical problem, the second presented a clash between two almost diametrically opposed fundamental conceptions of biology. The discussion developed round Lysenko's forceful statements that the external conditions under which a plant develops have a profound effect not only on the somatic, but also on the sex cells. Therefore, responses of the constitution of an individual plant to its environmental conditions are inheritable, contrary to the views of "bourgeois" geneticists. This theory is based on three incomplete years of experiments with the vernalization of winter wheat and rye; none of these experiments was carried beyond the fourth generation and the results do not appear fully conclusive[2, 5]. Nevertheless, Lysenko claims that the possibility of "changing the nature of plants" has been definitely proved, and promises in the near future to develop new varieties of winter wheat with increased cold-hardiness, of cotton requiring less heat for its growth, etc.

On the face of it, Lysenko's theory is nothing but Lamarckism in its simplest form, and this was pointed out by several speakers. Such accusations of being unfaithful to Darwinism appear, under Soviet conditions, to be tantamount to charges of high treason. Lysenko, therefore, had to insist that his theory is nothing but a development of most orthodox Darwinian views. His defence is worth quoting, since it provides a typical example of methods of discussion adopted by some Soviet scientific investigators: ". . . no work can possibly produce positive results if it starts on the basis of Lamarckism. If, by suitable breeding of plants, we have already succeeded in altering their hereditary nature in the desired direction, this alone proved that we are not Lamarckists. . . ." Lysenko insists further that he is not against the science of genetics, but "genetics as one of the most important sections of agro-biological science must be . . . remade in our Soviet way, without accepting many anti-Darwinian tendencies of fundamental genetic conceptions".

The problem of the inheritance of acquired characters has such an extensive literature and is still so far from its solution, that recent Russian work on vernalization and allied phenomena should be regarded merely as providing additional experimental data on the subject. Some of the results may be suggestive, but they certainly do not in any way justify Lysenko's assertions that the secret of "changing the nature of plants" is now discovered. These assertions would not be worth recording, were it not for the fact that they led, not to a healthy discussion, but to unscrupulous attacks on the large Russian school of geneticists deservedly appreciated by biologists in other countries. It is true that Lysenko and his colleagues veiled their attacks, for example, on Vavilov, by professing profound respect for his work; but at the same time they lost no opportunity for stressing what they consider to be anti-Darwinian tendencies in his ideas. In a country where Darwinism—as interpreted by Engels and Lenin—constitutes the ideological basis of official philosophy, arguments of this kind savour of denouncing an enemy of the State. Some practical effects of these accusations were pointed out by Meister[5], who said that certain Soviet editors already refuse to publish articles dealing with genetics, which appear to them bordering on counter-revolution. It is also perhaps not a mere coincidence that the International Genetical Congress, which should have been held in Moscow this summer, has been postponed.

On the whole, the discussions, which must have stirred very deeply all biological workers in the Soviet Union, appear to be of very limited theoretical interest. They are, however, of outstanding significance in revealing the atmosphere in which scientific investigators in totalitarian countries have to live and work.

[1] NATURE, **139**, 185 (Jan. 30, 1937).
[2] "Changing the Nature of Plants" (in Russian). Pp. 46 + 10 figs. (Moscow, 1937.)
[3] *Pod Znamenem Marxisma*, **2**, 96–118 (1937).
[4] *Front Nauki i Techniki*, **2**, 54–61 (1937).
[5] *Front Nauki i Tekniki*, **2**, 62–80 (1937).

Willard Gibbs and his Work

A Commentary on the Scientific Writings of J. Willard Gibbs, Ph.D., LL.D., formerly Professor of Mathematical Physics in Yale University.
Vol. I: Thermodynamics; dealing with the Contents of Volume One of the Collected Works. Edited by Prof. F. G. Donnan and Prof. Arthur Haas. Pp. xxiii+742. Vol. 2: Theoretical Physics; dealing with the Contents of Volume Two of the Collected Works. Edited by Prof. Arthur Haas. Pp. xx+605. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1936.) 45*s*. net.

IT is now sixty-four years since Willard Gibbs published in the *Transactions of the Connecticut Academy* the first of his classical papers on thermodynamic theory, and thirty-five since the publication of his "Elementary Principles in Statistical Mechanics".

Almost contemporaneous with the last-mentioned event was the introduction by Planck of the 'quantum of action', which was destined to revolutionize atomic and molecular physics. It is not inappropriate, now that the new theories have largely taken shape, that Gibbs's work should be rediscussed with the view of examining how much of it retains its validity in the light of modern physics.

The two volumes under review have been prepared under the auspices of Yale University, where Willard Gibbs was professor. They consist of a symposium, to which a number of distinguished workers have contributed, with the double object, first of doing honour to the memory of Willard Gibbs, secondly of providing a commentary to guide the reader of his collected works. This last indeed is very necessary, for Gibbs's own treatment is frequently far from easy to follow and, apart from this, both nomenclature and methods differ appreciably from modern practice.

In view of the above intention, Gibbs's notation has been adhered to, and the commentary begins with a very brief but very valuable note on symbols and nomenclature by Prof. F. G. Donnan, for which anyone who has lost himself in the maze of 'free energies', 'available energies' and 'thermodynamic potentials', as envisaged by various authors, will be indeed thankful.

The first volume, which is under the general editorship of Prof. Donnan and Prof. Arthur Haas, deals with the subject-matter of vol. 1 of Gibbs's Collected Works, that is, mainly with his first three classical papers.

The general theory of thermodynamics as expounded by Gibbs forms the theme of quite a number of the contributions, in particular articles (*D*) "The General Thermodynamic System of Gibbs", by J. A. V. Butler, (*G*) "The Phase Rule and Heterogeneous Equilibrium" by G. W. Morey, and (*J*) "The Fundamental Equations of Ideal Gases and Gas Mixtures" by F. G. Keyes. Prof. E. A. Milne contributes an article on the thermodynamic functions and criteria of equilibrium, and Prof. Schreinemakers one on graphical methods using the free energy function. To the same group belongs the leading article (*N*) of the second volume, "The Thermodynamic Principles as Extended and Perfected by Gibbs" by Prof. Arthur Haas.

Special subjects such as osmotic equilibrium (E. A. Guggenheim), the thermodynamics of elasticity and interface phenomena and capillarity (James Rice) are dealt with in separate articles.

There is naturally a good deal of overlap; thus Gibbs's paradox in connexion with the diffusion of two gases into one another is described and discussed by both Dr. Butler and Prof. Haas, and this is not an isolated case. On the whole, this overlapping is rather an advantage than otherwise; the differences of presentation are often complementary and illuminating.

It is, however, to be regretted that, although Gibbs's famous criteria for equilibrium are explained at least three times, namely, by Butler and by Milne in vol. 1 and by Haas in vol. 2, there appears to be nowhere an adequate discussion of their validity, at any rate in the most difficult case, that of unstable equilibrium. Butler alone attempts to deal with this case, and he follows Gibbs's own lines; but unfortunately Gibbs is here entirely unconvincing. In view of the importance of these criteria a careful and critical examination would not have been out of place.

The second volume, which deals nominally with vol. 2 of the Collected Works, contains two articles, (*N*) and (*O*), devoted to classical thermodynamics. The first has already been mentioned above. The other, by Prof. Epstein, deals with the subsequent continuation by Nernst and others of Gibbs's purely thermodynamical work.

Other articles by Leigh Page, E. B. Wilson and Arthur Haas concern Gibbs's contributions to the theory of light, to vector analysis and multiple algebra and to dynamics respectively.

The bulk of this volume is devoted to Gibbs's work on statistical mechanics, most of it being from the pen of Prof. Haas; but the last two

articles but one, by Epstein, contain a very instructive criticism and appreciation of Gibbs's work in the light of recent theories. Haas himself, at the end of article (*R*), has dealt with the derivation of the ideas of wave-mechanics from Gibbs's conception of phase-space, and the whole of this section is highly suggestive and deserves the most attentive reading.

Admirable as the "commentary" is in general, one cannot help feeling occasionally that it is itself at times in need of a commentator to clear away obscurities.

This is noticeable, for example, in the treatment of elastic solids in vol. 1 (art. *K*), which is far more difficult to follow than the usual expositions of the analysis of stress and strain in treatises on elastic theory. In one place (p. 445) the writer of the article uses as "more convenient" a set of strain-variables which do not form a tensor and which, for that reason, would be highly inconvenient for use in an isotropic solid.

Another example may be taken from vol. 2, pp. 192–203, where a number of difficulties occur. Thus (*a*) on p. 192, the reader is not told why the vanishing of $\int Dv_n df$ must involve $\frac{\partial D}{\partial t} = 0$; (*b*) on pp. 196–97, the vital assumption by Gibbs of the form $\exp\{(\psi - \varepsilon)/\Theta\}$ for P is described as "plausible"; but there are an infinity of forms for P which will ensure the convergence of the integral $\int \ldots \int P\varepsilon dq_1 \ldots dp_n$, and the reader might well expect to be told why one "plausible" form is preferred above all others; (*c*) on p. 198, the statement that $\int \ldots \int dq_1 \ldots dq_n = f(V)$ is not true unless the q's are Cartesian co-ordinates, in which case f can only be a power, as correctly stated on p. 200; (*d*) on p. 202, no explanation is given of the absence of a term in $d\Theta$ in equations (56) and (60), although $\bar{\varepsilon}$ as defined by (55) appears to be a function of Θ.

Taken as a whole, however, the commentary forms a most welcome addition to the literature of a difficult subject, and will be not only a worthy monument to one of the greatest mathematical physicists of the nineteenth century but also an excellent exposition of his ideas by some of the greatest experts in the subject at the present time. The work involved has clearly been enormous, and the editors and their collaborators have well deserved the congratulations which they undoubtedly will receive.

It is perhaps still too early, in the present fluid condition of physical science, to estimate Willard Gibbs's position in the development of theoretical physics and chemistry. Those who hope for such an estimate from these two volumes are likely to be disappointed. We are given a very full and very instructive paraphrase of Gibbs's work, and deductions from it. We are shown its connexions with contemporary and subsequent developments; but no real attempt is made to apply critical analysis to the work itself and to discriminate between the best and (at any rate) the second-best. Yet that in such a mass of new methods and results weaknesses or indeed failures must have occurred seems inevitable; even Newton was not exempt. A commentary written in a more critical spirit would certainly have done Gibbs's memory no harm and would undoubtedly have helped towards a better understanding of his work.

Even on the question of the relative value and permanence of the thermodynamics and the statistical mechanics—which represent widely different scientific philosophies—we are left in doubt. Possibly this is the unavoidable result of the symposium method, and of a natural diffidence on the part of individual contributors. But the reader puts down the book with the feeling that the final summing-up about Gibbs has yet to be written.

L. N. G. F.

The Peasant Farmers of Ireland

The Irish Countryman: an Anthropological Study. By Dr. Conrad M. Arensberg. Pp. xi+216. (London: Macmillan and Co., Ltd., 1937.) 10*s*. 6*d*. net.

DR. ARENSBERG'S anthropological study of the peasant-farmer population of western Ireland will be held to confirm their views by those who believe that much of the primitive survives in the modern Irishman. It is this element in his make-up, they would maintain, which has persisted, certainly from pre-conquest, and possibly from prehistoric, days, and lies at the root of a misunderstanding between governors and governed, dating back so far as the twelfth century and distorting, as it would appear to the Irish, the vision of Giraldus Cambrensis.

As a social anthropologist, Dr. Arensberg's approach to the culture of the west is that of the analyst of patterns of behaviour. He shows how the whole social nexus of the peasant-farmer class, with which he is dealing, nucleates in the land,

that is, in the farm holding, not merely as a matter of the internal economy of a single unitary organization, but also as one among a number of similar organizations, with mutual accommodations, perhaps even obligations, in co-operation at times of pressure in their agricultural functions, and a conditioned relation to the traders of the nearest or central town. The all-pervading influence of the land, and the character of the social economy to which it gives rise, can be discerned most clearly, perhaps, in such diverse matters as the system of passing the control of the farm to one of the sons at the oncoming of age—though not necessarily of senility—match-making, the late age for marriage, and the system of retail purchase and credit, which are not a question of finance simply, but depend on kinship, social relation, or other economically extraneous considerations, rather than price and quality.

It is interesting to translate Dr. Arensberg's study of patterns and nuclei of behaviour into the more formal and familiar terminology of traditional methods of observation. The primitive character of this community, with which he is concerned, immediately becomes more clearly apparent. It is then evident that in the peasant-farmer population we are dealing with a community in which the unit is the family, supplemented by the extended family and the kinship organization. It has its age classes, each with its club-house, and headed by an assembly of elders, who regulate the affairs of the community and are the repository of tradition. Marriage follows on or accompanies initiation into manhood, which goes with the accession of responsibility on the farm. Hence the late age of marriage. It follows also from this peculiar economy that the town is literally the market town, a meeting place for the exchange of produce, which functionally has no independent existence. There is also a place for primitive religious belief, as over and above the orthodox creed, there is an all-pervading animism, the belief in "they", the fairies, or *sidhe*.

It is perhaps not remarkable that a mentality in which these elements of behaviour are so deeply engrained as to have survived for centuries should have been incompatible with a system of landlordism.

Chemistry for Everyman

Chemistry, Matter and Life

By Dr. Stephen Miall and Laurence Mackenzie Miall. Pp. x +296 +8 plates. (London: Edward Arnold and Co., 1937.) 7*s*. 6*d*. net.

THE popularization of chemical science is a notable feature of the twentieth century, and the appearance of the volume under consideration is welcome evidence that the demand for books which give a readable and accurate account of the achievements of scientific chemists still continues. In looking back over the past thirty years or so, it is of interest to note how the methods have altered by which authors have sought to capture the interest of their readers. Formerly, it seems to have been considered necessary to emphasize in the titles chosen the wonder, the romance or the mystery of chemistry, and in the text the reader was constantly being aroused to amazement and wonder. Each sentence, almost, ended in an exclamation mark, and it was sought to hold the attention of the reader by means of slogans and the devices of the advertising agent.

Nowadays, these methods of exposition have fortunately almost disappeared, and the intelligent and educated public is now supplied with books, such as the one before us, in which the facts and theories of chemistry are presented clearly and soberly and left to make their own impression. One cannot but welcome the present work, in which the authors "have tried to describe in language that any educated person can understand some of the main principles of chemistry, the nature of matter, and some of the chemical changes that take place in living plants and animals". The qualifications of the senior author, at least, are a sufficient guarantee that the attempt has not been made in vain.

Within the compass of less than three hundred pages, and in a succession of twenty-seven chapters, the authors have considered briefly, sometimes too briefly, the general aspects of much of present-day chemistry. In the first eighteen chapters we have presented to us an account of modern views regarding the constitution of matter, of the arrangement of atoms and molecules in crystals, of the spontaneous transformations which atoms are undergoing in radioactive substances and of the similar transmutations which can now be brought about artificially. The discussion of these and other topics leads on to the consideration of some of the substances which are formed in the bodies of plants and animals and of the chemical processes which take place in the living

organism. These closing chapters are necessarily less easy to read and understand than the earlier ones, yet the authors have succeeded in giving to the general reader an idea of the truly extraordinary work which has been achieved by chemists in unravelling the molecular constitution of the complex compounds which build up the structure of plants and animals, which control the health of the animal organism and which give to plants their marvellous colours.

The book can be recommended to all who wish to obtain some knowledge of what the science of chemistry means. It is readable and reliable, and is well illustrated by diagrams and plates; but why, one may ask, should there be given on the jacket a picture of an alchemist in his laboratory rather than a picture of, say, Ramsay or of Robinson? Is it thought that the fading glamour of alchemy, of which there is no mention in the text, may act as a lure? ALEX. FINDLAY.

Technological History

The Collected Papers of Rhys Jenkins, M.I.Mech.E.

comprising Articles in the Professional and Technical Press mainly prior to 1920 and a Catalogue of other Published Work. (Links in the History of Engineering and Technology from Tudor Times.) Pp. x+247+8 plates. (London: Newcomen Society, 1936.) 21*s*.

TWO things strike one at the first glance into this handsome volume: first, the wide range of Mr. Jenkins's researches and his large output; secondly, the reflected glory which shines on the Newcomen Society through having published the volume, apart from the fact that it is "a token of the affectionate regard in which he is held by members of the Society".

Closer examination of the work reveals that it is nearly all based on hitherto unpublished material obtained from the most out-of-the-way sources, indicative not only of keen research, but also of a flair for knowing where to look. Not only so, but also Mr. Jenkins has visited the localities where the industries he describes have been carried out; he has in some cases located their sites and he has exhausted the traditional sources of information locally. What is so refreshing about the author is that he brings to the sifting of the evidence and the weighing of facts a critical inquirer's mind. He examines the stories which have hitherto served as history, and extracts from them whatever modicum of truth they may contain. His papers may be studied as models of historical research, and he himself is rightly regarded as the doyen of students in the field of engineering and industrial history.

The papers have been gathered from many sources, but are reprinted substantially as they appeared; where new matter has come to light after the publication of any particular paper, this matter has been dealt with by Mr. Jenkins in an appendix.

In general, the papers represent Mr. Jenkins's activities prior to the founding of the Newcomen Society by himself and others in 1920; since that date, most of his contributions have found their way into the *Transactions* of that Society. Taken together, they thus form a corpus of all his work up to date.

Turning to the subject-matter in detail, it may be conveniently classified under these headings: mechanical technology; steam engineering and foundry work; hydraulic and sanitary engineering; industrial and economic history. In the space at disposal, attention may be directed to a few of the papers. Foremost among them are those which elucidate the history of the steam engine and the work of Sir Samuel Morland, Thomas Savery, Thomas Newcomen and Henry Beighton. It may be said without hesitation that Mr. Jenkins's researches in this direction have added more to our knowledge than the whole of that available previous to his time. Another subject treated in a masterly manner is the history of paper-making in England in 1495–1788; even the site of the mill of John Tate, the first English paper maker, had been lost. The history of an industry—that of tin-plates—that has been associated with Mr. Jenkins's native county—is the subject of what will undoubtedly remain a classic memoir.

Sufficient perhaps has been said to indicate the interest of these "Collected Papers". To conclude the volume there are complete lists of the published works of Mr. Jenkins; authorities quoted, and a really good index. This is, we believe, the first time that such a volume has been published by an engineering society in Great Britain, and the Society, the editor, Mr. E. W. Hulme, and the printers are to be congratulated on the results of their combined efforts. No student of industrial history can afford to overlook this remarkable volume.

Vitamins in Theory and Practice
By Dr. Leslie H. Harris. Pp. xix + 242. (Cambridge: At the University Press, 1937.) 8*s*. 6*d*. net.

THE first edition of Dr. Harris's book was published at the end of 1935 and reviewed in NATURE in the spring of 1936 (137, 868). Its deserved success is doubtless one reason why a new edition has been needed so soon; another is the speed with which advances in vitamin chemistry have been made during the last eighteen months, a speed unusual even in this exceptionally fast-moving branch of biochemistry.

During that period the exact structures of aneurin chloride (vitamin B_1) and of lactoflavin (part of the 'vitamin B_2 complex') have been made known, and both have been completely synthesized. The detailed structures of two antirachitic vitamins, calciferol (vitamin D_2) and the 'natural' vitamin of halibut and tunny liver oils (vitamin D_3) have been worked out and a generally accepted formula has been proposed for each; the latter has been prepared from inactive substances, both 'natural' and of laboratory origin, and it has also been obtained crystalline, though too recently for the fact to be recorded by Dr. Harris. The claim by Evans to have isolated vitamin E, which he calls "tocopherol", is accepted by Dr. Harris, but he would not find that all workers in this field agree with him on the matter.

Apart from expanding his book to include these items of new discovery, the author has made few additions. He might, perhaps, with advantage have included reference to the more recent work on the treatment of habitual abortion with wheat-germ oil or extracts made from it (Shute, Watson, Currie), especially as this work confirms the original observations of Vogt-Möller, recorded in this edition in words identical with those used in the first. But Dr. Harris is perhaps wise in a book of this nature, intended for lay consumption, to err on the side of caution.

A. L. BACHARACH.

Thirty Years of Nature Photography:
a Personal Record of Two Observers. By Seton Gordon. Pp. xi + 100 + 108. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1936.) 21*s*. net.

THE author has been photographing birds and their nests since 1903, inspired originally by the books of Richard Kearton. His wife had also observed and photographed sea and moorland birds, and after marriage the two enthusiasts helped each other in this fascinating pursuit. The beautiful plates of this book are the result of their collaboration, the letterpress explaining the methods used, with particular emphasis on the necessity for a 'hide', and for two observers to use it.

There are photographs of sea birds, moorland birds, a few of seal and deer, and two remarkable pictures of crested tits. The account of the taking of these photographs shows that considerable physical fortitude, besides infinite skill and patience, went to the making of a book which admits the reader to the intimate family life of these untamed creatures.

Most of the photography was done with a large camera from a hide, a hand camera being used for sea birds only. The photography of the latter is comparatively simple as they are not very shy, the main difficulty being the inaccessibility of their haunts. But photographs such as those of the golden eagles caressing each other above their eaglet, feeding and sheltering the eaglet, and of the hooded crow with her nestling are wonderful achievements, alike in photographic skill and bird study. Regarded pictorially, the 'close-ups' are better than such pictures as "Stags Crossing a River", where the lens is too good for the picture, the deep focus giving no sense of recession.

The author comments on the difficulties found in enforcing the Wild Birds Protection Act. Books such as this must, we hope, turn a reader's thoughts to study of a bird as a lovely sentient being, rather than as a stuffed corpse or a blown egg.

Flora of Jamaica:
containing Descriptions of the Flowering Plants known from the Island. By William Fawcett and Dr. Alfred Barton Rendle. Vol. 7: Dicotyledons—Families Rubiaceæ to Compositæ. By the late Spencer Le Marchant Moore and A. B. Rendle. Pp. ix + 303. (London: British Museum (Natural History), 1936.) 15*s*.

THE continuation of this valuable work is very welcome, and we note with pleasure that there is every hope of its speedy completion. The present volume is filled almost entirely by the accounts of the Rubiaceæ and Compositæ, which were prepared by the late Mr. Spencer Moore and have been completed by Dr A. B. Rendle. The latter author has also worked out the Campanulaceæ, and has successfully unravelled the difficulties which obscured the identity of some of the ten species of *Lobelia* occurring in Jamaica. All students of tropical American plants will be grateful for the attention to nomenclature and synonymy, the care in examining historic types, and the general finish which have from the first been marks of this distinguished production.

Einführung in die Vektor- und Tensor-rechnung:
unter besonderer Berücksichtigung ihrer physikalischen Bedeutung. Von Prof. Dr. Harry Schmidt. Pp. vi + 125. (Leipzig: Max Jänecke, 1935.) 5.80 gold marks.

THIS is an excellent account of vector analysis, starting at the beginning, based on sound mathematical principles, and clearly explained. The vector theorems are well illustrated by hydrodynamical applications; the tensor of the second order (the work is carried no further) is exemplified by the theory of elasticity. The author believes that an exact treatment need not be more difficult, and is certainly easier to understand, than a popular exposition lacking in rigour and based on intuition. With this we entirely agree, and can recommend this book to all who wish to learn vector methods and their application.

The Search for the Isotopes of Hydrogen and Helium of Mass 3

By The Right Hon. Lord Rutherford, O.M., F.R.S.

AFTER the discovery by Urey of the isotope of hydrogen of mass 2 (deuterium) and its concentration by electrolysis, it was natural to examine whether any other stable isotopes of hydrogen, and particularly ^3H (triterium, symbol T), are present in ordinary hydrogen. In this article an account will be given of the chequered history of the many investigations to throw light on this question, and incidentally also of attempts made to detect the presence of the helium isotope of mass 3, which is believed to be produced in certain transmutations.

It was natural to suppose that the concentration of deuterium by electrolysis of water should lead also to a concentration of triterium to a considerable extent. Using a direct spectroscopic method, Lewis and Spedding[1] in 1933 looked for the presence of a spectrum line corresponding to ^3H in hydrogen released from a rich sample of heavy water, but with negative results. They concluded that if triterium were present at all its concentration was less than 1 in 6×10^8, compared with ordinary hydrogen.

