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## Industrial Recruitment and Unemployment Problems

NO passage in the King's speech on the evening of May 6 won more cordial approval than his reference to the unemployed. In the midst of the rejoicings and demonstrations of loyalty, at a time when the industrial population of Great Britain was never so large, his words reminded all that there are still more than two million unemployed. The King's wish and appeal to find them work takes us to the central problem. The development of minor interests, the provision of occupations for occupation's sake, even the provision of allotments, may do much to bring them hope and a sense of fellowship with the community. It does not touch the real need. Only as they find work and recover an established place in the scheme of things can they regain their independence and true estate of manhood or womanhood.

To that task, scientific workers cannot be indifferent. Both rightly and wrongly, science has been blamed for much of the human wastage which has come from the rapid application of scientific knowledge in industry and elsewhere. Scientific workers have their own contribution to make in the concentration of purpose and concerted endeavour which will remove the reproach of chronic, hopeless unemployment from our land; and happily they are increasingly displaying their sense of this responsibility.

Despite the attention which has been focused upon this problem in recent years, there is still no definite answer to the question how we are to find work for the unemployed on the scale required. The magnitude of the problem is well defined and the interpretation of the statistics of unemployment has been ably discussed before the Royal Statistical Society by Mr. J. A. Dale. It is clear, moreover, that no revival of trade such as may be looked for with any reasonable confidence offers the prospect of absorbing more than a fraction of the numbers concerned.

It is also more widely realised that the problem of unemployment needs to be considered as a whole, and a policy developed which takes into account all the relevant and definitely ascertained facts. Attacks on the problem piecemeal, even on such special aspects as that of juvenile unemployment, can never yield adequate results and may indeed place obstacles in the way of the more far-reaching measures which the consideration of

the whole problem would suggest. Two reports, entitled "The Entrance to Industry" and "The Exit from Industry", which have been issued by P.E.P.\*, commend themselves particularly to the scientific worker for this reason. They are concerned with the social and individual, rather than the purely industrial aspects of unemployment, and make a noteworthy attempt to deal with the problem as a whole. They bring discussion to a concrete point and set forth facts and figures which must be accepted or refuted.

Both reports have as their background the conception of social security—the continued development on lines the soundness of which has been demonstrated by the severe tests of recent years of those measures of social insurance which should guarantee that no one shall starve or be ignorant or suffer ill-health, merely because he is poor or destitute. They direct attention to points of friction and danger which still exist in the wage-earner's life and to their effects on the question of unemployment as a whole.

In the first place, both reports demonstrate that the task is not simply to find or create an additional two million or more paid jobs of some sort. Increasing employment cannot be of much help unless we simultaneously maintain and if possible raise the quality of employment. That means not only increased earnings but also an enhanced status for labour, shorter working hours, holidays with pay, welfare work, provision for retirement in old age.

It must also be recognised that all employment has not the same social value. The employment of a man in middle life who may be the head of a family, for example, is socially more important than the employment of a young person or of an elderly person, even when all regard is had to the much more serious effects of continued unemployment on the young.

These two reports are accordingly based on the principle that any adequate employment policy must not only raise the status and standards of labour but also concentrate employment primarily upon those for whom it is economically most necessary and socially most desirable—that is to say, upon able-bodied men in the prime of life,

most of whom are or should be supporting wives and young families. The proposals advanced are thus not to be regarded simply as schemes for raising the school-leaving age, for day continuation schools, for retirement pensions and so forth, but as carefully considered and immediately practicable sections of a new social and economic structure in which the gains of individual enterprise and self-reliance will be preserved, while the insecurity which undermines peace of mind and co-operation, together with the exploitation of boys and girls by their parents and employers at the expense of their futures and of the national good, will be smoothly and permanently eliminated.

It is from this point of view that the first report directs attention to the conspicuous gap in our social services in the provision for boys and girls between fourteen and eighteen years of age. Between these ages, boys and girls pass through a vital phase in development. Important changes take place in their physical and psychological make-up, and their adult character begins to emerge. The importance of these years has been largely overlooked both by industrialists and by the community as a whole. In the absence of a carefully planned recruitment policy in particular industries, scientific vocational guidance is extremely difficult, and misfits, blind alley work and eventual unemployment often cannot be avoided. Although at the moment the number of school leavers is increasing, within the next forty years the age group fourteen to eighteen is expected to decrease considerably and to represent a much smaller proportion of the total population. Its economic and social value will correspondingly increase, and the elimination of waste and frustration as well as the raising of its quality by more careful preparation for industry, citizenship and leisure becomes correspondingly even more important.

Such considerations endorse the policy already suggested when the problem is viewed against the background of adult unemployment. The report accordingly advocates a definite policy for this age group: to extend educational influences over the whole period, to ensure that the health of boys and girls is supervised effectively up to the age of eighteen and to introduce an organised system of industrial recruitment, training and welfare supervision. As concrete proposals it recommends raising the school-leaving age to fifteen years and smoothing the transition from

\* "The Entrance to Industry: a Survey of Points of Contact between Education and Industry in Great Britain, together with Proposals for raising the School Leaving Age and for Part Time Continued Education until 18, presented as a Contribution towards a New Employment Policy by P E P (Political and Economic Planning)". Pp. 56. 1s. "The Exit from Industry: a Survey of the Provision for Old Age and for Retirement from Gain Occupation in the United Kingdom, together with Proposals for a National Retirement Pensions Scheme, presented as a Contribution towards a New Employment Policy by P E P (Political and Economic Planning)". Pp. 52. 1s. (P E P, 16 Queen Anne's Gate, S.W.1, 1935.)

tutelage to self-dependence by introducing compulsory half-time attendance at day continuation schools up to the age of eighteen. It is estimated that these proposals would eliminate most unemployment among boys and girls and create opportunities for the absorption of about half a million unemployed men and women over eighteen by 1940, at a net cost of between £9 millions and £14 millions if maintenance allowances were not paid to those above fifteen years of age, and between £20·5 millions and £25·5 millions if maintenance allowances were paid at the rate of 5s. per week.

The proposals of the second report are no less attractive. They visualise the extension of the compulsory contributory old age pensions scheme so as to provide retirement pensions at the age of sixty-five years or later (at the option of the individual). The finance of the pensions scheme is simplified by sharing the cost between the State, the employer and the worker. There would be savings on unemployment benefit and assistance, etc., and taking these into account it is estimated that the net cost of the scheme at the outset would be between £20·6 millions and £22·8 millions a year. Under the scheme, some 620,000 persons already retired would receive a retiring pension, and rather more than 470,000 persons still in employment would be afforded an opportunity of retiring on a pension sufficient for minimum needs, and it is estimated that at least 100,000-160,000 younger workers would in consequence be absorbed.

The case for these proposals rests, however, as much on their indirect effects as on their effect on those immediately concerned. By reducing the risk of unemployment in adult life and removing entirely the fear of destitution and dependence in old age, it alleviates two of the major causes of

friction in the wage-earner's life. The increased social security cannot but have a beneficial effect on the general welfare and health of the industrial population, and the steadying stimulating influence on the home market should tend to increase purchasing power, in keeping with the proved experience during the world depression of those countries which have highly developed social insurance as against those that have not.

The reports submit a strong case which is all the more impressive in that they visualise the employment situation as a whole. Put in another way, they suggest ways and means by which the large increase of leisure made possible by mechanisation may be regulated so that it does not take the injurious form of unemployment. To defer the age of entry into industry and to facilitate the honourable retirement in later years is obviously only a partial cure. None the less, if the estimates of the reports are approximately correct, the reduction of adult unemployment by some 600,000 persons offers a large contribution to the elimination of that hard core of unemployment, constituting about a million who are out of work for long periods, many of them wholly and permanently. The exact details of the schemes now produced matter less than the broad lines of the policy of concentrating employment where it is socially most desirable and providing specially for certain categories of people so as to take them out of the industrial field without hardship and indeed with advantage to themselves. The great merit of the reports is that they represent a scientific analysis of the situation upon which an alert, constructive and critical public opinion can be built up, not the least important element in which is that of scientific workers themselves.

## Reviews

### Respiration

*Respiration.* By Prof. J. S. Haldane and J. G. Priestley. New edition. Pp. xiii+493+17 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 30s. net.

AS is implied in the title page, the present volume is a new edition of a former work, namely, "Respiration", by Prof. J. S. Haldane, published by the Yale University Press. Even in the title page, there are quite a number of

changes as between the present work and the former one. At the outset, the Clarendon Press is to be congratulated upon the production of an attractive volume, and the original author is to be congratulated on having secured the help of Dr. Priestley. Nor must it be forgotten that Priestley's collaboration in authorship has a particular appropriateness, for Priestley was Haldane's helpmate in the particular research which in one sense formed the climax of Haldane's work, the discovery of a simple method for the

analysis of alveolar air and the consequent investigation of the effect of carbonic acid on respiration.

I have used the word "climax" above, but I am not sure that it is the right word: to ascend a summit, from the top of which new and unexplored territories stretch out— Is that reaching a "climax"? Never mind: the book reduced to its simplest terms is the account of the ascent of that summit and the subsequent exploration of the promised land which revealed itself from the top. That, as I say, is the book reduced to its simplest terms; but it cannot be reduced to very simple terms. In writing a novel, it is possible to work the subsidiary love affairs of the subsidiary characters into the whole theme, because the author has a perfectly free hand. But with Prof. Haldane it is otherwise; he has for most of his life been in some sense a public servant—a gas referee or an expert called in by this or that Government Department. The themes at which he has worked have often been thrust upon him by some public urgency, and necessarily appear as somewhat detached issues in the book. Their unity with the whole is to be found less in the subjects themselves than in the treatment of them all by the same master mind.

In a new edition, it is natural to seek for the fresh material that has been grafted on to its predecessor. In this connexion the reader will be much interested in Chapter iv, in which he will find Prof. Haldane's views on osmotic pressure set out in an attractive way. The cleavage between the present author and previously unchallenged views is expressed in the following sentence: "It was shown quite clearly by Haldane, that van 't Hoff's conception of osmotic pressure was mistaken. It is neither the concentration per litre of the solute molecules, nor that of the solvent molecules which determines osmosis, but the diffusion pressure of the solvent. Water passes through a semi-permeable membrane into a solution because the diffusion pressure of pure water is greater than that of the diluted water in the solution. The osmotic pressure is not the excess of the diffusion pressure outside the solution, but the external mechanical pressure required to equalise the two diffusion pressures".

Another very important chapter, most of the material in which is new, is Chapter xiii entitled "Air of Abnormal Composition". It treats of such subjects as the town air, that of occupied rooms, the discomforts of warm and cold air, escapes of gas, mine air containing various impurities including dust, the air of sewers and ships and of tunnels. In this chapter will be found much of the lore which Haldane has accumulated during his investigations into such matters

as the safety of the Mersey Tunnel or miner's phthisis.

It is not to be thought, however, that these chapters are the only important additions; the whole book has been brought up to date, and should be on the shelf of anyone who seeks up-to-date information on almost any matter connected with respiration.

J. B.

### Arts of West Africa

*Arts of West Africa (Excluding Music)*. Edited by Michael E. Sadler. (Published for the International Institute of African Languages and Cultures.) Pp. xi+101+32 plates. (London: Oxford University Press, 1935.) 5s. net.

RECENT exhibitions of the art of Indian, Chinese, African and 'primitive' peoples, such as that of the Burlington Fine Arts Club (see p. 927), have afforded the British public an opportunity of judging at first hand the merits of non-European achievement in this field. The exhibits were, no doubt, to many something of a surprise. The exhibition of African art was supplemented by the simultaneous publication of "Arts of West Africa", which enables those who are not acquainted with the literature dealing with African art, by now becoming extensive, though of unequal value, to taste the quality of this exotic production at their leisure. It had, however, a more serious purpose. Its publication was suggested in the course of discussions of the Committee on Education of the Colonial Office and was intended to vindicate African art, as something more than a 'bush' product, in the eyes of those who are interested in the West African and more especially those, administrators and others, who are in a position to influence the course of his future development.

The volume is by several hands. The most substantial contribution is by the editor, Sir Michael Sadler, who writes on "The Significance and Vitality of African Art" and is also responsible for the bibliography. Sir William Rothenstein has written a foreword, and the educational aspects of African art are considered by Mr. G. A. Stevens, formerly head of the Art Department of Achimota College, Gold Coast Colony, and Mr. Gabriel Pippet, also a member of the staff of that institution, who describes his methods of utilising the services of a native craftsman in teaching wood-carving. The principal feature of the book, however, is the thirty-two plates with descriptive notes of each object figured by Mr. Richard Carline.

The examples of African art here shown are sculptured human figures and masks, all in wood, with one exception, which is of pottery, decorated bowls of wood or pottery, and musical instruments,

utensils, stools, etc., of wood, metal or gourd, all showing characteristic employment of art motifs for decorative effect.

The area from which the examples shown are drawn is almost exclusively British territory, although, as Sir Michael points out, the whole of West Africa forms a single artistic province, including indeed differentiated local schools, but to be distinguished as a whole from the rest of Africa. The virtual restriction to British West Africa has excluded some of the most striking and aesthetically notable of the sculptures; but the examples given here are so far typical as to afford ample evidence by which to test the high estimate of the merits of African art formed by European critics. They will also enable those open to conviction to appreciate it as something more than merely grotesque and bizarre and as worthy of serious study as an expression of a real and strong emotional reaction to reality, in forms which may be denominated 'art' in the more conventional sense of that term.

It is precisely here that difficulty arises in any attempt to develop the artistic genius of the African along lines in harmony with his bent as exhibited in this tradition. African art, as known in the examples which have attained the high standard of aesthetic appreciation, belongs to the past. It is the product of a pagan environment, a product of a religious and ethical background which has now passed, or is passing, before the onset of white civilisation and the Christian religion. Surprise has been expressed that the anthropologist collecting examples of African art as ethnographical specimens should have chosen those which almost universally were aesthetically right, according to the standards of the critics. The explanation is that to the anthropologist this is no primitive art, as it is conventionally regarded, but an art which is the product of a long course of cultural development, in which emotional expression, technique and cultural environment generally have attained a certain state of equilibrium, susceptible of definition. His choice has fallen advisedly, therefore, on those specimens which seem most perfectly to exemplify that equilibrium and to display most completely the ethos of the people, their 'soul', as well as their highest and most characteristic technical accomplishment. In African art it combines a religious or magical symbolism, expressed through representation of natural forms, with a disposition of mass and line which displays a remarkable feeling for pattern, but is conditioned by the technique of the knife. The importance of this technique in the production of characteristic forms is indicated by Mr. Pippet's experiment in employing a native demonstrator for teaching wood-carving.

In so far as the aim is representation, African art is crude and imperfect, whatever may be its unconscious success as abstract art. The anthropologist who regards these matters, not from the point of view of abstract art, but in terms of culture, and in so far as his studies have practical application with the view of cultural development, may well question, now that the state of equilibrium has been disturbed, whether the elimination of crudities and imperfections of technique, as well as the suppression or transformation of the central emotional inspiration, may not also eliminate the artistic feeling for pattern and design. More often than not, in European children, the process of perfecting eradicates the capacity to charm found in the *naïveté* of their early efforts, to which Sir William Rothenstein compares the appeal of African art.

#### A Base-Less Fabric

*The Natural Logarithm.* By Sir Charles Vernon Boys. Pp. 31. (London: Wightman and Co., Ltd., 1935.) 2s.

NO practical man ever saw the least difficulty either in the idea of logarithms to a given base or in the use of common logarithms in arithmetical work. But if the practical man becomes inquisitive as to the methods by which his tables have been computed for him, or if he has to learn the use of logarithms in integration, the mathematician takes him seriously in hand; a quarter of a century ago, he was plunged into uncongenial algebraical analysis, into which the mysterious  $e$  was introduced dogmatically; nowadays, he is more likely to be told that the logarithm is defined as an integral, and to be set the bewildering task of pretending that he has never used a logarithm in his life. Sir Charles Boys, in his younger days, met with the first fate, and for a long time the natural logarithm seemed to him utterly artificial. Now he has found a direct line of approach, and he has written a tract which he tells us he would have swallowed whole if it could have been given to him when he was trying to digest Todhunter's account of the exponential series.

The interesting fact is that Sir Charles Boys has really turned, like the pure mathematicians, to the integral: his central investigation concerns the area under an arc of the rectangular hyperbola  $y = 1/x$ . But there is a difference. Having found, by a simple geometrical argument, that the area under an arc depends only on the ratio of the abscissæ of the end-points, the practical man is satisfied to recognise that the areas are logarithms, to some base or other. He finds that he can

calculate these logarithms, and the value of the base does not interest him: patently, the values of these logarithms are what he wants in integration, while if he wants logarithms to base 10 he has only to divide his areal logarithms all by the same constant, namely, the areal logarithm of 10 itself.

The crucial stage then is to devise a process of calculation. Sir Charles Boys gives Archimedes' quadrature of the parabola, and replaces the hyperbolic arc by an arc of a parabola. He shows that even the simple choice of the parabola which touches the hyperbola at the two end-points of the arc gives an approximate logarithm accurate to 1 in  $10^7$  if the argument is between 1.0 and 1.1. This parabola lies inside the hyperbola, and the approximation is necessarily in excess. An obvious modification is to introduce a parabola which crosses the hyperbola and allows some compensation of errors, and Sir Charles makes an ingenious choice which, without adding substantially to the arithmetic, reduces the error from 1 in  $10^7$  to 1 in  $10^{11}$ .

The weakness of the presentation is that both to determine the best parabola and to estimate the error Sir Charles uses the classical logarithmic series. If, after all, we are dependent on this series, the work becomes on the arithmetical side a mere curiosity. The classical series, as the author shows—though not in the language a mathematician would use—follows at once from the identification of the logarithm with the area, and since obviously the series *could* be used for calculation, the question whether the existing tables were actually calculated as efficiently as they might have been is of no practical importance. The practical man does not want to recalculate logarithms of any kind, but he does want to understand the natural logarithm, and this tract will show him very clearly how natural it is. On p. 22,  $H^3$  and  $A^3$  should be  $H_3$  and  $A_3$ .

E. H. N.

### Scientific Study of Dust

*Dust.* By Dr. S. Cyril Blacktin. Pp. xi+296+2 plates. (London: Chapman and Hall, Ltd., 1934.) 18s. net.

DR. BLACKTIN has written a book which is a mixture of philosophy and fact. In modern days this is unusual in a scientific textbook, and initially makes rather interesting reading. The scientific reader in search of a lucid exposition of dusts and smokes, however, will find it rather difficult to differentiate between the facts and Dr. Blacktin's own philosophy. The author has considered every conceivable aspect of smokes

and dusts, even explaining how they help in the scientific detection of crime. (Under the heading of dusts he includes such widely diverse systems as sandstorms, volcanic eruptions and ice particles.)

One is left with the impression after reading the book, however, that Dr. Blacktin would have done well to have specialised more on the scientific and technological applications of the subject, rather than to have dwelt on a large number of extraordinarily interesting and out of the way facts, which are somewhat irrelevant to the scientific investigation of atmospheric pollution or its allied problems.

The author has also introduced a new nomenclature, and a new set of definitions which, as the old ones of Gibbs (depending upon size) have been in general use for some years, is to be regretted, especially as the new ones are founded more on assumption of certain properties of particles than on fact. Most workers will disagree strongly with some of the definitions and statements. Thus—taking only one example, for the book provides much material for polemical discussion—Dr. Blacktin's definition of the difference between a smoke and a dust is that the latter is a disperse system in which the individual particles are breaking up and becoming smaller, due to a self-abrasive or disruptive approach action, whilst in the former the particulate matter is increasing in size, due to coagulation. There is no doubt of course about coagulation, but almost certainly this process continues until the particles are so heavy that they fall out under gravity. All the experimental and theoretical evidence is against a change in which disintegration commences and the particles become more numerous. Nor is there any evidence of an equilibrium state which would exist if Dr. Blacktin's views were correct. The coagulation of a smoke system, of course, becomes very slow as the particles get larger and less numerous, but this is due to the lack of Brownian diffusion and hence the small chance of collision, which also suggests the remoteness of the possibility of self-abrasive action in dusts of larger particle size.

Dr. Blacktin's book, however, will be valuable as a guide to industrial and technological workers. There is no phase of the subject on which he has not touched, in industry, in physiology or in Nature. He has also included an invaluable collection of almost six hundred references, and the work will be useful as a book of reference on the subject to the reader who has little or no previous knowledge of dusts. One criticism the reviewer must make is that he has found the English very obscure in places; this is a very real blemish in a book of this description.

## Short Notices

*Scottish Folk-Lore and Folk Life: Studies in Race, Culture and Tradition.* By Donald A. Mackenzie. Pp. ix+310. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1935.) 10s. 6d. net.

MR. MACKENZIE gives his readers a comprehensive view of the main heads of Scottish folk-tradition and belief. He ranges from food taboos to giants, fairies and goddesses. One of the more remarkable of the topics with which he deals is the attitude of the Scottish people towards the pig. Among the other peoples of Britain it has always been more or less a staple article of diet; but in Scotland, although there is evidence that it was eaten and was a victim in sacrifice, generally, or at least widely, it has been avoided as an article of food. Mr. Mackenzie holds that this attitude is pre-Christian, and derives it from the East, whence he thinks it may have been taken by the eastern Celts from Attis worship and the legend of the slaying of the god by a boar.

Current theories on the Celtic (or 'Keltic') question find little favour with the author, and he will not tolerate views which make Scotland dependent upon Ireland. In race and in folk-lore and tradition, he argues strongly for the individuality of Scotland, which he maintains has developed on the whole with singular freedom from alien influence. On the other hand, he seeks to show that in such matters as the food taboo, already mentioned, and the belief in mother-goddesses, there is cogent evidence of a cultural diffusion from the East. Mr. Mackenzie might have been more convincing had his treatment been more systematic, and loose statements and slips less frequent. "Alpine" and "Armenoid", for example, as racial terms are not interchangeable. La Tène is not "early" Iron Age and "the late Mr. Gray" could not have measured 5,000 recruits during the War, as, to the regret of his friends, he died two years before it began.

*New Light on Old Masters.* By Prof. A. P. Laurie. Pp. 163+12 plates. (London: The Sheldon Press; New York: The Macmillan Co., 1935.) 6s. net.

IN this book, miraculously compressed to a modest 163 pages, is summarised that fund of information on the painter's methods and materials so authoritatively expounded in Prof. Laurie's earlier volumes. To effect this sweeping condensation, without sacrificing the scientific and historical approach, must have been extraordinarily difficult; but Prof. Laurie, by pursuing the substance rather than the form, has contrived not only to retain practically every significant fact from his earlier works, but also to introduce many new ones. Obviously, he has made certain unwilling sacrifices of style and spaciousness: occasionally, an argument has been so condensed as to lead perilously near to a brilliant *non sequitur*. But his matter is intensely interesting.

A concise opening survey of the development of the palette precedes a description of Italian quattrocento painting methods, as set forth in the "Libro

dell'Arte" of Cennino Cennini; and a later chapter on the Van Eyck technique is particularly good. The final section, on scientific examination of paintings—a field wherein Prof. Laurie has been a bold pioneer—is illustrated by references to actual problems encountered. One could wish that the author had underlined more heavily the present limitations of certain scientific weapons: for many who should know better tend nowadays to regard, for example, X-ray examination of any painting as an unerring criterion of pedigree, provenance and general respectability.

P. D. R.

*The Neural Basis of Thought.* By George G. Campion and Sir Grafton Elliot-Smith. (International Library of Psychology, Philosophy and Scientific Method.) Pp. vi+167. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1934.) 9s. net.

THIS book takes its stand on the view that the terms which are used in thinking processes are constantly changing and developing, and in reality display none of that fixity which has sometimes been considered to be the main characteristic of the 'concept'. It is suggested that this is due to the fact that the material of thought is always being influenced by affective or emotional responses. Head and Holmes have demonstrated that in "some way the essential organs of the thalami are the centre of consciousness for the affective side of sensation". There are, as is well-known, innumerable paths of connexion between the thalami and the cortex. The authors hold that these "are return paths for reflex neural impulses from the cortex which excite relay cells in the thalami, and that these relay cells in turn send stimuli both to the essential thalamic organs and also to the same cortical areas from which the paths conveying the return impulse originated". Hence it is argued that thought processes must be pictured as based upon a constantly circulating stream of neural impulse from cortex to thalami and from thalami to cortex.

*Measures and Weights.* By Sir Flinders Petrie. Pp. x+22. (London: Methuen and Co., Ltd., 1934.) 2s. net.

IN this little book, Sir Flinders Petrie returns with the added experience of his excavations in southern Palestine to a subject of which he has always stressed the significance. "The study of ancient measures used in a country," he says here, "is a basis for discovering the movements of civilization between countries. The study of ancient weights serves to show the trade connections at any given period." Beyond his introductory remarks, however, Sir Flinders does not discuss the general principles, with which he has dealt elsewhere, but outlines the subject only for ready reference as to detail in the practical work of the archæologist.

### Systems of Echo Sounding

THE recent revival in shipbuilding has re-awakened interest in various items of ship equipment. One of the most important of these developments has taken place in the methods of sounding, and it has recently been stated, by a high authority in these matters, that no modern ship could be considered properly equipped without the fitting of echo sounding. It is the purpose of this article to review briefly the principal systems at present in use, and to attempt to draw a fair comparison between them.

The first suggestion that submarine depths could be measured by determining the time interval between the moment of transmission and the return of the echo, appears to have been made by Arago in 1807. In 1855, Lieut. M. F. Maury, of the U.S. Navy, who devoted particular attention to navigation and meteorology, made unsuccessful experiments designed to realise the method in practice.

The loss of the *Titanic* in 1912 prompted Richardson to formulate a similar suggestion in more explicit form. This, together with the general growth of shipping, stimulated workers in various countries. It is undoubtedly a fact that work on submarine listening during the War did much to lay the basis for the technique required to develop a genuine aid to navigation. Although it is reported that Behm succeeded in measuring depths in Lake Ploen in 1912, it was not until January 1923 that the first public report made by the Director of the

line of soundings from Gibraltar to Port Said in July 1922. This apparatus was designed by Dr. H. C. Hayes, of the U.S. Navy. Within a year or two, every important maritime country in the world had announced the completion of successful trials of echo sounding apparatus of one sort or another.



FIG. 2. Fathometer indicator, Universal Type, 432.

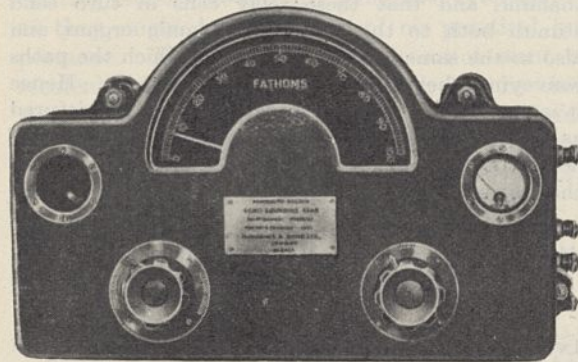


FIG. 1. Indicator employed with Admiralty High Frequency Gear.

French Hydrographic Service showed that this new and indirect method of measurement was well adapted to practical needs. This report was to the effect that a line of soundings had been run across the Mediterranean in April 1922 in connexion with a projected submarine cable. In June 1922, the U.S.S. *Stewart* obtained a line of echo soundings across the Atlantic from the American coast to Gibraltar, and continued the

The method of initiating the pulse of a sound and receiving the echo and measuring the time interval between the two events may be considered broadly under two distinct headings:—

(A). THE SONIC SYSTEM: In this case, (1) a steel hammer strikes a steel plate in the bottom of the ship and sends out a highly damped compressional wave. (This method has been used by the British Admiralty, and 'Fathometer'.) (2) A Fessenden, or similar oscillator, sends out a short pulse of sound at a frequency of a few thousand cycles per second. (This method is also used by 'Fathometer'.) (3) Detonation of an explosive; for moderate depths a gun may be fired at the surface of the water, or for greater depths, the charge may be exploded beneath the surface (Behm).

(B). THE SUPER-SONIC SYSTEM: In this system a high-frequency oscillator is employed giving a beam of sound waves up to as much as 30,000 or 40,000 cycles per second. This sound wave is of such high frequency that it is inaudible to the human ear. There are two principal systems which employ this method:

(1) The Langevan-Chilowsky system. This employs a quartz mosaic between two steel plates of such thickness that the fundamental frequency of vibration is of the order of 30,000 or 40,000



cycles per second. A suitably cut quartz plate possesses the property of expanding when an electric field is applied in one direction and contracting when the field is reversed. The application of an oscillatory condenser discharge to the quartz plates produces an oscillatory mechanical movement of the steel plates. As the radiating surface is several wave-lengths in diameter, a sound-beam is produced.

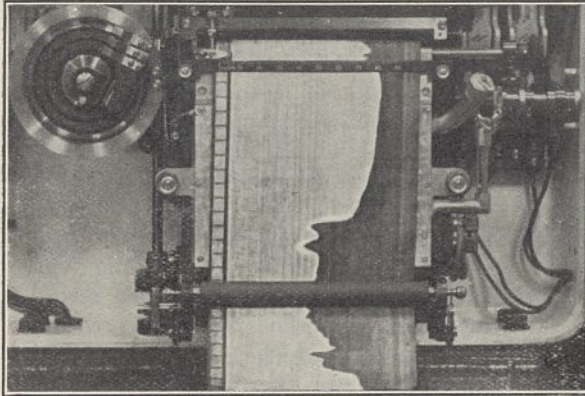


FIG. 3. Contour being drawn by 'straight line' recording gear.

(2) The British Admiralty high-frequency system. This employs a laminated structure of nickel with a resonant frequency of approximately 16,000 cycles per second. Nickel possesses the property of contracting in an increasing magnetic field and increasing in length in a diminishing field. The laminated structure constitutes a closed magnetic circuit provided with a toroidal winding, so that an oscillatory condenser discharge through the windings sets up an oscillatory magnetic field in the nickel, and produces corresponding mechanical vibrations. The vibrations are concentrated into a beam of about 45° angle.

It must not be judged from the foregoing description that all of the devices enumerated are equally well-adapted to every purpose. For example, the non-directional properties of the sonic system necessitates that the hydrophone or receiver be comparatively remote from the transmitter in order that the latter part of the transmission may not interfere with the front part of the returning wave train, especially in moderate depths of say 10 fathoms. This separation has the effect of compressing the scale at its lower end, rendering precise readings more difficult just where precision is sometimes most needed. The short wave train and the directional properties of supersonic systems both enable the transmitter and receiver to be placed close together, and under favourable

conditions makes possible readings to within a foot or so of the keel, at least in the case of the Admiralty magnetostriction system.

A further advantage of the use of a supersonic frequency is that the tuned receiver is less subject to disturbance from water-noise and general ship's noises than is the case at lower frequencies.

On the other hand, low-frequency sounds are less subject to attenuation in passing through the hull of the ship and also in passing through great depths. In the case of the Langevan-Florisson system (30,000-40,000 cycles per second) it is necessary to cut a hole in the bottom of the ship and transmit through a thin diaphragm, and even then it is not considered practical to apply this system to depths greater than 750 fathoms. In contrast to this, sonic systems have been employed to sound the greatest ocean depths. The Admiralty high-frequency magnetostriction system (about 16,000 cycles per second) combines to a great extent the advantages of both sonic and supersonic systems and is employed without the necessity for cutting the ship. Depths of more than 1,000 fathoms have been sounded by this system, transmitting and receiving through a  $\frac{5}{8}$  in. thick steel hull, and the echo was then of such an intensity as to hold every promise of taking soundings in the greatest ocean depths. The following comments upon this system are made in a paper on "The Fiord Region of East Greenland", by Louise A. Boyd, published recently by the American Geographical Society:—

"This installation represented the very latest development in ultra sonic depth-measuring

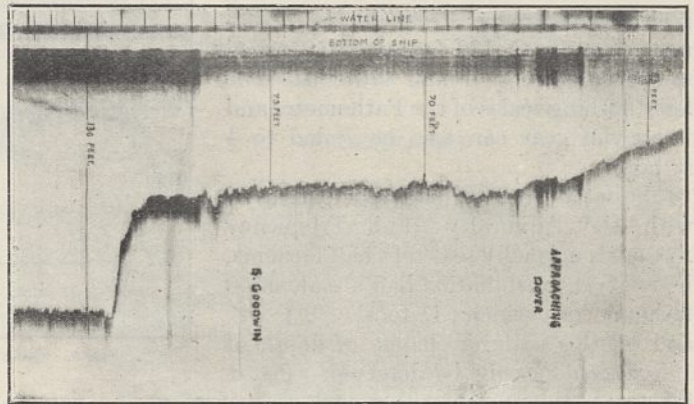


FIG. 4. Record on Admiralty "Challenger" magnetostriction recorder. Minute time scale along water line. Speed of ship, 22 knots.

technique, and the trial showed that its efficiency was greater than that of any previous apparatus of the same size and type. In the tests off the Lofoten-Vesteraalen islands not only were the desired 1800 meters obtained, but approximately 2200 metres (1200 fathoms). Reaching that depth, the ocean bottom leveled off, and the instrument

was still recording vigorously when we turned back toward shore."

The question of accurately recording the time interval between transmission and reception of a sound pulse raises difficulties of considerable magnitude; when the speed of sound in water is approximately 4,800 ft. per second, this means that a depth of 400 fathoms (allowing for the double effect of the reflected sounds) corresponds

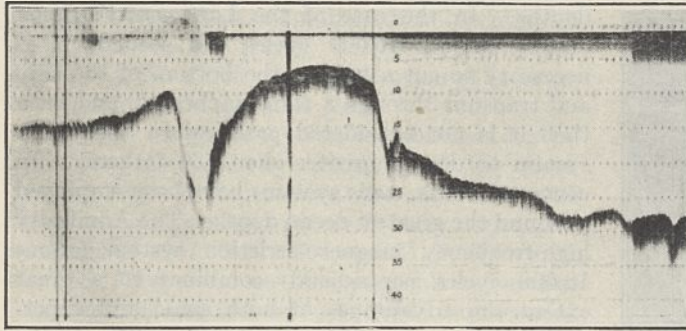


FIG. 5. Shallow water record.

to one echo-second. In other words, on whatever scale may be selected for recording the depth, changes of one foot must be made by the recording agent in a 2400th of a second. It is easy to see that to do this with precision involves immense care and thought in design.

Many devices have been brought out to achieve this result. The earliest method was to make a scale of feet or fathoms with the full limit of the depth required marked on it in the smallest readable markings. The original scale of the British Admiralty listening gear was a circular drum 12 in. in diameter, on which 130 fathoms was scaled to feet markings or half fathoms. The light flashing scales of the Fathometer and Langevan gear can also be scaled to  $\frac{1}{2}$  fathoms.

The latest form of indicator employed with the Admiralty High Frequency System is normally scaled to half fathoms, but a recent installation had a scale of 50 fathoms on which 1 foot = 0.1 in., and on this scale, a change of depth of 1 foot could easily be detected. Fig. 1 illustrates this instrument, which is well adapted to use on the bridge, being the 'indicator type' in which a pointer moves over a large dial with a convenient open scale, and remains steady at the depth, only moving as the slight changes of echo time impel the needle.

For navigation the echo sounder was employed originally to delineate the 100 fathom line, and it was accepted by the ships' officers in the early stages for the purpose of getting the check on

position. Recently, the interest taken by the ship-owner has greatly enlarged its usefulness in the direction of lesser depths, with the view of preventing grounding or straining the ship when passing through channels or mouths of rivers where mud and silt have made the depth of the fairway uncertain to a few feet. The demand for shallow depths has become so acute that the reading of 3 feet under the bottom will become an essential of echo sounding.

The Fathometer light-flashing scale gives deep and shallow readings within coarse limits by employing two speeds for the flash as it travels round a circular dial (Fig. 2), but the light-flashing method cannot be read to sufficient accuracy to ensure a ship passing over a bar within an accuracy of one foot.

The best method of reading very shallow depths is by large-scale recording, and a method has been recently introduced in which 1 ft. =  $\frac{1}{8}$  in. This

machine would enable a ship to pass over a bar within 1 foot of the bottom with absolute accuracy. A 2-speed gear would enable the scale to be decreased ten times, thus enabling the gear to be used either for shallow or deep echo sounding.

#### RECORDING GEAR

The most effective type of recording gear up to the present time has been the British Admiralty

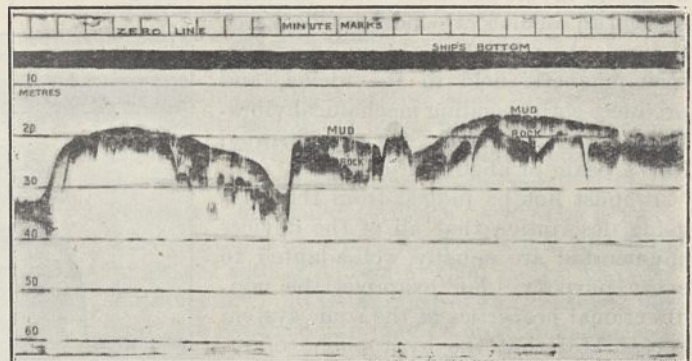


FIG. 6. Record showing mud surface and under surface of rock.

pattern on which the echo depth is marked by a pen moving on a straight path by means of a cam motion. The record paper is fed over a wet wick, and the echo signal marks the paper, which is impregnated with starch-iodine. This method, which can be called straight line recording, has a uniform scale and gives a true picture of the shape or contour of the bottom (Fig. 3): but it must be observed that the records cannot be described as true to scale, because the rate of movement of

the ship is much greater than that of the record paper on the scale of depth. For example, a ship moving at 15 knots will travel 1,500 feet per minute, and even if the record paper were fed at the rate of 3 inches per minute, the maximum width of the paper is only 5 inches for a depth of 100 fathoms or 600 feet.

This compression of distance, however, is not a disadvantage, as it only tends to exaggerate the contour, and a hole or bank will be indicated with a steeper rise or fall, say, in the proportion of 3 or 5 to 1, according to the speed of the ship (Fig. 4).

Fig. 5 is taken from the British Admiralty pattern boat gear, which operates on precisely the same principle as the *Challenger*, but is specially adapted for shallow water. It will be seen from this diagram that a very great degree of accuracy in exceedingly shallow water can be obtained.

ADVANTAGES AND DISADVANTAGES OF CERTAIN TYPES OF DISTORTION

The desirability of avoiding the compression of the scale near the zero due to the large separation entailed by the use of sonic systems has already

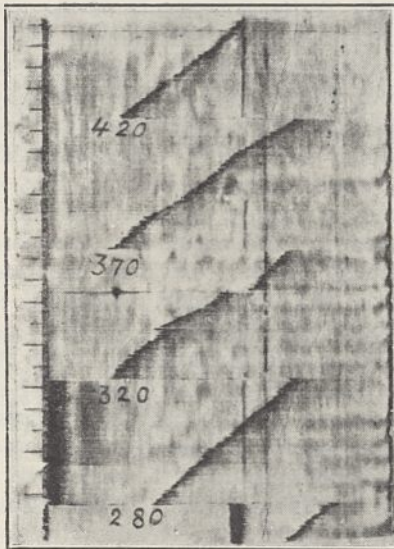


FIG. 7. Example of sounding by phasing.

been mentioned. Another form of distortion is introduced by recorders of the Fathometer type, in which the stylus traverses the paper along the arc of a circle. A line of soundings obtained over a symmetrical bank produces a record on which the bank appears to be inclined toward the centre of curvature of the stylus path. Soundings taken along the same line but in the opposite direction will incline the bank in the opposite direction with

reference to neighbouring features on the chart. The Admiralty chemical recorder, on the other hand, due to the rectilinear path of the stylus produces a symmetrical record of a symmetrical bank, and gives a faithful record of any irregularities in the sea bottom passing along the same line in either direction. Fig. 6 illustrates the accuracy with which this method can detect the nature of the bottom, showing the two echoes that

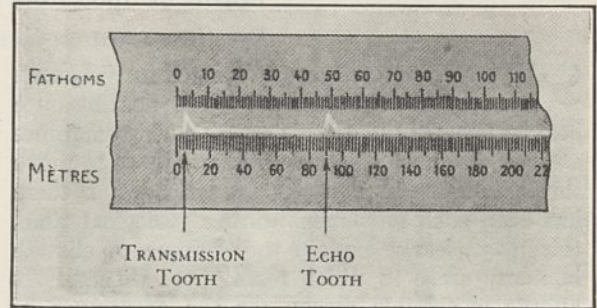


FIG. 8. Scales of light-flash echo-meter.

can be obtained, (1) from the soft initial surface of mud, and (2) from the under surface of rock. By an ingenious method of phasing, it is possible, in this instrument, to retain an open scale and at the same time read up to very considerable depths; for example, in one instrument a scale of 90 fathoms to 5 inches or 18 fathoms per inch can be retained, while by phasing, soundings up to 250 fathoms can be taken. Fig. 7 shows a typical example of this. In studying this chart and applying the figures written on the chart, it will be seen that the sections of slope can be added on to one another to give a true representation of the formation of the bottom. This is not, of course, actually necessary when the 100 fathom phase is applied.

INDICATORS

In the combined recording and indicating bridge instrument supplied by the Submarine Signalling Company, a light travels round a dial in eclipse and flashes out at the moment the echo is received. In the 'Echo-Meter' 'Marconi' (Fig. 8) a curved scale is employed and a flashing light is given a uniform velocity along the scale, and flashes up in a small peak at transmission and again when echo occurs. Thus it is possible, as these flashes take place with great frequency, to read roughly the echo distance or depth on the scale. From the point of view of the bridge officer, the use of light for 'indicating' is open to certain objections; in the first place, on a bright day it is difficult to see, and conversely at night it is not advisable for eyes that have to look out into the darkness also to have to watch a small flashing light on the bridge. In this respect the Admiralty pattern

indicator (Fig. 1) seems to have distinct advantages, where a simple pointer on a dial is employed, which is dimly illuminated at night.

Echo sounding, as an item of standard equipment, has now definitely come into being, and there is little doubt that with increased experience ships' officers will become more familiar with the

technique of using this instrument. As a result, an immensely increased and much more accurate knowledge of the conformation of the bottom of the sea, particularly on regular routes, will be developed; and navigators will find more and more that they can determine their position accurately by this means.

### Fossils as Indicators of Continental Drift\*

By SIR ARTHUR SMITH WOODWARD, F.R.S.

STUDENTS of fossils are interested in Wegener's theory that the continents are floating on a heavier layer of the earth's crust which, sometimes at least, becomes plastic and allows them to move through different longitudes and latitudes. If there has been such movement during geological time, this may clearly explain the changes of climate in many areas to which fossils bear witness. It affords a possible reason for the occurrence of plants and animals of temperate or even sub-tropical habit among the fossils found in the present arctic and antarctic regions. It also perhaps shows why the land and fresh-water life of the coal period throughout the northern hemisphere was so remarkably uniform.

The use of fossils, however, in testing Wegener's theory and in determining former land connexions is not so simple as it might at first appear. For example, some who have noted the remarkable similarity between the graptolites in the earlier Palaeozoic rocks on the two sides of the Atlantic have concluded that western Europe and eastern North America must have been close together when these graptolites lived in a continuous shallow sea. Others, who have studied also the associated life, have decided that the two areas in question were already separated in Cambrian to Silurian times by a great Atlantic Ocean in which sargasso seas sent forth both to the east and to the west the same floating organisms. There are thus two equally plausible interpretations of the facts, one in favour of Wegener's idea that during the Palaeozoic era the continental lands were continuous, while the other points to the immense antiquity and the permanence of at least one ocean basin.

Again, the extensive and nearly uniform distribution of many of the Devonian fishes, which must have lived chiefly in fresh-water lakes and rivers, seems remarkable if the continental areas in the Devonian period were as widely separated as they are at present. It must, however, be remembered that there were already other fishes in the contemporary seas, and certain sporadic

fossils suggest that the normally fresh-water forms could also live in the sea, like the existing sturgeons. In this case, they could spread along the coasts and attain their strangely wide distribution even if the lands were arranged approximately as they are at the present day.

There is also the great difficulty, that many fossils which look superficially alike and might be regarded as nearly identical, are really parallel developments from common ancestors. This has been recognised for many years by those who have studied molluscan and brachiopod shells, and it is now becoming familiar to those who investigate other groups. The principle is perhaps most easily understood by reference to discoveries of fossil mammals in North America.

The early Tertiary ancestors of the camels in North America were small animals shaped like gazelles with pointed hoofs. According to Prof. W. B. Scott, they divided into two distinct groups, one adapted for browsing on shrubs and trees, the other adapted for grazing. Afterwards, the toes in each of these two groups became blunt, and the characteristic cushioned foot of the modern camels was developed. The camel foot therefore arose independently in at least two separate lines derived from the same stock. According to Prof. H. F. Osborn and others, the Tertiary ancestors of the horses and rhinoceroses in North America also show parallel lines of evolution. The gradual approach to the one-toed foot of the horses and to the horned snout of the rhinoceroses occurred in several distinct groups at the same time, though sometimes at different rates. Prof. Osborn has also pointed out, in his recent great work on the Titanotheres, that these massive horned mammals, which flourished during the middle of the Tertiary era, evolved on several distinct lines, and independently acquired horns and other features which were approximately the same.

Remembering these facts, it is interesting to consider some of the fossil animals which have actually been regarded as proving former connexions of some kind between lands which are now well separated.

The skeletons of certain fossil Sparassodonts

\* Extended account of a contribution to the discussion on "Wegener's Hypothesis of Continental Drift" at the meeting of the Geological Society of London on January 23, 1935.

found in the Lower Tertiary deposits in Patagonia are so similar to the skeleton of the marsupial Thylacine now living in Tasmania, that these animals have sometimes been referred to the same family. They have therefore been interpreted as indicating a former direct connexion between South America and the Australian region. In their palate and successional teeth, however, the Sparassodonts are more nearly similar to some of the early Tertiary primitive Carnivores known as Creodonts, which lived in the northern hemisphere and might well be regarded as also the ancestors of the Australian Thylacine. The Sparassodonts and the Thylacine, therefore, may be merely parallel developments from the same northern source, which migrated southwards by two different land-routes to the remote, widely-separated areas where they are now found.

Among the fossils discovered in late superficial deposits in Australia and some adjacent islands, there are species of a peculiar horned tortoise, *Miolania*, which has the tail armoured with rings of bone. A nearly similar tortoise, which has been referred even to the same genus by some authors, occurs in a rock of uncertain age in Chubut, Patagonia. Here again, at first sight, there seems to be evidence of a former direct connexion with the Australian region and South America. *Miolania*, however, belongs to a sub-order of Chelonians which had a very wide distribution over the northern hemisphere before it became specially characteristic of southern lands. The species found in Australia and South America may therefore be merely independent offshoots of the

same source which have retreated south by different routes.