Experiments with a similar object were carried out in Princeton University in 1934 by Lozier, Smith and Bleakney[2]. A sensitive form of mass-spectrograph designed and operated by Bleakney was used to detect the presence of charged molecules TD of mass 5. They estimated that the concentration of T was about 5 in 10^6 after the initial volume of ordinary water had been reduced to 1 part in 225,000. The experiments were continued by Prof. H. S. Taylor and his collaborators[3] until the volume was reduced to 1 part in 150 million. In these experiments about 75 tons of ordinary water were electrolysed down to 0·5 c.c. The concentration of T/D using Bleakney's method was found to be about 1 in 10^4, and they concluded that the abundance of T in ordinary water was about 7 in 10^{10}.

In the meantime Oliphant and Harteck[4] in Cambridge had found definite evidence that the bombardment of a deuterium preparation by fast deuterons led to two types of transformation, in one of which an isotope of hydrogen of mass 3 was liberated, and in the other an isotope of helium of mass 3. From the energies released in these reactions, it was deduced that the masses of these two isotopes are nearly the same, namely, 3·0171 when the mass of a hydrogen atom is taken as 1·0081. The general evidence suggests that both these new isotopes are stable under normal conditions.

It was clear that it was matter of much scientific importance to obtain sufficient quantities of these new isotopes not only to determine their masses with precision but also to investigate the interesting transformations which might be expected to occur when the ions of these isotopes were used for bombarding purposes. An account will be given later of attempts to obtain detectable quantities of these gases by direct transmutation, but I will first deal with experiments to obtain detectable quantities of triterium by continued electrolysis of heavy water. Before the completion of the Princeton experiments, the feasibility of large-scale electrolysis was discussed by Prof. Urey with Prof. Tronstad and Engineer J. Brun of the Norsk Hydro-Elektrisk Kvoelstofaktieselskab of Oslo, Norway, which was producing heavy water in quantity by the electrolytic method. The most suitable methods to employ for the concentration of triterium were discussed by Dr. Farkas and Dr. Oliphant of Cambridge with the representatives of the Norwegian company, which very kindly agreed to carry out the elaborate research programme required. A brief statement of the methods employed, given by the Company, is as follows :

"If ordinary heavy water containing a small quantity of triterium oxide is electrolysed to a small volume, it is to be expected that, in all probability, it will become rich in T_2O. The object of the experiments was to try to accomplish this by electrolytic means.

"The basis used was 43·4 kilos of heavy water produced electrolytically and having an average D_2O content of 99·2 per cent. During the course of nine months and a half, this heavy water was electrolysed to a volume of 11 c.c.

"The electrolysis was carried out under conditions that ought to be considered favourable for the concentration of any triterium oxide that might happen to be present in the heavy water. During the first part of the electrolysis nickel cells provided with iron cathodes were used, but during the last part of the process glass cells with electrodes made of platinum were employed. The cells were constructed in such a manner that there was excellent communication between the anolyte and catholyte. In addition to this, provision was made for efficient reflux condensation of the water

vapour, so as to ensure the purity of the gases developed by the electrolysis.

"The electrolyte used consisted of heavy potassium hydroxide—KOD. In order that the concentration of the electrolyte should not increase too much during the electrolysis, the potassium hydroxide was gradually eliminated from the electrolyte by distilling off the water. The D_2O content of the dry potassium hydroxide obtained by this process was regenerated by being first treated with dry CO_2, the water liberated thereby being then distilled and passed back to the cell.

"The density of the cathodic current during the electrolysis varied from 0·2–0·4 amp./cm.^{2}. The temperature of the electrolyte varied from 30° to 50° C.

"After the electrolysis had been completed, the contents of the cells were treated with dry CO_2 (for the purpose of converting the potash into carbonate), and the heavy water was distilled off. No further purification was effected."

Part of this concentrated material was handed to Dr. F. W. Aston to examine in his precision mass-spectrograph whether any triterium was present. The following statement of the behaviour of this material has been given to me by Dr. Aston:

"The vapour of the concentrated heavy water was allowed to pass continually through the discharge tube which was in a very favourable state, the diatomic molecular lines being about 1,000 times as bright as the triatomic. The line 5 was examined by a 40 minutes exposure and the limits of detection estimated by very short exposure of line 4 (D_2) down to 1 second. Line 5 was unquestionably D_2H and no trace of a companion in the position expected for DT could be detected. This would have been about 0·5 mm. away and easily resolved. A second test was made with an exposure of 50 minutes with the same result. As line 4 could have been detected with an exposure of 1/20 second, it follows that

$$\frac{DT}{D_2} < \frac{1}{50{,}000}$$ "

The conclusion of Dr. Aston, that no trace of triterium could be found in the concentrated sample by his very direct and simple method, is very disappointing after the time and labour spent in Norway in preparing this material. While it is, of course, difficult to make any certain comparison of the concentration of T to be expected in these two large-scale experiments, it does not seem likely that the concentration of T would be less in the Norwegian experiment. I am informed by the Norwegian company that, in all, 13,000 tons of ordinary water were used for the production of the 43·4 kilos of heavy water employed by them to concentrate the triterium, while Taylor and his collaborators started with 75 tons. The rather low yield of heavy water in the Norwegian experiments was due to the fact that the cells used were ordinary technical electrolysers for the production of hydrogen and oxygen, heavy water being regarded as a by-product. In any case it is to be expected that in the earlier stages of the electrolysis the triterium would be enriched at least as much as the deuterium.

There is thus rather a conflict of evidence with regard to the concentration of triterium in the two similar experiments. The American observers obtained a positive result indicating a value of $T/D = 1/10^4$ in their enriched sample, while Aston by a more direct method could detect no triterium at all in the Norwegian preparation, and concludes that T/D must be less than 2 in 10^5. Unfortunately, an intercomparison of the samples is not possible, for Prof. H. S. Taylor informs me that their enriched sample has been lost. It is hoped, however, that it will be possible to arrange to test the Cambridge sample in Princeton by the sensitive method devised by Bleakney. It is important to decide that the ions of mass 5 shown by this apparatus are in fact due to molecular ions TD.

It was felt desirable, however, to confirm the negative result found by Aston by a transmutation test. This is in some cases a delicate method of analysis, as is shown by the fact that the presence of the small amount of deuterium in ordinary water can readily be observed by its use. Experiments were consequently made by Kempton and Miss Maasdorp in Cambridge, to test whether hydrogen separated from this concentrated material showed any characteristic difference from ordinary deuterium, when the accelerated ions were used for bombarding purposes. The ion beam was analysed by a magnetic field, and the part of mass 3, no doubt mainly due to charged DH molecules, was allowed to fall on a target consisting of a deuterium compound. The intensity of the beam of mass 3 was very small compared with that observed for the D ions. From general considerations, we might expect the following reactions to occur for fast ions corresponding to ^3H and ^3He:

$$\begin{aligned} {}^2D + {}^3H &\rightarrow {}^4He + {}^1n \\ {}^2D + {}^3He &\rightarrow {}^4He + {}^1H \end{aligned} \quad . \quad . \quad . \quad (1)$$

the energy released in each case being about 20 million volts. Owing to the copious production of neutrons from the ordinary D—D reaction, it is not possible to distinguish the small number of neutrons or protons to be expected from the above reactions. On the other hand, the α-particles arising from these reactions should have a range in air of 2–3 cm., and should be readily distinguished from protons, owing to their greater ionizing power. Careful search failed to reveal any

such α-particles, and the number must have been less than 1/5,000 of the protons arising from the D—D reaction. Assuming that these reactions are all equally efficient at the voltage used, it follows that

$$T/D < 1/5{,}000.$$

While the limit of detection of T by this method is 10 times lower than that deduced by Aston, this conclusion nevertheless affords a useful check in indicating that very little if any T can be present.

It is desirable to add a short statement of attempts made to detect the artificial production of ^3H and ^3He in the D—D reaction already referred to. Since these transformations are highly efficient, and take place for very low bombarding energies, it is to be expected that both ^3H and ^3He should accumulate when an ordinary glow discharge is passed through heavy hydrogen. Accordingly experiments were carried out in America and in Cambridge to produce these new isotopes by passing heavy hydrogen slowly through a discharge tube across which a potential of 60–70 kilovolts was applied. Samples of the gas obtained by this treatment were tested in America for the presence of ^3H and ^3He by the sensitive method of Bleakney, previously mentioned. At first, evidence[5] of small traces of these gases was found, but we understand that later work has failed to confirm these conclusions.

In the Cambridge experiments made by Oliphant, the treated gas mixed with an excess of helium was passed through the discharge tube, which produced a beam of fast ions for experiments on transmutation. After acceleration, the beam of ions was analysed by passage through a magnetic field, and the ion beam of mass 3 was found to be very feeble compared with that of mass 2, owing to the presence of helium, which has the property of dissociating the charged molecules produced by the discharge. The method of detection of ^3H and ^3He was similar to that already described. A search was made for α-particles which might be expected to arise from the reactions (1), when the ions of mass 3 fell on a target containing deuterium. No such α-particles were detected, and the number was certainly less than 1/20,000 of the protons liberated from the deuteron beam under the same conditions. Assuming as before that these transformations are all of equal efficiency, it is evident that ^3H and ^6He cannot be present to the extent of 1/20,000 in the deuterium gas.

Attempts have been made by G. P. Thomson and F. A. Paneth in London to produce ^3He by the D—D reaction in sufficient quantity to be detected by the extremely sensitive micro-methods developed by Paneth, but so far without success. It may be that the reaction of ^3H and ^3He with D takes place very easily, so that a stage is soon reached when these isotopes are destroyed in the discharge as fast as they are produced.

The rapid disappearance of ^3H and ^3He by transmutation would account for the very small abundance of these isotopes in the earth and presumably in the sun. A number of experiments have been made to detect the helium isotope of mass 3 in ordinary helium by direct spectroscopic methods, but with entirely negative results. This, however, is not surprising when we consider that terrestrial helium is probably derived from the α-particles of mass 4 expelled from the radioactive substances present on our earth.

It is a striking fact that while in transmutation experiments using counting methods the D—D reaction is on a marked scale, giving rise to very large numbers of ^3H and ^3He particles, yet it does not seem feasible at the moment to obtain sufficient quantities of these two interesting isotopes to study their properties by ordinary physical chemical methods.

[1] Lewis and Spedding, *Phys. Rev.*, **43**, 464 (1933).
[2] Lozier, Smith and Bleakney, *Phys. Rev.*, **45**, 655 (1934).
[3] Schwood, Taylor, Lozier and Bleakney, *J. Amer. Chem. Soc.*, **57**, 780 (1935).
[4] Oliphant, Harteck and Rutherford, *Proc. Roy. Soc.*, A, **144**, 692 (1934). Oliphant, NATURE, **137**, 396 (1936).
[5] Bleakney, Harnwell, Lozier, Smith and Smyth, *Phys. Rev.*, **46**, 81 (1934).

Social and Political Application of Nutritional Science

THE historical development of any science is twofold. First come the discoveries of natural principles and facts of theoretical interest. These are followed at varying intervals of time by their application to practical life. The history of nutritional science offers no exception to this rule.

Recently, the trend of nutritional investigation has undergone a marked change. While disinterested studies of a purely theoretical nature will always bulk large in the pages of scientific journals, there is clear evidence that pride of place is now being given to researches which will hasten the practical application of the new nutritional teaching. In short, there are welcome signs of a lessening gap in the relations between those who are engaged in ascertaining the facts of nutrition and those whose duty is the application of that knowledge to the practical affairs of public health.

Some evidence of this will be found in the fact that the number of papers noted in the section of *Nutrition Abstracts and Reviews* (published by the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Aberdeen), devoted to the application of nutrition to human health has increased by more than 90 per cent in the last five years.

The two outstanding features of present-day investigations are first, the attention which is being paid to the determination of nutritional needs, and secondly, the ascertainment of the extent of means to supply these needs. The economic blizzard which struck the world in the years around 1931 gave tremendous stimulus to this type of study, and we find the world's literature during the years of depression abounding in papers dealing with the influence of the economic crisis on the nutritional needs and health of the people, the dietary resources of the unemployed in relation to their physical fitness, and the prevalence of malnutrition in children and young persons living under conditions of limited means in distressed areas.

The relation between poverty and national physique has been re-examined in the light of our new knowledge of nutritional needs. Many recent studies have shown that as income increases the greater is the consumption of milk, eggs, fruit, vegetables, meat and fish. This finding is not altogether new. It has long been established from the innumerable records of family expenditures published by the well-known economists of the nineteenth century that additional increases in income are associated with an increasing amount spent on food, and further, that the struggle to consume better kinds of nourishment is greater than the striving to increase total amounts of consumption. Le Play and Engel, who were the first to generalize these laws, maintained that the upper classes were to be differentiated from the lower by the amounts of animal food they consumed.

What is entirely new, however, is the realization that rising income, associated with increased consumption of milk, eggs, fruit and the rest, goes hand in hand with decreased death-rate, better growth of children, greater adult stature and much improved general health. The explanation of this lies in the fact that the foods mentioned are just those found to be richest in vitamins, mineral matter and first-class protein, constituents proved by laboratory experiments to be essential for the preservation of health. This is the crux of what has been called 'the newer knowledge of nutrition'. It calls for a change in point of view rather than any fundamental or revolutionary alteration in dietary habits.

Undoubtedly, disquieting features in the state of national fitness have been revealed as a result of these recent dietary and family budget investigations in Great Britain, and very naturally a lively public interest in the whole nutrition question has been aroused. Social conscience is especially sensitive because, not only in Great Britain but also in many other countries, it has been estimated that a very large proportion of the population falls into groups in which the income per head is less than that considered sufficient for the purchase of foods necessary for the maintenance of optimum health. The unfulfilled needs of the people of Great Britain for essential foodstuffs have been assessed at £200,000,000 a year.

Inevitably, controversy has arisen. On the question of needs, typical examples of disagreement are those which surround the standards advocated by expert medical opinion and those adopted by Government departments responsible for unemployment assistance and other forms of public relief. In official circles the inclination has been to think in terms of minimum needs; that is to say, the level fulfilling conditions which would keep the population at the present average standard of health and physique. The scientific investigator, on the other hand, cannot conscientiously study anything less than an optimum, which has been defined as a level of requirement above which no subsequent addition would add to the individual's share of good health and of full physical development. Again, the absence of precise objective standards by which to measure the state of nutrition of a given individual offers another serious difficulty. The adoption of differing standards and the varying mental conceptions and impressions of individual observers have led to confusion in the assessment of malnutrition and the subsequent comparison of data from different sources. As a result, allegations that substantial and progressive declines in the health of communities have followed the years of economic depression are often difficult either to refute or to substantiate. Further fuel has been added to the fire of controversy by the expressed opinion of statisticians that some of the most recent contributors to the discussion on the relation between poverty and nutrition have based their findings on faulty methods and meagre and uncertain data.

The task of those who would distinguish what is true from what is false is not made any easier by the number of different bodies, official and non-official, which have contributed to the discussion. Data from all sorts of different sources—medical, chemical, physiological, social—have been accumulated piecemeal.

Questions of nutrition now regularly form an outstanding feature of the official reports, issued from

the Ministry of Health and the Board of Education, dealing with the state of national health and the welfare of infants and school children ; and, year by year the number of local authorities which have instituted inquiry into nutritional conditions in their own areas becomes greater and greater. Further, in Great Britain at any rate, there have arisen within the last few years numerous semi-private organizations the self-imposed task of which is partly to educate the 'man in the street' upon what is properly considered to be a matter of immediate public concern, and partly to stimulate official circles into making authoritative pronouncements regarding what constitutes an adequate diet and how the Government proposes to bring such a diet within the economic compass of every section of the community. Chief among these are : the Committee Against Malnutrition, the Children's Minimum Council, the People's League of Health, and PEP (Political and Economic Planning), all of which have, by well-directed propaganda and other means, done much to focus public attention on the urgent need for the formulation of a sound national nutrition policy.

Whatever may be one's opinion on the validity of individual statistics purporting to show the extent of malnutrition and its precise relationship to family habits and circumstances, there is no doubt that, viewed in the widest perspective, a serious amount of malnutrition prevails in almost every country in the world, especially among children. Furthermore, it seems that where the dietary standards fail, the major cause is not ignorance but poverty.

It is not surprising, therefore, that following the presentation of facts there should have been a cry for official action. Before action can be taken, however, the public health administrator must satisfy himself that the principles suggested to him by the scientific investigator do really concern him. Broad generalizations must be accepted with caution. Alarmist statements on the prevalence of under-nutrition must be considered judicially. Facts must be verified and must be interpreted with greater precision in order to determine whether action is justified and what form it should take. The tendency in Government circles, therefore, has been towards further inquiry rather than to the hasty acceptance of the new ideas.

In the United Kingdom, the Minister of Health and the Secretary of State for Scotland appointed, in May 1935, an Advisory Committee to examine the quantitative and qualitative facts of nutrition and to report as to any changes in the diet of the people which might appear desirable in the light of modern advances in our knowledge. This Committee has recently issued its first report, the outstanding features of which are the Committee's adoption of the standards of dietary requirements drawn up by the League of Nations Committee to which reference is made below, its recognition of the importance of milk and its recommendation that in impending legislation dealing with the national milk supply the primary objective of the Government should be to ensure that specified amounts (two pints per day for every pregnant and nursing mother, and a pint and a half for every child) are brought within the purchasing power of the poorest. It has also accepted as reasonable and likely to be in accordance with the facts, the broad picture on food consumption at different income levels prepared by the Market Supply Committee and used by Orr as the basis of his estimates in "Food, Health and Income" ; but recommends that it should be regarded not as final but rather as a framework to be filled in when an adequate number of budgets have been obtained and individually analysed. These are conclusions of far-reaching importance.

Of much wider interest, however, is the attention which has been paid to the nutrition question by the League of Nations. The Health Organisation has been engaged in the study of nutrition in its relation to public health since 1925. On the proposal of the Australian delegate, who, incidentally, was one of the first to appreciate the close nexus of interest between problems of health and agriculture, the League, at its sixteenth Assembly in 1935, recommended that the Health Organisation should continue and develop its work on nutrition in collaboration with the International Labour Office and the International Institute of Agriculture. At the same time, the Assembly decided upon the creation of a Mixed Committee of experts on agriculture, economics and public health, charged with the duty of presenting a general report to the Assembly on the problem of nutrition in its public health and economic aspects. The nineteenth International Labour Conference adopted a similar recommendation. In October 1935, the Health Committee decided to set up a Technical Commission on Nutrition composed of three experts each from the United Kingdom, the United States and France, and one from each of six other European countries. This Commission, at its first session in London in November 1935, laid down the physiological bases of nutrition and established the food requirements of human beings during their growth from conception until adult age. With a view to the application of these recommendations in different countries and their adaptation to varying geographic, economic and social conditions, the report was circulated for the observations of academies of medicine, research councils and other authorities in various countries

the competence of which covers nutritional problems. At its second session, held in Geneva in June 1936, the Technical Commission examined the observations communicated by these bodies, revised and amplified its London report, and presented it to the Mixed Committee in conformity with the Assembly's resolution of 1935.

This revised report, embodying considered international opinion on human dietary standards, represents the first and most outstanding contribution towards evolving order out of the chaos of specialized data on requirements which has confronted nutritional workers in recent years. A yardstick has at last been provided by which to measure diets and determine how far they are deficient for health. As already mentioned, the report has been adopted by the Advisory Committee on Nutrition responsible to the British Ministry of Health, and, in common with all the other work of the League's Technical Commission on Nutrition, has created a considerable impression not only in Europe but also over-seas. Thus, items included on the agenda of the Inter-Governmental Conference of Far-Eastern Countries on Rural Hygiene have been inspired by the Commission's work, as also has the recent formation of numerous national councils, such as those in Australia and in the British Colonies, specially set up to study local nutritional problems along the lines of the League's recommendations.

Perhaps nowhere have the suggestions of the League been acted upon with greater promptitude than within the British Colonial Empire. In April 1936, the Secretary of State for the Colonies addressed a dispatch calling for a comprehensive survey of the nutrition position in each Dependency. One of the main purposes of the dispatch was to direct attention to the important bearing which nutrition should have upon agricultural, veterinary, educational and general policy in the Colonial Empire. In planning the production of any territory the aim should be twofold; on one hand, the provision to the entire population of a locally grown food supply considered adequate by medical science and, on the other, the growth of remunerative export crops. Already many replies have been received, some of which have been made available as public documents. "Food in Relation to Health" has been issued by the recently established Nutrition Committee in Trinidad; a similar report, based on the well-known work of Nicholls, describes conditions as they apply in Ceylon; the report of a specially formed nutrition committee has been presented to the Legislative Council of British Guiana; and a "Nutritional Review of the Natives of Zanzibar" has also been submitted.

To consider these reports and to advise generally on nutritional matters relating to the British Colonial Empire, the Prime Minister, in November 1936, appointed a Committee of the Economic Advisory Council consisting of medical, agricultural and economic specialists. This Committee is expressly commissioned to keep in touch with the work of the League of Nations and enable His Majesty's Government to assist and support it more effectually.

No attempt has been made here to deal exhaustively with the subject under review. Rather the aim has been to present a brief general outline touching the reasons for, and the nature of, Government intervention and official international co-operation on a subject of intense universal interest. Unavoidably, the writer's approach has been from the British point of view. One must remember, however, that in the United States of America, in the U.S.S.R., in Italy and in many other countries, evidence that Governments have accepted their obligations to give authoritative public guidance on questions of nutrition is equally conspicuous.

By far the most important thing is that the League of Nations has been accepted as the common platform on which national aspects of the problem can be debated in their world setting and in an atmosphere of reason and mutual comprehension.

Obituary Notices

Prof. J. W. Michaelsen

PROF. J. WILHELM MICHAELSEN, *Hauptkustos* in the Hamburg Zoological Museum, died on February 18 in his seventy-seventh year. Born in Hamburg, he joined the Hamburg Museum in 1887 and worked there until the time of his death. As a young man he became interested in the Oligochæta, and from 1886 until his death he wrote many papers on their anatomy, classification and geographical distribution. He also wrote on the Tunicates and the Polychæta, but his main interest was the Oligochætes, and it would be difficult to over-estimate the extent of his contribution to our knowledge of this group. Vastly learned, disinterested and careful of minutiæ he belonged to the great tradition of German scholarship, and the sheer quantity of his work—his papers on the Oligochæta alone bind up into eight very bulky volumes—testifies to an extraordinary industry and persistence of motive. In addition to this, he found time to make journeys to the southernmost corners

of America, Africa and Australia in pursuit of evidence to throw light on the palæogeographical problems arising out of his study of Oligochæte distribution.

There has never been any question as to the consistently high quality of Michaelsen's work, and his co-specialist and in his own line his only peer, the late J. Stephenson, has for a heading to his monumental monograph on the Oligochæta (Oxford Univ. Press, 1930) the words, "To my Friend and Master W. Michaelsen of Hamburg".

Those of a younger generation who had the good fortune to correspond with Michaelsen will testify to his great kindness and patience. Even when he was a man in the seventies he would go to extraordinary lengths to assist a beginner who applied to him for help or information. On one occasion, he copied out a whole paper himself by hand and traced the drawings to send to a young student who wrote to say that the particular work was not available. He had the rare characteristic of cheerfully acknowledging his own mistakes, and was entirely free from that failing which overtakes so many men who have devoted their lives to the mastery of a specialism, the failing which consists in treating a difference of opinion, especially one coming from a younger man, as a personal affront. His letters reveal a simple, unexpectedly humorous and kindly man.

Prof. A. Erman

THE death of Prof. Adolf Erman on June 26 inflicts an incalculable bereavement upon both the Egyptological world and a large circle outside it. In the realms of his own subject he was without doubt regarded as the foremost scholar, since it was he who first placed the study of the ancient Egyptian language upon a scientific basis. His "Ägyptische Grammatik", which first appeared in 1894 and which was destined to pass through four editions, revolutionized the method of approach to the classical language, while the later phase of Egyptian, known as "New Egyptian", was fully dealt with in his "Neuägyptische Grammatik" of 1880 and 1933. Yet he was far from belonging to that class, all too large even at the present day, of specialists who never trouble to interpret their discoveries for the benefit of the general reader. He could write excellent descriptive prose, informed by a considerable sense of humour, which presented a living picture to his readers, as in his "Ägypten", translated into English by Lady Tirard under the title of "Life in Ancient Egypt", his "Religion der Ägypter", translated by the same author and called "Handbook of the Egyptian Religion", and his "Literatur der Ägypter" of which the English edition has been prepared by Prof. A. M. Blackman. The last-named book is perhaps his greatest contribution of this kind, enabling the student of the past for the first time to become acquainted with specimens of ancient Egyptian literature of all periods, beautifully translated and explained.