The same explanation almost certainly applies to the little Mesosaurian reptiles which are found in the Permian rocks of South America and South Africa, and have been quoted as part of the evidence that at the end of the Palæozoic era these two lands were directly connected. In the Coal Measures of both North America and Europe, which represent a somewhat earlier geological period, there are ancestors from which the Mesosaurians were possibly derived; and these reptiles may have gone south in parallel ways down the African and American continents. Similarly, the Dicynodont reptiles, which occur in slightly later rocks in both countries, may have wandered southwards independently, for they are known to have been distributed at the time over Europe, Asia and North America. These fossils therefore do not help to prove that South America and South Africa formed a continuous land when the reptiles in question were living; and the recent discovery of numerous large Rhynchosauria in the same rocks in southern Brazil suggests that there was no such land-connexion, because no trace of these reptiles has been found in the well-explored corresponding rocks in South Africa.

It is thus evident that when former changes in land-connexions are being discussed, it is not enough merely to compare lists of fossils. The precise relationships of each fossil need first to be determined so far as possible; and even if this precision can be reached, there are often alternative interpretations which have to be considered.

## Obituary

PROF. H. B. BAKER, C.B.E., F.R.S.

THE recent death of Herbert Brereton Baker removes a familiar name from the roll of chemists who made their reputation before the opening of the present century. He was born on June 25, 1862, as the second son of the Rev. John Baker, curate-in-charge at Livesey, near Blackburn—a district in which the distress arising from the cotton famine was then intense, and the relief of which was a real concern of the Baker family. After a period of schooling at Blackburn, both boys were enabled, by sacrifice and rigid economy on the part of their parents, to become pupils at Manchester Grammar School. Beginning on the classical side, young Baker turned over to science, securing later a scholarship at Balliol, as well as a Brackenbury school scholarship. The teaching of chemistry at the Manchester Grammar School was then in the capable hands of Francis Jones, and Baker was always ready to acknowledge his debt to one whom he termed "the best of all teachers".

Baker's tutor at Oxford was H. B. Dixon, and the enthusiasm for investigation which the senior man possessed in an eminent degree was communicated to his pupil. After taking a first class in natural science, Baker was appointed demonstrator at Balliol and private assistant to Dixon; an association which led him to the main investigations of his life—the effect of moisture on chemical change.

In 1884 Baker was appointed chemistry master at Dulwich College, and on his initiative a science side was developed on the same lines as at Manchester. The chemistry department at Dulwich had already some tradition of research, and equipment for such work had been provided by Baker's predecessor, Alfred Tribe, best known, perhaps, as a collaborator with J. H. Gladstone. The tradition was more than maintained by Baker, and, in spite of heavy teaching duties, he published during this period a great deal of the work with which his name is specially associated. It is indeed a remarkable fact that Baker

was elected a fellow of the Royal Society in 1902, while he was still a schoolmaster.

After a short period as headmaster of Alleyn's School, he returned in 1903 to Oxford, succeeding Vernon Harcourt as Dr. Lee's reader at Christ Church. To a man of Baker's temperament the opportunities offered by such a post were naturally more attractive than the administration of a large school; and he took a prominent part in the long overdue reorganisation of the teaching of chemistry at Oxford.

In 1912, the year in which the Chemical Society awarded him the Longstaff Medal, Baker was appointed to the directorship of the Chemistry Department of the Imperial College of Science and Technology in succession to Sir Edward Thorpe, and this post he occupied until his retirement in 1932. It was not long before the placid course of academic teaching and research was rudely disturbed by the outbreak of war, and Baker was one of the first chemists called on in 1915 to deal with the serious problems of gas warfare; in this field he rendered distinguished service, taking a prominent part in devising measures of protection against poison gas, especially phosgene. His work was recognised by the award of the C.B.E.

The War over, Baker returned to the administration of a department overflowing with students, and to the research work in which his interests mainly lay. His position as one of the leaders of British chemistry was afterwards recognised by the award of the Davy Medal of the Royal Society in 1923, and by his election as president of the Chemical Society for the period 1926-28. Apart from his special scientific interests, Baker took a share in the activities of the University of London, and served for a number of years on the Senate and its committees.

Baker had married in 1905 Muriel, only daughter of H. J. Powell, partner in the Whitefriars Glass Works, herself a chemist and a collaborator with her husband in various researches. Mrs. Baker and a daughter survive him.

The starting point of Baker's life-work was Dixon's observation that a spark could be passed through a mixture of dry carbon monoxide and oxygen without any explosion occurring. A natural development was the study of the effect of thorough drying in other cases of combustion, and Baker was able to show that the combination of various solid elements with oxygen at a high temperature is enormously retarded, or even prevented altogether, provided stringent measures are taken to dry the apparatus and the materials. The successful distillation of phosphorus in dried oxygen was a striking case in point.

Following up these early observations, Baker studied the behaviour of thoroughly dried substances which ordinarily react—in some cases violently—with one another. Among the remarkable results of his drying technique was the proved absence of reaction in the following cases: (a) sulphur trioxide and lime, (b) hydrogen and chlorine, (c) ammonia and hydrogen chloride. It was further shown that the thermal dissociation normally characteristic of ammonium chloride and mercurous chloride does not occur when the substances are thoroughly dried.

Subject to the same conditions, a mixture of electrolytic hydrogen and oxygen can be heated to a high temperature without explosion or even partial combination.

Many workers have attempted in vain to repeat these classical experiments. Baker showed, for example, that ammonia gas, previously dried by pure quicklime, could be finally desiccated over carefully purified phosphorus pentoxide without any appreciable absorption of the gas by the pentoxide. This has been frequently challenged, but it is now clear that he was entirely in the right, and that few have succeeded in reproducing his technique.

The earlier work on ammonium chloride and mercurous chloride led Baker, in collaboration with his wife, to examine the case of nitrogen trioxide. As hitherto prepared, this substance invariably dissociated on evaporation, but it was now shown that the thoroughly dried liquid could be vaporised without decomposition. The incidental observation that nitrogen trioxide had an abnormally high boiling point initiated an investigation into the influence of intensive drying on the physical properties of liquids generally, and in various papers and addresses to the Chemical Society between 1922 and 1929, Baker described determinations made of the boiling point, surface tension, vapour density, etc., of intensively dried liquids: many of these substances had been desiccated with phosphorus pentoxide over the War period. Intensively dried benzene, for example, was found to boil 20°-30° above the normal boiling point.

These remarkable observations have attracted much interest and not a little criticism. That the behaviour of substances dried by Baker's technique undergoes alteration seems fairly certain, but no quantitative assessment of this change (as distinct, say, from super-heating effects in the case of the boiling point) is yet available and no completely satisfactory interpretation of the phenomenon has yet been advanced.

Another field of research in which Baker was active was the determination of atomic weights. Tellurium, mercury and silver were cases in which collaborators under his direction applied the accurate manipulative methods of which he was a master.

Baker was first and foremost an experimentalist, and his skill in glass-blowing and other practical arts was plain to all who saw him at work. Chemical craftsmanship was his chief joy, and up to within a few weeks of his death, in spite of physical disabilities, he was to be found in his laboratory, devising and constructing apparatus for a fresh attack on old problems. Brereton Baker was a modest man of simple tastes and homely interests whose character and personality secured for him a warm place in the hearts of very many pupils and co-workers.

J. C. P.

We regret to announce the death on May 14, at the age of sixty-eight years, of Prof. Edwin B. Frost, associate of the Royal Astronomical Society, and emeritus director of Yerkes Observatory.

# Supplement to NATURE

No. 3422

JUNE 1, 1935

## 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. 918.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

### The Slowing Down of Neutrons by Protons

FERMI and his co-workers have pointed out that if a neutron source is surrounded by a material rich in hydrogen the neutrons lose energy to the protons on collision, and, after about twenty impacts, their energies are reduced to the order of those due to thermal agitation. They tried to discover whether temperature affects the density of such a neutron 'gas' by measuring the activation produced in rhodium by a neutron source surrounded by hydrogenous substances at room temperature and at 200° C. No difference in activation was detected<sup>1</sup>.

We have performed a somewhat similar experiment by measuring the activity produced in a silver cylinder surrounding a neutron source when both were surrounded (1) by air, (2) by water at room temperature, (3) by liquid hydrogen (-253° C.). The silver was activated to its equilibrium value, and its radioactivity was measured by an ionisation chamber and electrometer. The activities in arbitrary units on removal of the silver from the neutron source were found to be:—

Arrangement	Maximum activity	Increase in activity divided by the activity produced when in air
In air	29	—
Surrounded by 1500 c.c. water in a Dewar flask	93	2.2
Surrounded by liquid hydrogen in the same Dewar flask	58	1.1

Because the silver tube separated the neutron source from the liquids, neutrons would pass through it in a manner exactly the same as when the liquids were not present. It is therefore reasonable to measure the effect of the liquids by the *increase* in activity which they produced rather than by the total activity.

The hydrogen in water has a density of 0.11 gm./c.c. while that of liquid hydrogen is 0.07 gm./c.c., that is, in a ratio 1.6 : 1 compared with a ratio of increase of activity of 2.2 : 1. The conditions were not quite so favourable for the production of radioactivity in the case of the liquid hydrogen since it was not possible to make up the loss due to evaporation, so that during the last few minutes—those most important for the activation of the

silver—the volume present was less than that of the water. It would, therefore, seem probable that the measure in activation of the silver was in proportion to the density of protons which surrounded the silver and the neutron source and that it was not affected by the change in temperature.

Our thanks are due to the Union Minière du Haut Katanga for the loan of the neutron tube and to the staff of the McLennan Laboratory for help with the experiments.

J. C. McLENNAN.  
E. F. BURTON.  
A. PITT.

Radium Beam Therapy Research,  
London, and  
McLennan Laboratory,  
University of Toronto.  
May 18.

<sup>1</sup> *La Ricerca Scientifica*, 2, No. 11-12, Dec. 1934.

### Collisions between Neutrons and Diplons

WHEN a stream of neutrons passes through a sheet of matter, neutrons are lost from the beam both by absorption and scattering. The latter can be avoided by placing the source of neutrons in the centre of a spherical scatterer, since with this arrangement as many neutrons must be scattered into the beam as are lost from it by scattering. In these circumstances any diminution of the number of neutrons in the beam must be attributed to absorption by the material of the sphere. The usual method of estimating the intensity of a neutron beam is to measure the induced radioactivity produced in a thin layer of matter such as aluminium or rhodium by means of a tube counter. The radioactivity so produced is proportional to the length of the neutron path in the detecting substance and will be given by  $k.n.d.\sec\theta_m$  ( $k$ , number of radioactive atoms produced per cm. path;  $n$ , number of neutrons in the beam;  $d$ , thickness of the sheet; and  $\theta_m$ , the mean angle of incidence).

For this reason absorption measurements using a spherical absorber do not necessarily give the true

absorption, since the effect of scattering will be to increase the value of  $\theta_m$  and thus increase the radioactivity produced. If each neutron is scattered several times, this secondary effect may cause an apparent increase in the strength of the beam by a factor as great as 2.

This secondary effect can be eliminated by using a sphere of detecting material instead of a sheet, and we have used this method to investigate the passage of fast neutrons through heavy water.

The beryllium-radon source was placed at the centre of a spherical flask containing the heavy water\* (98.4 per cent); the whole was surrounded by a nickel cylinder which had the small spherical detectors stuck on its inner surface. After activation, the cylinder was slipped over a cylindrical aluminium counter for measurement. The following results were obtained.

Absorber	Detector	Absorption (per cent)	Effective cross-section
D <sub>2</sub> O	Al ( <sup>27</sup> Mg <sup>13</sup> )	11	$7.0 \times 10^{-25}$
D <sub>2</sub> O	Si ( <sup>28</sup> Al <sup>13</sup> )	15	$9.7 \times 10^{-25}$
D <sub>2</sub> O	P ( <sup>31</sup> Si <sup>14</sup> )	12	$7.7 \times 10^{-25}$
H <sub>2</sub> O	Al ( <sup>27</sup> Mg <sup>13</sup> )	13	$8.4 \times 10^{-25}$
H <sub>2</sub> O	Si ( <sup>28</sup> Al <sup>13</sup> )	13	$8.4 \times 10^{-25}$
H <sub>2</sub> O	P ( <sup>31</sup> Si <sup>14</sup> )	11	$7.0 \times 10^{-25}$

The reduction in the activity of the detectors excited by the neutron beam can be accounted for in two ways: either neutrons are removed by true absorption or, after being slowed up by a collision, the neutrons are less effective in exciting artificial radioactivity.

If true absorption were a significant factor in our experiments, one would expect a marked difference between the absorption in heavy and light water; since this is not found it seems probable that the observed reduction is due to the differential slowing up of the neutrons.

Owing to the smaller mass, the velocity of neutrons is reduced by a greater amount on collision with a proton than on collision with a dipion. The simplest interpretation of our results is that the velocity excitation curve for silicon, aluminium and phosphorus rises steeply as the velocity is increased, and then remains fairly independent of velocity within the range of velocities used.

That the neutrons actually do suffer a greater decrease in velocity on colliding with protons is confirmed by independent experiments on the excitation of silver (Fermi effect). As Fermi showed, silver is much more strongly excited by neutrons which have been slowed up by collision with protons than by the same neutrons before they have been scattered. We found in agreement with the experiments of Herszfinkiel, Rotblat and Zyw<sup>1</sup> that although the activity induced in silver is increased by passing the neutrons through heavy water, the increase is only about one third of that produced by the same amount of ordinary water.

Thus the results of our experiments can be accounted for in an elementary way as being due to the large difference in mass between the dipion and the proton.

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May 17.

### Evidence on the Velocities of 'Slow' Neutrons

WE have searched in a number of ways for experimental evidence of the existence of neutrons of thermal energies, using a radon-beryllium source of fast neutrons and allowing them to diffuse through materials rich in hydrogen<sup>1</sup>. Until very recently we could find no such evidence, but repetition of one of our early trials, under much improved conditions, has strongly suggested the presence of such very slow neutrons.

Specimens of silver, rhodium and iodine (the last in an envelope of thin glass) were placed in turn within a long hollow paraffin wax cylinder the inner and outer radii of which were respectively 2.1 cm. and 3.7 cm. The cylinder fitted closely into a Dewar vessel which itself was surrounded by wax to a thickness of about 7 cm. The source was placed in a cavity in the outer wax. We observed the  $\beta$ -ray activity induced in each specimen with the whole apparatus at room temperature; the inner wax cylinder and the specimen were then cooled to the temperature of liquid oxygen (90° K.) and the observations repeated. The thermal capacity of the wax sufficed to prevent serious rise of temperature during irradiation. The specimens were allowed to regain room temperature before being presented to the counter.

The ratios of the activity induced with the wax cold to that with the wax at room temperature were found to be as follows:  $1.26 \pm 0.04$  for silver (25 sec. period);  $1.29 \pm 0.04$  for silver (150 sec.);  $1.23 \pm 0.07$  for rhodium (44 sec.); but  $0.84 \pm 0.06$  for iodine (25 min.). The change in the linear dimensions of the cylinder did not exceed 1 per cent. We conclude that an appreciable proportion of the neutrons concerned had energies comparable with those of thermal agitation, and were able to attain some measure of thermal equilibrium with the medium through which they were passing.

Fermi and his collaborators<sup>2</sup>, using a rhodium detector in a medium of liquid hydrocarbons, have found no variation of the activity induced at 200° C. from that at room temperature. We tried with a silver detector in an oil bath up to 250° C., and found a decrease of about 20 per cent. The increase of volume of the oil due to the rise of temperature was, however, of similar order of magnitude; our result was thus inconclusive.

The difference between the behaviour of iodine and that of silver and rhodium would seem to indicate that iodine absorbs preferentially neutrons of velocities different from, and probably higher than, those which are most effective in the other cases. In this connexion we may mention that we find the absorption of 'slow' neutrons by a block of iodine to be greater for an iodine detector than for detectors either of silver or of rhodium.

The radon was generously given to us by the Radium Committee of the Medical Research Council, through Prof. S. Russ.

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J. R. TILLMAN.

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April 12.

\* The 100 gm. of heavy water used was kindly lent to us for these experiments by the Imperial Chemical Industries, Limited.

<sup>1</sup> NATURE, 135, 654, April 27, 1935.

<sup>2</sup> Fermi and others, *Ricerca Scientifica*, October 1934.

<sup>3</sup> *ibid.*, December 1934.



## The Fermi Proton Effect in Silver

IN the course of investigating the radioactivity induced by the neutron produced by the bombardment of diplogen with diplogens, we observed that the yield of radio-element produced in silver increases by a factor of about ten when the sample of silver was surrounded by a layer of paraffin 3.5 cm. in thickness during the exposure, showing the Fermi proton effect. The decay curve obtained with the Geiger counter is shown in Fig. 1, which suggests the fact that it cannot be expressed by a single exponential curve. The apparent value of half-period is about 30 sec. at the beginning, becoming approximately 2 minutes at 4 minutes after the bombardment ceased.

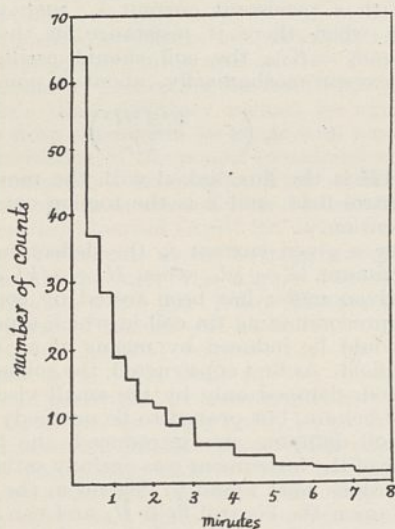


FIG. 1.

J. Bjerger and C. H. Westcott have reported that the ratio of the yield of radio-element produced in silver by beryllium-radon neutrons to that by the diplogen-diplon neutron is about 100 to 15. It is generally accepted that the mean energy of the neutron is greater in the former case. We have therefore two alternatives. In the first case we consider the beryllium-radon neutron to contain an appreciable amount of components softer than that of the diplogen-diplon neutron and these softer components were effective in the experiment of Bjerger and Westcott. In the second case, the yield of radio-element produced in silver is not a monotonic function of the energy of the neutron, decreasing with decreasing energy from the region of energy of the beryllium-radon neutron to that of the diplogen-diplon neutron, but below this value of energy it increases with decreasing energy. In this argument it is assumed that the Fermi proton effect is due to the decrease of energy of the neutron by its collision with protons.

SEISHI KIKUCHI.  
SHIGEO NAKAGAWA.  
HIROO AOKI.

The Physical Institute,  
Imperial University,  
Osaka.  
March 10.

## Radioactivity of Potassium

KLEMPERER<sup>1</sup> has recently shown that postulation of the existence of a radioactive isotope,  $^{40}_{19}\text{K}$ , with a large nuclear spin, affords the most likely explanation of the radioactivity of potassium. He appears, however, to have over-estimated the value of the nuclear spin ( $i = 4$  or 5 units) necessary to obtain a sufficiently high half-value period for the isotope. Klemperer made use of a statement due to Gamow<sup>2</sup>, which was based on theoretical reasoning. The latter author reached the conclusion that, if two radioactive elements possess the same upper velocity limit in their  $\beta$ -ray spectra, and if one of them suffers unit change in nuclear spin during decay while the other preserves its spin unchanged, then the ratio of their half-value periods is about 100.

However, if the value of 700 electron-kilovolts for the upper velocity limit of the  $\beta$ -particles emitted by potassium is inserted in the Sargent equations between decay-constant and energy (as given by Klemperer), 250 days is obtained for the half-value period on the assumption that  $\Delta i = 1$ , and 36 minutes on the assumption that  $\Delta i = 0$  in the decay. These periods stand in the ratio of  $10^4$ , and not  $10^2$ . From the actual curves of Sargent<sup>3</sup>, a value of about  $10^{2.3}$  is derived for the same ratio. These figures are considerably higher than that quoted by Gamow, and are probably more acceptable in view of the facts that the theory is only an approximate one and that Gamow states that the ratio may be considerably in excess of 100.

On the supposition that the half-value period is increased by a factor lying between  $(2,000)^{\Delta i}$  and  $(10,000)^{\Delta i}$  when the spin changes by  $\Delta i$  during the radioactive transformation, it is necessary to assign a spin of only 2 to 3 units to the nucleus of the hypothetical isotope in order to increase its half-value period to a reasonable figure.

In conclusion, it may be pointed out that Klemperer's views are supported by the fact that the isotope,  $^{42}_{19}\text{K}$ , the existence of which has been definitely established by Hevesy and Høffer-Jensen<sup>4</sup>, is also a misfit as regards the Sargent relations. Here again, the existence of quite a small nuclear spin of this isotope would clear up the contradiction between  $\beta$ -velocity and life-time.

C. HURST.

Jesus College,  
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April 26.

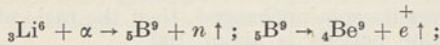
<sup>1</sup> *Proc. Roy. Soc.*, **148**, 633; 1935.  
<sup>2</sup> *Phys. Z.*, **35**, 540; 1934.  
<sup>3</sup> *Proc. Roy. Soc.*, **139**, 659; 1932.  
<sup>4</sup> *NATURE*, **135**, 96, Jan. 19, 1935.

Induced  $\beta$ -Radioactivity by  $\alpha$ -Particle Bombardment

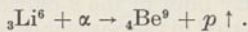
LORD RUTHERFORD'S classical experiments showed that the emission of protons from the nuclei of the light elements, when these were bombarded with  $\alpha$ -particles, was a fairly general phenomenon. No protons, however, were observed from helium, lithium, beryllium, carbon or oxygen. These results are significant, and suggest that  $^4_2\text{He}$ ,  $^{12}_6\text{C}$  and  $^{16}_8\text{O}$  are very stable structures, probably consisting of close combinations of  $\alpha$ -particles. The great stability of these isotopes is confirmed by Aston's work and by their behaviour under bombardment by high-speed ions. But both lithium and beryllium are

disruptible by  $\alpha$ -particles with the emission of neutrons, and while the structure  $2\alpha+n$  for  ${}^4\text{Be}^9$  will explain why no protons are emitted from this isotope under  $\alpha$ -particle bombardment, it is difficult to see why no proton emission has been observed from lithium when bombarded with  $\alpha$ -particles.

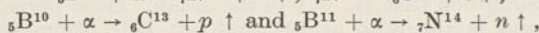
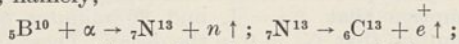
In addition, it has been found that all elements which emit protons under  $\alpha$ -particle bombardment also emit neutrons, and, moreover, that many nuclei emit both protons and neutrons. It is significant that neutron emission followed by positron radioactivity has been observed by Miss Meitner<sup>1</sup> when lithium is bombarded by  $\alpha$ -particles, and this suggests that proton emission from this element should also be observed. The reaction detected by Miss Meitner is:—



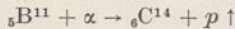
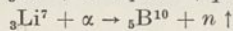
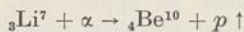
and we should therefore expect to observe



In addition, the neutron and proton emission from boron, namely,

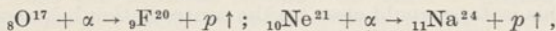


as well as the emission of both protons and neutrons from  ${}^7\text{N}^{14}$  and  ${}^9\text{F}^{19}$ ,  ${}_{11}\text{Na}^{23}$ ,  ${}_{13}\text{Al}^{27}$  and  ${}_{15}\text{P}^{31}$  suggest, therefore, that the following reactions from the structurally similar nuclei  ${}^3\text{Li}^7$  and  ${}^5\text{B}^{11}$  should be possible:



It is significant that  ${}^4\text{Be}^{10}$  and  ${}^6\text{C}^{14}$  are  $\beta$ -radioactive, so that these actions indicate that the delayed emission of 'negative' electrons should be observed from lithium and boron when these elements are bombarded by  $\alpha$ -particles of suitable energy. The detection of such  $\beta$ -radioactivity with lithium would be evidence in favour of proton emission from this element.

In a similar way, the production of  $\beta$ -radioactive isotopes by proton emission from isotopes such as  ${}^8\text{O}^{17}$ ,  ${}_{10}\text{Ne}^{21}$ , etc., for example,



is possible. The abundance of these isotopes is, however, too small for such reactions to be detected experimentally. As, however,  ${}^3\text{Li}^7$  and  ${}^5\text{B}^{11}$  are the more abundant isotopes of lithium and boron, we anticipate that the induced  $\beta$ -radioactivity due to  ${}^4\text{Be}^{10}$  and  ${}^6\text{C}^{14}$  should be experimentally detectable.

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March 15.

<sup>1</sup> Meitner, *Naturwiss.*, **22**, 420; 1934.

### A Completely Supraconducting Galvanometer

SINCE it was thought that interesting experiments might be performed if it were possible to measure quantitatively persistent currents in a supraconducting circuit much smaller than have so far been detected with a magnetometer, there has been constructed in this laboratory a completely supraconducting moving-coil galvanometer. The coil consists of 100 turns of fine lead wire, connected

by leads of lead to the experimental circuit. The coil is suspended in the liquid helium by a rigid wire connected above the cryostat to an ordinary galvanometer suspension and mirror. With this arrangement the suspension remains nearly at room temperature. The coil is completely shielded from moderate external magnetic fields by placing it inside a supraconducting cylinder of sheet lead, and thus is subjected only to the controlling magnetic field from a pair of copper coils within the cylinder.

Mathematical investigation of the characteristics of a resistanceless galvanometer showed that its behaviour would be interesting, apart from its possible applications. Assuming that, when the external circuit is also supraconducting, the whole can be treated as a circuit having zero resistance and self-inductance  $L$ , it was found:

(1) With a persistent current  $i_0$ , such that the deflection when there is resistance in the circuit would be  $d_0 = Ki_0$ , the coil should oscillate, undamped except mechanically, about a point

$$d' = d_0 \left( 1 + \frac{n^2 A^2 H^2}{kL} \right)^{-1}$$

where  $nAH$  is the flux linked with the moving coil in its control field, and  $k$  is the torsion constant of the suspension.

(2) For a given current  $i_0$  the deflection should be a maximum,  $d' = \frac{1}{2}d_0$ , when  $H = \sqrt{kL/nA}$ .

The galvanometer has been tested by connecting it to a supraconducting tin coil in which a persistent current could be induced by means of an external magnetic field. As first constructed, the coil oscillated as expected, damped only by the small viscosity of the liquid helium, but proved to be unsteady. When artificial oil damping was introduced, the practical behaviour of the instrument was entirely satisfactory. The deflections were found to depend in the manner expected upon the control field  $H$ , and can be used to give quantitative measurements of the current. The sensitivity of the present instrument at the optimum field is about  $5 \times 10^{-5}$  ampere per mm.

This confirmation of the predicted behaviour shows definitely that true persistent currents throughout the circuit were induced, agreeing quantitatively with the law of induction, when the field was applied to the tin coil. In view of recent experiments upon the effects of magnetic fields upon supraconductors, it is interesting to note that the same deflection is obtained whether the control field is altered before or after the tin portion of the circuit becomes supraconducting, or before or after the persistent current is induced.

Some of the experiments in which an instrument of this kind may be of use are:

(1) Further investigations of the thermoelectric effect between two supraconductors around their transition points.

(2) An attempt to settle the still doubtful question of the Hall effect in a supraconductor.

(3) Experiments on the distribution of persistent currents.

(4) Studies of persistent currents which may throw some light on the recently discovered anomalous magnetic behaviour of certain supraconducting alloys.

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May 4.

### The Dyestuff Industry

WHILST in general agreement with the admirable article on "The Dyestuffs Industry and its Lessons", in *NATURE* of April 27, I cannot endorse your acceptance of Mr. C. J. T. Cronshaw's argument that "the industry languished because the pioneer spirit and the creative instinct which brought it into being abandoned it too early". I hold that the breakdown was entirely on the side represented by Mr. Cronshaw—the managerial and commercial side. Often in the distant past have I discussed the problem from this point of view with Griess, Caro, Dewar, Witt, Meldola, Martius and others. The commercial community is not likely to recognise this, simply because the scientific spirit is foreign to its nature.

Mr. Cronshaw attributes our downfall to the too early retirement of Perkin and others. I fear he has not the necessary feeling for the conditions prevailing in Perkin's time. History cannot be written at a distance from the events by those who have had no direct knowledge of the period considered and of the men concerned. I have more than once discussed the situation, most recently in an article in the *Pharmaceutical Journal* (April 29, 1931).

Perkin's retirement meant nothing, except that he was beaten in the race. His original discovery of the dyestuff Mauve was a pure fluke. His great and real discovery was of himself—of his inborn, outstanding ability as a chemical engineer, to use the now fashionable term. He built up the industry from nothing—in particular, he transferred chemistry from glass to iron. On the other hand, he proved himself to be without imaginative power—the additions he made to the colour palette were negligible. His second advance with alizarin was inspired from Germany and was again due to his constructive ability. He worked too much in secret and failed until too late to foresee the need of a fully organised system of prospecting the field. In fact, he was himself too narrowly trained. He worked all but alone. The real advance in the industry came through E. C. Nicholson and Hofmann: through their expansion of the Rosaniline industry. In fact, the initial establishment of the dyestuff industry in England was the work of the triumvirate, Perkin, Nicholson and Hofmann. Perkin only led off. Long before Perkin retired, the fate of the industry was sealed, already in 1865, when Hofmann returned to Germany, outwearied by his attempts to create a school here. I began to study chemistry under him just before he left. Great as was the work he did, sound and broad as were the foundations he laid in aniline, our commercial outlook was too narrow and unintelligent for us to utilise his services. Our men of means and our manufacturers did not send their sons to him. His work was largely done with German assistants.

When Hofmann left the country and Nicholson retired, Perkin was left pivotless; the example they had set him was withdrawn. He made his wonderful spurt, on his second horse Alizarin, without any support from a field; soon he was left scurrying alone across the course. Nicholson had retired because his partners would not move with the times. When the firm acquired Perkin's business, it was only to prove itself unable to carry the burden. On Playfair's advice, both Griess and Dewar were approached but offered pettifogging terms. The

firm took Meldola and later on Green but did not know how to use either with effect.

Our downfall was just lack of business wit: it was due to our complete failure to place ourselves upon a scientific footing. Williams, Thomas and Dower missed our third opportunity—that which Otto N. Witt gave them, of leading in the azodyestuff industry—long before Duisberg's advent. Griess and Witt, properly used together, could have established the industry here well in advance of the Germans.

We are not out of the wood to-day. Our industry is insufficiently organised on the technical side: far too narrowly commercial in its outlook. The Germans have succeeded, not through one-man management but through the close association of technical and commercial interests. The main result of our so-called rationalisation has been to eliminate technical ability and understanding to a more than dangerous extent. We are to-day, I believe, in most serious danger of again being beaten by German scientific organisation. We cannot think in high places: the commercial mind still prevails and will not brook true technical leadership. Something more than the mere association of a few academic professors with the industry is needed. In fact, the signs are only too clear that we are no longer making the progress we should: if indeed we are 'holding water'.

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### Mutation Rates in Man

THERE is at present no information concerning mutation rates in vertebrates. But where a gene produces a very great unfitness from the Darwinian point of view, that is to say, greatly diminishes the mean number of offspring produced by its bearers, then it will tend to disappear if its numbers are not kept up by mutation. The rate of disappearance is extremely slow for an autosomal recessive, very rapid for a dominant or a sex-linked recessive.

Epiloia, or tuberosa sclerosis, is a condition in which tumours of the skin, brain and sometimes of the heart and kidney, are liable to be associated with epilepsy and mental deficiency. The mortality rate is high in severe cases, and probably most affected individuals have no children. Pedigrees of the condition show that it is an autosomal dominant. In each generation, however, a proportion of cases, which we estimate at about 25 per cent, are sporadic and are presumably due to mutation. The frequency of epiloia in south-eastern England appears to be of the order of 1 in 30,000. This implies a mutation rate of about 1 in 120,000 per generation.

Hæmophilia is a sex-linked recessive condition. It is so fatal that the marriage rate of hæmophilics is about a quarter of the normal, and their actual fertility doubtless still lower. In other words, three quarters or more of the hæmophilic genes in males are wiped out in each generation, and must be replaced by mutation if the population is in equilibrium. A simple calculation shows that, if there were no mutation, the incidence of the disease would be decreasing at such a rate that 1,000 years ago the whole population of England would have been

hæmophilic. Several human pedigrees show that hæmophilia may arise by mutation. The frequency of hæmophilia in London males certainly exceeds 1 in 100,000 at birth and may well exceed 1 in 30,000. A rough estimate of the mutation rate is 1 in 50,000 to 100,000 per X-chromosome per generation.

Several other sub-lethal dominant conditions, such as neurofibromatosis, seem to have frequencies, and therefore mutation rates, of the same order. The highest mutation rate known for any locus in *Drosophila* is about 1 in 300,000 for the white locus. Thus if we take the generation, and not, of course, the year, as unit, man seems to be somewhat more mutable than *Drosophila*. A full account of our investigations will be published elsewhere.

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Colchester.

J. B. S. HALDANE.

University College,  
London.

### A New Virus Disease of Tomatoes

IN 1931 the first appearance in Europe of the tomato virus disease known as 'spotted wilt' was recorded by this virus station<sup>1</sup>. Since that date, the disease has spread through the length and breadth of Great Britain, and its ability to attack ornamental plants of all kinds has made the virus one of the major problems of the horticulturist.

In view of these facts, it may be worth while recording the recent appearance of an apparently new and equally serious virus disease of tomatoes. The virus in question was isolated from some diseased tomato plants sent in for examination, and the symptoms it produced on the various experimental plants differed from any with which I am familiar. On tomato the symptoms are briefly as follows. The first signs of infection, developed on the fifth day following inoculation, were pronounced yellowing of

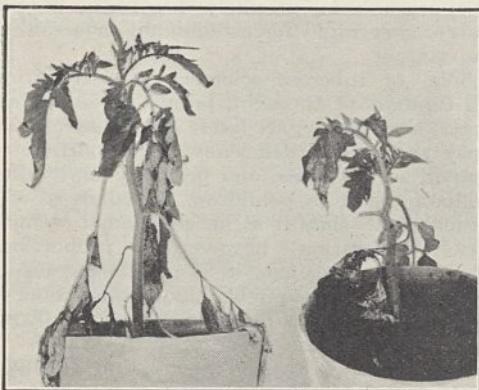


FIG. 1. A new virus disease of tomatoes; the lesion in the stem at soil level (right hand plant) is characteristic.

the inoculated leaves together with the appearance of yellow or purple rings or circular necrotic spots. Later, the youngest leaves showed a tendency to twist round and become pale yellow in colour. The next development was the appearance of a gross lesion on the stem, at and just below soil level; this was followed by a general wilting and collapse of the plant (Fig. 1). The stem lesion appeared to be more characteristic of infection of younger plants.

The virus causing this disease has been differentiated from all the known viruses affecting tomatoes in the British Isles by ultra-filtration and immunity studies, by its physical properties and particularly by its symptom expressions on differential hosts. The unusual reaction of the virus upon cowpea, *Vigna sinensis* (Fig. 2), is alone sufficient to differentiate it from the viruses of the tomato streak group.

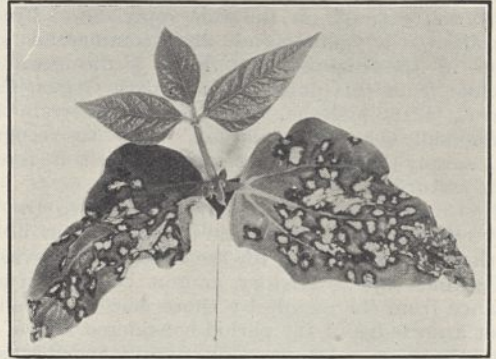


FIG. 2. The tomato virus upon cowpea; the virus is usually confined to the inoculated leaves.

I wish to express my indebtedness to Mr. Lawrence Ogilvie, of the Long Ashton Research Station, Bristol, who sent me the affected plants.

KENNETH M. SMITH.

Potato Virus Research Station,  
School of Agriculture,  
Cambridge.  
May 8.

<sup>1</sup> NATURE, 127, 852; 1931.

### Pleistocene Coastal Deposits in Palestine

ANYONE who has travelled by train along the coast of Palestine from Haifa to Ludd cannot have failed to notice, soon after rounding the northern point of Carmel, a low ridge of sandstone running roughly parallel with the railway line and the sea. It begins 5 km. to the south of Cape Carmel, and continues for approximately 32 km.

The Crusader's Castle at Athlit was built with stone taken from this ridge, and more recently, in 1930, two big quarries were opened in it to the north of Athlit Station to supply the stone for the great breakwater of Haifa harbour.

The rock of which the coastal ridge is formed has generally been regarded by geologists as a marine formation of Pliocene age, and had not attracted the attention of prehistorians. In the course of a short visit to Athlit in April of this year we decided to devote some time to this problem, and two days were spent in a close examination of the area. In the quarry sections, which have an average height of about 13 m. and are more than half a kilometre in length, the following observations were made:

(1) The ridge is mainly composed of wind-blown sand showing typical æolian current bedding, and containing comminuted shells.

(2) A conspicuous layer of red earth varying in thickness from a few centimetres to 1 m. divides the sandstone into two approximately equal series.

(3) In this layer a considerable number of flint implements were found at various points.

(4) Land shells occur in both the upper and lower sandstones and in the red earth.

It was at once evident that the flints were not of any considerable age—certainly not Pliocene. The most interesting specimens found *in situ* were a side-scraper of Mousterian type and two small Levallois cores. The remainder were mere chips and small flakes. Among those found adhering to fallen blocks, or on the quarry floor, were three good Levallois flakes, a rough circular scraper, and a Levallois core; the remainder were small flakes and chips. So far as can be judged from the material at our disposal, the industry closely resembles the Upper Mousterian found in the caves of the Wady Mughara (Mugharet-El-Wad, Layer G; Et-Tabūn, Layer B).

It seems safe to conclude that the bulk of the ridge is relatively late Pleistocene in age, and that it is essentially eolian in origin.

These discoveries raise more than local problems in Palestinian geology and prehistory, and we propose early next year to make a detailed investigation, not only of this ridge, but also of the coastal deposits southwards.

Cambridge.

D. A. E. GARROD.  
E. W. GARDNER.

### Dielectric Polarisation of Phenol

It is well known that the molecular polarisation of alcohols in a non-polar medium is exceptional in that it at first increases with concentration and then falls finally to a lower value than that at which it started. The data of Williams and Allgeier<sup>1</sup> show that at 25° up to a molar fraction of 0.345 the polarisation of phenol in benzene is constant, whilst those of Donle and Gehrckens<sup>2</sup> show a decrease in polarisation at 22° up to a concentration of 0.05 molar fraction phenol and those of Phillip and Haynes<sup>3</sup> an increase at 20° in dilute solutions. I have measured the polarisation of phenol in benzene at 70° with the following results:

$c_2$	$\epsilon$	$d$	$P_2$
0.10737	2.540	0.84750	73.43
0.13404	2.639	0.85340	73.56
0.20170	2.934	0.86808	75.35
0.20330	2.943	0.86804	75.55
0.32460	3.567	0.89425	76.20
0.40717	4.063	0.91188	75.85
0.45454	4.375	0.92147	75.52
0.59956	5.458	0.95200	73.79
0.72570	6.517	0.97512	69.78
1.00000	9.161	1.0307	66.72

$c_2$  is the molar fraction of phenol,  $\epsilon$  is the dielectric constant,  $d$  is the density, and  $P_2$  is molecular polarisation of phenol. The molecular polarisation of benzene at this temperature is 26.928.

The behaviour of phenol at this temperature appears to be similar to that of the lower alcohols, which would be expected from its hydroxylic nature.

These results give a value of  $\infty P_2$  of 71.0, which, if we take  $P_E + P_A$  to be 31.0<sup>4</sup>, gives 1.5 debyes for the dipole moment, compared with the values 1.55 of Donle and Gehrckens and 1.70 of Williams.

A. R. MARTIN.

Chemistry Department,  
University of Aberdeen.  
March 18.

<sup>1</sup> *J. Amer. Chem. Soc.*, **49**, 2416; 1927.

<sup>2</sup> *Z. Phys. Chem.*, **B**, **18**, 316; 1932.

<sup>3</sup> *J. Chem. Soc.*, **87**, 998; 1905.

<sup>4</sup> Donle and Gehrckens, *loc. cit.*

### Catalysis of Ester Hydrolysis by $D_3O^+$ Ions

It has been observed by Moelwyn-Hughes<sup>1</sup> that the catalytic influence of  $D_3O^+$  ions on the inversion of cane sugar in heavy water is greater than that produced by  $H_3O^+$  ions in ordinary water, and Schwarz<sup>2</sup> observed that the acid hydrolysis of methyl and ethyl acetates takes place about 50 per cent more quickly in heavy than in light water under similar conditions.

The rate of hydrolysis of methyl acetate in sulphuric acid solutions has been determined by means of a viscosity method by which the whole reaction can be followed with less than 1 c.c. of solution, and it is found that the ratios of the catalytic coefficients in heavy and light water (taking the sulphuric acid as completely dissociated in both cases) are  $k_{D_3O^+}/k_{H_3O^+} = 1.86$  at 15° and 1.68 at 25°. These ratios are nearly the same as those found by Moelwyn-Hughes for the inversion of cane sugar.

J. C. HORNEL.

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West Mains Road,  
Edinburgh.  
March 27.

<sup>1</sup> *Z. phys. Chem.*, **B**, **26**, 272; 1934.

<sup>2</sup> *Akad. Anz. Wien*, April 1934.

### Esterification of Phosphate in the Respiratory Breakdown of Sugar in Higher Plants

HARDEN and Young<sup>1</sup> showed that phosphate undergoes an important cycle of changes in the fermentation of sugar by yeast juice, being first converted into a hexosephosphoric ester and finally liberated as inorganic phosphate when all the sugar was fermented. Recently, Meyerhof<sup>2</sup> showed an identical condition in the production of lactic acid from hexose in muscle extracts. The view has therefore been expressed that esterification with phosphoric acid may be a necessary step in the biological degradation of sugar. In the higher plants, however, there has been no direct proof of esterification in respiratory sugar metabolism, though a close parallel between alcoholic fermentation and anaerobic respiration has been assumed from the first and has been confirmed not only by the discovery of identical enzymes in both, but also by the fact that phosphate stimulates plant respiration. Phosphate has also been shown to disappear when added to ground peas<sup>3</sup>; and phosphoric esters have even been isolated from plants<sup>4</sup>.

I have obtained definite results on this phase of sugar breakdown in higher plants by devising a method of preparing cell-free glycolytic aqueous extracts (stable for a few hours) by plasmolysing fermenting peas (*Pisum sativum*). The fresh extract, presumably containing the full zymase-complex in solution, actively ferments glucose, fructose or sucrose with evolution of carbon dioxide, under strictly aseptic conditions. In order to follow esterification and sugar breakdown, 40 c.c. of the fresh extract at pH 6.2, after nitrogen had been bubbled through, was incubated with glucose, in presence of toluene, at 30° C. A suitable quantity of a phosphate buffer was added and samples withdrawn after every 5–15 minutes of mechanical shaking. The value of inorganic phosphate in the trichloroacetic acid filtrate

of the samples, as determined by the Fiske and Subbarow method, was found to fall rapidly and steadily and rise again in 30-60 minutes nearly to, but sometimes above, the original level; while glucose (Folin's blood sugar method) showed a fall at the beginning, then a rise and next a rapid and steady fall from a point where all the esterified phosphate was beginning to be liberated. This result has been repeatedly and consistently obtained with extracts from several varieties of peas, not from ground peas alone. When efforts were made to measure the carbon dioxide output in response to phosphate in a differential manometer, the large amount of colloidal protein present as impurity in the extract interfered by holding large quantities of the gas.

This demonstration of phosphate esterification brings the higher plant (pea) fully in line with yeast and animal muscle in this respect. But it is to be expected that when the new problems confronted in these cell-free extracts are fully investigated, the course of respiratory sugar breakdown in higher plants may have its own individual peculiarities, as in fact further new results I have obtained seem to hint. Detailed results, and the method of preparing the extracts, are to be published shortly elsewhere.

M. SADASHIVA RAO.

Plant Physiological Laboratory,  
Institute of Agricultural Research,  
Benares Hindu University.  
March 18.

<sup>1</sup> *Proc. Chem. Soc.*, 21, 189; 1905; and onwards.

<sup>2</sup> *Biochem. Z.*, 183, 176; 1927.

<sup>3</sup> *Biochem. Z.*, 165, 1; 1925.

<sup>4</sup> *Biochem. Z.*, 219, 364; 1930.

#### Application of Microchemical Tests in Assessing the Quality of Ash Timber

DURING the last few years, attention has been given in this laboratory to the study of the anatomical structure of ash timber in relation to the maximum crushing strength in compression parallel to grain. Consignments of trees from seven localities have been studied, and each site had a distinctive strength specific gravity regression. Variations in the amount of wood substance per unit volume, therefore, do not account completely for variations in strength, and it has been shown that the arrangement of the wood substance in the annual ring also influences the mechanical properties<sup>1</sup>. The fact, however, that specimens of equal specific gravity and closely similar anatomical structure sometimes differ by more than 30 per cent in maximum crushing strength suggests that still other factors are involved and that probably the physical and/or chemical nature of the wood substance is of great importance in determining strength.

Several methods of examination were tried in comparing pairs of specimens of strong and weak types of timber, the individuals of each pair being matched in respect of specific gravity and gross anatomical features, but differing considerably in strength. It was discovered that a phloroglucin-hydrochloric acid solution could be used to distinguish between the members of each pair. In strong specimens, the whole of the fibre-walls stained red, and in the weakest type the middle lamella region stained a faint pink, the secondary walls remaining

unstained. All intermediate types of staining were observed.

So far, the method has been applied with success to timber tested in compression parallel to the grain. It has also indicated excessive weakness in a number of defective hockey sticks, and it is intended in the immediate future to investigate the toughness of ash by the same method.

With regard to the nature of the chemical reactions involved, it is not at present possible to do more than direct attention to the fact that of the so-called standard lignin reagents, phloroglucin-hydrochloric acid is apparently the only one capable of differentiating between strong and abnormally weak types of timber.

S. H. CLARKE.

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Princes Risborough.  
April 10.

<sup>1</sup> Clarke, S. H., *Forestry*, 7, 26; 1933.

#### The Classification of Coals

FROM a chemical point of view may I dissent from much that is said about the Stopes nomenclature for the visible ingredients of bituminous coals in Dr. Lessing's article in *NATURE* of April 27.