The greatest of Erman's undertakings, however, was the enterprise of the Berlin hieroglyphic dictionary, which he edited jointly with other colleagues. This vast work, intended to cover the whole history of ancient Egyptian, is still in process of publication, the first five volumes having appeared between the years 1926 and 1931. It has been justly said that the wide range of Erman's abilities made him an interpreter of Egyptian civilization unrivalled by any other except the Frenchman Gaston Maspero. He has left to his successors a standard of scholarship which can only be maintained if the scientific principles which he so assiduously taught during his long life are faithfully obeyed. A. W. SHORTER.

WE regret to announce the death on August 3 of Prof. Josef Woldřich, director of the State Geological Institute at Prague, at the age of fifty-seven years. Born in Vienna, Prof. Woldřich became well known in Central Europe for his geological investigations, which began with a re-examination of certain Bohemian rocks, notably those studied by the Frenchman Barrande and more recently by the late Prof. J. E. Marr of Cambridge. After the Great War, he was appointed to the chair of geology at the new University of Brno in Moravia. Here he commenced a series of geological studies of the lesser-known districts of Slovakia, a work of extreme importance for the compilation of the modern geological maps of Czechoslovakia. He had been director of the State Geological Institute for the past three years.

WE regret to announce the following deaths:

M. André Beaumont (M. Jean-Louis Conneau), one of the pioneers of aviation, aged fifty-seven years.

Dr. W. M. Cumming, lecturer in bacteriology in University College, Dundee, an authority on tuberculosis, aged thirty-nine years.

Mr. C. E. L. Gilbert, C.I.E., formerly chief conservator of forests, Bombay Presidency, on August 8.

Prof. Vernon L. Kellogg, professor of entomology in Stanford University in 1896–1920, permanent secretary of the U.S. National Research Council in 1920–32, aged sixty-nine years.

Prof. Hans Reck, the distinguished German volcanologist, who was associated with the discovery of human remains at Oldoway, Tanganyika, in 1914, on August 4, aged fifty-one years.

Prof. A. E. Seaman, emeritus professor of geology and mineralogy in the Michigan College of Mining and Technology, on July 9, aged seventy-nine years.

Mr. A. Sharples, formerly Government mycologist, Federated Malay States, and head of the Division of Plant Pathology, Rubber Research Institute of Malaya, on August 6.

Mr. J. W. N. Sullivan, author of "Three Men Discuss Relativity" and other books of a popular character on aspects of modern science, on August 12, aged fifty-one years.

Prof. J. G. Thomson, professor of medical protozoology in the London School of Hygiene and Tropical Medicine, on August 13.

News and Views

The Sun's Outer Envelope

ACCORDING to a cabled statement from the New York correspondent of *The Times* published on August 14, Major Stevens of the United States Army, flying over Peru at a height of 30,000 ft. on June 8, during the total solar eclipse, obtained some very surprising photographs of the eclipsed sun. Surrounding the corona with its irregular streamers, there was found a bright envelope one million miles high in which the details of the corona became insignificant. The first natural reaction is to ascribe this result to photographic effects of over-exposure, especially as no details of the size of the image secured or other optical details of the apparatus used are given. But the name of Harvard University behind the announcement renders one unwilling to look to any simple instrumental explanation of this unexpected phenomenon. A link between the corona and the zodiacal light seems suggested, but no indication is given in the report of any extension in the zodiacal plane, such as would be expected. Again, since the zodiacal light and the corona both have the same distribution of radiation as ordinary sunlight, one would expect any connecting matter to be similarly conditioned. Only over-exposure, which blots out all coronal details, would account for the even globular envelope unless this outer envelope is relatively much stronger in light of short wave-length. It would be interesting to know what visual observations were made from the aeroplane. If these agreed in general outline with the photographs secured from the ground, then the photographs from the stratosphere suggest an extensive outer atmosphere giving bright line or bright band radiation which must be examined spectroscopically at the next suitable total eclipse. Further and fuller details of the photographs will be impatiently awaited.

Anglo-Egyptian Treaty Honours List

THE additional Egyptian Honours List issued in connexion with the signing of the Anglo-Egyptian Treaty in London, and published in the *Egyptian Mail* of July 28, contains the names of the following men of science: *Third Class of the Order of Ismail* (Commander), Dr. E. Hurst, director-general of the Physical Department of the Ministry of Works, and Mr. F. Newhouse, inspector-general of irrigation in the Sudan; *Second Class of the Order of the Nile* (Grand Officer), Dr. Roy S. Dobbin, professor of obstetrics in the Egyptian University, Cairo; *Third Class of the Order of the Nile* (Commander), Dr. J. Templeton, chief botanist, Botanical and Plant Breeding Section, and Dr. W. T. H. Williamson, chief chemist, Chemical Section, of the Ministry of Agriculture, Dr. J. H. Grindley, expert for technical education, Major W. L. Forsyth, professor of bacteriology, and Prof. D. H. Bangham, dean of the faculty of science in the Egyptian University, Cairo; *Fourth Class of the Order of the Nile* (Officer), Mr. G. H. Jones, director of the Mycological Section, Prof. H. Priesner, director of entomological research, and Mr. C. H. Broun, senior botanist of the Ministry of Agriculture, Prof. T. L. R. Ayres, professor of physics, Dr. O. Zdanski, professor of geology, and Prof. A. Naef, professor of zoology in the Egyptian University, Cairo.

Centenary of Dr. Edmund Weiss (1837-1917)

ON August 26, 1837, Dr. Edmund Weiss, the distinguished Austrian astronomer, was born at Freiwaldau, in Austrian Silesia. A part of his boyhood was spent in England, where his father was physician to a health institution, but he received his education at Troppau and at the University of Vienna, and at nineteen years of age became assistant to Karl von Littrow (1811–77) in the old Vienna Observatory which had been erected in 1826 by Joseph von Littrow (1781–1840) on the site of the observatory established by Father Maximilian Hell, *S.J.*, in 1753. At first Weiss was employed on geodetic work, but it being proposed to remove the old observatory, which was situated among the narrow streets of the Austrian capital, to a more favourable situation, Weiss, in 1872, was sent on a tour of European and American observatories to study their methods, and optical works, and to him fell the task of planning the equipment of the new observatory at Währing, the foundation stone of which was laid in June 1874. On von Littrow's death in 1877 Weiss was appointed to the directorship. This post he held for thirty-two years, retiring in 1910. He died on June 21, 1917, at the age of seventy-nine years. During his career Weiss took part in several eclipse expeditions, was one of the observers of the transit of Venus in 1874, wrote on comets, meteors and orbits, and prepared a revised edition of Oeltzen's catalogue of Argelander's zones from 15° to 31° S. declination. He was a member of the Vienna Academy, a *correspondant* of the Paris Academy of Sciences, and for thirty-four years an associate of the Royal Astronomical Society.

Reginald Harrison (1837–1908)

MR. REGINALD HARRISON, who was equally eminent as a Liverpool and as a London surgeon, was born at Stafford on August 24, 1837. He was educated at Rossall School and St. Bartholomew's Hospital, and qualified in 1859. In 1866 he became fellow of the Royal College of Surgeons, and the following year was appointed assistant physician to the Royal Infirmary, Liverpool, becoming full surgeon in 1874. He was at first a general surgeon, but before long he specialized in diseases of the male genito-urinary system, and in 1889 he left Liverpool for London on his appointment as surgeon to St. Peter's Hospital for Stone and Other Urinary

Diseases. Harrison was the author of "Surgical Disorders of the Urinary Organs" which became a standard text-book, and went through four editions, as well as of "Selected Papers on Stone, Prostate and Other Urinary Diseases" and "The Use of the Ambulance in Civil Practice". During his residence in Liverpool he re-organized medical education at the Royal Infirmary, and took an active part in the introduction of the ambulance system, in which he continued to take an interest after his removal to London, being president of the Street Ambulance Association at the time of his death. He was the recipient of many distinctions, including those of Knight of Grace of the Order of St. John of Jerusalem, president of the Medical Society of London, and Hunterian professor of surgery and pathology of the Royal College of Surgeons. In 1903 he inspected the School of Medicine at Cairo for that College and received the Imperial Ottoman Order of the Medjidie.

Roman Dorchester

THE Dorset Natural History and Archæological Society, concurrently with its share in the excavation of Maiden Castle, is investigating a site at Colliton Park, Dorchester, on which a county hall is to be erected. The site is within the walls of the Roman city and has not been built on since Roman times. In view of its situation, it was thought probable that Roman buildings would be found there, and the last opportunity upon which the site would be available for examination could not be allowed to pass by. Already, it is reported (*The Times*, Aug. 14), a large part of a house has been disclosed, of which one range of five rooms contains three for bathing, a central dressing-room, with a hot bath on one side with its hypocaust, still largely intact, and on the other side the cold bath-room. North of this range of rooms is a corridor looking out on the courtyard, in which is the well, now cleared to a depth of thirty feet. The filling of the well was found to be entirely composed of wreckage from the building, and included broken parts of at least nine stone columns, four of which are complete though fractured. They probably formed the colonnade of the corridor. At right-angles to the first range of rooms is a second, consisting of seven rooms. All these have mosaic floors, of which one is in perfect condition, while another, though badly damaged, still shows traces of considerable beauty. This latter has panels containing a head of Flora and another head which has not yet been identified. One of these rooms has a hypocaust beneath. An unusual feature in a Roman house in Britain is the lower part of two windows with internal splays. As this house is clear of the building line of the new hall it is hoped to preserve it intact. Trial trenches are being dug to find the other buildings which are thought to lie beneath the surface. As the whole area is to be explored, further financial assistance towards the considerable cost is required.

The Gyro Compass on the Hudson Bay Route

IN a summary of the eighth report of the Imperial Shipping Committee on Hudson Bay Marine Insurance Rates, published by H.M. Stationery Office, 3d. net, which appears in *The Times* of August 13, it is mentioned without comment that the Committee quotes tributes by captains of ships to the value of a gyro compass in contributing to the confidence with which the Strait and Bay were navigated. It is stated that other masters have expressed the view that a gyro compass is essential for navigating the Hudson Bay with safety. The Committee submitted to the underwriters that a further reduction of premiums should be made in respect of vessels equipped with gyro. An illustration is given of the saving of premium which could be effected by installing a gyro compass for one voyage, two voyages, and three voyages in the same season; against this is set the cost of hiring a gyro compass for, say, three months, which including fitting would, it is stated, be approximately £200, plus a very small charge for inspection. The Committee concludes that there is now a considerable inducement to the owner of a vessel to instal a gyro compass for voyages to the Hudson Bay. A gyro compass is specially desirable in the Hudson Bay area on account of the proximity of the north magnetic pole, off the Prince of Wales Land; a ship entering Hudson Bay must approach this pole within at least 14°, and owing to the low value of the horizontal magnetic force (which becomes zero at the magnetic pole), the directive force on the compass is low, and disturbances have a proportionately large effect. On the other hand, the distance from the geographical pole, which is one of the factors in determining the directive efficiency of the gyro compass, is more than 25°.

Electricity and Marketing

AN account is given of the Farmer's Conference at the Royal Agricultural Show held at Wolverhampton on July 8, in the *Electrician* of July 16. Mr. F. H. Slade read a useful practical paper on "Electricity and Marketing". He said that now the rural distribution of electricity is extending so rapidly, the British farmer will be able to compete on better terms with the foreigner. He described machines for the electro-mechanical grading and packing of fruits. Such machines will grade in one hour 700 lb. of gooseberries or 1,400 lb. of plums or 180 boxes of tomatoes, without bruising them and with less loss of bloom than by hand methods. A 1½ h.p. electric motor can divide hard fruit into fine sizes and two qualities at the rate of 1,000 bushels per day, ready for cold storage. It pays a grower having 20 acres or more to instal grading and refrigerating plant. The care of apples in a refrigerator is a matter of 'atmospheric control'. In a suitable atmosphere the fruit can have its life-cycle speeded up fifty per cent or the ripening of the fruit can be slowed down by fifty per cent. The average cost of cooling milk in a refrigerator for dairy purposes costs on an average about a penny for thirty gallons. Refrigerated stores for eggs are replacing water-glass immersion. Thanks to electricity, the British farmer, instead of merely getting low prices in season and losing markets out of season to foreign competitors, is now in a much

better position to get profitable returns. Mr. Borlase Matthews mentioned that eight years ago there were 600 British farmers using electricity; the number now is more than 30,000. He mentioned that electricity was available to every exhibitor in the Show and for the first time they had a telephone exchange in the Show yard.

Practical Difficulties in International Telephony

IN Europe, telephone operation is mostly in the hands of State administrations, although there are some large private telephone undertakings. To ensure satisfactory international joint working, uniform provisions for the calls are an indispensable necessity. With this end in view, the International Consultative Committee for Telephony, known as the C.C.I.F., has drafted recommendations and working instructions intended for application to international telephone traffic. In the *Ericsson Review*, No. 1, 1937, Mr. A. Lignell, director of telephones at Stockholm, discusses these recommendations from the point of view of practical operation. He points out that an international call makes use of the subscriber's line, the exchange equipment at both ends and one or more international lines, as well as two or more operators for making the connexions. This type of call is much more difficult to deal with both in respect of time occupied and handling than a local call, and as a rule is of greater importance than a purely local connexion. The C.C.I.F. has therefore recommended that a local call ought to be cut off to allow of an international call, and this is prescribed in its "instructions to operators". At the plenary meeting of the C.C.I.F. in Copenhagen in 1936, there was formulated a question to the following effect, namely, whether international calls should be established with the "least possible delay", instead of connecting them immediately, and so simplifying and cheapening the equipment of local and trunk exchanges. Mr. Lignell is afraid that such simplification would lead to appreciable economic and other disadvantages in international traffic. At the present costs of trunk lines, this seems inevitable. It is to be hoped that the priority over internal traffic which international regulations accord to international traffic may be maintained.

Illuminated Show Cases

WHEN lamp fittings are used in the normal way, electricians usually assume that the ambient temperature is about 27° C. and this gives a rise of 23° C. in the connecting leads before the maximum permissible operating temperature (50° C.) of the rubber insulation is attained. If the lamp fittings are used in enclosed shop windows or show cases, the assumption about the ambient temperature is no longer valid, as it depends on the aggregate wattage of the lamps in the enclosure. In a technical report of the Electrical Research Association (E.R.A.) published in *World Power* of April, a very thorough research by H. G. Taylor, W. Lethersich and the late P. D. Morgan has been made to find out the actual heating and to suggest methods of reducing the ambient temperature when excessive. Four methods are considered. A fan can be used to disturb the air, and so provide a uniform temperature throughout the enclosure. Another method is to provide natural ventilation by holes at the top of the case for egress of the hot air and others at the bottom for ingress of the cold air. Forced ventilation may also be used. The last method considered is to use special glass which either transmits the infra-red rays emitted by the lamps, etc., or has a high thermal conductivity and so facilitates the transfer of heat from the inside to the outside of the show case. The first two methods were found to be of considerable value. It was found that if the area of the holes bored in the top and bottom of the show case was about 4 per cent of the area of the top and bottom, the maximum temperature rise was reduced by fifty per cent.

Oil Transport in the Middle East

So far as is known, the large oil-fields of the Middle East are situated in Iran and Iraq. In Iraq the principal producing field is in the neighbourhood of Kirkup to the east of the Tigris and 145 miles north of Bagdad. In Iran, oil is derived mainly from two large oil-fields. The exploitation of petroleum on a modern commercial scale in these countries is a very recent development which is producing social changes in the ways of the inhabitants, and in the economic sphere it is widening the basis of trade, increasing the revenue and bringing money into the country. In the Year Book of the Cambridge University Engineers' Association for 1936, Colonel H. E. Medlicott describes the engineering difficulties of constructing 1,600 miles of roadway in Iran, sometimes skirting precipitous hillsides. The Anglo-Iranian Oil Company has already raised more than seventy million tons of oil from the two main oil-fields. In Iraq, the Iraq Petroleum Company had under its concession to construct a pipe-line system from Kirkup to the Mediterranean. It was decided that the line should debouch at two points on the Mediterranean, Haifa to the south and Tripoli to the north. The distance along the pipe-line route from Kirkup to the Euphrates is 156 miles, and from there two sections bifurcate, the southern section going to Haifa and the northern section traversing Syria to Tripoli. The crossings of the Tigris and the Euphrates had to be made by 'Blondins' (overhead cable ways) and steel towers about 140 feet in height had to be erected in concrete to support the massive steel ropeways over the rivers which carried loads of ten tons from one bank and deposited them on the other. The author is strongly of the opinion that the Middle Eastern history of the near future will be a record of steady progress, sociologically, economically and politically.

Mining and Geology in South Australia

WE have received the annual report of the Director of Mines and Government Geologist of South Australia for 1935 (Adelaide: Government Printer, 1936). After a lengthy list showing that more than a hundred

plaints were investigated by the wardens, there is a series of short reports concerning mineral deposits, of which the most interesting is probably that "the Government Geologist was appointed to the Geological Advisory Committee assisting the operations of the Anglo-Persian Company's geologists who are making an examination of Australian territory for The Commonwealth Oil Refineries Ltd." This is followed by a report of the chief inspector of mines on the inspection work, whilst the general manager gives a report of the operations of State batteries and cyanide works. The mineral production of 1841–1935 closes the report, and shows a value of only a little more than 55 million pounds, of which three fifths is derived from copper ore and a quarter derived from iron ore. We have also received the Mining Review (No. 64) for the half-year ending June 30, 1936, of the South Australian Department of Mines. The review records the progress of mining operations in the first half of last year. The large-scale operations at Iron Knob and the many small gold mines scattered throughout South Australia are particularly noted.

The Problem of Reality in Physics

THE April number of *Current Science* contains a report of a lecture delivered at the Indian Institute of Science, Bangalore, by Prof. R. Ortvay, of Budapest, on "The Problem of Reality in Physics". Prof. Ortvay outlined the positivistic and realistic attitudes in physical science, the contrast between which he described as analogous to the relation between nominalism and realism in philosophy. To the positivist our only direct data are sensations, which alone constitute physical reality. All other 'existence' is constructed mentally out of sensations, and possesses a lower degree of importance. It follows that it is a senseless question whether anything exists that cannot be observed. This doctrine originated with Mach, and is shared by Bohr, Heisenberg, Dirac, Schrödinger and Philipp Franck. On the other hand, physical realism, the chief representatives of which in physics are Planck, Laue and Sommerfeld, chooses as its fundamental task the construction of a description of the world which is independent of our individuality. In Prof. Ortvay's opinion, positivism and realism are ultimately equally legitimate, just as in a logical system it is to a certain degree arbitrary what is to be considered as belonging to the basis of the system and what as a deduction. Positivism, in the form which was developed under the influence of quantum mechanics, leads to a profound change of our idea of the physical state of a system, but does not destroy the notion of the objectivity of a state, and so is not beyond realistic expression. On the other hand, Prof. Ortvay does not agree with the identification of observability and existence. He believes that we must maintain that certain things exist which can never be observed.

Research on Radium Therapy

RADIUM therapy in Great Britain was given a great stimulus with the formation of the Radium Beam Therapy Research unit towards the end of 1933. A series of papers during the last two years shows valuable contributions on many sides of the subject. Two of these papers have appeared in NATURE, one in the *Journal of Scientific Instruments* upon the properties of a new tungsten-nickel-copper alloy, the remaining seven in the *British Journal of Radiology*. Most of these papers are contributed by physicists, and deal in an exhaustive way with the physical properties of the radiation used and its intensity variations among the tissues that it penetrates. One paper, entitled "Delivery, Estimation and Control of Tissue Dosage in Radiation Therapy", by C. A. P. Wood and T. A. Green, exhibits in the most happy way how the carefully acquired physical data are being put to the direct service of the clinic. This paper may be said to mark an advance in the development of the use of big radium units in the treatment of cancer. The paper shows the importance of a knowledge of the state of radio-sensitiveness of the tumours being treated and how a best selection of the ports of entry of the radiation can only be made by those having the necessary anatomical knowledge combined with experience of the various modes of spread of cancer.

Indian Science Congress Association: Silver Jubilee

THE twenty-fifth annual session of the Indian Science Congress Association will be held in Calcutta on January 3–9 under the presidency of the Right Hon. Lord Rutherford. To mark the silver jubilee of the Association, the meeting is to be a joint session with the British Association. About a hundred men of science have been invited from Great Britain, while invitations have also been extended to a number of scientific workers in other countries. The Congress will be divided into the following sections under the presidents named: (1) Mathematics and Physics, Dr. C. W. B. Normand, director-general of observatories, Meteorological Office, Poona 5; (2) Chemistry, Prof. S. S. Bhatnagar, director, University Chemical Laboratories, Lahore; (3) Geology, Mr. D. N. Wadia, officiating superintending geologist, Geological Survey of India, 27 Chowringhee, Calcutta; (4) Geography and Geodesy, Dr. A. M. Heron, director, Geological Survey of India, 27 Chowringhee, Calcutta; (5) Botany, Prof. B. Sahni, professor of botany, University of Lucknow; (6) Zoology, Prof. G. Matthai, professor of zoology, Government College, Lahore; (7) Entomology, Mr. M. Afzal Husain, principal, Punjab Agricultural College, Lyallpur, Punjab; (8) Anthropology, Dr. B. S. Guha, Zoological Survey of India, Indian Museum, Calcutta; (9) Agriculture, Rao Bahadur T. S. Venkatraman, Imperial sugar-cane expert, Lawley Road, Coimbatore; (10) Medical Research, Sir Upendranath Brahmachari, professor of tropical medicine, Carmichael Medical College, Calcutta, and honorary professor of bio-chemistry, University of Calcutta; (11) Veterinary Research, Sir Arthur Olver, animal husbandry expert, Imperial Council of Agricultural Research, New Delhi; (12) Physiology, Col. R. N. Chopra, officiating director and

professor of pharmacology, School of Tropical Medicine, Calcutta; (13) Psychology, Dr. G. Bose, University College of Science, 92 Upper Circular Road, Calcutta. The main part of the British Association delegation will arrive at Bombay on December 16, and will tour Northern India before attending the Congress. The address of the General Secretary of the Indian Science Congress Association is c/o The Geological Survey of India, 27 Chowringhee, Calcutta.

Lubrication and Lubricants

THE *Journal of the Institution of Mechanical Engineers* of May describes the arrangements which have been made for a general discussion on lubrication and lubricants which is to take place at the Institution on October 13–15. The executive committee, with Dr. H. J. Gough as chairman, desires to make this an opportunity to review the present state of knowledge on the subject by means of contributions from those who are especially qualified to discuss the major problems, the immediate objects being to establish a correlation between theory, academic research and trade practice, to elucidate the methods of design of bearings, to obtain current views upon bearing metals and to explore the significance of laboratory tests. In connexion with the meetings, it is proposed to organize an exhibition. In view of the importance of the subject, the active co-operation of other societies has been invited and already more than forty British and foreign institutions have accepted. The programme, in its present state, contains about a hundred papers divided into four distinct groups dealing respectively with journal and thrust bearings, engine lubrication, industrial applications, and properties and testing, each of which has been split up into appropriate sections and subsections. From these it would appear that no aspect of the widespread applications of lubrication has been lost sight of, and besides those problems and considerations associated with all classes of machinery, such cases as those arising in connexion with wiredrawing, wire rope transmission, chains, metal pressings, cutting fluids and the like are to be subjects of discussion. In the group comprising properties and testing, the papers will deal with three main sections under the headings friction and wear, physical properties, and chemical properties. The papers already promised are being prepared by leading authorities on their subjects, and it is desired that further offers to contribute to the discussion should be addressed to the secretary, The Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.