In the first place, there seems to me to be nothing particularly new or advantageous in it. Every observant person knows that bituminous coal is usually composed of bright and dull layers; and for a century or more these have been distinguished as the 'bright coal' ('Glanzkohle') and 'dull coal' ('Mattkohle') respectively. It has also been long known that between such layers there is an amorphous powdery substance that blackens the hands, and commonly called 'mineral charcoal', or by miners the 'dant'. I have never been able to see any sufficient reason for substituting such terms (imported from France) as 'vitrain' and 'clarain' for the 'bright coal', 'durain' for the 'dull coal' and 'fusain' for the 'mineral charcoal' or 'dant', unless indeed for consistency 'charbon' be also substituted for 'coal' in naming the main substance. Inasmuch as such substitutions have tended to mystify people, and to make believe that somehow or other coal is better explained thereby, I deprecate the further elaboration of them referred to in Dr. Lessing's article.

Secondly, I think the article misleading in saying that "the subdivision of coal into the four visible Stopes ingredients has been widely accepted in Great Britain and in most European countries" without indicating that, outside the exclusive circle of the 'Coal Research Club', it has been much criticised and by no means generally adopted.

Throughout the systematic researches into the chemical constitution of coals and their maturing which for years past have been carried out in my laboratories here, and which have comprised coals from all parts of the world and representative of all stages in the peat → brown coal → lignite → bituminous coal → anthracite series, the Stopes nomenclature has been of little assistance, and I venture to think it has no chemical significance. Our experience does not support Dr. Lessing's statement that its four isolated components are "different and typical in their chemical composition . . . associated with mineral matter in characteristic amount and composition . . . [and] contain groups of organic

compounds and plant residues in defined ratios". Moreover, although it has been repeatedly suggested that the coking propensities of bituminous coal reside in the 'vitrain', we here disbelieve it.

It seems to me that a scientific classification should not only be applicable to all types of coals but also have a more fundamental basis than any yet proposed.

WILLIAM A. BONE.

Imperial College of Science  
and Technology,  
London, S.W.7.  
April 29.

AN adequate and reasoned reply to Prof. Bone's letter would require more space than, as I am given to understand, NATURE can afford; I must, therefore, let the statements in my article, which I endeavoured to make in a critical and impartial spirit, speak for themselves.

I may, however, be permitted to refer to two points raised in Prof. Bone's letter. A perusal of the literature on the formation and the chemical and petrographic constitution of coal and its commercial preparation and utilisation during the last ten years provides evidence of the wide use of the terms proposed by Stopes and of the acceptance of what they are intended to signify. I tried to make it clear in my article that only qualified acceptance has been accorded to them in some quarters.

Prof. Bone's experience that the isolated coal components are not different and typical in their chemical composition is contrary to the results of hundreds of analyses and carbonising tests published by workers in Great Britain and many other countries. My own work on the behaviour of the coal components during carbonisation, and on the composition and distribution of the mineral matter in coal, furnishes ample proof for the statement made in my article. However, by its very nature the composite character of coal does not permit of ready generalisation, and if Prof. Bone is aware of cases in which typical differences in composition between coal components or their ashes cannot be recognised, he would earn the thanks of other workers interested in the subject for bringing these exceptions to their notice.

R. LESSING.

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Westminster, S.W.1.

### Philosophy and Modern Science

WHEN I read Dr. H. Dingle's book "Science and Human Experience" I found that I agreed with nearly all of it; now I find myself in disagreement with most of his article in the Jubilee issue of NATURE. I realise that he may not be expressing his own views, but be trying to summarise those of others, and that most of those he expresses are prevalent; but I cannot convince myself that they are right. The differences begin with what he calls the fundamental principle of the rejection of unobservables. No distinction is made between sensations and concepts. Dr. Dingle makes general observability part of his criterion; since each sensation is private to one individual, he thereby leaves the whole basis of our experience out of science. The principle cannot be applied to concepts, because in fact they are not observed by anybody. If we are realists we may

say that they are inferred; if we are phenomenalists we may say that they are constructed. If there is any change in scientific thought in this respect, it is that our realists have now a greater disposition to modify their ideas of *what* is real when new data derived from sensation become available.

The scientific validity of a concept in fact depends on quite different criteria; it depends on whether the concept and the postulated laws that it satisfies help to co-ordinate our sensations. If different people find the same concepts useful, that is because to a considerable extent they have similar sensations and similar processes of thought; but what are sensations to one are concepts to another. The rejection of unnecessary concepts is not a fundamental principle at all; it is a practical rule of method, like not putting six pairs of knives and forks on the table for a two-course dinner. Thus I cannot agree that the rejection of absolute position was the great feature of the principle of relativity; the important thing was the statement of the laws satisfied by relative position. Admittedly the method made the detection of the law easier; that is why it was a good method. But the important thing was the application of the principle that a formally simple law has an appreciable *a priori* probability. I have shown in my "Scientific Inference" that this principle is fundamental, and that without it we could never attach a high probability to any quantitative law however often it is verified; but though it is universally used, people seem to have a curious reluctance to admit that they are using it. Let us respect the broom; but there is no need to be ashamed of the electric light.

The confusion between sensations and concepts again vitiates Dr. Dingle's answer to the question 'Do things exist when they are not observed?' Sensations obviously do not; but would Dr. Dingle return the answer 'No' to the question, 'Did Neptune exist before it was observed?' The fact is that when we say we observe a thing we do nothing of the sort; we have certain sensations and we assert the result of a long chain of inference from them, which is not the shorter because we have made inferences of the same type so often that we carry them out rapidly and often forget that they are there. The perturbations of Uranus afforded just the same kind of ground epistemologically for inferring the existence of Neptune that a telescopic observation does.

The 'principle of causality', again, has no scientific status. As has been repeatedly pointed out, nobody has ever succeeded in stating it in such a way that it will help us to say *what* laws are causal. We know of many actual causal laws, and there is reason to believe that many others remain to be discovered; but the notion of a universal principle of causality is by nature incapable of verification and in practice useless. What is used in practice, consciously or not, is the simplicity postulate.

I am mystified by Dr. Dingle's statement that a probability is the ratio of two integers. Given that a point is equally likely to be anywhere within a length  $a$ , what is the probability that it lies within distance  $a/\sqrt{2}$  of one end? Or does he contemplate a field such that all distances between possible positions are integral multiples of some universal length, so that continuous variation is excluded?

HAROLD JEFFREYS.

St. John's College,  
Cambridge.

THE necessity for condensed expression is, I think, responsible for the questions raised by Dr. Jeffreys. I admit (indeed, insist on) the distinction between sensations and concepts, but left it unstated because I thought it was implied in the language used. The principle of rejection of unobservables must refer only to concepts; we cannot speak of observing sensations because a sensation is an observation, not a thing to be observed. I cannot reject a sensation of whiteness which may come to me, but I can reject the concept, ghost. I do not share Dr. Jeffreys's objection to the phrase, "observing a concept" (for example, observing Neptune). It is unambiguous and far more concise than any alternative which his letter suggests.

I agree completely (though I should express it differently) with Dr. Jeffreys's paragraph containing the question, "Did Neptune exist before it was observed?" If that question has a meaning, the answer is the ordinary commonsense one—yes; for Neptune is conceived as an object existing in space and time. This answer, however, contradicts the principle of rejection of unobservables, so we must ultimately (for scientific purposes of course, not for practical life) give up the concept, and then the question becomes meaningless. It is the task of science to discover the significant substitutes. Twenty years ago the question was asked: Does an electron exist during a transition between two Bohr orbits? We do not now answer yes or no, but abandon the concept of a spatio-temporal electron moving from orbit to orbit.

Dr. Jeffreys's probability problem, as he says, involves continuous variation and therefore is irrelevant. Science aims at the correlation of observations which are discrete. Hence, unless we wish to correlate unobservables at the same time, the only kind of probability which is applicable is that involving integers; for example, statistical probabilities such as the familiar ones deduced from experiments on throwing dice.

The difficulties of mutual understanding in these matters are illustrated in an amusing way by the letters of Dr. Jeffreys and Prof. Levy. The former admits that the views I expressed are prevalent but thinks they may not be mine. The latter regards them as not only not prevalent, but also essentially my own private analysis!

HERBERT DINGLE.

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May 8.

### Existence of Three Alum Structures

THE crystals which comprise the alum series have generally been considered to be isomorphous on account of the similarity of their chemical formulae and of their crystal classes. The more direct evidence of X-ray diffraction shows, however, that there are at least three different structures involved. It is proposed to call these the  $\alpha$ ,  $\beta$  and  $\gamma$  structures, in order of their discovery.

The  $\alpha$  structure is that of potassium alum<sup>1</sup>, and of the other common alums which have been examined. The  $\beta$ -structure is that of methyl-ammonium alum<sup>2</sup> and of caesium alum, though the  $\alpha$ -structure can be induced in the former by deposition on rubidium alum. Sodium alum is the sole example so far found of the  $\gamma$ -structure.

The presence of the form {210} on crystals grown from neutral aqueous solution seems to be characteristic of the  $\beta$ -structure. This property provides an easy way of separating caesium and rubidium alums, for crystals grown from a solution of the two can be distinguished by eye.

The non-isomorphism of the alums raises doubts concerning other series of salts. Nevertheless, it is probable that only in the cubic system can such pseudo-isomorphism exist, for the high symmetry is due to that of the component groups, and may be maintained with different arrangement of these groups. In the other crystal systems it is improbable that the axial ratios and inter-axial angles of a number of crystals of similar chemical constitution would be almost equal unless the crystals were truly isomorphous.

An account of the structure of sodium alum and an examination of the relationship between the  $\alpha$ ,  $\beta$  and  $\gamma$  structures will be published elsewhere.

H. LIPSON.

George Holt Physics Laboratory,  
University, Liverpool. March 13.

<sup>1</sup> Lipson and Beevers, *Proc. Roy. Soc., A*, 148, 664; 1935.

<sup>2</sup> Lipson, *Phil. Mag.* (in the press).

### Conductivity of Oils and Waxes

A FEW years ago I detected a curious region of negative temperature coefficient of the conductivity of heavy oils, namely, a rising conductivity with decreasing temperature<sup>1</sup>. It occurred in the neighbourhood of the solidifying point. A similar phenomenon has recently been observed by W. Jackson with paraffin wax<sup>2</sup>, just below its melting point. The effect is thought to represent probably a characteristic of both oils and waxes, at least of those containing hydrocarbons. It seems therefore desirable to put forward a theory to account for it.

A transition between the glassy and the crystalline phase in a mixture like oil must extend over a certain range of temperature. The conductivity of the oil in this range is therefore that of a two-phase system. The experimental curves suggest that the extrapolated conductivity of the glassy phase in the transition region is lower than that of the crystalline phase. Consequently the region of negative temperature coefficient may easily be explained by progressive crystallisation with decreasing temperature. This theory also accounts for the dielectric absorption which is always very pronounced in the melting region.

Assuming the theory to be correct, it is possible to calculate from experimental conductivity curves, obtained with special oils and waxes, the melting curve, the latter yielding the relative amounts of components of given 'melting point'. This curve permits certain conclusions to be drawn as to the approximate chemical composition of the oil, provided its basic nature is known.

This work has been carried out for the British Electrical and Allied Industries Research Association, and will probably be published in detail in due course.

A. GEMANT.

Engineering Laboratory,  
University, Oxford.  
March 9.

<sup>1</sup> *Z. Phys.*, 75, 613; 1932.

<sup>2</sup> *NATURE*, 133, 647; 1934.



### Raman Spectrum of Trideuter-Acetic Deuteracid

AN account of the preparation of trideuteracetic deuteracid ( $\text{CD}_3\text{CO}_2\text{D}$ ) by one of us (C. L. W.) will appear shortly in the *Journal of the Chemical Society*. Its Raman spectrum has been examined and gives preliminary results of great interest. The spectrum was obtained from 1.5 c.c. of the substance exposed for  $23\frac{1}{2}$  hours to excitation from a mercury arc filtered to transmit only the 4358 Å. line.

Displacement	a	b	c	d	e	f	g	h
$\text{CH}_3\text{CO}_2\text{H}$	447	621	895	1360	1430	1666	2942	3022
$\text{CD}_3\text{CO}_2\text{D}$	411	580	800	1025	1093	1657	2150	2218

In the accompanying table, the Raman displacements observed are compared with definitely established displacements for acetic acid. All the displacements of  $\text{CH}_3\text{CO}_2\text{H}$ , except *f*, are modified to lower wave number values, but since this frequency is attributable to an inner vibration of the  $\text{CO}_2\text{H}$  group, no change in its value is to be expected. The displacements *g* and *h* most probably have their origin in the C-H link, and preliminary calculations of the expected modification give results in good agreement with the observed values. It is possible that one of these displacements arises from an O-H link, but definite proof of this will be obtained, we hope, by an examination of the spectrum of acetic deuteracid ( $\text{CH}_3\text{CO}_2\text{D}$ ). The examination of  $\text{CH}_3\text{CO}_2\text{D}$  will also give valuable information regarding the other displacements. At present, the origin of these is a little uncertain. Most probably *a* and *b* are associated with bending frequencies of a C-C or C-O link; from intensity considerations, *c* almost certainly belongs to the C-C link; whilst *d* and *e* may arise from the  $\text{CH}_3$  or  $\text{CO}_2\text{H}$  groups, and it is hoped this will be decided by the proposed investigation of  $\text{CH}_3\text{CO}_2\text{D}$ .

Work is proceeding on  $\text{CH}_3\text{CO}_2\text{H}$  prepared by the same method and measured by the same technique, partly to obtain comparable experimental data and partly to clear up certain points on which there is not complete concordance in the results of previous investigators.

The complete results for the three acids and a discussion of the origin of the frequencies will be published elsewhere as soon as the investigation is finished.

W. ROGIE ANGUS.  
A. H. LECKIE.  
C. L. WILSON.

Sir William Ramsay Laboratories of  
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University College,  
London, W.C.1.  
March 18.

### Infra-Red Absorption Spectrum of Crystalline Sodium Nitrite

THERE are very few data available in the infra-red absorption spectra of solids which enable an application of the modern ideas of point group symmetry to the classification of 'proper' vibrations. We have recently examined the absorption spectrum of sodium nitrite in the solid state. The substance has already been shown to be orthorhombic, and thus biaxial, with considerable separation between the indices of refraction. There are two molecules in the unit cell,

and there will be eight particles in the basic group: accordingly we shall expect  $3(8 - 1) = 21$  'proper' vibrations, of which six will be 'inner' vibrations, and fifteen 'external' or lattice vibrations. Generally, some of the inner vibrations will coincide in pairs, but if the nitrite group is angular, its symmetry will be  $C_{2v}$ , which is the same as that of the crystal group<sup>1</sup>, and we may expect considerable separation between the pairs. These conditions do not occur in the free ion, and A. Langseth and E. Walles<sup>2</sup> have obtained a clear and satisfying Raman spectrum for the aqueous solution with  $\nu_1 = 1331$ ,  $\nu_3 = 1240$ ,  $\nu_2 = 813$   $\text{cm}^{-1}$ . In our case all the fundamental frequencies and overtones are doubled, bands occurring at  $\nu_2 = 707$  and  $834$  (10);  $\nu_3 = 1127$ ,  $1220$  (14);  $\nu_1 = 1330$  and  $1392$  (10);  $2\nu_2 = 1378$ ,  $1626$  (4);  $2\nu_3 = 2252$ ,  $2439$  (2);  $2\nu_1 = 2646$ ,  $2762$  (3). The numbers in brackets give an approximate measure of the relative intensities. The bands at  $707$   $\text{cm}^{-1}$  and  $834$   $\text{cm}^{-1}$  have faint wings on each side, which may perhaps be explained by the trichroism of the substance.

Dr. W. R. Angus and Mr. A. H. Leckie of this Department have kindly examined the Raman spectrum of the solid. They find a broad band in the region of  $1350$   $\text{cm}^{-1}$  with a strong sharp maximum at  $1314$   $\text{cm}^{-1}$ , a weak indication at  $1352$   $\text{cm}^{-1}$ , and a weak but sharp peak at  $1400$   $\text{cm}^{-1}$ . We are continuing the infra-red analysis with polarised light.

Ziegler suggested a vertical angle of some  $132^\circ$ , but our results are in agreement with those of Langseth and Walles, since the frequencies satisfy a central force system with an angle of  $96^\circ$ . There seems to be a single bond between the nitrogen and each oxygen atom, whereas the binding in the nitro-group is of the same type as in  $\text{SO}_2$ , corresponding to a vertical angle of some  $120^\circ$ .

C. R. BAILEY.  
J. W. THOMPSON.

Sir William Ramsay Laboratories of  
Inorganic and Physical Chemistry,  
University College, London, W.C.1.  
March 20.

<sup>1</sup> G. E. Ziegler, *Phys. Rev.*, **38**, 1040; 1931.  
<sup>2</sup> *Z. phys. Chem.*, **B**, **27**, 209; 1934.

### A New Emission Spectrum in Selenium Vapour

IN the course of a systematic study of the excitation of selenium vapour in a high-frequency discharge, we have observed, on the short wave side of the main  $1\Sigma^- - 1\Sigma$  system<sup>1</sup>, a new system of about forty weak and diffuse bands degraded to the red which may be approximately represented by the following formula:

$$\nu = 29,890 + 285 n' - 3 n'^2 - 390 n''.$$

These bands appear at low temperatures, before the main system becomes visible; but when the temperature is raised, the main system becomes incomparably more intensified than the new one.

The similarity of the vibrational structure of the new system to the main one<sup>2</sup>,

$$\nu = 25,905 + 281.3 n' - 2.42 n'^2 - 387.2 n'' + 0.63 n''^2,$$

together with the conditions of the excitation and their appearance (large structureless bands) make it plausible that the new system is to be attributed to the excitation of the  $\text{Se}_2$  group in a polyatomic molecule of selenium. This seems to be confirmed by the fact that a set of absorption

bands observed by Moraczewska<sup>3</sup> in selenium, at a temperature at which its vapour is certainly polyatomic, represents the continuation of our  $n''=0$  sequence. A further study of this system promises interesting conclusions as to the binding energy and structure of such polyatomic molecules, of which little is known.

A full account of our investigations will be published in the *Bull. Acad. roy. Belgique*.

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<sup>1</sup> B. Rosen, *Z. Phys.*, **43**, 100; 1927.

<sup>2</sup> E. Olsson, *Z. Phys.*, **90**, 138; 1934.

<sup>3</sup> M. Moraczewska, *Z. Phys.*, **62**, 275; 1930.

### Suggested Polarisation of Electrons

G. P. THOMSON<sup>1</sup> has investigated the peculiar form of asymmetry in the scattering of electrons reported by Rupp<sup>2</sup>. According to Rupp, fast electrons when scattered first by gold through 90° and then passed through a gold foil show asymmetrical diffraction rings, while Thomson could not find any asymmetry up to the voltage of 160 k.v.

We have repeated these experiments, extending the voltage up to 190 k.v., but no effect was found. As in Rupp's experiments, a thick target was used for the first scatterer. Special precautions were made to prevent the non-uniformity of backgrounds; photometric as well as visual comparisons were made on rings up to  $\sqrt{35}$  and  $\sqrt{36}$ . Eight plates were obtained at voltage ranging from 150 to 190 k.v., but none of them showed any asymmetry such as reported by Rupp.

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MOTOHARU KIMURA.

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March 2.

<sup>1</sup> Thomson, *NATURE*, **132**, 1006; 1933. *Phil Mag.*, **17**, 1058; 1934.

<sup>2</sup> Rupp, *Phys. Z.*, **33**, 158, 937; 1932.

### Magnetron Oscillations

IN recent issues of *NATURE*<sup>1</sup>, a discussion took place between us regarding the short wave oscillations produced by split-anode magnetron valves. After further discussion in private correspondence, we are now agreed on the following points:

(1) The oscillations observed by Posthumus<sup>2</sup> in 2- and 4-anode magnetron circuits with wave-lengths of the order of 1 metre appear, on the experimental evidence, to be of the same type as those previously observed by Megaw<sup>3</sup> and others in 2-anode magnetron circuits with similar wave-lengths. The original difference of opinion on this point arose through the emphasis laid on the static negative resistance characteristics in Megaw's explanation of these oscillations.

(2) Static negative resistance characteristics ('dynatron' characteristics) can be observed in both 2- and 4-anode magnetrons under suitable experimental conditions. With usual valve dimensions, these characteristics enable oscillations to be maintained only in circuits of rather low decrement.

(3) At very short wave-lengths, the effect of electron inertia on the dynamic characteristics is such that the term 'dynatron' applied to these oscillations by Megaw is probably a misnomer. At such wave-lengths the maintenance of oscillations

appears to depend on the final energies of the electrons, which may be less than the energy corresponding to the anode voltage, rather than on the angles traversed by the electrons during their transit, which determine the static 'dynatron' characteristics. This conclusion follows from the success of the 'rotating field theory' of Posthumus<sup>4</sup> in predicting the relation between optimum wave-length range, anode voltage and magnetic field strength.

(4) It appears from recent experiments carried out by Megaw that there is no discontinuity between the short wave oscillations under discussion and the longer wave oscillations, which are adequately explained by the negative resistance characteristics, when the decrement of the oscillatory circuit is sufficiently low. With circuits of higher decrement, discontinuities may be observed due to the decrease in valve impedance which may occur when the oscillation period is comparable with the electron transit time, particularly when higher modes of oscillation of the circuit are readily excited.

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E. C. S. MEGAW.

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<sup>1</sup> *NATURE*, **134**, 324; 1934. **134**, 699; 1934.

<sup>2</sup> *NATURE*, **134**, 179; 1934.

<sup>3</sup> *J. Inst. Elec. Eng.*, **72**, 326; 1933.

<sup>4</sup> *Wireless Eng.*, **12**, 126; 1935.

### Dew Ponds

THE legend that dew has anything particular to do with 'dew ponds' seems to die very hard. The essence of a dew pond surely is that it should be watertight, which those who make them seem to know quite well. Except in very abnormal years such as 1921 (and I suppose 1933 and perhaps 1934, though I have not seen the figures) the rainfall in England for the year largely exceeds the loss by evaporation from a water surface, and in an average year an empty watertight pond will have accumulated about 5 inches of water from January 1 to the end of April, will lose 2 inches during the next three months and will then progressively become deeper until at the end of the year it has 11 inches. Evaporation averages about 15 inches and never exceeds 20 inches, so that making allowance for the probability that it is a good deal more in exposed ponds than in the relatively sheltered tanks in which it is measured, it would seem that 2 feet of water in the early spring would see any watertight pond safely through any summer. It is also desirable that there should be no standing vegetation, which downland farmers know, though they attribute its bad effect to the roots perforating the floor of the pond rather than to transpiration, which is extraordinarily effective. Last summer (1934) a cement tank in my garden with *Potamogeton crispus* and *Lemna* lost 5 inches of water, while a precisely similar tank a few feet away which had three good clumps of *Alisma plantago* lost 19 inches and went dry.

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May 15.

Mechanism of Feeding in Blood-sucking Diptera

In a previous communication<sup>1</sup> I reported the discovery of a sucking stylet in ticks which, to all appearances, was the homologue of the hypopharynx in other blood-sucking arthropods. On the analogy of the feeding mechanism in ticks, it seemed reasonable to postulate that in biting flies the food-channel is not formed by the apposition of the labrum-epipharynx and the hypopharynx, as has hitherto been supposed, but that it is represented exclusively by what has until now been regarded as the hypopharyngeal extension of the salivary duct. I referred to this tentative conclusion at the meeting of the Royal Entomological Society of London held on October 3, 1934<sup>2</sup>. I have now carried out numerous dissections upon freshly killed specimens of *Stomoxys calcitrans*. As will appear from Figs. 1 and 2, the labrum-epipharynx in this species of fly is entirely unconnected with the buccal chamber and is practically separated from the hypopharynx by an inward thrust of the apodeme, whilst the buccal chamber itself is continued directly into the expanded proximal portion of the hypopharynx, with the salivary duct terminating distally at this point.

Trichromatic Vision

THE trichromics, that is those who see three colours in a bright spectrum, red, green and violet, are confused by many with the anomalous trichromatics, whereas they are quite distinct. The anomalous trichromatics, as defined by the late Lord Rayleigh, make an anomalous equation and do not agree with the normal equation, and they may not be colour-blind. The trichromics are invariably dangerously colour-blind, and though they may make an anomalous equation they may also agree with the normal equation.

The following case will make this clear. Examined with Ishihara, read all the figures with the ease and rapidity of a normal sighted person. Examined with lantern, called red, white; white, red; green, red; and green, white. Tested by colour equations, 10 red,  $\lambda 633 + 10$  green  $\lambda 540$ , being the normal equation, matching the light of the arc. Made equations ranging from 10 red + 33 green to 10 red + 5 green. He also made the normal equation. The luminosity in each case was correct. Saw three colours in the spectrum red, green, and violet; described  $\lambda 585$  as red mottled, saw green at  $\lambda 574$ , named isolated division  $\lambda 553.5 - \lambda 598$  as all green.

It will be seen that this case appears both as a high grade red anomaly, a high grade green anomaly and he also made the normal equation. It will be noticed that the trichromatic in conditions of difficulty, as for example with small lights, make dichromatic mistakes.

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May 3.

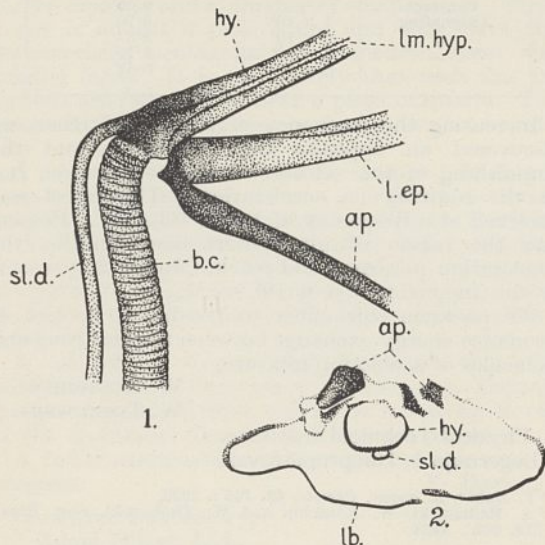


FIG. 1. Buccal chamber and the proximal portion of the mouth parts of *Stomoxys calcitrans* (the labium is not shown). Side view: ap., apodeme; b.c., buccal chamber; hy., hypopharynx; l.ep., labrum-epipharynx; lm.hyp., lumen of hypopharynx; sl.d., salivary duct.  $\times 90$ .

FIG. 2. Transverse section through the mouth-parts of *S. calcitrans* at level of articulation of the apodemes: ap., apodemes; hy., hypopharynx; lb., labium; sl.d., salivary duct.  $\times 110$ .

Furthermore, in fresh specimens the hypopharynx is seen to be provided with a distinct orifice at its distal extremity, and its tubular character is shown by the fact that, when the flies are fed on a suitable colouring substance (for example, hæmatoxylin) that has previously been sweetened with sugar, the hypopharynx takes the stain along the entire length of the walls of its lumen, while its external surface retains its normal colour.

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Vitamin and Nitrogenous Food Requirements of the True Lactic Acid Bacteria

It has now been successfully shown in this laboratory that all the lactic acid bacteria, *Streptococci* as well as rod-shaped forms, demand an alkali stable substance, related to bios, for their growth. The rod forms require, in addition to this substance, lactoflavin and possibly still another activator.

Earlier research seems to indicate that the true lactic acid bacteria are very fastidious in their requirements as to nitrogenous food. Without knowledge of the facts mentioned above, it has been impossible to study this question because the lactic acid bacteria do not grow in a complete mixture of the amino acids present in genuine proteins when activators are absent. It has now been found that the *Thermobacteria* show just as narrow requirements as regards nitrogenous food as do the higher animals, and for some species the requirements are even still more specialised. On the other hand, the *Streptobacteria* are satisfied with ammonia salts and a trace of cysteine, and the *Streptococci* even with ammonia salts as the sole source of nitrogen.

A detailed report will be published shortly.

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<sup>1</sup> NATURE, 134, 644; 1934.

<sup>2</sup> Proc. Roy. Ent. Soc., 9, 76; 1934

### Origin of Chemistry: the Definition of Flame

In a recent publication<sup>1</sup> I have shown that practically all the technical achievements on the chemical side which have been credited to the Classical Period, to the Middle Ages, or even (by the least instructed) to our own times, in reality go back to the much earlier civilisations, the crafts of which were largely destroyed by the irruption of the people of the Iron Age, those cruder but better armed ancestors of many of the present inhabitants of Europe.

In my further investigations of the development of chemistry proper, which will form the subject of another work to be published before long, the same dependence on earlier periods is abundantly evident. An interesting example is provided by the definition of flame. Most of the histories of chemistry attribute to van Helmont (1577-1644) the statement that "flame is burning smoke". Kopp<sup>2</sup> (who is probably the origin of their information), however, pointed out in the corrections to his "History of Chemistry" that the statement occurs in Albertus Magnus (1193-1280)<sup>3</sup>, which "is notable for its time". It goes back, of course, at least to Aristotle<sup>4</sup>, but an interesting link with van Helmont is the statement in Albertus<sup>5</sup>, which is also taken from Aristotle, that "flame is burning or ignited *spirit* or smoke" (*flamma est spiritus sive fumus succensus sive combustus*), in which the approach to van Helmont's definition of gas<sup>6</sup> (*hunc spiritum incognitum hactenus, novo nomine gas voco*) is clear.

It is also generally overlooked that Albertus describes<sup>7</sup> the inflammability of intestinal gases, again anticipating van Helmont. The work "De Alchimia" attributed to Albertus, from which much of the information as to his contributions to chemistry has been taken by the historians, is clearly much interpolated in the form in which it is printed<sup>8</sup>, but parts of it are contained in old manuscripts<sup>9</sup> and parts are also extracts from his authentic works. One of the main sources of information on alchemy in Albertus's time was the treatise "De Anima" attributed to Avicenna<sup>10</sup>, and practically all the information in European authors was then of Arabic origin. If the authorship of a Latin treatise of this time is unknown then, provided it is of a well recognisable type, it may be safely regarded as Arabic. Further details will be given in my forthcoming work.

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<sup>1</sup> Partington, "Origins and Development of Applied Chemistry", Longmans, 1935; pp. xii+597.

<sup>2</sup> "Beitrag zur Geschichte der Chemie", 3 parts, Braunschweig, 1869-75; iii, 84. Kopp, *ibid.*, 70, is in error when he says Geber's name is not quoted by Albertus, since 'Geber Hispanensis' is mentioned in "De Mineralibus", II, ii, 3; but since the passage deals with gems, not alchemy, probably Jabir is not meant.

<sup>3</sup> "Meteororum", I, iii, 5; IV, iii, 17; Opera omnia, ed. Borgnet, 38 vols., Paris, 1890-99; vol. iv, pp. 504, 787.

<sup>4</sup> "De Coelo", ii, 4; "Meteorologicorum", iv, 9; the word  $\phi\omicron\sigma\mu\alpha$ , *phlogista*, occurs frequently in the latter work, for example, ed. Fobes, 1918, 387b ff., and Stahl's views are much less original than is commonly supposed.

<sup>5</sup> "Meteor.", IV, iii, 17; Borgnet, iv, 787.

<sup>6</sup> "Complexionum atque misionum elementalium figmentum"; Ortus Medicinæ, Amsterdam, 1648, p. 106; 2 ed., Venice, 1551, p. 66.

<sup>7</sup> "Meteororum", III, iii, 4; Borgnet, iv, 643; sicut est videre in ventositatē sicca egrediente de ventre hominis: hæc enim si per pannum subtilem emittatur, et candela adhibeatur tota inflammatur flamma lata et dispersa; also in "Philosophia Pauperum", Pars. IV, cap. 17; Borgnet, v, 491: this is the origin of van Helmont's *gas pingue*.

<sup>8</sup> Borgnet, xxxvii, 545-573; the text is merely a reprint of that in vol. xxi of the edition of Jammy, Lugduni, 1651, and is obviously based on a very late, 16th cent., manuscript.

<sup>9</sup> Brit. Mus. Sloane 323, fols. 61 ff.; 14th cent.

<sup>10</sup> Also extensively used and quoted by Roger Bacon.

### Influence of High-Frequency Field on the Combustion of an Acetylene - Air Mixture

THE investigation of the processes of the combustion of gas mixtures in a high-frequency electric field by Haber<sup>1</sup> and later by A. Malinowski and ourselves<sup>2</sup> led to the conclusion that the influence of a high-frequency field ( $10^6$  sec.<sup>-1</sup>) in reducing combustion velocity is approximately half that of a constant electric field of the same strength acting under similar conditions.

A. Malinowski maintains the view that this effect is due to the different efficiencies of the two types of field in removing active centres (ions and electrons) from the combustion zone of the gas mixture.

Our further investigations on the dependence of the field frequency and the velocity of combustion have established the fact that increasing field frequency results in a decreasing effect of the field. As can be seen from the accompanying table, at sufficiently high frequencies the effect of the field becomes negligible.

Electric field (670-700 volt/cm.)	Frequency	Decrease of the velocity of combustion (per cent)
Constant	—	9.00
Alternating	$1 \times 10^5$	6.70
"	$6 \times 10^5$	3.37
"	$5 \times 10^6$	1.70
"	$8 \times 10^6$	0.57

Increasing the frequency of the field further, we discovered an opposite effect, that is, not the diminishing of the velocity of the combustion, but on the contrary its acceleration. This effect was observed at a frequency of  $1.8 \times 10^7$  sec.<sup>-1</sup>. Passing into the region of ultra short wave-lengths, the acceleration increases and reaches finally 20 per cent at the frequency  $3.4 \times 10^7$  sec.<sup>-1</sup>.

We presume this effect to be due to a sort of resonance energy exchange between the electrons and molecules of a reacting mixture.

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<sup>1</sup> F. Haber, *Z. angew. Chemie*, 42, 745; 1929.  
<sup>2</sup> A. Malinowski, W. Rossichin and W. Timkowski, *Sov. Phys.*, 5, 212, 902; 1934.

### Twinning in Alpha Iron

ABUNDANT twinning has been observed in pure alpha iron (carbon 0.0022 per cent, silicon 0.0018 per cent) which has been passed slowly through the critical range, and also in pure alpha iron deformed and then recrystallised below the critical range. In the former, banded structures are common; in the latter, banded structures are the exception. However, the forms or habits of annealing twins in alpha iron are quite distinctive.

Orientation relationships of individual grains were established by means of a back-reflection Laue X-ray method which I have developed. The only twin relation observed was of the type ordinarily described as (112) twinning. This twinning, considered symmetrically, is, of course, identical with the octahedral twinning commonly observed in metals of the face-centred cubic lattice.

It was also observed that the formation of alpha iron upon cooling through the critical range involves

the genesis of macromosaic structure, probably subsequent to the twin formation—analogueous to the behaviour of copper upon solidifying. It is believed that the forms assumed by the various constituents in steel, in particular the so-called Widmanstätten figures observed in alpha iron after quenching from above the critical range, are the result of the twinning and macromosaic lattice movements rather than of the crystallographic uniformity of the gamma-to-alpha transformation process, as was proposed by Mehl and Smith.

Results will be published at an early date.

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### Pyrites in Quartz

PYRITES ( $\text{FeS}_2$ ) in the form of small crystals and specks of a brassy-yellow colour may be found frequently in quartz. Four pieces of Brazilian quartz, containing pyrites inclusions, have now been found which are of unusual interest.

One of these pieces is a well-shaped cap of good optical quality, very clear and completely devoid of feathers, 'smoke', etc., and containing three large pyrites crystals and a number of smaller ones. Their colour is almost a pure white and they have the characteristic pentagonal dodecahedron form and striated faces. It is very rarely that such fine inclusions are found in so clear a piece of quartz. The specimen is interesting also in that it has two beautifully etched faces.

A fifth specimen has also been found having a complete hole (approx.  $10 \times 4 \times 8$  mm.), in which a crystal doubtless at one time existed, for the faces of the hole are striated corresponding to the structure of the pyrites crystal. Unfortunately, in the process of working the quartz the hole was cut into, so that its vapour content escaped before an examination could be made.

A superficial examination indicates that the inclusions tend to lie in one particular plane through the quartz, and, further, the water inclusions in one of the specimens also lie in the same plane.

A fuller examination of the specimens is now in progress.

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### The Minimum in the Gamma Function

It is well known that the gamma function  $\Gamma(z)$  for real and positive values of  $z$  has a minimum between  $z=1.46$  and  $1.47$ . In a number of texts on the theory of functions it is stated that the minimum occurs at  $z=1.4616321\dots$  and that the corresponding value of  $\Gamma(z)$  is  $0.8856032\dots$ . Only one text that we have examined, namely Joseph Edwards's monumental work "Integral Calculus", vol. 2, chap. xxiv (Macmillan, 1922), gives any indication of how the minimum points can be calculated. The method therein explained depends on certain properties of the gamma function and of the related logarithmic derivative  $d \ln \Gamma(z+1)/dz$ , commonly written  $\psi(z)$ , following Gauss. At best, the problem is finally one in successive approximation.

There is another approach to the problem, admittedly crude, but effective. Gauss ("Werke", 3,

161-162) left us a table of  $\log \Gamma(z+1)$  to twenty decimals, and a table of its logarithmic derivative,  $\psi(z)$ , to eighteen decimals, by steps of 0.01 in the argument  $z$  between  $z=0$  and 1. It should be possible, then, by inverse interpolation in Gauss's table to find the value of  $z$  for which  $\psi(z)$  vanishes. This value of  $z$  will be the abscissa of the minimum in  $\Gamma(z+1)$ , so that again by interpolation it should be possible to find the minimum value of  $\log \Gamma(z+1)$ . Finally, by Thompson's twenty place logarithms ("Tracts for Computers", No. 14, Cambridge, 1927) the minimum in  $\Gamma(z)$  itself can be determined.

Using Everett's interpolation formula, and retaining sixth differences, we have in this manner found that the zero of  $\psi(z)$ , and hence the minimum in  $\log \Gamma(z)$  and in  $\Gamma(z)$  occurs at  $z=1.461632144968362268$ . Interpolation with the same formula gives the minimum of  $\log \Gamma(z)$  equal to  $9.94723917439338526292$ ; whence, by Thompson's logarithms, it turns out that the minimum of  $\Gamma(z)$  is  $0.88560319441088868870$ . In all of these values there is the usual likelihood of an error of a unit or so in the terminal digit.

It is interesting to notice that since we are here dealing with an extreme value of the gamma function, the value of  $\Gamma(z)$  at the minimum is relatively insensitive to changes in  $z$ ; hence, though it is not possible to determine  $z$  to more than eighteen decimals—the extent of Gauss's table of  $\psi(z)$ —the limit of accuracy in determining  $\log \Gamma(z)$  is not  $z$ , but is Gauss's table of  $\log \Gamma(z+1)$ . Hence, our values of  $\log \Gamma(z)$  and  $\Gamma(z)$  should be correct except for the possibility of errors in the twentieth decimal, as mentioned above. As an illustration of this principle, it might be added that a change in  $z$  of one unit in the eleventh decimal place produces a change in  $\log \Gamma(z)$  of a unit or so in the fifteenth place.

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### Light-Waves as Units of Length

I WISH to correct an error that occurs in my article on this subject in NATURE of March 30 (p. 496). The mean value of the wave-length of red cadmium in normal air from this table should be  $6438.4691 \times 10^{-10}$  metres, and not  $6438.4687 \times 10^{-10}$  metres, which is the mean of the last three determinations.

Originally I considered that only these later results should be used on account of the uncertainty, in the earlier work, regarding the carbon dioxide content of the air. Further consideration at the proof-reading stage led me to include the determination of Benoit, Fabry and Perot, in view of the probability that the actual lengths of the international substandards, No. 26 and  $T_3$ , were known to a greater accuracy with reference to the prototype metre than was the case with the various national standards. The correction was made in the proof, but the revised value for the mean was not inserted. The vacuum wave-length given at the end of the article was derived from this revised value, and therefore needs no alteration.

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May 2.

## Points from Foregoing Letters

EXPERIMENTS with silver bombarded by neutrons and surrounded by air, water and liquid hydrogen, lead Prof. J. C. McLennan, Prof. E. F. Burton and Mr. A. Pitt to suggest that the radioactivity induced in silver is probably not affected by changes in temperature. Dr. P. B. Moon and Mr. J. R. Tillman find, on the other hand, that the radioactivity of silver, rhodium and iodine bombarded by neutrons which have traversed paraffin wax cooled with liquid oxygen, is appreciably different from the radioactivity obtained at ordinary temperature, being greater in the case of silver and rhodium and smaller in the case of hydrogen.

From the change in artificial radioactivity produced in spherical detectors of aluminium, silicon and phosphorus by neutrons slowed down after passing through heavy water, as compared with the effect produced after passing through ordinary water, Messrs. C. H. Collie, J. H. E. Griffiths and L. Szilard deduce that neutrons suffer a greater decrease in velocity on collision with nuclei of light hydrogen atoms (protons) than on colliding with the nuclei of heavy hydrogen atoms (deutons or deuterons).

A 'decay curve' of silver activated by neutrons, slowed down by passage through paraffin, cannot be expressed as a single exponential curve, according to Seishi Kikuchi, Shigeo Nakagawa and Hiroo Aoki. They suggest as one possible explanation of results obtained by Bjerger and Westcott that, within certain limits, the yield of radioactive material decreases as the velocity of the exciting neutrons decreases, but below a certain velocity an increase in the yield takes place.

Dr. C. Hurst supports Klemperer's view that the natural radioactivity of potassium is due to a hitherto undetected isotope of mass 40. He calculates that a nuclear spin of only 2 or 3 units (instead of the 4 or 5 units postulated by Klemperer), would be sufficient to account for the slow period of decay.

The fact that both neutrons and positive electrons are emitted by lithium bombarded with  $\alpha$ -particles leads Mr. H. J. Walke to expect that protons would also be given off. Delayed emission of 'negative' electrons should be observed from lithium and boron when bombarded by  $\alpha$ -particles.

A supraconducting galvanometer has been constructed by Prof. E. F. Burton and Messrs. H. Grayson Smith and F. G. A. Tarr. They describe some experiments carried out with it, and indicate further fields of research in which the instrument would be useful.

From the percentage incidence of certain hereditary diseases (haemophilia and epiloia), which have a high mortality ratio, Dr. L. S. Penrose and Prof. J. B. S. Haldane calculate that such diseases must arise as mutations, with a frequency of about 1 in 100,000.

Dr. Kenneth Smith directs the attention of horticulturists to the appearance of a new virus disease attacking tomato plants, and describes the symptoms which characterise the new disease.

Miss D. A. E. Garrod and Miss E. W. Gardner report the finding near Mount Karno, Palestine, of flint implements in a layer of red earth within a deposit of wind-blown sandstone, hitherto thought to be a marine formation of Pliocene age. The

implements are of Mousterian and Levallois type and the deposits in which they are found must belong to the late Pleistocene, a fact which is likely to lead to the revision of some of the current views concerning the age of other geological formations in Palestine.

The molecular polarisation of phenol in benzene has been measured from the dielectric constant and the density of its solutions by Dr. A. R. Martin. He finds that as the concentration is increased the molecular polarisation increases and then decreases, as it does in the case of the lower alcohols.

In the breakdown of sugar by fermenting peas, combination of the sugar with phosphoric acid appears to be a necessary step, according to experiments reported by Mr. M. S. Rao. In this respect, chemical reactions in higher plants seem to be similar to those in animal muscle.

Mr. S. H. Clarke points out that the crushing strength of ash timber when compressed parallel to the grain is roughly indicated by the colour that the wood stains with phloroglucin and hydrochloric acid. In strong specimens the fibre-walls stain red and in weaker types the middle lamella region stains a faint pink. The test has been used to detect weakness in hockey sticks.

In view of the fact that X-ray analysis shows potassium, caesium and methyl-ammonium alums, previously considered isomorphous, to have in reality different structures, Mr. H. Lipson raises the question whether similar differences of structure may not exist in other supposedly isomorphous series. He concludes that such pseudo-isomorphism is only likely to occur in crystals of the cubic system.

The electrical conductivity of heavy oils and of paraffin wax, in the neighbourhood of melting point, rises with decreasing temperature. This abnormal behaviour, Dr. A. Gemant suggests, may be due to progressive crystallisation with decreasing temperature, the substances considered behaving as two-phase systems.

The spectra of light scattered by ordinary acetic acid and by the corresponding compound containing heavy hydrogen, have been investigated by Messrs. W. R. Angus, A. H. Leckie and C. L. Wilson. From the displacement observed in some of the spectrum lines, they tentatively connect those lines with the known valency links between atoms (C—H, O—H, C—C, C—O).

The absorption of infra-red light by crystalline sodium nitrite has been determined by Messrs. C. R. Bailey and J. W. Thompson. Its relation to the light scattered by sodium nitrite crystals and solution gives an indication of the arrangement of the atoms and the molecular forces involved.

A high-frequency discharge through selenium vapour has yielded light attributed by Messrs. B. Rosen and M. Désirant to the excitation of the  $Se_2$  group in the polyatomic molecules of selenium.

The effect of a high-frequency electric field upon the combustion rate of a mixture of acetylene and air is reported by Messrs. W. Rossichin and W. Timkowski. They find that an increase in frequency between  $10^5$  and  $10^7$  sec.<sup>-1</sup> causes a decrease in the velocity of combustion, but with higher frequencies the effect is reversed.

## News and Views

## Prof. Graham Kerr and Parliamentary Representation

THE appointment of Mr. John Buchan as Governor-General of Canada necessitates a by-election for a representative of the Scottish universities in the House of Commons. We are very glad to see that Prof. J. Graham Kerr, regius professor of zoology in the University of Glasgow, has been adopted as a candidate by the Unionist Association of the Universities of Edinburgh, Glasgow, Aberdeen and St. Andrews. It would be difficult to find a man of science who could more worthily represent the Scottish universities in Parliament than Prof. Kerr. He combines long experience of the teaching and administrative sides of these universities with wide scientific interests and a high position in the political field, being president of the Scottish Unionist Association, chairman of the Glasgow Unionist Association, and holding similar offices in other Unionist organisations. Prof. Kerr's election to Parliament would involve considerable self-sacrifice, for it would mean the giving up of the life tenure of his chair of regius professor of zoology in the University of Glasgow. In these days, when the whole of our communal existence is permeated by science and its applications, it is the duty of scientific workers to take an active part in shaping the destinies of the nation by promoting the election into the House of Commons of representatives having scientific knowledge and outlook. At present there is not a single fellow of the Royal Society in the House of Commons, and if, as we hope and expect, the Scottish universities return Prof. Graham Kerr as their member, they will be rendering a notable service to science and the nation.