Sphinx

THE problem of publishing results too specialized for such a journal as NATURE and not substantial enough for the proceedings of a learned society, which nevertheless have some permanent value and deserve to be recorded, is difficult. Many a pertinent observation must be buried in field-club notes in the files of local weeklies, and a glance at the pages of Dickson's "History of the Theory of Numbers" will suggest the magnitude of the task of the conscientious historian in any subject in which isolated statements can be significant. These remarks are prompted by the appearance recently in *Sphinx*, a monthly devoted to mathematical recreations and published privately by M. Kraitchik, Institut des Hautes Etudes de Belgique, 65 rue de la Concorde, Bruxelles, of an article "On Hyper-Exponential Numbers", in which Mr. H. J. Woodall, formerly associated with Lieut.-Colonel Cunningham in a series of extensive computations, discusses some sequences which resemble the sequence of functions forming the exponential scale but replace the *e* of the analyst by an integer. Mr. Woodall gives specimens of classification, determines a few orders of magnitude, and finds a few inequalities. No better medium of publication exists for such work, but the fact remains that a future investigator is much more likely to repeat Mr. Woodall's calculations than to discover that the work has been done.

Bleaching of Wood-pulp

IN connexion with the article on "Wood Pulp and the Future" (see NATURE, **139**, 867, May 22, 1937) we have received a letter from the Development and Research Department of the Pennsylvania Salt Manufacturing Co., 1000 Widener Building, Philadelphia, pointing out that the use of an emulsion of chlorine in water in multi-stage bleaching processes is the result of investigations made by this Company and is patented in twelve countries. It may be stated that the writer of the article was fully aware of the part played by the organization concerned in developing this particular method of bleaching. In a short survey covering such a wide field, however, it was not considered necessary to give references to the work of individual firms; in the case of bleaching processes in fact, this would indeed have been a particularly difficult matter, owing to the large number involved.

Genetical Society

THE summer meeting of the Genetical Society was held at the Courtauld Genetical Laboratory, Inner Circle, Regent's Park, on August 10. The demonstrations shown by Prof. R. Ruggles Gates and his staff included the following: many new species and varieties of *Ænothera*, in connexion with the genetic survey of the genus in eastern Canada; Indian and Japanese varieties of rice, with X-ray mutations, autotriploid and allotriploid progenies, showing an inverse relation between the number of extra chromosomes and the size of the plants; a cytological survey of various species of the Phalarideæ; cytogenetical studies of *Cicer arietinum*; experiments with the growth of pollen tubes in cotton plants, and a chromosome survey of various Malvaceæ.

Research on Mental Disease

THE annual report for 1936–37 of the Birmingham Joint Board of Research for Mental Disease consists entirely of pathological laboratory findings. Fifty-six named varieties of micro-organism are described as

occurring in the cavities or excretion of insane subjects and 769 tests were made of serological agglutination, though the absence of any record of control investigation among the sane population leaves the reader in difficulty as to the precise value of these results. The Board apparently does not concern itself with the psychological approach to the study of mental disease.

New Comet 1937 g (Hubble)

DR. E. P. HUBBLE, at Mount Wilson, discovered a new comet of magnitude 13 on August 4. Its position was R.A. $22^h\ 49{\cdot}3^m$, S. Decl. 21°, and its daily motion -30^s in R.A. and 6′ S. in Decl. Later observations have been made, but there is no mention of the positions, except one from Bergedorf. Cunningham and Shapley have computed the following orbit :

T	1937 Dec.	11.56	U.T.
ω	54°	54′	1937·0
Ω	11	12	
i	9	53	
q	0·9010		

Its position in the constellation of Aquarius is not very favourable for observation in northern latitudes, and although it is approaching both the earth and the sun and will increase in brightness, it is not likely to become a conspicuous object. Its distances from the earth and sun at present are 1·1 and 2·1 units respectively, and on September 20 these will be 0·75 and 1·7 respectively.

Announcements

THE President of the French Republic has conferred the honour of La Croix de Chevalier de la Légion d'Honneur on Mr. Geo. E. Pearson, the governing director of the Wellcome Foundation, Ltd.

THE following appointments and promotions have recently been made in the Colonial Service : G. L. Carson, assistant conservator of forests, Malaya ; W. P. Gaskell, inspector of mines, Nigeria ; I. G. John, meteorological officer, Survey Department, Malaya ; F. Birkinshaw (State agricultural officer, Perak), chief field officer, Agricultural Department, Malaya ; W. G. Leckie (agricultural officer), senior agricultural officer, Kenya ; J. N. Milsum (agriculturist), senior agricultural officer, Malaya ; W. L. Watt (agricultural officer), senior agricultural officer, Kenya ; M. E. Dommen (assistant conservator of forests, Cyprus), assistant conservator of forests, Nigeria ; S. T. Phillips (inspector of plants and produce), senior inspector of plants and produce, Gold Coast ; S. A. Roach (industrial instructor, Education Department, Tanganyika), livestock officer, Department of Agriculture, Sierra Leone ; E. Wall (executive engineer, Public Works Department, Nyasaland), senior executive engineer, Public Works Department, Nigeria.

DR. THORVALD MADSEN, chief of the State Serum Institute of Copenhagen, has for the seventh time been elected president of the Health Committee of the League of Nations.

MR. FIORELLA H. LA GUARDIA, Mayor of New York City, recently laid the corner stone of a new health centre in New York, forming the ninth building which had been started under the plan of the New York City Department of Health to create full-time health districts.

AN international Congress of Tourism, Thermalism and Climatism will be held in Paris on October 14–17. Further information can be obtained from the Secrétariat Général de la Fédération thermale et climatique française, 127 Avenue des Champs Elysées, Paris VIIIe.

THE twenty-first International Congress against Alcoholism will be held in Warsaw on September 12–17 under the patronage of the President of the Polish Republic, with Dr. Chodzko, formerly Minister of Public Health, as president of the executive committee. The following papers, among others, will be read : "The Influence of Alcohol on the Brain", by Prof. Rosé, of Wilno ; "Wine as a Factor in Alcoholism", by Drs. Dauphin, Fillion-Roux and Faisant (France) ; and "Alcohol and Mental Disease with Special Reference to Beer as a Cause of Alcoholism", by Prof. Vermeylen of Brussels. Further information can be obtained from Dr. R. Hercod, La Glycine, Epinettes, Lausanne.

MESSRS. BOOTS have issued a booklet dealing shortly with the use of protamine insulin (with zinc). It has a much more prolonged action than ordinary insulin, and is therefore more convenient to use. The booklet contains fourteen references to original papers, and may be obtained on application to the Wholesale and Export Department, Station Street, Nottingham.

"ZOOLOGIA SPECIALIS" is the title of a book catalogue (No. 711) issued by Gustav Fock (Leipzig), containing, amongst other items, books and papers from the libraries of the late Prof. G. Grimpe of Leipzig and of Prof. L. Plate of Jena. The catalogue details 5,737 items, amongst which Vermes, Mollusca, Crustacea, Aves, Mammalia and scientific periodicals are especially well represented.

A SMALL book entitled "Clinical Colorimetry with the Pulfrich Photometer", compiled and published by Carl Zeiss, of Jena, in collaboration with Dr. W. Krebs (London : Carl Zeiss (London), Ltd. ; W. and G. Foyle. 7*s.* 6*d.* net), gives details of a number of colorimetric tests applicable to clinical material. The technique of these tests is adapted for use with the Pulfrich stufenphotometer made by Messrs. Carl Zeiss. It will probably prove very useful to clinical pathologists.

ERRATUM.—In the fifth line from the bottom of the first column of p. 23 of NATURE of July 3, 1937, the names "Millikan and Cameron" should be replaced by "Bethe and Heitler". Millikan and Cameron have advanced no theory of showers.

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 324.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

World-wide Effect in Cosmic Ray Intensity, as Observed during a Recent Magnetic Storm

MR. S. E. FORBUSH[1] noted a very striking similarity between the variation of the horizontal component of the earth's magnetic field intensity and of the intensity of the cosmic ray ionization (as registered by two Compton cosmic ray meters) at Cheltenham, Maryland, U.S.A., and Huancayo, Peru, during the very severe magnetic disturbances between April 25 and April 30 of this year.

Our cosmic ray research station on the Hafelekar (2,300 metres above sea-level, near Innsbruck, Austria) gave results which corroborate Mr. Forbush's statements very strikingly. The magnetogram was taken from the registrations of the Vienna-Auhof Terrestrial Magnetic Station. We are obliged to Dr. M. Kofler, acting director of the Meteorologische Zentralanstalt, of Vienna, for placing the hourly values of the horizontal magnetic intensity at our disposal.

In Fig. 1 these values reduced to Greenwich Mean Time are plotted (thin curve) together with the bi-hourly means of the cosmic ray ionization on the Hafelekar, as registered with our Steinke standard apparatus shielded on all sides by lead (10 cm. thick) and in addition by iron plates (7 cm. thick). All values were reduced to standard pressure.

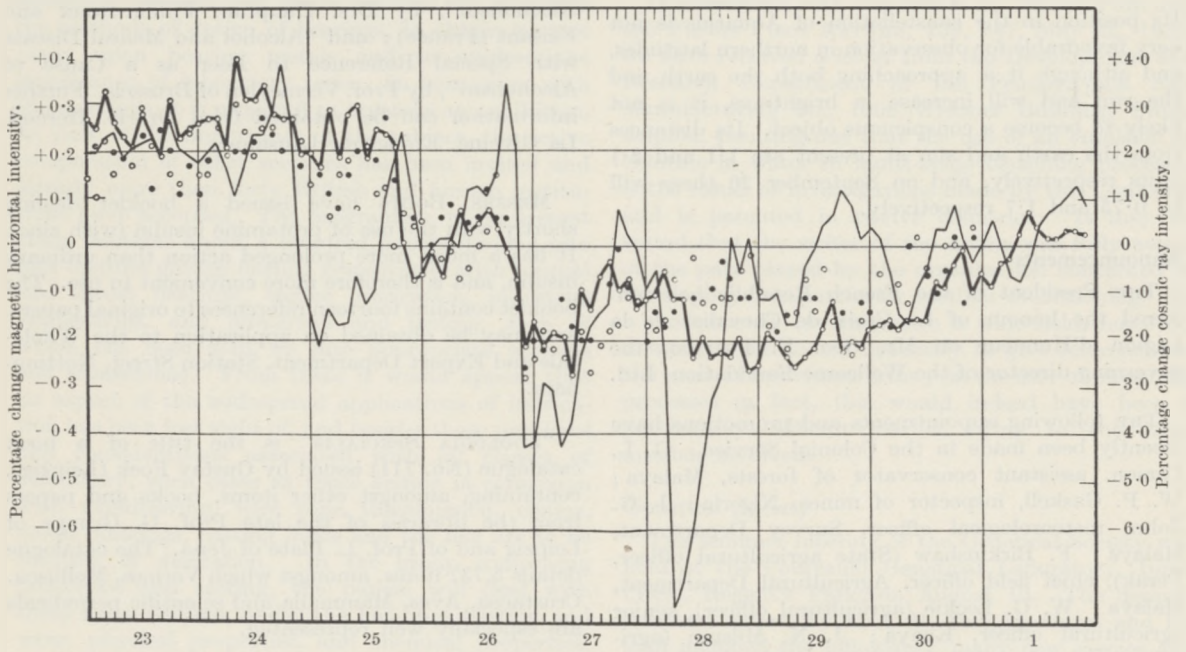

FIG. 1.

BI-HOURLY MEAN VALUES OF COSMIC RAY INTENSITY AND OF MAGNETIC HORIZONTAL INTENSITY, APRIL 23 TO MAY 1, 1937.

●, Cosmic ray intensity, Huancayo. o, Cosmic ray intensity, Cheltenham. o—o—o, Cosmic ray intensity, Hafelekar.

The variations of the ionization observed during the magnetically disturbed days (April 24–30, 1937) were uncommonly large: the maximum of the bi-hourly ionization means was 2,485 *J*. (April 24), the minimum 2,339 *J*., the deviations from the total average being + 3·9 and − 2·8 per cent respectively. Even the daily mean values varied by as much as + 2·7 per cent (April 24) and − 2·2 per cent (April 29).

In Fig. 1 the heavy-lined curve indicates our bi-hourly ionization values; the corresponding values of Cheltenham and Huancayo, indicated by small dots and circles in Fig. 1, were taken from Mr. Forbush's paper cited above.

The general trend of the curves of these two stations is in beautiful agreement with our curve. The magnetic intensity curve from Vienna-Auhof is nearly identical with the curve of the two American stations.

In Fig. 2 the daily mean values of the horizontal intensity are plotted together with the cosmic ray ionization and with the number of triple coincidences as observed by L. Jaeger on the Hafelekar with two sets of Geiger-Müller counters, consisting each of three counters placed vertically above each other. Here once more the close similarity in the variation of the cosmic ray intensity and the horizontal magnetic force during the magnetic storm is clearly demonstrated.

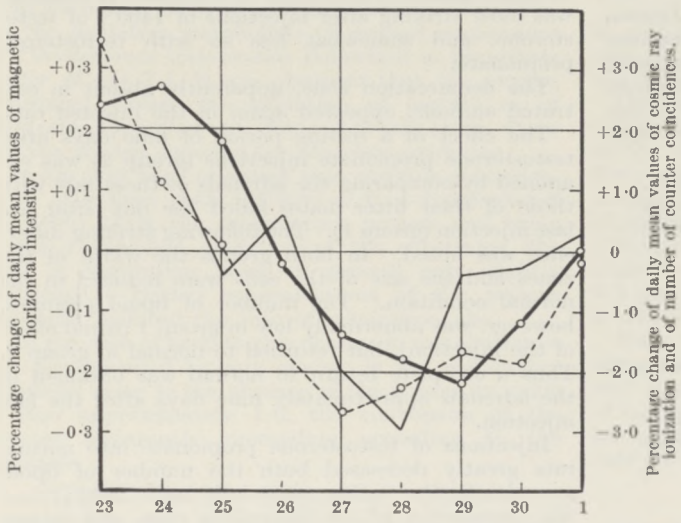

Fig. 2.

DAILY MEAN VALUES OF COSMIC RAY IONIZATION, OF NUMBER OF COUNTER COINCIDENCES AND OF MAGNETIC HORIZONTAL INTENSITY, APRIL 23 TO MAY 1, 1937. o—o—o, COSMIC RAY IONIZATION; o- -o- -o, NUMBER OF COUNTER COINCIDENCES; ———, MAGNETIC HORIZONTAL INTENSITY.

We think that Forbush's results taken together with our own results prove: (1) that cosmic ray ionization was influenced all over the earth by the magnetic disturbances between April 24 and 30 of this year and that a decrease of the cosmic ray intensity followed a decrease of the magnetic intensity; (2) that the magnitude of the variations of the cosmic ray intensity during magnetically disturbed days may amount to as much as ± 3 per cent; (3) that these variations occurred simultaneously all over our planet. We agree with Mr. Forbush in concluding that the study of the magnetic storm effects will give valuable information on the energy spectrum of the cosmic radiation.

A detailed analysis of the magnetic effects on cosmic ray ionization during one whole year (1936–37) will be published later in *Terrestrial Magnetism and Atmospheric Electricity*.

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[1] *Phys. Rev.*, **51**, 1108 (1937).

Concentration of Mesothorium-I by Duckweed (*Lemna*)

IT is characteristic of the waters of the earth's crust —among which we can distinguish more than 550 different mineralogical species—that all these chemically different water solutions constitute theoretically one and the same natural body—a unique great water-equilibrium of the earth's crust[1]. They are in constant close material connexion. This connexion is produced by two physical equilibrium systems common to all natural water-solutions:

Water⇄water vapours (in contact with gaseous atmospheres).
Water⇄pellicular water (in contact with solids).

The solid substance of the earth's crust is penetrated by pellicular water-solutions[2]. It is characteristic that there are chemical elements which do not enter into the constitution of these solutions[3]. Among these elements one, on account of its great geochemical and geological importance, must be studied with the greatest attention, namely, thorium. Two deductions can be made from this characteristic of thorium atoms in the geochemical history of thorium:

(1) In relation to the content of thorium atoms in sea-water[4]: either not thorium atoms, but the products of their disintegration—mesothorium-I, radio-thorium, and thorium-*X*—are present in sea-water, or the thorium atoms are included in the dispersed solid particles distributed in sea-water.

(2) In relation to the thorium content of living organisms: thorium atoms should not be found in the living organisms, which obtain all their metallic atoms from water-solutions, soil-solutions and surface or underground waters.

To verify the second deduction, researches were carried out by B. Brunowsky and C. Kunasheva in the Biogeochemical Laboratory of the Academy of Sciences, Moscow, which proved its truth. A large quantity of duckweed belonging to two species, *Lemna minor* L. and *Lemna polyrrhiza* L., was collected in 1933 from the Orangery Pond at Peterhof (near Leningrad), and a 200-litre sample of water taken. The plant mass was divided into two lots. The first lot (30·4 kgm. live weight) was dissolved, and the isotopes of radium and thorium separated in the solution by ammonia. The fraction of the solution containing radium isotopes was examined after two years by way of Tn for its mesothorium content, which proved to be $(10{\cdot}3 \pm 0{\cdot}3) \times 10^{-15}$ per cent. A month after the separation, in the fraction containing thorium isotopes, the thorium-*X* was precipitated by barium sulphate, and the quantity of radio-thorium evaluated by determination of Tn. The radio-thorium content of *Lemna* proved to be exactly such as should have generated in *Lemna* from mesothorium-I during the period of time between the taking of samples and the separation of the isotopes.

In 1935, the second lot of *Lemna*, which had been preserved in an air-dry condition for two years, was dissolved and the Tn content determined. The calculation of the mesothorium-I content of *Lemna* was then made on the basis of the observed ionization

effect, taking into account the possibility of thorium atoms being either absent or present. In the first case, the content was calculated to be $10{\cdot}2 \times 10^{-15}$ per cent, and in the second $9{\cdot}05 \times 10^{-15}$ per cent. These results, compared with the mesothorium-I content given above for the radium isotope solution, which certainly contained no thorium atoms, led to the conclusion that the thorium content of *Lemna* does not exceed 1 per cent of the quantity in equilibrium with mesothorium I, that is, that *Lemna* does not contain isotopes of thorium.

Analogous tests of the pond water proved the presence in it of $8{\cdot}25 \times 10^{-17}$ per cent of mesothorium-I, and not exceeding 20 per cent of the radio-thorium for equilibrium with the mesothorium-I. This suggests that, although isotopes of thorium are present in water, they are not assimilated by *Lemna*. On the other hand, *Lemna* accumulates mesothorium-I and concentrates it a hundredfold as compared with its content in the water. The plant, therefore, assimilates radioactive elements, if present in the nutrient medium, in strict accordance with their chemical properties.

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[1] Vernadsky, W. I., "History of Natural Waters" (in Russian), **1**. (1933–36).
[2] Vernadsky, W. I., *ibic.* **1**, 11–12.
[3] Vernadsky, W. I., *Priroda* (in Russian), No. 8–9, 26 (1933).
[4] Vernadsky, W. I., *Priroda* (in Russian), No. 5, 414 (1932).

Histological Changes produced by Castration and by Sex Hormones in the Adrenals of Normal and of Castrated Male Rats

IN our previous publications[1] we have shown that in male rats after castration the weight of the adrenals increases and that this 'castration hypertrophy' decreases or disappears after injections of androsterone, androstanediol, dehydroandrosterone, testosterone, testosterone propionate, androstenediol and androstenedione. In the present communication the results of histological examination of these adrenals are given.

The occurrence of 'castration hypertrophy' in the adrenals of male rats has been observed previously. The effect of injections of some of the hormones mentioned above has been studied only on the *X*-zone of castrated mice[2,3].

The hypertrophy of the 'castration' adrenal is due to the hypertrophy of the zona fasciculata and reticularis, especially the latter, resulting chiefly from a considerable increase in the size of the cells composing these layers. The lipoid content of the outer half of the zona fasciculata is definitely increased while that of the reticularis is decreased.

The 'demarcation zone' lies between the glomerulosa and fasciculata zones, and consists of 1–4 rows of cells, in which lipoid granules are normally few or absent; after castration it becomes impregnated with lipoid and hence appears to be absent.

The width of the zones and size of the cells return to normal or nearly normal size if sufficiently large doses of sex hormones are injected into castrated rats. Moreover, some hormones may decrease to below normal both the zones and the size of the cells (androsterone and androstanediol).

Vacuolation, which is slightly increased in the zona fasciculata after castration, is decreased after injections of sex hormones, sometimes in a most striking degree, almost disappearing with high doses of androsterone. Testosterone presents a special case; small doses decrease vacuolation, but after high doses (1400 γ) it appears again.

Most doses and hormones investigated produced in all zones, in some cases excluding the glomerulosa, a partial, sometimes nearly complete, disappearance of lipoid granules. The discrepancy between the very pronounced vacuolation and greatly decreased number of lipoid granules, as shown by Sharlach R staining, was most striking after injections of 1400 γ of testosterone, and somewhat less so with testosterone propionate.

The demarcation zone, apparently absent in castrated animals, appeared again in the injected rats.

The effect of a resting period of nine days after testosterone propionate injections (group 2) was examined by comparing the adrenals of these rats with those of their litter mates killed the day after the last injection (group 1). The following striking difference was noted. In both groups the width of the zones and the size of the cells were reduced to the normal condition. The number of lipoid granules, however, was abnormally low in group 1 (usual effect of the injection), but returned to normal in group 2. Thus a complete return to normal was obtained in the adrenals approximately nine days after the last injection.

Injections of testosterone propionate into normal rats greatly decreased both the number of lipoid granules in the cortex (especially with 1500 γ) and the vacuolation of the fasciculata cells, and caused an increase in the number of faintly stained nuclei with a poor chromatin network.

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[1] Korenchevsky and co-workers, NATURE, **135**, 434; **136**, 185 (1935); **137**, 494 (1936). *Biochem. J.*, **29**, 2534; **30**, 558 and 1514 (1936); **31**, 467, 475 and 780 (1937).
[2] Cramer and Horning, *Lancet*, I, 1330 (1937).
[3] Deanesly and Parkes, *Quart. J. Physiol.*, **28**, 393 (1937).

Prevention of Assimilation in Respiring Cells

UNTIL recently it was generally assumed that so-called 'resting' cells, suspended in a buffer solution in the presence of a nitrogen-free substrate, could be employed in studying respiration separately from other metabolic processes. Some doubt as to the validity of this assumption is suggested by the studies of Cook and Stephenson[1], which show that the oxygen consumed during the oxidation of glucose, lactate or acetate by *Bact. coli* amounts to only from two thirds to three fourths of that required for complete oxidation.

Barker[2] advanced considerable evidence that this incomplete oxidation may be due to an oxidative assimilation, which in the case of the oxidation of acetate by the colourless alga *Prototheca Zopfii* may be represented as

$$CH_3COOH + O_2 \rightarrow CO_2 + H_2O + (HCHO).$$

Barker also reported that the amount of carbon assimilated varies with the nature of the substrate. Giesberger[3] also observed this phenomenon with different species of *Spirillum* and showed, moreover, that the amount of carbon assimilated from a given substrate varies with the different species.

The fact that this intimate relation between respiration and assimilation is encountered in such widely different groups of organisms makes it probable that the phenomenon is of a quite general nature. It seemed, therefore, of importance to investigate whether respiration and assimilation are indeed intimately associated in one reaction chain as suggested by the equations advanced by Barker and Giesberger, or whether it is possible to block one process and not the other.

In the course of investigations (Warburg technique) on the oxidative metabolism of washed suspensions of *Pseudomonas calco-acetica* Beijerinck in phosphate buffer of *p*H 7·1, it was observed that the oxygen consumed during the oxidation of acetate or of butyrate amounted to only approximately three fourths of that required for complete oxidation.

It has now been observed that suitable concentrations of sodium azide (*M*/600) or 2 : 4-dinitrophenol (*M*/4000) block the assimilatory process and bring about a complete oxidation of the substrates, the rate of respiration being in general only slightly decreased. Higher concentrations of the poisons markedly reduced the rate of respiration also.

In the case of acetate this change in metabolism is not accompanied by any change in the respiratory quotient, since in the absence of the poison its value is also approximately 1·0, the conversion of the acetate apparently proceeding according to the equation

$$2CH_3COOH + 3O_2 \rightarrow 3CO_2 + 3H_2O + (HCHO).$$

The oxidation of butyrate, however, presents another picture, as under normal conditions the respiratory quotient was approximately 0·68, suggesting that the reaction may be represented as

$$2C_4H_8O_2 + 7O_2 \rightarrow 5CO_2 + 5H_2O + 3(HCHO).$$

In the presence of the azide or dinitrophenol the observed respiratory quotient was 0·8, the value characteristic of the complete oxidation of butyrate.