## Ergometrine, a New Alkaloid from Ergot

THE clinical observations of Moir (*Brit. Med. J.*, i, 1119; 1932), that aqueous extracts of ergot are more effective in producing the uterine contractions to which this drug owes its medicinal use than are any of the known ergot alkaloids, for example, ergotinine, ergotoxine, ergotamine, has recently led to the isolation by H. W. Dudley and C. Moir (*Brit. Med. J.*, March 16, 1935) of a new ergot alkaloid which promises to become of great importance in obstetric practice. The new alkaloid, termed ergometrine, is a crystalline, water-soluble base, of which 0.82 gm. was obtained from 10 kgm. of defatted ergot. Oral administration of ergometrine, in a dose of 0.5-1.0 mgm., produces strong uterine contractions after  $6\frac{1}{2}$ -8 minutes. By way of contrast, doses as large as 2-3 mgm. of ergotoxine and ergotamine, given by mouth, have a relatively feeble oxytocic effect after an interval of 35 minutes or more, and a similar type of activity is shown by the recently discovered ergot alkaloids, sensibamine and ergoclavine. Even when given by injection, the ergotoxine-ergotamine alkaloids are rather slow in action, and often produce such unpleasant symptoms as headaches, nausea and depression. Ergometrine is stated to be free from these undesirable subsidiary effects.

A SAMPLE tube has been sent to us of ergometrine as manufactured in the laboratories of British Drug Houses, Ltd., and supplied in tablets containing 0.5 mgm., suitable for oral administration. It is astonishing that the recognition of this active principle of ergot should have been so long delayed, and it may be that even more valuable secrets will ultimately be disclosed by this remarkable parasitic mould, the investigation of which has already yielded ergosterol and its irradiation products, including artificial vitamin D. Further reports on the pharmacology and chemistry of ergometrine will be awaited with considerable interest. In the issue of the *Lancet* of May 25 (p. 1243), M. S. Kharasch and R. R. Legault discuss the possibility that ergometrine may be identical with, or closely related to, the ergotocine recently isolated by these workers and their collaborators (*Amer. J. Obst. and Gyn.*, February, 1935, p. 155). Pure crystalline ergotocine is being manufactured in large quantities by the Eli Lilly Company, the recommended clinical dose for oral administration being 0.4 mgm.

## Prof. P. Lenard of the University of Heidelberg

THE Physical Institute of the University of Heidelberg has recently, in honour of Prof. Lenard, been renamed the 'Philipp Lenard-Institut'. A correspondent has sent us a cutting from the students' magazine of that University, giving Prof. Lenard's reply to the congratulations of the Heidelberg students on this occasion. The following is a translation of Prof. Lenard's reply, and we prefer to make no comment upon it:—"I am very grateful to the students of the University of Heidelberg for their congratulations on the renaming, by the Ministry, of the Institute which was built some years ago under my direction. I hope that the Institute may stand as a battle flag against the Asiatic Spirit in Science. Our Leader has eliminated this same spirit in politics and national economy—where it is known as Marxism. In natural science, however, with the over-emphasis of Einstein, it still holds sway. We must recognise that it is unworthy of a German,—and indeed only harmful to him—to be the intellectual follower of a Jew. Natural science properly so-called is of completely Aryan origin and Germans must to-day also find their own way out into the unknown. Heil, Hitler!"

## Rationalisation of Scientific Publication

A POINT raised in the leading article in *NATURE* of March 9 on the subject of "Rationalisation of Scientific Publication", relating to the duplication of abstracts, led Dr. Ainsworth Mitchell to state the views of the Society of Public Analysts in a letter published in our issue of May 11, p. 791. Further communications have since reached us from other members of the Society. The main contention is that the Society produces at its own cost something for the use of its members which is not supplied by

the British Chemical Abstracts; and that these specialised abstracts are widely appreciated. In so far as a large number of members of the Society of Public Analysts are members also of one or both of the societies maintaining the Bureau of Chemical Abstracts, no reasonable objection can be raised to this action. None the less, the unprejudiced onlooker may regret the example when overlapping and duplication are still so widely apparent in chemical literature, and when the major scientific societies find the burden of publication a severe tax on their resources. He may still be entitled to conclude that it is idle to deplore such financial limitations or to lament the growing difficulty which besets every scientific worker of keeping abreast of his subject until there is to be found a much greater willingness to make generous sacrifices in the general interest. It is unfortunate that a phrase in the original article, intended merely to indicate the ground covered by the abstracts of the Society of Public Analysts, has been construed to refer to the matter and data of the abstracts in a way which the Society would have been justly entitled to resent. Such criticism of any society is, however, most effectively disarmed by the measure in which the Society publicly as well as privately supports the central institutions for the co-ordination of scientific literature in the particular science it avows.

#### Export of Antiquities from Egypt

A REPORT from Cairo points to the possibility of further restrictions on the export of antiquities from Egypt. Under the existing antiquities law, which has been in operation for a little more than a decade, the rights of the State in the allocation of the proceeds of legitimate excavation have been well—indeed some would say too well—protected; but it has proved difficult to check clandestine digging. The finds from these illicit activities frequently, but not invariably, find a final resting place in the Cairo museum, but a considerable number still are smuggled out of the country. According to a dispatch from the Cairo correspondent of *The Times* in the issue of May 25, violent protest has been raised in the Arab newspapers as a result of reports of the value of papyri, and especially of the new fragments of a Gospel now in the British Museum, which have been sold at high prices to European collections. Inquiries by *The Times* correspondent have elicited the admission that sales by Cairo dealers to private collectors have been due to the fact that the Cairo Museum has not shown an interest in papyri except when of historical importance. As a consequence of this agitation, however, the Minister of Education, Nequid Bey Hilali, has appointed a committee to inquire into the question of illicit sales of antiquities. Although archaeologists may sometimes have felt the burden of the regulations imposed upon legitimate excavation to be unduly irksome, they will have no quarrel with any measure checking that destruction of scientific evidence which is the inevitable accompaniment of clandestine digging and illicit sales.

#### Control of Architecture

THOUGH a nation may not be judged wholly by its architecture, this at least forms an outward and visible sign of its mentality, and since many buildings outlive a number of generations, it is our duty to posterity to see that the structures we erect are not only fitted for their purposes, but also are outwardly gracious and in harmony with their surroundings. Great developments in building are in progress, municipal, institutional, commercial and most of all domestic owing to the programmes of slum clearance. These developments merit the employment of only qualified architects, to ensure the greatest economy in the expenditure of money and the most suitable results in design which proper training can alone give. The Royal Institute of British Architects sent last January to the Minister of Health a memorial expressing the readiness of the architectural profession to give assistance in the matter of slum clearance schemes, and pointing out that many of the local authority staffs have neither the time nor the experience to deal adequately with these large problems. Most people will admit the wisdom of employing a properly qualified professional man for any service, be it medical, legal or architectural, and the suggestion that public money should only be spent under competent professional advice appears to be sound reasoning. A great deal of time is given gratuitously by architects in serving on panels to assist in the improvement of designs submitted to local authorities, and through a very complete system of professional education the advice and service of competent men is now obtainable in all parts of the country.

#### Recent Acquisitions at the British Museum (Natural History)

OF all the regions of the world, the Pacific coast of South America is, perhaps, the most poorly represented in the Museum collection of fishes, and a representative series of the marine fishes of Chile has long been required. Through the kindness of Mr. V. Cavendish-Bentinck, of the British Embassy at Santiago, arrangements have been made with the Chilean fisheries authorities to supply the Department of Zoology with well-preserved specimens of the more important fishes. The first consignment of what promises to be a collection of considerable importance has now been received, and another consisting of specimens collected in the Juan Fernandez Islands is expected within a few weeks. Among the specimens acquired by exchange for the Zoological Department are examples of the Hawaiian land snail *Achatinella*. The species and races of these snails, which are often restricted to single ridges and ravines (in some cases even to single trees), are classical examples of the effects of isolation in species-formation. The Department of Mineralogy has acquired by purchase a remarkable set of 98 meteoric stones which fell in 1869 as a shower at Tenham station, Kyabra County, South-West Queensland, and are as yet undescribed. Another purchase is a fine doubly-terminated crystal of ruby and a faceted colourless chrysoberyl (7.15 carats) from the ruby



mines at Mogok, Upper Burma. Chrysoberyl is usually of pronounced colours, the variety alexandrite, for example, being green by daylight and red by lamp-light, and a colourless gem of this species has not previously been recorded.

THE Department of Botany has received more than 2,900 numbers as a result of the British Museum Expedition to East Africa. These were collected by Dr. G. Taylor, assistant-keeper in the Department: some additional numbers collected by Mr. P. M. Syngé have not yet arrived. Four groups of mountains were visited—Aberdare, Beringa, Ruwenzori and Elgon. The longest period was spent on Ruwenzori itself, and extensive collections were made in the Namwamba valley up to the snow line: the plants from the adjoining Nyamgassani valley, where Mr. Syngé collected, will afford an interesting floristic comparison. Although main attention was paid to the mountains, the flora of the plains was worked so far as possible, and the aquatic flora from the rivers yielded much of interest in relation to researches being carried out in the Department. It is not possible to give an analysis of the collection at present, but it contains several new species and a large number of plants not previously represented in the Museum. The herbarium of William Rashleigh (1777-1855) was recently purchased from a second-hand bookseller. This is entirely of seaweeds and is contained in three volumes. Its main interest is that it contains the herbarium of John Stackhouse (1742-1819) the author of "Nereis Britannica" (1795-1801) in which some of the first post-Linnean genera of algae were published. Some years ago, an effort was made to trace the herbarium in order to clear up some points which had arisen regarding nomenclature, but nothing could be learned beyond the fact that it had been bequeathed to Rashleigh. The collection was offered for sale in the ordinary way. A small volume of mosses collected by Dr. W. K. Kane on the U.S. Grinnell expedition in search of Sir J. Franklin (1853-55) has been purchased. These were apparently the original set of the "Kane Portfolio" arranged by T. P. James. Most of the cryptogams collected on the expedition were lost when the vessel was abandoned.

#### Linnean Society of London

AT the anniversary meeting of the Linnean Society of London held on May 24, the president, Dr. W. T. Calman, delivered a presidential address, "The Meaning of Biological Classification". The Linnean Gold Medal was presented to Sir David Prain, a past-president of the Society, in recognition of his services to botany. In making the presentation, Dr. Calman mentioned that Sir David began his scientific work as a member of that great service which has produced so many eminent naturalists, the Indian Medical Service, that he became the head of Indian botany when he was superintendent of the Botanical Survey of India and of the Royal Botanical Gardens, Calcutta. When Sir David returned to England, he became director of the Royal Botanic Gardens at Kew, an office which he filled with conspicuous success

until his retirement in 1922. But although his success as an administrator has been conspicuous, he has never forgotten that the business of a scientific man is scientific research, and his contributions to systematic botany, particularly that of the Indian Empire, are of a kind that would have gladdened the heart of Linnæus himself. The following officers were elected for the year 1935-36: *President*, Dr. W. T. Calman; *Treasurer*, Mr. Francis Druce; *Secretaries*, Mr. John Ramsbottom (botany), and Dr. Stanley Kemp (zoology). The new members of the Council are Dr. B. Barnes, Mr. D. J. Scourfield, Lieut.-Colonel R. B. Seymour Sewell, Mr. W. H. Wilkins and Dr. E. B. Worthington. The president announced that he had appointed the following vice-presidents: Prof. G. D. Hale Carpenter, Mr. Francis Druce, Dr. Margery Knight and Prof. Macgregor Skene.

#### Temperament in Industry

PROF. MAJOR GREENWOOD delivered the second of his Heath Clark Lectures, under the auspices of the National Institute of Industrial Psychology, on May 20, on "Temperaments, Physical and Psychological, in Modern Science". He pointed out that the ancient physicians were deeply conscious that differences of temperament entailed psychological consequences which expressed themselves in bodily as well as mental reactions, and that it was the duty of the physician to diagnose and treat these conditions. In Great Britain the work of Kretschmer has received considerable attention, but the infinitely clearer and scientifically more rigorous work of Boldrino and the Italian School has been unduly neglected. Boldrino has shown that it is probable that certain morphological types, roughly corresponding to the old 'sanguine' and 'melancholies', do differ in resistance to such diseases as tuberculosis, in distribution through the social classes, and even in fertility, but in respect of psychological characters there is much less evidence of any such relation. Prof. Greenwood considered the claims of some modern work on temperament that had relied on statistical correlations: he emphasised that statistical description is fundamentally group-description only, and has little diagnostic value in individual cases. He illustrated this by data on accidents, and showed that, while the application of tests would undoubtedly eliminate many likely to be accident prone, yet they would also eliminate some who are not, and so do an injustice to individuals. Although Prof. Greenwood feels that, with respect to a finer gradation of temperamental qualities, we are indefinitely far from any fool-proof system of routine testing, yet we may be near to the time when an elimination of extreme variants on a basis of temperamental tests will be practicable.

#### Poisons and their Detection

DR. G. ROCHE LYNCH delivered the thirtieth Bedson Lecture in Newcastle-upon-Tyne on May 16. After a brief outline of the history of poisoning from ancient times up to the beginning of scientific

investigation with Marsh, about a century ago, and Stas in 1850, Dr. Roche Lynch discussed the general characteristics of poisons. With the exception of a few of animal origin, like snake venom and certain serums, tolerance toward all poisons increases with repeated small doses; narcotics, alkaloids, metals and even castor oil. This seems to be due to growing immunity of the cells as well as to increased rate of excretion or destruction. In general, detoxication takes place mainly in the liver with increasing efficiency, the processes seeming to be developments of natural responses. Quite large amounts of the heavy metals have been found, lead up to 146 parts per million being demonstrated in normal bone where no industrial or similar causative contact had occurred. Difficulty arises with the modern synthetic medicinals; they have often only a narrow margin between the medicinal and the toxic doses and have little allowance for idiosyncrasy. Many of them are completely destroyed, or changed in the tissues into something else in a short time. The barbituric acid group are particularly dangerous, and should be brought under regulation. They are all hypnotics, but their behaviour from a toxicological point of view is very different. Some of these compounds are almost completely destroyed in the body, so that analysis only reveals a trace, and others are readily found in considerable quantity both in the excreta and in the organs. Opinion therefore as to the cause of death must depend on the type of barbiturate present and the amount isolated. Dr. Lynch then dealt in greater detail with arsenic, strychnine and carbon monoxide, illustrating his remarks with references to, and exhibits from, famous criminal cases.

#### Conservation of the Flora of Great Britain

In the report of the work of Flora's League, a society for the preservation of wild flowers, ferns and trees, covering the years 1932-34, the League records its work, in collaboration with other bodies, for the conservation of the British flora, and its plans for the future. In co-operation with the Cotteswold Naturalists' Field Club, the Gloucestershire station of *Ranunculus ophioglossifolius*, which grows in this and one other county only in England, has been secured for all time, while in Lancashire special efforts are being made to preserve the endangered flora of the sand-dunes in the vicinity of Ainsdale, the only known habitat of *Epipactis dunensis*. Following on the successful re-introduction of *Maianthemum biflorum*, the may lily, in Ken Wood, under the direction of Mr. J. S. L. Gilmour, assistant director of the Royal Botanic Gardens, Kew, the League has plans for the cultivation of rare species of wild-plants for their seeds, to sow in wild flower gardens or in haunts from which they have disappeared; though record of the site and other details of each such experiment will be reported to the Department of Botany of the British Museum (Natural History) to avoid any confusion of records of field botanists. Under the auspices of the Wild Plant Conservation Board of the Council for the Preservation of Rural England, the British Wild Plant Nurseries and Seed

Exchange Agency has been originated by Mr. C. S. Garret at Derby, for this purpose, but not to be run as a commercial profit-making concern; while the Green Cross Society and the British Empire Naturalists' Association, affiliated organisations, have similar seed-distributing schemes. The president and founder of the League is Sir Maurice Abbot-Anderson, and it has offices at the Council for the Preservation of Rural England at 17, Great Marlborough Street, London, W.1.

#### Meteorology in Northern Rhodesia

THE Meteorological Report for Northern Rhodesia for 1931-32 (No. 9) is the first of this series that has appeared since responsibility for the direction of meteorological work in that colony was taken over by the Director of the British East African Meteorological Service (Mr. A. Walter), for although the new service was officially inaugurated in 1929, it was not until the end of 1931 that Northern Rhodesia was included in it, control being meanwhile in the hands of the Director of Surveys. The new regime began soon after the completion of the Territorial First Order Meteorological Station at Broken Hill—a station exactly similar to the other first order stations already established in Kenya, Tanganyika and Uganda. Before the end of the year, autographic records of temperature, humidity and atmospheric pressure were in operation there, and were used for obtaining the hourly readings of these elements that appear in this report for the six months January-June 1932. The work of Broken Hill includes the distribution of forms and equipment to the subsidiary stations within the colony, the handling of all the records obtained at such stations, and the issuing of weather reports, including the results of pilot balloon ascents, to aeroplanes passing over Northern Rhodesia. The report is on the same general lines as the earlier annual reports; it includes, in addition to statistical tables on normal lines, discussions of the separate meteorological elements, among which rainfall, as in the tropics generally, is of the greatest immediate practical importance. There is in addition an account of a waterspout that was seen near Nsalushi Island, in the swamp area of Lake Bangweolo, on February 19, 1932, and particulars of slight earth tremors reported from a number of subsidiary climatological stations.

#### Distributing Electricity to Country Districts

DURING the last ten years, the distribution of electricity by means of overhead lines has made rapid progress; but there are still nearly 80 per cent of the occupied rural areas of England where electric supply is not available. There is a vast amount of development work to be done in these areas. Already the capital sunk for distributing power is considerably in excess of that used for generating power. The annual expense in distribution is at the present time three times greater than that for generation. The progress already made shows that there is plenty of scope for technical improvements which would increase the factor of safety and lower the cost of

supply. The rural schemes already installed prove that an overhead distribution at 11,000 volts (11 kv.) is economical when the loads are small. When heavier loads are anticipated, 33 kv. is generally adopted. In a paper by R. Dean read to the Institution of Electrical Engineers on May 15, the available data relating to rural design have been collected and the many numerical tables given will enable engineers to obviate many tedious calculations. Official regulations and a number of practical details in design are also given. For rural supply, it has been found that wood poles are the best. Both concrete and steel poles are about 12 per cent more expensive. The admissible factor of safety for wood poles has now been reduced to 3.5. At the time of constructing the 132 kv. grid, steel-cored aluminium was the most popular conductor to use, but the author's tables show that copper-cored steel or steel-cored copper provide rather cheaper lines. The requisite experience has not yet been obtained of the effects of electrochemical action on these lines after a number of years exposure to the weather. There are many subsidiary advantages in favour of steel-cored aluminium for high-voltage lines.

#### Prof. Patrick Abercrombie

THE University of Liverpool gave London its first professor of town planning in Prof. S. D. Adshad, who has held the chair of town planning in the Bartlett School of Architecture at University College since 1914. The University of London is fortunate in securing as his successor Prof. Patrick Abercrombie, who since 1915 has been Lever professor of civic design at Liverpool. During these last twenty years he has been engaged in educating town planners, and has himself been a leader in every movement for the improvement and preservation of town and country alike. His interest in planning is not confined to town and industrial areas: he was one of the three mainly concerned in the founding of the Council for the Preservation of Rural England, and his work there has shown the necessity of proceeding by country preservation to country planning, and finally to national planning. He has recently been appointed to prepare the plans for a national park in Snowdonia. The series of town planning schemes published by the University Press of Liverpool, the *Town Planning Review* started in 1910 and issued for the last twenty-five years under his editorship, form a fine written and pictorial record not only of the work of Prof. Abercrombie himself, but also of all those who have devoted themselves to these problems during recent years.

#### Health of the Army during 1933

LIEUT.-GEN. J. A. HARTIGAN, Director-General of the Army Medical Services, details in his first report, recently issued, the health of the Army at home and abroad for the year 1933. (H.M. Stationery Office. 2s. 6d. net.) The total strength at home and abroad was 184,000 men. The general health of all ranks fell little short of the high level reached in 1932, some increase in the admission rate being almost wholly accounted for by an increase in the incidence of

influenza. The chief causes of death were injury, tuberculosis, pneumonia and suicide, and of invaliding, tuberculosis and inflammation of the middle ear. Venereal diseases have again diminished, but tonsillitis still claims a number of victims and has slightly increased. The admissions for diphtheria show a welcome reduction, and it is remarked that at the depots at Caterham and Woolwich, where Schick testing and immunisation when necessary are carried out as a routine, the disease is practically non-existent. In addition to the statistics, details are given of the various measures that are being adopted at home and abroad for the prevention of disease.

#### Conference on Atmospheric Pollution

THIRTY-SIX representatives of local authorities and other organisations co-operating with the Department of Scientific and Industrial Research in the investigation of atmospheric pollution met on May 27 in the half yearly conference on atmospheric pollution at the offices of the Department. A report was received from Dr. G. M. B. Dobson on the progress of the researches carried out under the Atmospheric Pollution Research Committee. Dr. Dobson informed the conference that a full-time investigator has been appointed by the Department as a preliminary to the undertaking of an intensive survey, at a selected centre, of various types of pollution with a larger number of instruments. The method developed at the Building Research Station for estimating sulphur in the atmosphere is now being adopted more widely by the local authorities. Further experiments combined with weather observations are being taken in hand to facilitate the interpretation of the data collected by means of the deposit gauge observations.

#### Lister Institute of Preventive Medicine

At the general meeting of the members of the Lister Institute of Preventive Medicine, which was held on May 21, the governing body presented the Institute's forty-first annual report. This report contains an excellent summary of the important research work carried out in the laboratories and Serum Department during the past year. The amount of research seems to be more voluminous than usual, and the list of communications published occupies several pages. With the aid of a grant of £3,400 by the Rockefeller Foundation, a Svedberg velocity and equilibrium centrifuge is to be installed, a new and valuable equipment that should find useful application in protein, virus and other researches.

#### Czechoslovak Institute for the Study of Sound

AN institute for the study of sound has just been established in Prague under the management of Profs. K. Teige, M. Seemen and V. Vojtěch. The purpose of the institute will be to bring together scientific and practical workers to investigate sound in its physical, technical and physiological aspects. In pursuit of these aims it is proposed to arrange inquiries, excursions, lectures, both scientific and popular, and to carry out experiments and publish the results. The first important step to be taken in this connexion will be the equipment of a research

laboratory, and one of the first tasks of the institute will be to investigate noise and the methods of dealing with it. Another subject for early inquiry will be the technique of musical instruments.

#### Announcements

THE Langley Medal for aerodromics of the Smithsonian Institution was presented on May 21 to Dr. Joseph S. Ames, of Johns Hopkins University, who is chairman of the National Advisory Committee for Aeronautics. The award was made "in recognition of the surpassing improvement of the performance, efficiency, and safety of American aircraft resulting from the fundamental scientific researches conducted by the National Advisory Committee for Aeronautics under the leadership of Dr. Ames".

THE Executive Council of the Universities Bureau of the British Empire has had before it nine nominations from Conferences of Universities overseas for the Carnegie Corporation Grants to the value of £400 each for the year 1935-36. A Selection Committee scrutinised these nominations and on May 25 the Executive Council approved the decision of this Committee to award these grants to Prof. T. J. Haarhoff, of the University of the Witwatersrand, Prof. T. H. Laby, of the University of Melbourne and Prof. Meghnad Saha, of the University of Allahabad.

THE curators of the Dr. Martini fund have awarded the 1935 prize of 1,000 gold marks to Dr. Carl, a former assistant at the Friedrichberg State Hospital, and at present senior physician in the serological and bacteriological department of the hospital, for a work on adenylic acid metabolism in normal persons and the insane and in the brain of animals.

THE annual visitation of the National Physical Laboratory, Teddington, Middlesex, will take place on Tuesday, June 25, at 3-6 p.m.