The oxidation of acetate by *Bact. coli* proceeds in a manner similar to that described for *Ps. calco-acetica*, and assimilation is also blocked by the same poisons. It was observed that *M*/4000 dinitrophenol tended to stimulate respiration to a slight extent while at the same time the oxidation proceeded to completion.

The observations suggest that it is indeed possible to block the assimilatory process in non-proliferating cells by the addition of critical concentrations of certain chemical agents, thus permitting the oxidation of a given substrate to proceed to completion at an almost normal rate. These observations also suggest that the so-called 'slimming' agents such as 2 : 4-dinitrophenol may exert their weight-reducing action in man by a suppression of assimilation, rather than simply by their stimulatory effect on respiration.

Full details will soon be published elsewhere.

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[1] *Biochem. J.*, **22**, 1368 (1928).
[2] *J. Cell. Comp. Physiol.*, **8**, 231 (1936).
[3] Dissert., Delft, 1936.

Nutritional Value of Some Indian Diets

MCCARRISON[1] has pointed out the great superiority of northern Indian diets as compared with those consumed in the east and south of India. It appeared to us to be of interest to compare the northern Indian well-to-do and poor Hindu diets, the ingredients of which he has listed[2], by feeding them to rats.

The diets were found to contain calcium and phosphorus in the following amounts :

TABLE 1.

	Ca (per cent)	P (per cent)	Ca : P ratio
Northern Indian	0·17	0·33	0·52
	0·18	0·37	0·49
Well-to-do Hindu	0·09	0·22	0·42
	0·09	0·21	0·43
Poor Hindu	0·018	0·08	0·23
	0·021	0·11	0·20

It will be noted that all three diets are low in Ca and P, and especially the poor Hindu diet, which has a rachitogenic Ca : P ratio.

Groups of 8 rats were fed on these diets, group *A* being fed on the northern Indian diet and *B* and *C* on the well-to-do and poor Hindu diets respectively. The diets were fed uncooked. The mortality in groups *A* and *B* was *nil*, but of those in group *C*, six died of pneumonia and none survived more than 105 days. The rate of growth of group *A* was about 2 gm./day, of group *B* about 1·4 gm./day and of group *C* about 0·9 gm./day. In the case of rats on stock diet, this is about 2·7 gm./day.

Rats were killed at intervals and the ash content determined in the lower incisors, one femur, tibia and fibula. The figures for bone ash at 105 days of age, which are typical of all the values obtained, are given below, together with figures from control rats on the Rowett Institute stock diet.

TABLE 2.

	ASH CONTENT OF BONES.			
Age (days)	*A*	*B*	*C*	Control
105	50·8	42·0	31·0	63·3

These values show that calcification was impaired in all three groups, compared with the controls, and especially so in group *C*. Changes in the same direction, but of smaller degree, were found in the teeth. This is in accordance with the well-known fact that the composition of the teeth is not so readily altered by dietary means as is that of the bones.

The width of the predentin in the upper incisor teeth was measured, the following average values being obtained :

A	*B*	*C*	Control
25μ	21μ	51μ	18μ

The normal value is about 16 μ and is increased when calcification is poor ; these values therefore indicate that the calcification of the teeth was impaired in all three groups compared with the controls, and especially so in group *C*. In groups *A* and *B*, the incidence of interglobular dentin was higher than normal. In group *C*, the dentin contained a great many interglobular spaces and also showed a high degree of stratification ; the predentin in this group had many vascular inclusions.

In breeding, all three groups were definitely inferior to normal rats on stock diet. Group *C* did not breed at all. Group *A* mated at the normal time, but the litter weights, weaning weights and number of young surviving to weaning were low. Group *B* showed the same poor reproductive performance and in addition the mating date was much retarded.

Although the number of rats used was small, the results confirm McCarrison's finding that the northern Indian diet is superior to both the Hindu diets. The poor Hindu diet is defective on all points; and it is of interest to note that, judged by modern standards, the northern Indian diet is further capable of improvement.

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[1] McCarrison, *Nut. Abst. Rev.*, 2, 3 (1932-33).
[2] McCarrison, "Food", pp. 113-115 (Madras, 1931).

Solubility of Silica Dusts

THE industrial disease of silicosis has been postulated to have a relation to the dissolution of particles of mineral silicates in the lung. Whether this 'solubility theory' of silicosis be true, considerable interest is attached to the production of soluble silica from finely divided mineral dusts. The amount of silicic acid which a mineral form of silica will yield in solution is exceedingly small when it is present as crystals or as coarse fragments. But if it be reduced to a particle size of the order of the dust in the air (that is, < 1 to 10 microns) then the dissolution rate becomes appreciable.

In a recent paper, Emmons and Wilcox[1] gave figures for the silica dissolved from a number of mineral silicates. The method adopted in the study of the dissolution of these dusts is open to grave criticism. For the separation of the liquid phase (blood serum) from the solid (the powdered mineral) these workers relied on centrifugalization at 3,500 r.p.m. for fifteen minutes: the dusts having been exposed to the serum for two months at 37°. The total amount of silica in the supernatant fluid was determined by ashing an aliquot, following by gravimetric analysis.

The rate of sedimentation of particles depends on their shape; a roughly spherical particle tends to settle more quickly than a fibrous particle, even though the particles be of approximately the same size. Centrifugalization at the modest speed of 3,500 r.p.m. for fifteen minutes will not completely remove fine particles of the size (1–10 μ) used by Emmons and Wilcox—particularly from a viscous fluid like blood serum; and the extent to which they are removed will depend on the particle shape. It is notable that the figures showing the greatest percentage of silica dissolved are for fibrous minerals. Thus, in the results for human blood serum, sericite and asbestos give a much greater apparent 'solubility' than opal, quartz or cristabolite. In some cases, for example, that of quartz, which sediments rapidly, the results may approximate to the true solubility figure, but in others where the rate of sedimentation is low they are probably greatly in excess. If the results are expressed in terms of the mgm. SiO_2 contained in 100 c.c. of solution, then figures of 5·0 and 3·8 are found for quartz, a solubility figure in reasonable agreement with other published data. But the figures found for sericite, namely, 14·3 and 9·2, are very much higher than other recorded results. It is suggested that these results do not, in fact, represent the silicic acid in solution; they represent the total amount of silica left in suspension, plus what small amount may be in solution. Only by high-speed centrifugalization, for example, 15,000 r.p.m. for forty-five minutes, is it possible completely to remove these particles from suspension.

A true measure of the amount of silicic acid which has gone into solution from a powdered mineral can be gained in two ways. The suspended material can be completely separated from the soluble, and the total silica in the separated liquid determined by gravimetric analysis; or secondly, advantage can be taken of the fact that in certain chemical reactions only the silica present as silicic acid will take part. Such a reaction is represented by the well-known formation of silico-molybdic acid, a substance which imparts an intense yellow colour to its aqueous solution even when it is present only in minute amount.

Powdered amorphous or crystalline silica when freshly suspended in water gives no colour on the addition of molybdic acid, but does so after it has stood in contact with the water for some hours, that is, when some of the silica has passed into solution as silicic acid. The measurement of the intensity of the yellow colour (or of the blue colour in a refinement of the method where the silico-molybdic acid is reduced to a blue complex) furnishes a means by which the amount of silicic acid in solution can be estimated, the maximum part of the suspended material having been removed by filtration through very fine paper. Results obtained by this type of procedure probably show fairly accurately the actual soluble silica content of the solution. Such results will vary, of course, with the concentration of the dust and its degree of fineness, as well as with the type of mineral and liquid used. In the accompanying table are presented figures which are believed substantially to represent the rate at which silicic acid will pass into solution from a powdered mineral of a certain range of particle size when suspended at a given concentration in a liquid.

DISSOLUTION OF MINERAL DUSTS

(mgm. SiO_2 dissolved by 100 c.c. of liquid)

(1) 0·1 gm. of dust in 100 c.c. of 1 per cent sodium bicarbonate

Days at 37°	Quartz		Sericite	
	20–40 μ	< 1–5 μ	Plate*	Fibrous*
1	0·71	0·70	0·32	0·51
3	0·97	1·65	0·39	0·57
5	1·02	2·08	0·32	0·62
8	1·20	2·74	0·46	0·78
Hours at 100°				
2	1·25	2·05	0·30	0·37
4	1·46	4·15	0·40	0·39
6	2·02	4·37	0·42	0·39

(2) 2 gm. dust in 100 c.c. acetic fluid at 37°

Days	Ppt'd. silica	Quartz	Kaolin	Mica
4	7·04	4·53	0·22	—
8	7·12	5·91	0·26	1·0
16		5·82	0·24	1·8

* Plates of sericite < 1–2·5 μ (few larger); fibres of sericite 1–10 μ in length by about 0·1–1 μ in width.

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[1] Emmons and Wilcox, *Amer. Mineral.* 22 256 (1937).

Synthesis of Benzanthrones

IN a recent publication by one of us[1], it was shown that the readily formed αγ-diethylethers of β-substituted glycerols could be used to prepare 2-substituted quinolines. We have now used these ethers for the synthesis of 2-alkyl- and 2-aryl-benzanthrones under the conditions of Bally and Scholl's synthesis[2], the mechanism of which is being further investigated.

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[1] *J. Chem. Soc.*, 1366 (1936).
[2] *Ber.*, **44**, 1665 (1911).

Propagation of Optical Contact

IT is not generally known that by a simple device so-called optical contact can propagate itself.

Contact is usually produced by the application of considerable pressure, first on the centre of the plate and thereafter in a spiral path outwardly to the periphery. If, however, the test plate is pierced by a small hole and pressure is applied at one point and then withdrawn, the surfaces, without further manipulation, will move together into optical contact.

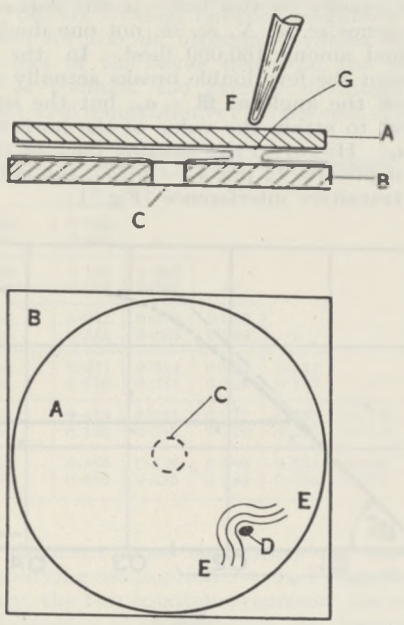

FIG. 1.

In Fig. 1, *A* is an optically polished glass disk, lying upon a test plate *B*, pierced by a hole *C*. Pressure is applied, say, at *F*, and then withdrawn. The Newton rings around the point, without further assistance, expand and disappear, leaving the surfaces in pseudo-contact and in darkness devoid of colours. A small speck of dust, such as *D*, will not arrest the movement. It is interesting to observe the rings at *E* attempting to encircle the speck and ultimately doing so, leaving around it two small bluish white rings, separated by a mottled dark one. These white rings suggest the following explanation of the phenomenon under consideration.

Optically polished glass surfaces, unless they are specially treated, have surface layers of something akin to grease. Pressure at *F* bends the plate *A* sufficiently to join the grease films, as at *G*. Surface tension forces around *G* expel the air and extend the liquid continuity over the whole surface. Light falling upon the area *G* passes through more or less completely, according to the equality of the refractive indices of the grease and glass. Viewed from above, the liquid region *G* appears dark and, from below, bright.

Light is reflected from the rounded surface tension contours, which regions appear bluish white. Newton rings may appear in the remainder of the area. From measurements made by Sir Isaac Newton, I reckon the thickness of each grease layer to be less than one millionth of an inch.

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Reversible Bleaching of Chlorophyll

CHLOROPHYLL solutions bleach slowly in light. This has been attributed to a reaction with dissolved oxygen[1]. For the quantum yield of this bleaching we found, in methyl alcohol solutions, values about $\gamma = 10^{-6}$, independent of oxygen concentration over a wide range, but disappearing upon a complete removal of oxygen from the solution.

In oxygen-free solutions, a *reversible* bleaching is observed instead of the above-mentioned irreversible one—that is, the extinction coefficient of the solution returns to its original value as soon as the illumination has ceased. When a solution containing 10^{-6} mol. chlorophyll per litre of methyl alcohol is illuminated with red light, of an intensity corresponding to the absorption of 10 quanta per sec. by each molecule, the extinction coefficient of this solution for red light is decreased—it is about 1 per cent less than in the dark. (A method of measuring effects of this order of magnitude was described previously[2].) This means $\tau \times \gamma = 10^{-3}$ (τ = mean 'life-time' of the bleached state). Since $\tau \leq 1$ sec. (because of the velocity with which the original state is re-established in the dark), γ is $\geqslant 10^{-3}$. More probably, $\gamma \simeq 1$, and $\tau = 10^{-3}$ sec. The quantum yield of the reversible bleaching is in any case much higher than that of the irreversible oxidation in presence of oxygen.

The reversible bleaching is proportional to the *square root of light intensity*. It is thus due to a recombination of the products formed by the photochemical dissociation of chlorophyll. The nearest assumption is that chlorophyll dissociates into a 'dehydrochlorophyll' and an H-atom. A life-time of 10^{-3} sec. is what one would expect for this kind of dissociation, if the recombination occurs by the first encounter of the dissociation products.

In a few experiments, under apparently unchanged conditions, *much stronger—but still perfectly reversible—bleaching effects were observed, rising to 50 per cent.* We may suppose them to be due to the presence of some unknown impurity 'stabilizing' the dissociated state—for example, by a temporary 'absorption' of the H-atom. In search of substances which may produce such an effect, we found that *formic acid* causes a considerable increase in the reversible bleaching of chlorophyll solutions (of the order of

10 per cent under the above-mentioned conditions). This is interesting in connexion with the assimilation process.

All reversible effects, even the strongest ones, are suppressed by traces of oxygen, and restored again by a removal of oxygen from the solution. 5×10^{-5} mol. oxygen per litre are sufficient to reduce by 50 per cent the bleaching observed in presence of formic acid. Oxygen either forms with chlorophyll a complex which prevents the dissociation of the chlorophyll molecule by light[3], or it takes away the energy of excited chlorophyll molecules by collisions, before they have had time to dissociate[4].

All reversible bleaching effects are also suppressed by *ferrous chloride*. This points to a relation between the above-described 'optical' bleaching and the reversible 'chemical' bleaching of chlorophyll by ferric salts[5]. In presence of ferric salts, chlorophyll is reversibly bleached by light even without the removal of oxygen. Fe^{3+} ions either are able to take an H-atom (or an electron) from an excited chlorophyll molecule despite its protection by an O_2 complex; or, alternatively, they react with excited chlorophyll molecules before these have had time to lose their excitation energy by collisions with oxygen.

Most of the above-described experiments were carried out with synthetic ethyl chlorophyllide *a*, kindly supplied by Prof. H. Fischer (Munich). The same effects were, however, also observed with the natural chlorophylls *a* and *b* which Prof. A. Stoll (Basle) has kindly put at our disposal. Our heartiest thanks are due to Prof. F. G. Donnan for his interest in this work and the hospitality of his laboratory.

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Transitive Interference in Gene Linkage

MORGAN'S hypothesis of interference has been subjected[1] to treatment in terms of the probability of non-independent events, as the probability of a double break is not equal to the product of the probabilities of the two single breaks. The *f*-values, that is, the experimental values of the freedom of exchange between two genes (recombination per cent in decimals) are thus substituted by the calculated—and greater—primary f-values, which would be manifest if the first break did not interfere with the occurrence of a later break. The i-values measuring the strength of interference are obtained at the same time as the frequencies of the expected double breaks suppressed by interference. The sum of the f-values between neighbouring genes yields the primary map-distance $\mathfrak{M}$ on the primary map. The calculations are carried out with each interval taken as leading, that is, the interval in which the whole process of interference (the twisting of the chromosomes) starts. The real leading interval is the one which leads to simple relations between i and $\mathfrak{M}$.

The application of this theory to the seven point experiment "Xple" of Bridges and Olbrycht[2] showed the *X*-chromosome of *Drosophila melanogaster* from gene *sc* to gene *f* to consist of two segments, the boundary lying between the genes *cv* and *c*[3]. This inference was confirmed cytologically, a constriction having been located almost at the same place[4].

The leading interval for both segments is *sc ec*, which conforms to the cytological observation[5]. Within one and the same segment, i decreases inversely as $\mathfrak{M}$, yielding the constant of interference

$$i\mathfrak{M} = a ,$$

unless $\mathfrak{M} < a$, for then this equation would give $i > 1$, an impossible frequency value. The assumption of the maximum possible value $i = 1$ for $\mathfrak{M} < a$ means that no double breaks exist, *a* being the distance of the absolute interference. The representation of $i\mathfrak{M}$ as a function of $\mathfrak{M}$ begins thus as a 45° straight line ($i\mathfrak{M} = \mathfrak{M}$) and continues with an angle at $\mathfrak{M} = a$ as a horizontal line. For the right segment the constant *a* amounts to $a_r = 0{\cdot}124$. In the experiment under discussion even the smallest $\mathfrak{M}$ of this segment is $> a_r$. On the left segment all $\mathfrak{M}$'s are evidently less than a_e; the $i\mathfrak{M}$ values lie nearly on the 45° straight line. For very small $\mathfrak{M}$ of this segment, they lie exactly on this line: in the region marked by the genes *sc*, *w*, *N*, *ec*, *rb*, not one double break was found among 160,000 flies[6]. In the "Xple" experiment the few double breaks actually occurring round off the angle at $\mathfrak{M} = a_e$, but the segment is too short to attain the value of the horizontal part $i\mathfrak{M} = a_e$. However, the existing part of the curve makes it possible to put $a_e = 0{\cdot}257$, the initial value of the transitive interference (Fig. 1).

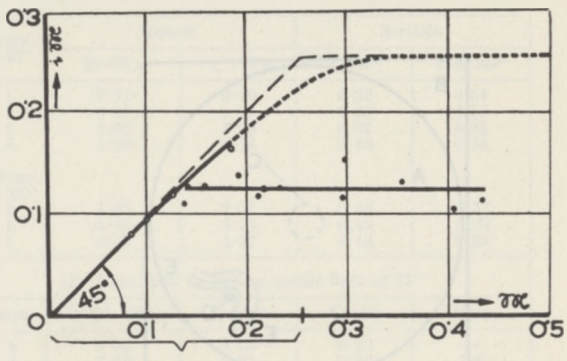

Fig. 1.

DOTS RIGHT SEGMENT, CIRCLES LEFT SEGMENT. ABSCISSÆ: PRIMARY MAP-DISTANCES BETWEEN THE MIDDLES OF THE INTERVALS, EACH PLOTTED FROM THE 0 POINT. INTERRUPTED LINES: SHORT DASHES, EXTRAPOLATED PARTS; LONG DASHES, LEFT SEGMENT ACCORDING TO THEORY.

The effect of a break in the left segment does not stop at the boundary, but induces interference in the right segment, which follows another law. This *transitive* interference begins at the boundary with an identical value of $i\mathfrak{M}$, in whichever interval of the left segment the first break occurred, and decreases along the right segment according to:

$$i\mathfrak{M} = a - b\mathfrak{M}_r ,$$

where $\mathfrak{M}$ is the whole map-distance between the two intervals, $\mathfrak{M}_r$ is the map-distance on the right segment from the boundary; $a = 0{\cdot}257 = a_e$, $b = 0{\cdot}559$ (Fig. 2). The limits of the validity of this equation can be discussed only when suitable experimental data are available.

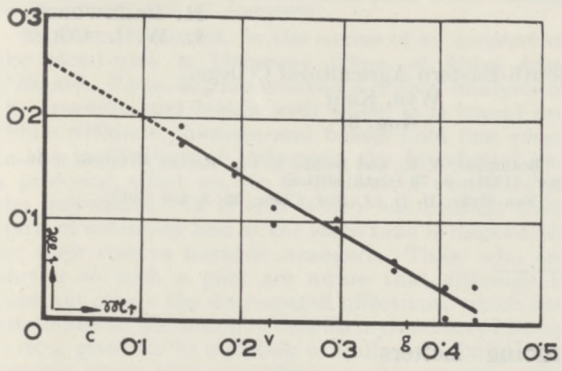

Fig. 2.

TRANSITIVE INTERFERENCE. ABSCISSA: PRIMARY MAP OF THE RIGHT SEGMENT; 0 POINT = MIDDLE OF THE INTERVAL cv c.

The three constants a_e, a_r, b make it possible to compute from six f-values between neighbour genes, which stand for the six observed f-values—that is, from the loci of the seven genes on the primary map—all 21 f-values, the average deviation being 0·6 per cent with a maximum of 1·8 per cent (Table 1).

TABLE 1. f-VALUES OF THE "XPLE" EXPERIMENT.

		sc					
ec	Calc.	0·068	ec				
	Obs.	0·068					
cv	Calc.	0·164	0·096	cv			
	Obs.	0·163	0·096				
c	Calc.	0·247	0·179	0·083	c		
	Obs.	0·245	0·180	0·084			
v	Calc.	0·371	0·314	0·227	0·147	v	
	Obs.	0·370	0·314	0·228	0·147		
g	Calc.	0·428	0·385	0·317	0·251	0·112	g
	Obs.	0·430	0·387	0·319	0·279	0·110	
f	Calc.	0·466	0·436	0·389	0·337	0·221	0·112
	Obs.	0·465	0·435	0·389	0·334	0·219	0 114

The left segment was calculated on the basis of the simplifying assumption $i = 1$. Using Morgan's terminology, the two equations represent the relation between frequency of crossing-over and frequency of recombination[7].

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Raman Spectra of Deuteroethylenes

THE various deuteroethylenes can be obtained by exchange from ethylenes and deuterium oxide on a nickel catalyst. 15 gm. of heavy water (D_2O) and 6 litres of ethylenes (N.T.P.) yielded after an exchange of several days at 150° C. a mixture of ethylenes containing about 50 per cent of the hydrogen as deuterium. The Raman spectrum of this substance was taken. In order to identify the lines and attribute them unambiguously to the different compounds, some of the deuteroethylenes have been prepared in a pure state. The ethylene C_2D_4 was obtained in the following way:

$$C_2D_2 + 2DBr \rightarrow C_2D_4Br_2;$$
$$C_2D_4Br_2 + Zn = C_2D_4 + ZnBr_2.$$

The compound so obtained contained about 10 per cent C_2D_3H; its D content was thus about 97 per cent of the total hydrogen. The *cis* and *trans* dideuteroethylenes were obtained in an analogous way starting from C_2D_2 and HBr. The comparison of the various spectra permits the classification of the lines as shown in the accompanying table:

C_2H_4	C_2D_4	$C_2H_2D_1$	C_2HD_3	$C_2H_2D_2$ *cis* and *trans*	$C_2H_2D_2$ asym.
1621	1515	1600	1545	1567	1581
3007	2251	3016	2272	2276	2221
1341	981	1397	996	2290	
3082	2304	3104		1282	1379
		1285		1214	
		2266	2215	3033	
		2965		3046	
				763	
				863	

(cm.$^{-1}$).

There is a slight discrepancy between the experimental results and the theoretical calculations carried out by Manneback and Verleisen. The potential function proposed by these authors has thus to be revised; this revision has been started by Manneback and his co-workers. The comparison of the first three lines (S_1 lines) of C_2H_4 and C_2D_4 gives a measure of the anharmonicity correction. The ratio of the product of these three frequencies should be 2. Deviations from this value are to be ascribed to the anharmonicity of the vibration. This constant was not taken into account in the earlier calculations; in fact, we find the value:

$$\frac{1621 \times 3007 \times 1341}{1515 \times 2251 \times 981} = 1{\cdot}954.$$

The results indicate that it is of the order of magnitude of 2 per cent. Several lines not given in the table could be detected in the spectrum of the dideuteroethylenes. It has not been possible to ascribe them unambiguously. Further work is in progress.

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Acidosis and Off-flavoured Milk

VETERINARIANS have assisted in explaining one cause of taint of milk when showing that in cases of acidosis the body fluids, including the milk, contain acetone and acetone-bodies. It was stated that the milk would react to Rothera's test[1].

As a result of recent experiences with samples of milk from cows suffering from acidosis, we can commend this very simple test to the dairy industry (it appears at present to be quite unknown) as a rapid and certain means of diagnosis, offering an explanation of many cases where the milk is mildly, but to a skilled palate, definitely of abnormal flavour even at the time of milking. Such cases have hitherto been somewhat vaguely ascribed to 'indigestion'. Furthermore, we find that for more accurate work, quantitative estimations may be made by the method of Van Slyke[2]. Several samples from cows giving tainted milk have been so examined, and in addition more than 98 per cent recovery has been obtained from samples of milk to which small amounts of acetone have been added.

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Points from Foregoing Letters

COMPARISON of the change in the intensity of cosmic rays for a period of nine days (April 23–May 1, 1937) during a magnetic storm at Innsbruck (Austria), Cheltenham (Maryland, U.S.A.) and Huancayo (Peru), shows very good agreement in the general trend, according to Prof. V. F. Hess and A. Demmelmair. There is also a close parallelism to the change in the horizontal component of the earth's magnetic field during this period, and the authors conclude that cosmic ray ionization was influenced simultaneously all over the earth by the magnetic disturbances, and that the study of the magnetic storm effects will give valuable information on the distribution of energy in the spectrum of the cosmic radiation.

Chemical analysis of a sample of duckweed (*Lemna*) shows, according to Prof. W. I. Vernadsky, B. K. Brunowsky and C. G. Kunasheva, that the plant contains about one hundred times more meso-thorium-I (10×10^{-15} per cent) than the water in which it grows (Orangery Pond, near Leningrad). On the other hand, although isotopes of thorium are present in water, they are not assimilated by the duckweed. The authors conclude that the plant assimilates radioactive elements in strict accordance with their chemical properties.

K. Hall and Dr. V. Korenchevsky find that the increase in the size of the adrenals in castrated rats is due to increase in the width of certain zones (fasciculata and reticularis) resulting chiefly from an increase in the size of the cells. They return to normal if sufficiently large doses of sex hormones (androsterone, testosterone, etc.) are administered. In a similar way, the large numbers of lipoid granules which invade the 'demarcation zone' upon castration may be made to disappear.

From the effect of critical concentrations of sodium azide or 2 : 4-dinitrophenol on the rate and extent of oxidation of acetate or butyrate by bacteria, Dr. C. E. Clifton deduces that these agents block the assimilatory process observed in association with the respiration of widely different non-proliferating cells under normal conditions. This blocking of the assimilatory process is accompanied by a complete oxidation of the substrate, at an approximately normal rate. He suggests that the weight-reducing action of the dinitrophenols in man may be due in part to a suppression of assimilatory processes.

By feeding rats with diets as used in Northern India, by well-to-do and by poor Hindus respectively, and observing the effects upon the teeth, the fertility and the health of the young, D. N. Mullick and Dr. J. T. Irving find that the Northern Indian diet is superior to both Hindu diets and that the poor Hindu diet is seriously defective as shown by both chemical and biological tests.

A table giving the amount of silica dissolved by a 1 per cent sodium bicarbonate solution and by acetic fluid from silica dusts (quartz, sericite) after various periods of time, is given by Dr. E. J. King. The author states that many of the values reported by Emmons and Wilcox for the solubility of finely powdered silicates are too high, because their method does not eliminate completely the fine particles in suspension.

The presence of a minute hole in a polished glass disk enables it to make 'optical' contact with another polished plate by application of slight pressure at a single point, according to Dr. J. W. French. The contact spreads spontaneously, due apparently to the surface tension effect of a grease-like film (less than one millionth of an inch thick) present at the glass surface.

D. Porret and Dr. E. Rabinowitch find that the reversible bleaching of chlorophyll by light is proportional to the square root of the light intensity. Formic acid causes a considerable increase in the reversible bleaching, while oxygen and ferrous chloride suppress it.

The interference in the two segments of the *X*-chromosome of *Drosophila melanogaster* is characterized by Prof. K. de Kőrösy by two constants, the *transitive* interference from one segment on the other by a third. The average deviation between the calculated and observed data is 0·6 per cent, with a maximum of 1·8 per cent.

A table showing the Raman spectra of various heavy-hydrogen substituted ethylenes is given by Prof. M. de Hemptinne, J. Jungers and Dr. J. Delfosse. Some of the lines were determined by using pure compounds (C_2D_4, $C_2H_2D_2$) and the remainder from a mixed sample. The authors find a slight discrepancy between the experimental results and the theoretical calculations carried out by Manneback and Verleisen.

Research Items

Blood-Brotherhood in Dahomey

M. PAUL HAZOUMÉ, in the course of an account of the blood-pact in Dahomey (*Trav. et Mem. Inst. d'Ethnol., Paris*, **25**), has essayed a critical analysis of the practices and beliefs with which it is bound up. While religious practices and beliefs hold first place in the institutions of Dahomey, the blood-pact has a profound effect on the formation of character in the individual. It is this which has created their spirit of solidarity and at the same time is responsible for their reserve towards strangers. Those who are parties to such a pact are aware that although it does not create the deep-seated affections, which are attributed to the action of certain mysterious philtres, it does give rise to a feeling of unlimited confidence, because those who are bound by this tie are aware that their 'brothers' will never betray them with impunity. In other words, the chastisement which is the sanction of a violated oath will keep those who have subscribed to the pact within the paths of duty it has laid down. In the mutual drinking of blood they have taken on a mutual obligation of affection, confidence and help which overrides even the claims of blood relationship. The assistance due extends from the erection of huts and work in the fields to sacrifice of life itself. It involves the taking up of arms on behalf of blood-brothers against injustice and treachery. It is also a protection against robbery ; and kings found in it an instrument of power for personal or political objects, disregarding rank and allying to themselves any who might prove useful to their purpose, including experts in magic and spies. On the other hand, no one was allowed to exploit this relation with the monarch for personal gain or social advancement. For long the pact had none but noble objects ; but unfortunately it was perverted to evil ends and became an instrument of crime. Originally it was confined to adult males. Now it is a means of assuring the fidelity of married couples, and thieves have resorted to it to join to themselves women, who assist in their nefarious practices by entering into friendly relations with those whom it is intended to rob.

Pain Nerves

WHEN a sharp or a hot object is applied momentarily to the toe, two bursts of pain are felt, the second following the first by an interval of nearly two seconds. T. Lewis and E. E. Pochin (*Clin. Sci.*, **3**, 67 ; 1937) show that this double response depends on the transmission of pain-sense by two sets of nerve fibres having widely differing rates of conduction. They point out that if a pain stimulus is applied at different points on a limb, the interval between the two sensations lengthens as the periphery of the limb is reached. It has been shown by others in the experimental animal that asphyxia interrupts conduction in the fast before the slow fibres ; cocaine, on the other hand, paralyses the slow fibres before the fast. Lewis and Pochin show that in man asphyxia abolishes the immediate but not the delayed response to pain, while cocaine abolishes the second response before the first.

Pharmacology of Tetramethylammonium

TETRAMETHYLAMMONIUM has various actions of pharmacological interest. A. J. Clark and J. Raventos (*Quart. J. Exp. Physiol.*, **26**, 361–392 ; 1937) have studied some of these actions and compared them with those of substances formed from it by altering some of the chemical groups in the molecule. The actions studied may be classified as muscarine actions (contraction of rat's intestine and inhibition of frog's heart), nicotine actions (contraction of leech muscle), atropine actions (inhibiting muscarine actions) and curare actions (inhibition of neuro-muscular conduction in voluntary muscle, which may be essentially an inhibition of nicotine actions). The action of drugs on the frog's rectus abdominis is apparently intermediate between these main types. Replacement of one methyl group by a straight-chain alkyl group of increasing length first increases the muscarine activity and then leads to the appearance of the opposed atropine activity. This is explained on a theory, to which Gaddum has given mathematical expression, according to which the antagonistic drugs combine with the same chemical groups in the tissues as the active drugs and block them up. The results generally agree quantitatively with this theory. These changes in the molecule do not much affect nicotine actions or curare actions. Replacement of all four methyls by ethyl, propyl or butyl abolishes muscarine actions and increases atropine actions. Replacement of methyl groups by increasing numbers of ethyl groups diminishes all actions except that on the leech, which is first diminished and then increased. The introduction of a phenyl group has an effect like that of the introduction of three carbon atoms in a straight chain.

Speed of Flight of Birds

IN a Circular (No. 428) published by the U.S. Department of Agriculture, May Thacher Cooke has collected all the records of the speed of flight of North American species of birds and of a few European species which have occurred in North America and are closely related to North American species for which no records are available. There are also included a few running speeds which show that for short distances quail may cover the ground at 12–15 miles per hour, the road-runner at 10–20 miles, while for the emu Le Souëf's record is quoted of a bird driven for 10 miles at a speed of 31 m.p.h. Of the flight records it must be said that many are unsatisfactory, since it would appear that in many cases no allowance has been made for favouring or adverse wind. Thus presumably arises the anomaly of one observation from a moving train giving a speed of 25 m.p.h. for the crow, while another gives 60 m.p.h., and an automobile observation 25–32 m.p.h. But the author seems to consider that wind has no great influence upon the flight of birds, and in support she quotes the case of brown pelicans timed along the beach at El Pismo : 14 m.p.h. with practically no wind, 16 m.p.h. with half a gale blowing half rear, 22 m.p.h. with wind velocity of 50 m.p.h. in the same direction. The old statement

is repeated that birds prefer a side or even a head wind to a following wind. Until observers realize that the speed of a bird's movement in relation to the ground has no biological meaning until corrections have been made for the influence of the wind, these faulty records will continue to accumulate.

Migrations of Salmon

FURTHER evidence of the actual movements of salmon in the sea is given by W. J. M. Menzies (Fisheries, Scotland, Salmon Fish., 1937, No. 1) from the recapture of marked fish. The main experiment was carried out in 1936 at Loch Inchard, twelve miles south of Cape Wrath, a spot chosen as the result of knowledge obtained from experiments in other localities in previous years. Of 1,255 fish marked, 11·7 per cent have been recaptured, at various places so far away as 145 miles to the south and 410 miles east, and south to the Yorkshire coast and even in Norway. The suggestion is put forward that these fish had collected at Loch Inchard from some feeding ground to the west or north, and thence migrated purposively to the positions at which they were recaptured. This view is supported in a remarkable manner by scale examination. As a result of extensive investigations in recent years, the type of parr growth, which differs from river to river, is now known for a large number of rivers. With one exception, all these recaptured salmon showed on their scales the parr growth typical of that of fish from the rivers in which they were recaught. This seems rather conclusive evidence that the fish were proceeding via Loch Inchard on a definite migration to their own particular rivers.

Hemipterous Insects of the Family Peloridiidæ

THIS small and scarce family of hemipterous insects was for a number of years only known from two examples from the southern extremity of South America. In 1920 a further example was discovered in New Zealand, and in 1924 a nymph was found on Lord Howe Island. Later, examples turned up in Australia and in 1933 a number of specimens were found in that country by Mr. I. W. Helmsing, which have enabled a more detailed study of the family to be made. In the *Annals and Magazine of Natural History* of May, 1937, Messrs. Helmsing and W. E. China discuss the Australian species, *Hemiodoecus veitchi*. The favourite habitat for this species appears to be among moss in forests of Antarctic beech (*Nothofagus moorei*). The few known examples of the family were formerly placed in the Heteroptera, but it is now agreed that its affinities are with the suborder Homoptera. These authors conclude that the establishment of a separate new suborder for the Peloridiidæ is not justified, and that the group belongs to a new series in the suborder Homoptera for which the name Coleorrhyncha was given by Myers and China in 1929. The Peloridiidæ are evidently a very primitive and generalized family associated with primitive vegetation (mosses), and it is concluded that its members may well have been descended in an almost direct line from protohemipterous ancestors.

Colour of Hydrangea Flowers

IT would perhaps be difficult to say whether pink or blue hydrangea blooms are most popular for floral decoration, but the reliable production of blue-coloured flowers has long been a horticultural desideratum. Mr. E. M. Chenery has made an exact study of this question, and his findings have recently been published (*J. Roy. Hort. Soc.*, **62**, Pt. 7, 304–320, July 1937). The paper considers the problem from historical and horticultural points of view, and also compares the influence of soil conditions with the physiology of the plant. From all sources of evidence, aluminium seems to be the element the presence of which induces a blue colour in the flowers, and not iron, as was at one time supposed. Analyses of blue and pink sterile flowers or petaloid sepals showed that aluminium was always greatly in excess of iron when the blue colour appeared. The anthocyanin from pink flowers would, however, form a blue delphinidin complex with both iron and aluminium ions.

Dipterocarpaceæ of the Eastern Tropics

IN Forest Products Research Records No. 16 (Timber Series No. 5. H.M. Stationery Office, 1937), Mr. S. H. Clarke, under the title "Gurjun, Apitong, Keruing, Kapur and allied Timbers", deals with a group of timbers from the eastern tropics which has in recent years become increasingly important to the wood industries of Great Britain. From a commercial point of view, the family Dipterocarpaceæ is the most important group of timber trees in the eastern tropics—occupying a more or less similar position in Burma, the Malay Peninsula, Sumatra, Borneo and the Philippine Islands to that occupied by the soft woods in the great forests of Canada and the U.S.S.R.; the dipterocarps, however, rarely occur in pure forests, yet they yield a larger volume of timber than all the other species occurring in mixture with them. The family comprises nineteen genera and some 380 species. The *Shorea* timbers are the lightest; *Dipterocarpus* and *Dryobalanops* moderately heavy, and, though not very durable under exposed conditions in the tropics, are well suited for constructional and other purposes in the temperate climates. The hardest woods of the family come into the genera *Vatica*, *Hopea* and *Balanocarpus*. These are too heavy and hard to be of use for general purposes in Great Britain, though they form the chief constructional timbers in the countries producing them. The chief exploited species of the family are magnificent trees with a bole running up to 80 ft. or more without a branch, and a diameter which may reach 5 ft. Resin or gum occurs in some of the species. The pamphlet gives a general classification of the timbers in a tabular statement showing the countries of origin and the chief species of the principal genera *Dipterocarpus*, *Dryobalanops*, *Shorea*, *Hopea*, *Vatica* and *Balanocarpus*.

Erosion Surfaces of Cornwall

MARINE action has clearly played a great part in shaping the physiographical features of Cornwall. Platforms at 1,000, 800 and 400 ft. have been mentioned and a 200-ft. level has been suggested. Mr. W. G. V. Balchin, in an article in the *Geographical Journal* of July, gives the result of his investigations in north Cornwall, and tries to date the platforms which he has recognized, pointing out that the present physiography had its origin, for the major part, in the dissection of a series of platforms. The erosion surfaces are generally separated by a bluff which when not of structural origin is probably due to marine action. In the area investigated the highest platform, notable on Bodmin Moor, is at 1,000 ft. and is probably late Miocene. Below that is a minor platform at 850–920 ft., and again one at heights

varying from 600 ft. to 820 ft. conspicuous near Camelford and probably later Miocene. The best preserved platform is at 300–430 ft., well seen between Boscastle and Tregardock and of Pliocene origin. Finally comes a surface at 240–285 ft. of late Pliocene age, noticeable in many of the flat-topped hills of the Padstow district.

Magmatic Differentiation

AT the Tercentenary Conference at Harvard University last September, Dr. C. N. Fenner summarized some of the major difficulties that are encountered in attempting to explain all the phenomena of differentiation of igneous magmas by a single process. The paper is now published in the *Journal of Geology* (158–168; 1937). It is pointed out that the Goose Creek diabase contains both quartzo-felspathic micropegmatite and very basic macropegmatite. Unless, therefore, liquid immiscibility be granted, both cannot represent residual magmas, since this would mean that the magma was differentiating simultaneously in two very different directions. The official interpretation of the Glen More ring-dyke (Mull) as an example of differentiation into gabbro and granophyre is shown to violate fundamental principles of chemistry and dynamics. Granitic rocks from the Bushveld Complex are similar to those which have been claimed as products of crystal fractionation from basic magma, and yet they have been demonstrably produced by the granitization of sedimentary quartzites. For many years, a controversy has been carried on as to whether, or to what extent, magmas are capable of assimilating solid rock. It has been repeatedly stated that the great obstacle to assimilation is the supposed inadequacy of the heat supply. Fenner describes phenomena from Alaska and the Yellowstone Park which irrefutably prove that "rhyolite magma was able to do things that the theory of crystal fractionation declares impossible". The facts show that rhyolite magma, so far from being the coolest of the evolution series, possesses great and hitherto unsuspected reserves of latent energy. Fenner insists on the necessity for giving such facts more adequate consideration. So did Goodchild more than thirty years ago, in a paper that was quietly ignored (*Trans. Roy. Soc. Edin.*, 202; 1904), so strong was the prejudice in favour of theory when theory and observation were in conflict. Fortunately, that prejudice is at last crumbling away, as the irrepressible facts become more widely known.

Retardation of Chemical Reactions

THE reaction between potassium permanganate and hydrogen peroxide is retarded by hydrogen peroxide in fairly concentrated solution, an effect which has been attributed to the formation of inactive H_4O_4 molecules at higher concentrations. K. C. Bailey and G. T. Taylor (*J. Chem. Soc.*, 994; 1937) have reinvestigated the reaction, measuring the extent of decomposition with a photo-electric colorimeter, the effects of stirring and of traces of manganous ions being particularly controlled. With initial permanganate and sulphuric acid concentrations constant, the reaction velocity reaches a maximum at $(H_2O_2) = 0{\cdot}005$ equiv./l., falls to a minimum at $(H_2O_2) = 0{\cdot}16$, and rises slowly at higher peroxide concentrations. With initial permanganate and peroxide constant, and the latter at concentration greater than 0·02, the velocity rises to a maximum with increase of sulphuric acid, falls to a minimum, and then rises again. Manganous ions catalyse the reaction powerfully at peroxide concentrations rising to the maximum velocity concentration but have little effect near the minimum velocity. Other effects were found and a theory covering all the data is not proposed. It is considered that the reduction of MnO_4' to Mn'' probably takes place in stages, the first perhaps involving the production of MnO_3' which may be capable of being re-oxidized to MnO_4' by a molecule of H_2O_2 with sufficient energy. A fair agreement with experiment is obtained by an empirical equation: $v = k_1(H_2O_2)(H_2SO_4)(KMnO_4) \;/\; (k_2 + k_3(H_2O_2)^2(H_2SO_4)^2)$, the terms in the denominator representing two types of retardation, the second being the re-oxidation of partly reduced permanganate by active hydrogen peroxide.

Investigation of Porous Structure

AN emanation method has recently been described (G. Graue and N. Riehl, *Naturwiss.*, 25, 423; 1937) which offers possibilities of examining the porous nature of catalysts and of studying reactions in solid phases. The emanation method of Hahn, first described in 1929, depends on introducing a radioactive element which forms a gaseous emanation on disintegration into the solid. The degree of porosity is indicated by the quantity of emanation which can be detected in the neighbourhood of the solid. This method has the disadvantage that it can only be used for special substances in which the radioactive substance can be included. The method now proposed is to allow the emanation to penetrate the solid from outside, the amount penetrating indicating the porosity. The method has been used to determine the true specific volume of crystalline and precipitated zinc sulphide. The value obtained for the specific volume of crystalline zinc sulphide was the same as that determined by the pyknometer method, but for precipitated zinc sulphide the value obtained by the emanation method was much smaller than that with the pyknometer. It must therefore be assumed that in amorphous (precipitated) zinc sulphide there are pores or fissures of atomic dimensions due to an irregular arrangement of atoms. It is possible that gases penetrate into the interior of solid catalysts not only by means of large pores, but also by interatomic pores and clefts due to badly formed lattices.

Recent Sunspot Activity

DATA contained in Nos. 36 and 37 of the Zurich *Bulletin for Character Figures of Solar Phenomena* for the six months October 1936–March 1937 show how considerable has been the sun's activity of late. The mean daily sunspot 'numbers' for each of the six months are, respectively, 89, 115, 123, 133, 128 and 84. The highest value reached in the preceding 11-year cycle was 108 for December 1929; but in the earlier cycle with a maximum in 1917 the value 155 was reached in August of that year. The mean number for the year 1936 was 80·4 as compared with 36·1 for 1935, 8·7 for 1934 and 5·7 for 1933. Since March 1937, activity has remained considerable. Large sunspots crossed the sun's central meridian on April 22·4, April 23·2*, April 24·6*, April 29·6, May 20·8*, May 27·2, June 4·9, June 15·6, June 16·9*, June 21·2, June 27·0 and July 28·6*. Those groups marked with an asterisk exceeded, at maximum development, 1,000 millionths of the sun's hemisphere as given by the Greenwich measures of area.

The Palace of Discovery at the Paris International Exhibition, 1937

By Dr. Pierre Biquard

EVERY day thousands of visitors from all parts of the world enter the Palace of Discovery of the Paris International Exhibition. Some go as experts to see how far science lends itself to spectacular demonstration. Others, realizing their lack of knowledge, go to learn. Furthermore, some people, especially the young, go brimful of eager curiosity, hoping to find somewhere in those halls an inspiration which will guide them in the choice of their career.

One thing is certain, no one is disappointed. It is obviously impossible to cover in a brief article the entire field of present-day science, and relate the history of scientific progress up to date. This is merely a brief statement of what has been achieved in the different sections of the Palace of Discovery. The Palace covers an area of 23,000 square metres. All branches of scientific learning are represented, from mathematics and astronomy to medicine and botany.

The greatest efforts have been made to replace by real demonstrations the silent testimony of documents and pictures. In all sections a staff of demonstrators escort the visitors and carry out experiments, though many work automatically and can be set in motion by the public. The magnitude of the undertaking is shown by the single fact that the electrical installation of the Great Palace is on a greater scale than that of a whole district in Paris: ten kilometres of feeders and sixty kilometres of cables were needed, and it is estimated that the cost of the electricity used during the course of the Exhibition will amount to 1,000,000 francs.

In accordance with the views of Auguste Comte, mathematics will be dealt with first. It may be true, as Emile Borel wrote in Paris, 1937, that "only those who have given up their lives to mathematical research know what it is, what are its aims and by what means it attains them"; nevertheless the rooms set apart for mathematics show to all visitors the development of this science from the earliest times and the growing importance that it has acquired in modern developments of physics, chemistry, biology, etc. Certain questions are explained by means of films: in this way visitors are introduced to such subjects as four dimensional space and the laws of similitude, showing that if the dimensions of an individual were increased ten times he would collapse under his own weight. Mathematicians are given the opportunity of working out on the spot at the blackboard problems the solutions to which are posted up the following day. It is interesting to see that the eternal riddle of the squaring of the circle occupies a place, and the value of π to 707 places of decimals is exhibited on the surface of a cupola.

The task undertaken by those responsible for the astronomy section has been no small one. They have had to crowd into a few rooms all that is known about a universe so vast that light takes a thousand million years to traverse it. Three models show the structure of portions of space of decreasing sizes: the first represents the galaxy, the diameter of which is of the order of five million light years: the second shows the sun and the twenty-five stars surrounding it in a portion of space through which light travels in twenty-five years: finally, the third model shows the sun and its attendant planets, that is, a very small space through which light travels in seventeen hours. The northern Milky Way is shown in a photographic enlargement measuring 20 m. $\times$ 4·5 m.; there are also many good photographs of nebulæ, of the sun, moon, planets, comets, etc. The movements of the planets in the solar system are reproduced in the great planetarium, and to make them more clearly visible, the rates of their revolutions have been multiplied by 432,000, allowing one revolution of Mercury around the sun to be seen in eighteen seconds. After having examined all that can be seen in space from the earth, the visitor naturally wonders what our world would look like to other beings living on some other planet. An answer to this question is given by a model 70 cm. in diameter which was made as the result of the observations of explorers of the stratosphere.

Physics occupies a favoured position in the Palace of Discovery. In a room dedicated to Galileo are seen the fundamental experiments relating to falling bodies, the oscillations of the pendulum, centrifugal force, the laws of composition of forces. All the foundations of the so-called 'rational' mechanics are there, and it is impossible not to dwell on the scientific progress in physics and astronomy made on this basis up to the time when its application to optics was found to be impossible.

The history of our knowledge concerning light appears in the section devoted to optics. After having thus learnt anew the laws of reflection and refraction, and measured the velocity of the propagation of light, the visitor can watch a series of experiments on interference, diffraction, polarization, interference photography, and will then perhaps be convinced of the truth of the wave theory of light. The photo-electric phenomena which can be examined later will give him food for thought.

Another section is given over to electrostatics. Once again the public may see the production of electric charges by the friction of cat skin and, on the other hand, watch the working of the Van de Graaf electrostatic machine set up under the direction of M. Joliot by MM. Lazard and Savel. This machine can produce sparks of several million volts passing between two spheres of three metres diameter.

The field of oscillations is the subject of another section in which electromagnetic and sound vibrations are studied. Special attention must be directed to the manner in which are exhibited the consequences of the discovery by Pierre and Jacques Curie of the piezo-electric property of quartz; the stabilization of high-frequency emissions, quartz pianos, emission and reception of ultra-sound waves, submarine sounding, etc.

Ampère's experiments and the laws of electrodynamics lead up to the triumphs of electrotechnics. By a parallel procedure, it is possible to follow the progress which, starting with the phenomenon of thermionic emission, has led to the creation of modern radiotechnics.

Some of the most beautiful experiments are shown in a section devoted to the states of matter and the

structure of the atom. Matter is heated, cooled, compressed under several thousand atmospheres, expanded, etc. The experiments shown on fluorescence and phosphorescence are as conclusive as they are beautiful. Last comes what is perhaps the most glorious chapter of modern science, the study of atomic particles and radiations. In this section are reproduced all the experiments which have marked a decisive step forward in the study of electrons, of X-rays and the radiation of radioactive bodies, thus passing from the first Crookes tube to the artificial radio-elements and to the cosmic rays made visible thanks to the Wilson expansion chamber.

Four laboratories have been chosen by the chemists to show the history of their particular branch of science: an alchemist's laboratory, Lavoisier's laboratory, Berthelot's laboratory and finally a modern chemical laboratory. While further on, the 'elements' air, water and fire have a special room reserved for them. A great illuminated chart shows the periodic classification of the elements and an ingenious arrangement demonstrates the structure of all the atoms, from hydrogen to uranium. The principal analyses and syntheses are reproduced before the visitors' eyes, notably the separation of the gases of the air and the synthesis of acetylene in Berthelot's 'electric egg'. With regard to each of the important branches of this science—physical chemistry, inorganic chemistry, organic chemistry, metallurgical chemistry, photochemistry, geochemistry—it is possible to estimate how much the researches of pure science have contributed to the progress of industry (paper making, manufacture of sulphuric acid, preparation of colouring matters, dyeing and printing of materials, etc.).

Biology, as might be expected, shows here a living summary of the work of Pasteur together with an exhibit of the developments of microbiology—discoveries relating to smallpox, intestinal affections, cholera and typhus.

Medicine is divided into: (1) the diseases of nutrition, (2) cardio-vascular pathology, (3) medical physics, and (4) the history of medicine, in which special stress is laid on the fundamental part played by the discovery of auscultation. Also, for surgery, the considerable progress made in the last ten or twenty years is shown, more especially the influence of discoveries bearing on asepsis and anæsthesia. If anyone wishes to learn more about his own organism, and to know what his qualities are, both good and bad, he may take his place on the seat where the human machine is tested. There, after a series of tests, his biometric ticket will be made out and may prove useful in choosing a profession. If the results are good, he will be all the more surprised when confronted with the sensorial illusions shown in the section of psycho-physiology. Experimental biology demonstrates how living beings react to physical and chemical reagents. Plant physiology and biology are illustrated by dioramas, films and collections. Finally, mention must be made of the section reserved for plant genetics, in which are exhibited the great facts of natural selection, of the formation of new species and of natural or induced changes.

Space will not permit the inclusion of the names of the many scientific men from France and abroad who have collaborated in the preparation of this great Exhibition. One exception must, however, be made in the case of the president, M. Jean Perrin. This Palace is the fruit of his untiring labours, and it is thanks to him also that France will soon possess a permanent Palace of Discovery.

It is only natural that in an exhibition representing the arts and technical sciences in modern life, scientific discovery should have its rightful place as the foundation of all progress. The Palace of Discovery brings this home to the general public and also shows the real beauty of science. Possibly, on leaving, the visitor will realize the truth of these words taken from Henri Poincaré's "Dernières Pensées": "Celui qui aura goûté à la Science, qui aura vu, ne fût-ce que de loin la splendide harmonie des lois naturelles, sera mieux disposé qu'un autre à faire peu de cas de ses petits intérêts égoïstes; il aura un idéal qu'il aimera mieux que lui-même et c'est là le seul terrain sur lequel on puisse bâtir une morale".

A Mesolithic Site in Brittany*

THE Mesolithic site of Téviec, a rocky islet situated about eighteen hundred metres west of the shores of the peninsula of Quiberon in Brittany, which has been explored by M. and Mme. Péquart, is up to the present the most important station of this period that has been submitted to systematic and complete examination. Incidentally, it may be said, it gains in significance by the fact that examination of human skeletal remains from Téviec has elicited from MM. Boule and Vallois a detailed analysis of the physical characters of Mesolithic man, so far as known from the remains which have survived, and a comparison of this race or type with those of the Upper Palæolithic.

The investigations leading to the discovery of the site were undertaken by M. and Mme. Péquart in the hope of throwing light on the domestic and tribal economy of the early inhabitants of Brittany, which had been neglected by archæologists owing to their preoccupation with the all-absorbing study of the monuments of the country. For this purpose they were convinced that there was little hope of obtaining undisturbed evidence on the mainland, and consequently directed their investigations to the numerous small islands which lie off the coast of the Morbihan. In 1926 they were attracted by the evidence of a kitchen-midden exposed by marine erosion on this barren rock—it is little more, its dimensions being only four hundred metres in its greatest length and two hundred metres at its greatest breadth, while its elevation over the greater part of its extent is no more than ten metres—and began its excavation in July, 1928. After twenty-one days' excavation they were rewarded by the discovery of the first burial. The work of excavation was continued in 1929 and 1930.

The island is completely barren, and even with the resources of modern civilization the excavating party found difficulty in keeping themselves provisioned

* Téviec: station-nécropole mésolithique du Morbihan. Par Marthe et Saint-Just Péquart, M. Boule et H. Vallois. (Archives de l'Institut de paléontologie humaine, Mémoire 18.) Pp. ii+227+19 plates. (Paris: Masson et Cie., 1937.) 220 francs.

during their stay on the island. There is, however, reason to believe that at the period of occupation under investigation the island was joined to the mainland, and the mode of life of the inhabitants was riverine, rather than marine. This view is supported by the character of the charcoal, of which an abundance was found. This is the produce of forest trees. The animal remains are also those of a forest fauna. The inhabitants, however, do not appear to have subsisted to any great extent by either fishing or hunting, and their diet was almost exclusively of shell-fish. There is no supply of fresh water on the island.

It was largely this difficulty of making any prolonged stay on the island that was responsible for the fact that it had not been explored archæologically. The site was actually first discovered by M. F. Gaillard in 1883, but he was able to do no more than make a few *sondages* on the north-west of the island. This brought to light some fragmentary evidence of a cooking-place and gave an approximation of the extent of the kitchen-midden ; but the great antiquity of the site was not appreciated. The present explorers recognized by the quantity of culinary refuse, molluscs, fish and game, the quantity of charcoal and the fragments of bone and stone, as well as of the finished implements of these materials, that they were dealing with a kitchen-midden, while the absence of pottery and polished stone as well as the Tardenoisian character of the industry, indicated a Mesolithic site, or to be more precise a site belonging to a phase of culture corresponding to the post-Azilian Maglemose, Mullerup, or Mugem.

The station covers a superficial area of about two hundred metres square, though without doubt originally it was much larger. Much of it has disappeared by marine erosion. The archæological bed runs to a depth of from 0·60 m. to 1 m. and is entirely homogeneous throughout its depth in composition and contents. It is composed of a black earth, heavily loaded with carbon, indurated, but breaking up readily, owing to the mass of organic material, bones and artefacts, it contains. The artefacts are homogeneous in character throughout. The site was, in the words of the authors, "vierge de tout remaniement".

A number of hearths and burials were found, constituting in all "18 monuments". The burials were of twenty-three individuals, male and female, adult, adolescent and infant. In several instances infants were found buried with adults, for reasons that are not apparent. It is not invariably the burial of mother and child. In one grave the adult was male. Provision was made for the after-life in the form of implements and ornaments, especially necklaces of shells, placed with the body. There appears to be a ceremonial use of deerhorn, possibly as a mark of a special position in the tribe, which recalls the magical significance of horns in Palæolithic art, as well as possibly being an anticipation of later belief.

The hearths which were found appear to fall into different categories. They are classified by the authors as domestic hearths, which show heavy and protracted use in the calcining of the stones used, cooking hearths, possibly set up for funerary feasts, and ritual hearths for sacrificial meals, which do not show the same signs of protracted use.

The burials are partly in the soil and partly covered by the kitchen-midden material. They show no signs of orientation. The bodies are disposed in a sitting position, with the legs forcibly flexed and the back against the wall, or else laid on the back, with head and shoulders raised, and the legs flexed, or sometimes crossed on the stomach.

The station is not in reality rich in industries of either bone or stone. Stone artefacts fall into three categories—small implements of geometric outline, finely and carefully worked, flakes retouched over part or the whole of their outline, and a group of specimens of larger size, bolder flaking, comprise nuclei, scrapers and thick flaked tools of various types, in which the fracture seems crude, rather than purposively directed. The bone objects include handles of deerhorn, polishers, objects of indeterminate use made from the tusk of a boar which may have been for piercing leather, and various points, of which one form, a "stiletto" (though only 15–17 cm. long) appears to be accorded a special position in certain burials. Several objects show a simple attempt at decorative art in the form of engraved parallel diagonal or vertical lines. There is no evidence whatever of anything in the nature of permanent structures for habitation.

This discovery of a Mesolithic habitation-necropolis has for prehistoric studies, and for the study of the Mesolithic in particular, a triple interest. It shows for the first time in the prehistory of Brittany a homogeneous and sealed station in the Morbihan of civilization of a people anterior to the builders of the megaliths, and proves, what had previously been denied, that Brittany was inhabited before the Neolithic age. In regard to French prehistory, Téviec may be regarded as the type station of the French Mesolithic, and in fact it is the first to furnish in abundance for France evidence relating to the fauna, flora and industries of that period, while it is the only station which has yielded such an abundance of material for the study of the physical characters of the peoples of Mesolithic age. Further, it throws a flood of light on their culture and beliefs. Finally, in relation to prehistory in general, it makes an important addition to knowledge of the distribution in Europe of Mesolithic culture and a link between the stations of the north of Europe and the south.

While it is clear that this Mesolithic civilization has no relation with the Neolithic of Brittany, there is no indication of its origin. Like the Mesolithic elsewhere, it shows certain features reminiscent of Palæolithic culture, and it may be that it is a descendant of a Palæolithic of Brittany as yet unknown.

The physical characters of the inhabitants of the site may be summarized as follows, although this affords only a very inadequate idea of the carefully detailed examination of the skeletal material which has been made by MM. Boule and Vallois.

From the twenty-three burials, twenty-one skeletons were obtained in such a state of preservation as to afford material for observation and study. In general terms, the subjects were not of an advanced age, and there was none who could be described as elderly. Of two very young individuals a few teeth only were obtained. Of the remaining twenty-one, six were infants and six only were truly adult, five ranging in age between twenty and twenty-five years. The sex was easily determined, as in all but one instance the difference between male and female was stongly marked. Out of fourteen individuals six were male and eight were female. An indeterminate individual was probably male, though a low stature possibly indicates a female.

The head measurements were: length, male, 180–190 mm., female, 170–190·2 mm.; breadth, male, 129–143 mm., female, 133–142 mm.; basi-bregmatic height, male, 128–150 mm., female, 129–142 mm.; capacity, male, 1,561 c.c., female, 1,548 c.c.; cephalic index, male, mean, 74·3, female, 75·1. The skulls show a tendency to vary from a moderate dolichocephaly to mesocephaly, this tendency being more pronounced in the female.

In general character the skull is massive, but without marked prominences, thick, and relatively capacious. In form it is 'beloid'. It is high, especially in the men, and carinated with a pronounced median ridge. The forehead is broad and rounded, the glabella moderately developed. The face is large and low, euryprosopic, and mesognathous to prognathous. The mandibles are robust with a pronounced chin. The dentition is megadont. The teeth are remarkable as showing the first known example of caries, not previously recorded before Neolithic times. The stature is distinctly below medium. The forearm is relatively long. The lower limbs show marked platymeria, and the tibiæ are platycnemic. As a type, this population is well evolved.

MM. Boule and Vallois have also, as a basis of comparison, made a detailed survey of all the skeletal material of man surviving from the Mesolithic period. This they classify into five types—the Ofnet brachycephal, the dolichocephalic-mesocephals of Téviec, the Ofnet dolichocephals, the Mugem dolichocephals, and the Natufians of Palestine.

On the whole, the authors are inclined to the view that notwithstanding certain clearly marked differences there is a close resemblance between Téviec man and the Chancelade skull of the Upper Palæolithic. It is certainly closer than to Cro-Magnon man. Of the three possibilities that the type is new in western Europe, that it is a cross-breed, or that it is a variation from Chancelade which has been produced in the long interval of time which has elapsed between the occurrence of the two types, the authors incline to the last-named.

The Electrotor Smoke and Dust Meter

A RECENT paper by Dr. S. C. Blacktin (*J. Indus. Hygiene and Toxicol.*) describes an instrument he has devised for measuring dust suspended in the air. It is of a new type, and in designing it he has attempted to "avoid extraneous mechanisms or electric batteries which mar convenience and portability". The instrument consists of a hand pump of 100 c.c. capacity which draws air through a number of small nozzles, causing it to impinge upon a disk of celluloid or ebonite which, during the impact of the air, is made to revolve by means of a coarsely screwed rod which engages a nut or suitable projection in a hollow piston rod. The revolution of the disk is said to electrify it by rubbing against insulating material. In operation, a clean disk is inserted in the cap and the pump handle is next withdrawn to its greatest extent, and the cap with its disk screwed into position. The pump handle is next pressed inwards, rotating and electrifying the disk and emptying the pump. The ingress port is now held in the dust or smoke dispersion to be determined and the pump handle is withdrawn to its greatest extent with a steady pull. The air or gas entering the ingress holes against the electrified disk is said to deposit its particle content. The records obtained appear to be circular rings upon the record disk, and these are examined in the usual way under a suitable microscope.

In the paper the instrument is illustrated and described, but no data are given on its efficiency of operation. The apparatus is very simple and, provided it fulfils the function it is intended for, should be a useful addition to the methods available.

It is not easy to see how the construction described could be very effective in its operation; for example, it appears that the dust deposit takes place upon the surface of the disk which is being rubbed by rotation and electrified. Mechanically speaking, it cannot be easy to ensure a suitable rubbing pressure between the disk and the surface in contact with it, taking into account the clearances required in the bearings of the screw and such like. However, as stated already, no information is given on its actual use.

J. S. OWENS.

Performance of Noise Meters in Terms of the Primary Standard

DURING the past few years considerable progress has been made on the intricate subject of noise measurement and many experimental data are now available. A paper on this subject was read by B. G. Churcher and A. J. King to the Institution of Electrical Engineers early this year.

Since loudness is a sensation and not a physical magnitude, its definition and measurement involve subjective considerations such as the manner in which the sound is heard. Until recently these factors were not specified, and so the various types of portable noise meters in use gave appreciably different indications for a given noise. The British Standard Institution (B.S.I.) has taken an important step in removing difficulties. It has published an authoritative glossary of acoustical terms and definitions (B.S.S. 661) to which most of the workers in Great Britain will conform. Loudness is defined as, "that subjective quality of a sound which, in general, increases regularly with the intensity within the limits of audibility". A natural loudness scale is one such that when the number of units on the scale is doubled the magnitude of the sensation experienced by normal listeners is doubled also. The expression

"equivalent loudness" has been adopted for the physical intensity level of the reference tone relative to the standard pure tone. The unit of equivalent loudness is the 'phon', which is defined as follows: "The standard tone shall be a plane sinusoidal sound wave train coming from a position directly in front of the observer and having a frequency of 1,000 cycles per sec". It is also stated that the listening must be done by both ears, the standard tone and sound under measurement being heard alternately. If when measured in this way the intensity level is found to be n decibels above the standard tone, the sound is said to have an equivalent loudness of n phons.

Equivalent loudness is defined in terms of the loudness-equality judgment of a hypothetical "normal observer" whose loudness judgment is representative of the average person. A group of persons is therefore selected; the larger and the more representative the group the more closely in all probability the group judgment will approximate to that of the normal observer. Experience shows that good results can be obtained, using mathematical statistical methods, with ten normal observers.

Reproducible noises of physically specified composition are set up by means of a loud speaker, and their phon values determined in accordance with the definition. The same noises can then be applied to noise meters of any type and the difference between the phon values is the meter error for the type and level of the noise applied.

The measurement of noise is a problem of great and increasing importance in engineering. The authors conclude that the B.S. phon enables a consistent and unifying system of noise measurement to be set up, relevant to the manner in which sounds are normally heard.

The measurement of the frequency, intensity, purity and field distribution of the experimental tones is effected by condenser microphone methods. The analyser has a range of 25–25,000 cycles per second, is continuously adjustable and is highly sensitive. The microphones are calibrated by means of a Rayleigh disk. An ingenious electromagnetic tone generator is described by means of which harmonic noises containing up to ten components of any relative intensity may be set up.

Academy of Sciences, Vienna

Annual Meeting

At the general meeting of the Academy of Sciences in Vienna, held on June 1, the following officers were elected: *President:* Dr. Oswald Redlich, emeritus professor of history in the University of Vienna; *General Secretary:* Dr. Egon von Schweidler, professor of physics in the University of Vienna; *Secretary of the Philosophical and Historical Section:* Dr. Heinrich Ritter von Srbik, professor of history in the University of Vienna.

The following were elected to membership of the Philosophical and Historical Section: *Active Members:* Dr. Camillo Praschniker, professor of classical archæology, Dr. Rudolf Egger, professor of Roman antiquities, and Dr. Johannes Mewaldt, professor of classical philology, all of the University of Vienna; *Corresponding Home Members:* Dr. Friedrich Wild, professor of English philology in the University of Vienna, Dr. Franz Martin, director of land administration records in Salzburg, Dr. Alfred von Verdross, professor of international law in the University of Vienna; *Honorary Foreign Member:* Dr. Edward Schröder, emeritus professor of German language and literature in the University of Göttingen; *Corresponding Foreign Members:* Dr. Walter Otto, professor of ancient history in the University of Munich, Dr. Jan Huizinga, professor of history in the University of Leyden, Dr. Friedrich Panzer, professor of German language and literature in the University of Heidelberg, Dr. Theodor Litt, professor of philosophy and pedagogy in the University of Leipzig, Dr. Adolf Grohmann, professor of semitic philology and cultural history of the Orient in the German University of Prague.

The following were elected to membership of the Mathematical and Scientific Section: *Active Members:* Dr. Karl Terzaghi, professor of hydraulic engineering in the Technische Hochschul in Vienna, Dr. Theodor Pinter, emeritus professor of zoology in the University of Vienna, Dr. Erwin Kruppa, professor of descriptive geometry in the Technische Hochschul in Vienna, Dr. Leopold Adametz, emeritus professor of animal genetics in the Technische Hochschul of Agriculture in Vienna, Dr. Richard Schumann, professor of geodesy and astronomy in the Technische Hochschul in Vienna; *Corresponding Home Members:* Dr. Josef Weninger, professor of anthropology, Dr. Johann Sölch, professor of geography, Dr. Roland Grassberger, professor of hygiene, Dr. Karl Mayrhofer, professor of mathematics, all of the University of Vienna, and Dr. Wilhelm Petrascheck, professor of geology, palæontology and stratigraphy in the Montani Hochschul in Leoben; *Corresponding Foreign Members:* Dr. Otto Grosser, professor of anatomy in the German University of Prague, Dr. Enrico Fermi, professor of physics in the University of Rome, Dr. Ernst Küster, professor of botany in the University of Giessen, Dr. Hermann Nilsson-Ehle, professor of botany in the University of Lund and director of the Plant Breeding Institute in Svalöf.

The following awards were made by the Academy: the Ignaz L. Lieben prize, which this year is awarded for physics, to be divided equally between Dr. Marietta Blau and Dr. Hertha Wambacher for their work on the photographic action of α-rays, protons and neutrons; the Rudolf Wegscheider prize for chemistry to Dr. Otto Brunner for his work on stearins and the vitamins of the eye; the Fritz Pregl prize to Oberst Max Haitinger for his work on fluorescence microscopy.

Science News a Century Ago

Dr. Andrew Fyfe on the Voltaic Battery

THE first article in the *London and Edinburgh Philosophical Magazine* of August 1837 was by Dr. Andrew Fyfe and was entitled "On the Use of Sulphate of Copper for exciting Voltaic Electricity and on the Employment of Iron in the Construction of Batteries". Fyfe was aware that sulphate of copper was easily decomposed by zinc, and was induced to try it as the exciting fluid in the galvanic battery; he found it far superior to the acids in common use. He had a trough constructed of copper and sheet-iron, the plates being of the same size and number as those in a zinc battery. When sulphate of copper was used in the batteries, "electrolyzation", he said, "commenced almost the instant the trough was filled, and continued in the same way as when zinc was employed, indeed I could observe little difference as to energy of action and to the time that it continued, with this exception, that in general there was rather less gas evolved in the volta-electro meter". In view of the cheapness of the materials used, he conceived that the iron trough might be used for certain purposes.

Fyfe, who was born on January 18, 1792, and died on December 31, 1861, graduated in medicine in 1814 at Edinburgh. At one time he was assistant to Thomas Charles Hope (1766–1844), the professor of chemistry, and himself lectured privately on that subject. In 1827 he published his "Elements of Chemistry". He was president of the College of Surgeons, Edinburgh, in 1842–43 and in 1844 was appointed to the chair of chemistry at Aberdeen, a post he held until his death.

Science in Parliament

COMMENTING on the approaching opening of the first parliament of the reign of Queen Victoria, the *Mechanics' Magazine* of August 1837 said, "The new parliament will, to all appearance, have a smaller number of scientific members (always few enough) than the last, which, in its turn, had fewer than that which preceded it. Sir George Cayley will have no seat in the first parliament of Queen Victoria, while Mr. Babbage is further off the object of his ambition than ever . . . The principal scientific men who remain there are Mr. Heathcoat, the member for Tiverton, well known for his inventions in lace machinery, and the (said-to-be-unsuccessful) steam plough; Mr. Handley, the member for Lincolnshire, whose exertions to introduce steam-machinery in agriculture have been great and long continued; and Mr. Jephson, the member for Marlow, who holds a high reputation in the mechanical world. We believe Mr. Rotch, the barrister, better known to fame as the inventor of the patent screw-fix, has not secured a seat on the present occasion, or, of course, he would have been added to the scanty list."

The First French Railway

IN August 1837, the railway between Paris and St. Germain—the first in France—was opened. Writing on August 26, the correspondent of *The Times* said, "Paris has put on her seven-leagued boots, and reached St. Germain in a stride! The chateau of Louis le Grand, and the fine terrace sweeping through the forest until it is lost in distance, have kindly consented to approach the metropolis for the gratification of the numerous *quidnuncs* who inhabit it; and St. Germain, with all its interesting scenery, although, if we are to credit the map, it is twelve good English miles from Paris, is now more accessible than the windmills of Montmartre. This *triomphe merveilleuse*, as the Parisians delight to call it, is the work of that grand miracle-monger of the nineteenth century—steam . . . For statistics, it will be sufficient to state that the *matériel* is composed of 105 vehicles, capable of containing 4,070 persons, and of transporting the entire population of Paris to St. Germain in the course of one fine Sunday. The railway, 4½ leagues in length, passes through a beautiful country, traversing no fewer than eighteen bridges, three of which are across the Seine. . . . There is a tunnel, Batignolles, which is divided into two galleries, being above 400 metres. The construction is very solid, the rails being fifteen times heavier than those upon the Liverpool and Manchester road." An account of the lines was published shortly afterwards in the *Mechanics' Magazine*, in which it was stated the rails were 60 lb. per yard as compared with the 30 lb. per yard of those on the Liverpool and Manchester line. By 1840 there were 265 miles of railways open in France; by 1860 this had increased to 5,863 miles and by 1882 to 17,006 miles.

Societies and Academies

Dublin

Royal Dublin Society, May 25.

Report of the Radium Committee for the year 1936. The total number of millicuries of radon issued during the year was 12,635, the number of cases recorded in the report being 552. The report includes a number of detailed reports by various users of radon supplied by the Society.

M. J. GORMAN: A non-bulbing derivative of yellow-fleshed Swedish turnip. A non-bulbing form described resembles Swedish turnip (*Brassica napus* var. *napobrassica*) in having yellow flesh, buff flowers, and behaving as a biennial. By selfing, successive generations were obtained of rape-like plants quite uniform in appearance and similar to the original.

J. BREEN, J. KEANE and T. J. NOLAN: The chemical constituents of lichens found in Ireland—*Pertusaria concreta*. The main constituent of this lichen is *nor*-stictic acid $C_{18}H_{12}O_9$. Besides mannitol, it also contains a small amount of a substance crystallizing in yellow needles, m.p. 287° C. This latter substance, $C_{14}H_7O_5Cl_3$, contains three hydroxyl groups and is probably a trichlor trihydroxy methyl xanthone. It gives an olive green coloration with ferric chloride.

Paris

Academy of Sciences, June 21 (*C.R.* 204, 1849–1908).

LÉON GUILLET and MARCEL BALLAY: Krupp's disease in steels.

CHARLES PISOT: The modulo 1 distribution.

MME. HILDA GEIRINGER: Chance variables arbitrarily connected. (Convergence according to Poisson's law.)

BERTRAND GAMBIER: Jonas surface and R surfaces.

SERGE BACHVALOFF: Pairs of stratifiable rectilinear congruences.

SZOLEM MANDELBROJT : The equivalence of two classes of functions of Paley and Wiener.

LÉON BRILLOUIN : Disturbance of a problem of individual values by deformation of the boundary.

GEORGES NADJAKOFF : A new species of permanent polarization of dielectrics.

PIERRE DONZELOT and JEAN BARRIOL : The relation between Raman frequencies and interatomic distances.

LÉVI HERMAN and MLLE. FANNY BERNSTEIN : Remarks on the properties of photographic plates treated with aqueous or alcoholic solutions of sodium salicylate.

HENRI BIZETTE and BELLING TSAÏ : The magneto-optical properties of compressed gases. The magnetic double refraction of nitric oxide. The magnetic rotatory power of helium.

FRANÇOIS BOURION and MLLE. ODILE HUN : The determination of the hydration of the ions of sodium iodide.

W. BRONIEWSKI, S. PRZEDPELSKI and S. SULOWSKI : Some physical and chemical properties of very pure steels. The steels were prepared from electrolytic iron and lampblack in an induction furnace, and contained less than 0·014 per cent of impurities other than carbon. Curves are given showing the variation of several physical properties as a function of the percentage of carbon.

J. BERTHOIS and J. FURNESTIN : Study of the sediments dredged by the *Président Théodore Tissier*. Continental plateau (Celtic and English Channel) and the North Sea.

LÉON AUFRÈRE, EDOUARD GIRARD and EDMOND VIGNARD : The alios of the forest of Montmorency.

EDGAR AUBERT DE LA RÜE : Contribution to the geological study of the New Hebrides.

GEORGES COLANGE and YVES LE GRAND : Observation of the atmospheric image of a lighthouse.

RAYMOND-HAMET and COLAS : The botanical origin of the Chuchuhuasha. The bark of a Peruvian plant, possessing physiological activity, locally named Chuchuhuasha much resembles *Maytenus communis*, but is regarded by the author as a new species of *Maytenus*.

LUCIEN PLANTEFOL : Demonstration of the extrinsic character of oxidations induced by glucose.

OCTAVE DUBOSCQ and MLLE. ODETTE TUZET : The fusome and crosswise cells of the calcareous sponges.

RAOUL LECOQ : The influence of iodine and of some inorganic and organic iodine compounds on the bone lesions of experimental rickets. Iodine exerts a clear curative action on bone lesions of the rat with rickets experimentally produced. This action is the same whether the iodine is free or in combination.

P. LASSABLIÈRE : A new property of foods, trophophylaxy.

HENRI BIERRY, BERNARD GOUZON and MLLE. COLETTE MAGNAN : The variations in the proportion of glycogen in edible oysters.

MME. VERA DANTCHAKOFF : The relation between genic sexual determinism and sex.

MAURICE FAVRELLE and GEORGES DE VICHET : The results of impregnation, by an Algerian male, of French parthenogenetic females of *Bacillus rossii*.

GEORGES CHAMPETIER and EMMANUEL FAURÉ-FRÉMIET : The roentgenographic study of an intracellular protein.

MLLE. RACHEL SCHOEN : Lymphogranulomatous virus and neoplasm.

GEORGES MOURIQUAND, HENRI TÊTE, GEORGES WENGER and PAUL VIENNOIS : The action of sterilization and of some modes of preservation on the anti-scorbutic power of lemon juice.

PIERRE GLEY : The antistreptococcic action of certain organic sulphur derivatives.

Brussels

Royal Academy (*Bull. Classe Sci.*, **23**, No. 4 ; 1937).

L. GODEAUX : An algebraic variety in three dimensions the operation of adjunction on which has the period three.

F. H. VAN DEN DUNGEN : Report on the legal systems of weights and measures in Belgium.

O. ROZET : A linear system of plane hyperelliptic curves.

G. DUFRANE : A birational transformation of space of four dimensions with a given fundamental curve.

D. S. MITRINOVITCH : A problem on the asymptotic lines of a class of surfaces.

N. NERONOFF : The reduction of a plane problem in hydrodynamics to the solution of a system of functional equations.

L. MATHÈWE : Note on the axial rotational periods of stars.

ELISABETH BODSON and FRANCINE DEHALU : New researches on the bands of aluminium oxide. New bands of the $^2\Sigma - {}^2\Sigma$ system of AlO obtained by explosion of an aluminium wire.

P. VAN RYSSELBERGHE : Application of affinity to coupled biochemical reactions. Theoretical study of some reactions produced by bacilli and algæ.

Cape Town

Royal Society of South Africa, June 16.

J. L. B. SMITH : The South African fishes of the families Sparidæ and Denticidæ. Sparid and denticid fishes occur in all tropical and temperate seas, and are of very considerable economic and taxonomic significance. In South African waters, there are forty species, many of which are endemic, and some are highly specialized and unlike any from other parts. Some species occur in vast numbers and are among the most important food-fishes of South Africa. The taxonomic relationships of the species have never been fully investigated, and the whole group has stood in need of critical revision, which has now been undertaken. Very considerable changes, both taxonomic and nomenclatorial, are proposed in the present work. Illustrations of all species of which no reliable figure exists have been provided, also photomicrographs of several selected scales of most species.

A. J. H. GOODWIN : Archæology of the Oakhurst shelter, George : (6) The Wilton deposit. Throughout the uppermost 3 ft. of deposit there is a single cultural continuity present. At 36 in., the culture is a normal Wilton ; after this level the typical Wilton stone implements are replaced by shell implements. After 18 in. there is an increase in pebble implements. In the uppermost 9 in. pottery appears. Throughout the whole Wilton period the subsistence basis remains the same, and consists of shell-fish, sea fish, and animals of modern type.

Cracow

Polish Academy of Science and Letters, May 10.

M. JACOB: A possibility shown by Cesàro of summing developments in series of Hermite polynomials.

J. WEYSSENHOFF: The metric field and field of gravitation.

A. KANIA: The magnetic declination at Cracow during the period 1914–36. The formula western declination $= 3{\cdot}200° - 0{\cdot}160°\ (t - 1925)$, t being expressed in years, obtained by the method of least squares, reproduces the observations, 589 in number, with a mean quadratic error of $\pm\ 0{\cdot}093°$.

H. LACHS and W. PIEKIELNY: The oxidation of sulphur vapour at low pressures.

G. BIRSTEIN and M. BLUMENTHAL: The kinetics of the phenomenon of crystallization.

B. KAMIENSKI: Superficial phenomena and the dissociation constant of weak electrolytes.

F. GORSKI: Researches on the utilization of the optical antipodes of racemic acid by *Aspergillus fumigatus*.

B. SWIDERSKI: The fauna of the Jurassic Klippes in the Czarny Czeremosz basin.

J. WILBURG: The survival, at a temperature of 38° C., of the tissues of the embryo of a fowl after its death.

MME. I. MIKULSKA: Comparative study on the biology and metamorphosis of the larvæ of the genus *Catocala*.

J. MARCHLEWSKI: The hybrids of guinea fowl (*Numida meleagris*) and a domestic cock (*Gallus domesticus*) obtained by artificial impregnation.

H. SZARSKI: The vessels of the thymus of some tail-less batrachians.

S. SKOWRON, Z. WICINSKI and S. ZAJACZEK: Observations concerning the result of defect or excess of the thyroid hormone in the maternal organism on thyroid body of the fœtus, and notes on the effect of partial extirpation of the parathyroid glands on parturition.

Moscow

Academy of Sciences, (*C.R.*, 14, No. 9; 1937).

L. KANTOROVIČ: (1) The moment problem for a finite interval. (2) Some theorems on nearly complete convergence.

K. PRESIDSKIJ: A theorem of Liapounoff.

G. M. KOVALENKO: Influence of carbon tetrachloride vapour on breakdown voltages of air.

D. I. MIRLIS: Kinetics of wetting and linear corrosion of metals in polyphase systems: metal-liquid-liquid, and metal-liquid-gas (2).

V. O. MOCHNAČ and V. S. BAGNIUK: The action of the halogen compounds of arsenic and phosphorus on ethincarboxylic acids (1). Addition reaction of arsenic chloride with tetrolic acid.

V. O. MOCHNAČ and A. I. STOLIAROV: Geometrical isomerism of halogen-substituted ethene acids. (2) Addition of hydrogen bromide to tetrolic acid.

N. S. VORONETS: The existence of the Upper Triassic in the region of the Bureya River basin.

A. S. SEREBROVSKY: The third variant in the 'triangle method'.

V. I. PATRUŠEV: Inheritance of biochemical characters by animals, and its relation to their growth. (1) Glutathione concentration in the blood and difference in size of breeds of farm animals. (2) The catalase content of the blood of horned cattle and of sheep.

Vienna

Academy of Sciences, June 10.

J. KISSER and K. LOHWAG: Histochemical study of lignified cell walls. The early wood of firs is much more resistant to chemical attack than the late wood, and the radial cell walls of the latter are more resistant than the tangential walls.

O. RIED: Influence of irradiated metal compounds on the growth and development of *Phaseolus vulgaris* L. Copper sulphate and sulphide lose their property of inhibiting growth when irradiated with ultra-violet light. The property of bacon fat of stimulating growth is increased by irradiation, especially in the presence of zinc oxide.

A. MALABOTTI: Action of β-indole-acetic acid on plants (2). Influence of growth-promoting substance on the cotyledons of *Phaseolus vulgaris* L.

J. JURIŠIĆ: Action of β-indole-acetic acid on plants (3). Action of heteroauxin on foliage leaves and cotyledons.

L. PORTHEIM: Action of β-indole-acetic acid on plants (4). Studies with buds of *Phaseolus vulgaris* L. The curvatures produced in leaves when drops of heteroauxin are placed on different parts are studied.

E. ROUSCHAL: Velocity of the transpiration current in maqui wood.

A. ERDÉLYI: Theory of confluent hypergeometric functions of several variables.

A. KAILAN and F. HARTEL: Velocity of catalytic hydrogenation of oleic and cinnamic acids.

H. DOSTAL: Kinetics of thermal polycondensation reactions.

H. LACHS and A. I. GROSMAN: Viscosity of cuprammonium solutions of cellulose.

D. BALAREW and N. KOLAROW: Vapour pressure and the size of drops.

M. MLADENOVIC: Elemic acid from manila-elemi (9). Dihydroelemolic acid.

K. PRZIBRAM: Correction to the paper of I. Leitner "Quantum Yield in the Coloration of Rock Salt by X-, γ- and β-Rays".

O. SCHINDLER: A new species of fish (Characidae) from north-east Paraguay.

June 17.

A. KÖHLER and A. MARCHET: Recent volcanic rocks in the Lainzer Tiergarten in Vienna.

P. and E. KRUMHOLZ: Diphenylcarbazone. Pure diphenylcarbazone has been prepared from the substance erroneously referred to by this name in the literature.

P. KRUMHOLZ and H. WATZEK: Autoxidation of diphenylcarbazone. Autoxidation is accelerated by traces of copper. The effect is highly specific and can serve for the quantitative estimation of minute traces (10^{-7} mol/litre) of copper in solution.

K. GRAFF: (1) Estimation of colours of stars in large instruments. (2) Red cloud and distribution of stars round δ, ε, ζ Orionis.

BERTA KARLIK and K. PRZIBRAM: Fluorescence of divalent rare earths.

W. SALOMON-CALVI: Continuation of the clay line in Asia Minor.

A. ROLLETT: Azocolours (3).

R. SKRABAL: Studies of the Raman effect (73). Derivatives of cyclic compounds with three and four atoms in the ring.

J. LÖBERING and K. P. JUNG: Kinetics of polymerized aldehydes.

O. BRUNNER and W. KLEINAU: Material of the retina (5). Isolation of vitamin C from the retina.

Appointments Vacant

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

ASSISTANT CLINICAL PATHOLOGIST in the Preventive Medicine Department Laboratories of the University of Bristol—The Secretary (August 28).

ASSISTANT IN AGRICULTURAL ZOOLOGY in the University of Aberdeen—The Secretary (September 1).

ASSISTANT LECTURER AND DEMONSTRATOR IN ZOOLOGY AND COMPARATIVE ANATOMY in University College, Cardiff—The Registrar (September 3).

ASSISTANTS (grade III) in the Meteorological Office—The Secretary (S.2.A.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (September 7).

DEMONSTRATOR IN BIOLOGY in the Royal Veterinary College and Hospital, Camden Town, London, N.W.1—The Secretary (September 7).

SECRETARY to the Institution of Civil Engineers—The Chairman of the Selection Committee, Institution of Civil Engineers, Great George Street, Westminster, S.W.1 (November 1).

JUNIOR SCIENTIFIC OFFICER (PHYSICIST) at the Fuel Research Station, Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16, Old Queen Street, London S.W.1 (quote *J.* 37/11).

Official Publications Received

Great Britain and Ireland

British Non-Ferrous Metals Research Association. Research Reports Association Series, No. 449: Creep of Non-Ferrous Metals and Alloys: a Review of Published Information. By W. A. Baker. Pp. 19. (London: British Non-Ferrous Metals Research Association.) 2*s.* [217

Report of the Harper Adams College Advisory Department, April 1936—March 1937. (Advisory Report, No. 12.) Pp. 23. (Newport, Shropshire: Harper Adams Agricultural College.) [227

Forestry Commission. Seventeenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1936. Pp. 42. (London: H.M. Stationery Office.) 9*d.* net. [227

International Lighthouse Conference, Berlin, 1937. Coloured Glass for Lighthouse Purposes. By J. G. Holmes. Pp. 53. (Smethwick: Chance Brothers and Co., Ltd.) [237

Technical Publications of the International Tin Research and Development Council. Series A, No. 55: The Determination of Cadmium in Tin-Rich Alloys. By Prof. D. Hanson and Dr. W. T. Pell-Walpole. Pp. 6. Free. Series A, No. 56: The Electrodeposition of Tin from Acid Sulphate Solutions. By A. W. Hothersall and W. N. Bradshaw. Pp. 16. Free. (London: International Tin Research and Development Council.) [237

Research Association of British Rubber Manufacturers. Seventeenth Annual Report for the Year 1936. Pp. 86. (Croydon: Research Association of British Rubber Manufacturers.) [267

Imperial Economic Committee. Fruit Supplies, 1936, including Vegetables, Flowers and Bulbs. A Supplement to Weekly Fruit Intelligence Notes prepared in the Intelligence Branch of the Imperial Economic Committee. Pp. 108. (London: H.M. Stationery Office.) 2*s.* 6*d.* net. [287

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (the National Fruit and Cider Institute), Long Ashton, Bristol, 1936. Pp. 296. (Bristol: The University.) [287

Eighteenth Annual Report of the Ministry of Health, 1936–37. (Cmd. 5516.) Pp. x+328. (London: H.M. Stationery Office.) 5*s.* net. [48

Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 50: A Ten Years' Experiment on the Spread of Leaf Roll in the Field. By Paul A. Murphy and J. B. Loughnane. Pp. 567–580. 1*s.* Vol. 21 (N.S.), No. 51: Investigations on a Molecular Constant for Soured Milks. By G. T. Pyne and J. J. Ryan. Pp. 581–586. 1*s.* Vol. 21 (N.S.), No. 52: The Chemical Constituents of Lichens found in Ireland—*Pertusaria concreta* Nyl. form *Westringii* Nyl., by J. Breen, Dr. J. Keane and Dr. T. J. Nolan; No. 53: The Chemical Constituents of Lichens found in Ireland—*Parmelia conspersa* Ach., by Margaret Mohan, Dr. J. Keane and Dr. T. J. Nolan. Pp. 587–594. 1*s.* (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [48

City of Leicester Municipal Libraries. Fifty-eighth Report to the City Council, 1st April 1936 to 31st March 1937. Pp. 20. (Leicester: Leicester Municipal Library.) [48

Other Countries

State of Illinois: Department of Registration and Education, Division of the Natural History Survey. Bulletin, Vol. 21, Article 2: Responses of the Large-mouth Black Bass to Colors. By Frank A. Brown, Jr. Pp. iii+33-56. (Urbana: Illinois State Natural History Survey.) [217

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 18, No. 7 (Mathematics, No. 22): Beitrage zur Geometrie der Kreise und Kugeln (18), von Sôzi Matumura; Über Flächen und Kurven (7), von Sôzi Matumura. Pp. 185–202. Vol. 18, No. 8 (Mathematics, No. 23): On a Pair of Surfaces mutually Related (6). Von Sôzi Matumura. Pp. 203–214. Vol. 18, No. 9 (Mathematics, No. 24): Über Flächen und Kurven (18). Von Sôzi Matumura. Pp. 215–228. (Taihoku: Taihoku Imperial University.) [227

Hyderabad Geological Series. Bulletin No. 2: A Brief Outline of the Geological History of Hyderabad State, with a Reference to its Mineral Resources. By Khurshid Mirza. Pp. iii+58. (Hyderabad: Geological Survey Department.) 1 rupee. [227

United States National Museum. Bulletin 153: Birds collected by the Childs Frick Expedition to Ethiopia and Kenya Colony. By Herbert Friedmann. Part 2: Passeres. Pp. xii+506+14 plates. (Washington, D.C.: Government Printing Office.) 70 cents. [237

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 22, No. 4: No. 33, The Hemiptera of the Templeton Crocker Expedition to Polynesia in 1934–1935. By E. P. Van Duzee. Pp. 111–126. (San Francisco: California Academy of Sciences.) [237

Regenwaarnemingen in Nederlandsch-Indië. Zes en vijftigste Jaargang, 1934. Pp. 129. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [237

Nyasaland Protectorate: Geological Survey Department. Colonial Development: Water Supply Investigation—Progress Report (No. 6) for the Year 1936. Pp. 15+2 maps. (Zomba: Government Printer). [267

Union of South Africa: Department of Irrigation. Magnetic Declination in South Africa (1936) published in connection with the Isogonic Magnetic Map of South Africa, south of Latitude 18° S. for the approximate Epoch, April 1936, particularly of the Union of South Africa. By A. D. Lewis. Pp. 19+2 plates. (Pretoria: Government Printer.) 2*s.* 6*d.* [267

Southern Rhodesia: Geological Survey. Bulletin No. 30: The Geology of the Country Around the Queen's Mine, Bulawayo District. By A. M. MacGregor, J. C. Ferguson and F. L. Amm. Pp. vi+175+20 plates. (Salisbury: Government Stationery Office.) 5*s.* 6*d.* [267

Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band 72, Abh. 2: Beiträge zur Osteogenese des Knochensystems beim Haushuhn, bei der Haustaube und beim Haubensteissfuss; eine vergleichend osteologische Studie. Von Hans R. Schinz und Rainer Zangerl. Pp. iii+117–165+4 plates. (Zürich: Gebrüder Fretz A.-G.) [267

Geological Survey of Uganda. Memoir No. 3: The Volcanic Area of Bufumbira. Part 2: The Petrology of the Volcanic Field of Bufumbira, South-West Uganda. By Prof. Arthur Holmes (Petrology), and Dr. H. F. Harwood (Chemical Analyses). Pp. xiv+300+5 plates. (Entebbe: Government Printer.) 21*s.* [267

Memoirs of the Geological Survey of India. Vol. 71: The Geology of Gangpur State, Eastern States. By Dr. M. S. Krishnan. Pp. vii+181+xviii+19 plates. (Calcutta: Geological Survey of India.) 6.12 rupees; 11*s.* [267

Royal Agricultural Society, Egypt. Technical Bulletin No. 30: Experiments in Egypt on the Interaction of Factors in Crop Growth. 6: Further Experiments on the Nitrogeneous and Phosphatic Manuring of Cotton. By Frank Crowther, Adolf Tomforde and Ahmed Mahmoud. Pp. 56. (Cairo: Royal Agricultural Society.) [277

Annales Bryologici: a Year-Book devoted to the Study of Mosses and Hepatics. Edited by Fr. Verdoorn. Vol. 9 (1936). Pp. iv+160. (Leiden: Chronica Botanica Co.; London: W. Dawson and Sons, Ltd.) 6 guilders. [48

Smithsonian Institution: United States National Museum. Bulletin 168: Nearctic Collembola or Springtails, of the Family Isotomidae. By J. W. Folsom. Pp. iii+144+39 plates. (Washington, D.C.: Government Printing Office.) 30 cents. [48

Bulletin of the American Museum of Natural History. Vol. 73, Art. 6: Catalogue of the Meteorites in the American Museum of Natural History as of October 1, 1935. By Dr. Chester A. Reeds. Pp. 517–672. Vol. 73, Art. 7: The Sense Organs involved in the Courtship of Storeria, Thamnophis and other Snakes. By G. K. Noble. Pp. 673–725. (New York: American Museum of Natural History.) [48

U.S. Department of Agriculture. Circular No. 433: Crow—Waterfowl Relationships, based on Preliminary Studies on Canadian Breeding Grounds. By E. R. Kalmbach. Pp. 36. 10 cents. Circular No. 436: Production and Agricultural Use of Sodium Nitrate. By Albert R. Merz and C. C. Fletcher. Pp. 12. 5 cents. (Washington, D.C.: Government Printing Office.) [48

State of Connecticut: State Geological and Natural History Survey. Bulletin No. 57: The Amphibia of Connecticut. By Lewis Hall Babbitt. Pp. 50+20 plates. (Hartford, Conn.: State Geological and Natural History Survey.) [48

Industrial Research Bureau. Bulletin No. 10: Indian Vegetable Oils. By N. Brodie. Pp. viii+116. (Delhi: Manager of Publications.) [48

Annual Report of the Imperial Dairy Expert for the Year 1935–36. Pp. ii+24+6 plates. (Delhi: Manager of Publications.) 1.4 rupees; 2*s.* [48

Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 14: A Preliminary Study of Root Characters as affecting Drought Resistance in Two Sugarcane Varieties and in their Seedlings. By Dr. H. Evans. Pp. 20. (Port Louis: Government Printer.) [48

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 153: The Moment of the Fluid Pressure acting on a Flat Plate in a Semi-infinite Stream bounded by a Plane Wall. 2: Case of Upper Boundary. By Susumu Tomotika and Isao Imai. Pp. 473–517. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 50 sen. [48

Smithsonian Institution: Bureau of American Ethnology. Bulletin 114: Fox Miscellany. By Truman Michelson. Pp. v+124. (Washington, D.C.: Government Printing Office.) 25 cents. [48

Catalogues, etc.

Edwards' Vacuum Pipe Line Installations. Pp. 8. (London: W. Edwards and Co.)

Polaroid and Polarized Light. By Prof. A. F. C. Pollard. Pp. 24. (London: Polaroid Products, Ltd.) 1*s.*