AT the annual general meeting of the British Science Guild, to be held on June 12 at 4.30 p.m., a lecture on "Gas Defence" will be given by Mr. J. Davidson Pratt, general manager and secretary of the Association of British Chemical Manufacturers. The meeting will take place in the lecture theatre of the Royal Society of Arts, John Street, Adelphi, London, W.C.2, and tickets (for which there is no charge) may be obtained on application to the Secretary of the British Science Guild, 6 John Street, Adelphi, London, W.C.2.

THE fourteenth annual congress known as the Journées médicales de Bruxelles will be held at Brussels from June 29-July 3, that is, while the International Exhibition is still open. The inaugural address will be delivered by Prof. Loeper, of Paris, on music and medicine. The subscription is 100 francs. Further information can be obtained from the general secretary, Dr. René Beckers, 141 rue Belliard, Brussels.

MESSRS. WHELDON AND WESLEY have recently issued Catalogue No. 40 of books, periodicals and

pamphlets on geology, palaeontology, mineralogy and mining. Upwards of 1,300 items are listed, including many older works of historical interest. Among the periodicals may be mentioned an exceptionally long run of the *Annales des Mines*, from its commencement in 1795 (as the *Journal des Mines*) down to 1918. There is also listed a large number of the *Memoirs of the Geological Survey* of Great Britain, and of the bulletins and monographs of the United States Geological Survey. The pamphlets include many extracted from early volumes of the *Philosophical Transactions of the Royal Society*.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An engineer at the Building Research Station, Garston, near Watford—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (June 4). A lecturer in mechanical engineering in the St. Helens Municipal Technical School—The Secretary for Education, Education Office, St. Helens (June 7). A temporary demonstrator in botany in the University College of Wales, Aberystwyth—The Secretary (June 8). A lecturer in mining in the Heanor Mining and Technical School—W. G. Briggs, Director of Education, Derby (June 8). A lecturer in mathematics in Merchant Venturers' Technical College, Bristol—The Registrar (June 11). A junior in the Records Section of the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (June 11). A lecturer in the Department of Civil and Mechanical Engineering, King's College, Strand, London, W.C.2—The Secretary (June 12). A woman lecturer in biology and the teaching of biology in the Department of Education, University of Birmingham—The Secretary (June 13). A lecturer in mathematics, a lecturer in science and a lecturer in general education at the Royal Military Academy, Woolwich—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (June 15). A lecturer in mathematics, a lecturer in botany and a lecturer in physiology in the Chelsea Polytechnic, London, S.W.3—The Principal (June 15). A Curator of the Public Museum and Art Gallery, Hastings—The Director of Education, 18 Wellington Square, Hastings (June 15). A lecturer in physics and mathematics in the Northampton Polytechnic, St. John Street, London, E.C.1—The Principal (June 21). A lecturer in botany at the Imperial College of Science and Technology, London, S.W.7—The Secretary (June 22). An assistant lecturer in chemistry in the University of Sheffield—The Registrar (June 22). A lecturer in electrical engineering at Loughborough College—The Registrar (June 30). Two University demonstrators in pathology in the University of Cambridge—Prof. H. R. Dean (July 10). A part-time demonstrator in chemistry in the London (Royal Free Hospital) School of Medicine for Women—The Warden, 8 Hunter Street, Brunswick Square, W.C.1. A lecturer in civil engineering and building in the Portsmouth Municipal College—The Registrar.

## Research Items

**Human Skeletons at Hythe.** The skulls and long bones preserved in the ossuary of the church of St. Leonard at Hythe, which were examined by Prof. F. G. Parsons nearly thirty years ago, have been subjected to further study by Dr. G. M. Morant and Miss Stoessiger. As a supplement to their report, which appeared in *Biometrika*, 24, 1932, Dr. Morant has now published a general account of the origin, history and character of the collection so far as his research has carried him ("The History of the Human Skeletons preserved in the Ossuary of the Church of St. Leonard, Hythe." F. J. Parsons, Ltd. Pp. 41. 1s. 6d.). The place of their storage is neither crypt nor charnel-house, but a passage-way under the chancel, made when the church was enlarged in the early thirteenth century, to serve as part of the processional path. On the basis of the thigh-bones, the number of individuals represented is at least 4,000. Popular tradition attributes them to those slain in a battle fought in 456 A.D. between Britons and Saxons, or to Danes who landed in 843, or to French who raided the coast in 1295. An examination of the bones shows that they consist of an almost equal number of male and female and vary widely in range of age, children alone not being present. It is concluded that they are the remains of inhabitants of the parish, extending over a considerable period of time, placed in the church for safe keeping after inhumation. Anthropologically they present peculiar characteristics, for which the only known parallel in the British Isles is found in the skeletal remains of indeterminate age from Spitalfields in London, which were brought to light at the extension of the Fruit Market in 1926. This Spitalfields series bears a close resemblance to a series from Pompeii and to another of Etruscans of the Roman period from north Italy. Not only does the Hythe type resemble that of Spitalfields closely, but it is also closely allied to modern series from Bologna, Czechoslovakia and Rumania. The Spitalfields people were probably Roman inhabitants of London of Italian origin and it is, therefore, probable that the Hythe people are descendants of foreigners who settled in the locality in Roman times.

**Protective Habit of Desert Kangaroo Rat.** Seth B. Benson has observed that a desert kangaroo rat (*Dipodomys deserti*) brought into the neighbourhood of objects which it regarded with suspicion, kicked considerable volumes of sand upon them, apparently with the view of discovering whether they were alive (*J. Mamm.*, 16, 67; 1935). During a period of about five minutes, it skirmished in front of the objects (in this case a pile of bread crusts), and the skirmish ended with the rat turning about, kicking sand upon the pile with force and precision by using its hind legs, and immediately whirling about to watch the effect of its storming. This action was repeated half a dozen times. It explained why the author had previously found many of his small mammal traps set off and partially buried in the sand, because the amount of sand thrown and the force with which it was thrown were enough to effect these results. The suggestion is that this action is a defensive action likely to be of particular value against such an enemy as the sidewinder snake (*Crotalus cerastes*), which inhabits desert places and is known to feed upon kangaroo rats.

**Researches upon the Tubercle Bacillus.** Konrad E. Birkhaug describes in two lengthy papers observations upon the general characters of several strains of the tubercle bacillus (*Ann. de l'Institut Pasteur*, 54, No. 1, p. 19; No. 2, p. 195; 1935). Avian, bovine and human strains show little difference in morphological characters, but are liable to dissociate spontaneously into three types of colonies, the *Ch* (chromogenic), *R* (rough), and *S* (smooth). For the avian strain, the *S* variety is the dominant type, and *Ch* and *R* varieties are relatively rare. For the mammalian strains, the dominant type is the *R* variety, and the *S* and *Ch* varieties are rarer. These varieties are not stable, but frequently change one into another both *in vivo* and *in vitro*. The *Ch* and *S* varieties develop at laboratory temperature (20°-30° C.), but the *R* variety develops only at 37°-40° C.; none of them develops anaerobically. The *R* varieties of the avian and mammalian strains are more resistant to dyes and disinfectants than the *Ch* and *S* varieties, but the latter are more resistant to heat and light than the former. The *Ch* variety of both avian and mammalian strains are generally avirulent to animals.

**A Brown Rot Fungus.** The brown rot fungi of tree fruits have received considerable attention of late years. Various species of the genus *Sclerotinia* are the chief causal fungi, but a brown-spored discomycete, *Lambertella Corni-maris*, has recently been found to produce brown rot symptoms upon a variety of fruits and vegetables (T. H. Harrison and A. F. Helaly, *Trans. Brit. Mycol. Soc.*, 19, Part 3, 199-214, February 1935). Dr. Harrison made a tour of some of the fruit areas of western Europe in 1931, and found apothecia of a fungus upon mummified pears in Switzerland and south Germany. They seemed to be characteristic of *Sclerotinia cinerea*, but were identified by Mr. S. P. Wiltshire as the fungus named above. Dr. El-Helaly made cultural studies of the fungus, which tolerates a wide range of acidity, and produces fruit bodies upon a variety of media. It excretes pectinase and oxidising enzymes, and induces disease upon apple, pear, plum, quince, orange, lemon, turnip and parsnip.

**Insect Pests of Lavender.** Dr. H. F. Barnes, of Rothamsted Experimental Station, has recently published a discussion on "Lavender Pests" (*J. Roy. Hort. Soc.*, March 1935). Few caterpillars were known to attack this fragrant crop, but the present article describes no less than thirteen species which have used it for food. Most of the species are very general feeders, and the list includes such common moths as the buff and white ermines, the garden tiger, lesser yellow underwing and the cabbage moth. Excellent half-tone plates illustrate both the caterpillars and the moths bred from them. Each species is described in detail, and its host range is given. The dot, bright line brown eye, small angle shades, gothic, mouse, bearded chestnut, silver Y, and willow beauty moths have all been described, in addition to those mentioned above.

**Cosmic Ray Bursts and their Variation with Altitude.** The bursts of ionisation (Hoffmann *Stösse*) which are produced in a closed chamber, have been studied by C. G. Montgomery and D. D. Montgomery (*Phys. Rev.*, March 15) at stations the altitude of which lay

between sea-level and 4,300 metres. The bursts were observed with and without lead above the chamber. The rate of occurrence of bursts increases with height much faster than the total intensity of the cosmic rays. The frequency distribution of bursts of different size remains approximately constant. The authors interpret their results in terms of Swann's theory, according to which the number of non-ionising primary cosmic rays remains constant as they go through the atmosphere, producing bursts *en route*. The probability of burst production, however, decreases as the rays pass through the atmosphere. On this view the probability of burst production in lead must follow a different law from the burst production in air.

**Glare from Motor-Car Headlights.** The dangers of the dazzle produced by motor-car headlights at night have been well known to every motorist for many years, but no thoroughly satisfactory method of preventing it has yet been devised. In a report issued by the Department of Scientific and Industrial Research (Paper No. 16, "The Evaluation of Glare from Motor Car Headlights". London: H.M. Stationery Office, 1s. 6d. net) it is pointed out that many factors contribute to the problem of glare; it is therefore very difficult to make practical road trials to assess the merits of various devices. This report gives a scientific method of analysing the various contributing factors, a knowledge of which is essential before the relative merits can be adjudged of the various devices. The term 'glare' is used to denote the driver's power to detect objects ahead of him on the roadway. The principal factors involved in determining this power are the candle-power in the direction of the observer's eye of the approaching light, the relative positions of the two cars and the object to be detected, their speed and the reflection factor of the road surface. The results obtained enable a quantitative study to be made of the conditions of visibility in the cases of a simple headlight using no anti-dazzle device, a dipped and swivelled headlight and a headlight giving a flat-topped beam. A factor of primary importance is the threshold difference in brightness between an object and its surroundings. Owing to the absorption or scattering of light by the atmosphere, the threshold value depends largely on the presence of mist or fog. Unfortunately, this threshold value varies with the previous exposure to light of the observer's eyes. The methods described in this report should enable the existing types of headlight beam to be compared quantitatively, and should aid in the discovery of the best type of beam for universal adoption.

**Artificial Radioactivity Produced by Neutron Bombardment.** E. Fermi and his co-workers have published (*Proc. Roy. Soc., A*, April 10) an account of their further experiments on the production of artificial radioactivity by neutron bombardment, of which preliminary accounts have already appeared in Italian. The most interesting result is the enormous increase in the activation of many elements when a quantity of a hydrogen-containing substance such as water or paraffin wax is placed in the neighbourhood of the element and neutron source. Some elements do not show this increase of activation, but it is observed in every case where the product of irradiation is known to be isotopic with the original element. Fermi's explanation of this effect is the slowing down

of the neutrons by impacts with hydrogen nuclei. The slow neutrons are very effectively captured by atomic nuclei, giving rise to new radioactive nuclei. A number of experiments have been performed to elucidate this effect. It is shown that the slow neutrons are strongly absorbed by some elements; the nuclear cross-section of cadmium, for example, reaches the relatively enormous value of  $10^{-20}$  sq. cm. The capture of the slow neutrons is in some cases accompanied by a  $\gamma$ -radiation. Chadwick and Goldhaber have shown (see *NATURE* of January 12, 1935) that the capture results in the case of boron and lithium in the emission of particles of short range. Fermi attempted to find an effect on the activation due to varying the temperature of the hydrogen-containing block. Such an effect might be expected if the neutrons were slowed down to velocities comparable with thermal velocities. No temperature effect was found; but Fermi points out that this result is not quite conclusive about the final velocity of the neutrons [see also this issue of *NATURE*, pp. 903-5]. Experiments have been made on the scattering of the slow neutrons, and they show that once the velocity is reduced to values at which the high efficiency of capture appears, the scattering by hydrogen is also considerable, the mean free path being of the order of a few millimetres in water. A small increase in the activation is observed when other elements such as lead, silicon and carbon are used instead of water or paraffin, and the mechanism of production of slow neutrons seems in this case to be obscure. The paper contains also some theoretical considerations on the properties of slow neutrons, and a systematic account of the activation of a large number of the elements.

**Oxidation of Carbon.** A new method discovered in the Northern Coke Research Committee's Laboratory of evaluating metallurgical cokes was outlined in a paper before the Durham University Philosophical Society by Dr. H. L. Riley, the director, on May 10. It is well known that in reactivity to oxygen, charcoal stands at the head, and graphite (or diamond) at the foot of the series of fuels, with low temperature, gas, and metallurgical cokes between. Some precision has been given to such determinations by earlier work at the station leading to a quantity known as the 'critical air blast', which is the minimum current of air which will maintain the combustion of a standard coke sample. This value is of considerable value in the choice of cokes for the domestic fire. In experimenting with wet oxidation methods, it has now been found that determination of the carbon dioxide liberated on oxidation of a graded coke sample by means of a saturated solution of potassium dichromate in syrupy phosphoric acid is a valuable indication of the quality of coke for metallurgical purposes. The above order of reactivity is reversed, except that the position of wood charcoal is anomalous (sugar charcoal is unreactive), and also diamond. There appears to be correlation with the proportion of graphite present, retort carbon oxidising readily. It was suggested that the reactivity to oxygen depends on hydrocarbon impurities, whereas these are relatively stable to the wet method, while the latter attacks the long weak valencies (3.4 A.) between the layers of graphite in the crystal lattice. Further, the negative chromate ion must be supposed to attack the positive centres, which must be present since graphite is a conductor of electricity like a metal.

### The Art of Primitive Peoples

AN exhibition of the art of primitive peoples, which will remain open until the end of July, is now on view at the Burlington Fine Arts Club, 17 Savile Row, London, W.1. It covers a sufficiently wide field to afford an opportunity for comparing and contrasting the ideals and achievement of the aesthetic sense among peoples of a widely differing cultural history and geographical environment, and of estimating how far, if at all, a common element is to be discerned in the development of artistic principles in varied conditions of race, technical skill and material employed as the medium of expression. While technique varies considerably in the specimens shown in the present exhibition, it is striking at a first glance how little, relatively, the tools employed, whether of stone, shell or metal, affect the 'polish' of the finished product. Hence, while it is true that this collection contains some of the finest known examples of so-called primitive art—it is indeed a possible criticism of the exhibition that it includes so little that is crude, but at the same time scientifically instructive—the general level of execution is higher than might reasonably be expected. There are few specimens that fail to attain the highest possible degree of finish of which the artist's intention was susceptible. The decorative designs, for example, applied in Polynesia to nearly every object of wood, even in daily use, such as the paddle from Austral Islands (No. 132) or the Maori tattooed head (No. 261), though carved with stone or shell, are often so delicately executed as to have an apparent superficial texture of lacework.

The peoples whose art is illustrated in the exhibition are widely distributed geographically. Both in number and artistic achievement the exhibits from West Africa hold first place. The remainder of the exhibits are drawn mainly from the South Seas, the most important sections being that of New Guinea and the art of the Maoris of New Zealand; but the Solomons, Easter Island, the Sandwich Islands, the Marquesas and other groups are also represented. America has been expressly excluded, as an exhibition of American art was held by the Club a few years ago; but there are a few masks and other objects made by the Indians of the North-West Coast and a collection of Eskimo ivory carvings. One case contains a miscellaneous collection of objects from areas not represented elsewhere in the exhibition. Here some bone needle-holders from Borneo and New Guinea show an incised scroll pattern which, in the use of a south-eastern Asiatic foliate *motif* highly conventionalised, contrasts markedly with other exhibits.

In an exhibition of this kind it is difficult to keep the anthropological and the artistic interests nicely balanced, and the rarity or ritual purpose of certain objects may tend to absorb attention to the neglect of artistic merits. Such, indeed, may be the fate of the whole of the collection of objects from the Sepik River, New Guinea, lent by the University Museum of Archaeology and Ethnology, Cambridge, among which are the remarkable and unique ceremonial feather-covered boards, of which the longest is 4 ft. 9 in. long (No. 245), and the orator's stool, which is beaten violently while the orator speaks, but is never sat on (No. 33).

An exhibition of 292 items, each of which anthropologically or artistically—and usually on both counts—is a treasure, precludes any attempt at

detailed description. A bare mention of a few of the more striking specimens must suffice. The important exhibit of examples of West African art—statuettes and carvings in wood and ivory and castings in bronze—includes a number of examples of the well-known Benin art. The general character of this group of exhibits will not be entirely unfamiliar to the public, thanks to the recent exhibition of African art. Those, however, who know it only from the illustrations which appear in books on African art, can have little conception of the vitality and purpose, which override faults in proportion, according to European standards, when these examples are seen in the round. Among the more striking examples here are the Benin flute-player (No. 68) and the carved ivory mask from Benin (No. 110); but even more remarkable in its kind is the carved ivory sistrum with beaters, also from Benin. There is also a wonderful expression of purpose, which is emphasised by the disproportionately short legs of the figures, in the wooden head-rest supported on two females with arms entwined, from the Congo (No. 126). The list of examples deserving prolonged study might even be extended to the whole of this section, if other exhibits did not equally demand attention.

Though less spectacular, the small collection of Eskimo ivory carvings is one of the most attractive and arresting features in the exhibition. It consists of male and female figures, a mask, a number of toggles, arrow straighteners, amulets and bow-drills. All, but particularly the amulets and toggles in the form of seals, whales and other fauna, display a wonderful realism and appreciation of the niceties of animal forms. The gems of this collection, however, are the ivory bows for fire-drills (Nos. 48–55), which are covered with figures of animals or with hunting and fishing scenes incised in a space which, at most, does not exceed three-quarters of an inch in breadth. These pictures, minute as they are, are instinct with vitality, full of action, and almost photographic in their truth to life.

The exhibits from the South Seas, and especially the section devoted to the Maori art of New Zealand, includes some choice specimens; some are already well known, while others, such as the War God from Hawaii collected by Capt. Cook on his last voyage (No. 189), are of historic interest. The use of 'mother of pearl' as an inlay, especially in the human figure, is well illustrated in the Solomon Islands group, while of all the representations of the human form in this section, the emaciated figures from Easter Island, with their peculiar facial character, continue to arouse the most interest, and to prompt what is, unfortunately, in the circumstances, a not very profitable ethnological speculation. New Guinea, outside the Sepik River area already mentioned, is well represented in a number of specimens in which the ethnological interest is perhaps greater than the purely artistic. Among these are specimens from Dr. A. C. Haddon's collections from the Torres Straits.

The list of objects to which reference should be made is far from exhausted; but enough has been said to indicate the importance of the collection as a whole as a demonstration of the artistic capacity of those backward peoples, to whom few outside the ranks of the student are habituated to conceding recognition in this field of activity.

## Report of the Commissioners for the Exhibition of 1851\*

AMONG the manifold recollections aroused by the Royal Jubilee, it is fitting that we should spare a moment for a backward glance to that May day of eighty-four years ago, when a vast concourse of people from all parts of the world were thrilled by the opening of the Great Exhibition of 1851; and, therewith, a tribute to the potent and beneficent spirit of its creator, the Prince Consort. "A complete and beautiful triumph," wrote the Queen in her diary of the opening day, and it became evident in the course of the summer that the venture was to prove a financial triumph. Some weeks before the closing day, the Prince excogitated a scheme for the disposal of the surplus, which amounted to £186,000. Its leading ideas, as set out in a memorandum written by him at Osborne on August 10, were the purchase of the Kensington Gore estate and its use for perpetuating the objects of the exhibition, so "that the different industrial pursuits of mankind, arts, and science should not again relapse into a state of comparative isolation from each other".

The publication of the Commissioners' ninth report is well timed. The eighth was published in 1911, so that the present report covers almost exactly the period of the reign of H.M. King George, and it shows how during that period his grandfather's remarkable foresight has had an accumulative influence upon higher education and upon the progress of science and art. It expresses the belief that "the Kensington Estate to-day, with its Museums, Libraries, Teaching Institutions and Scientific Societies, fulfils in its range and completeness the aspirations of the Prince".

The policy of the Commissioners since 1911 has been guided by the decision then formed to spend no more money on buildings but to concentrate effort on subsidising youthful talent. It was in pursuance of this policy that they established the industrial bursaries, on which they now spend £3,750 a year, or more than a seventh of their income. They hoped thereby to bring the universities and their affiliated technical colleges into closer relation with scientific industry through introducing into industrial firms a larger proportion of men with a scientific training and outlook. The bursary is intended to make the holder independent of financial assistance from his parents during the period of his training and to remove any restriction upon his choice of occupation or place of abode, with suitable safeguards against the unfair exploitation of the scheme in the immediate pecuniary interests of the employer. In this way more than three hundred well-equipped young students have been helped into industry, and a number of the chief scientific and executive officers in the most important industrial concerns in Great Britain began their careers as bursars of the Royal Commission. Already fully 25 per cent of those employed in industry and the public services have been appointed to positions of considerable responsibility, while 13 per cent hold managerial or equivalent rank. Simultaneously "there has manifested itself a clearer appreciation of the benefits to be derived from a more liberal treatment of those in whose ranks are to be found many of our future captains of industry".

Another development since 1911 has been the

\* Ninth Report of The Commissioners for the Exhibition of 1851. Pp. 44. (London: Spottiswoode, Ballantyne and Co., Ltd., 1935.)

foundation of a postgraduate scholarship in naval architecture, the need for which had been pointed out by H.M. King George when he was president of the Commissioners. Practically all the scholars appointed are in permanent positions on the design, research and administrative staffs of industrial firms and Government institutions.

Science research scholarships were first instituted by the Commissioners in 1891 under a system which continued in force with excellent results for thirty years, in the course of which they were supplemented by other schemes modelled upon them by various bodies interested in the promotion of science. In 1921 it was recognised that the provision made by the Department of Scientific and Industrial Research for scholarships of the same type justified the Commissioners in leaving this field and launching a project whereby a smaller number of awards of much higher value (maximum £450 a year for two or three years) should be made to enable a few experienced research workers in the universities of Great Britain to continue their investigations untrammelled by routine tasks. These are known as senior studentships and they cost £5,250 a year. At the same time, the value of the awards to students from the Dominions was increased to £280 and these, the Overseas Scholarships, absorb £6,250. No important university in the Dominions is, the Commissioners observe, without its quota of professors and lecturers who owe their early training in research to these awards, and any additional funds placed at the Commissioners' disposal might advantageously be applied to extending their scope to include the more recently developed countries of the Empire, and in particular India.

A census taken some years ago showed that the 560 scholars appointed between 1891 and 1929 had already provided 16 vice-chancellors, principals or deputy principals, 144 professors and many more readers and lecturers on the staffs of universities and colleges, and more than two hundred held positions of the first rank in the public services and scientific industries of the Empire. No fewer than forty have already been elected to fellowship of the Royal Society.

H.M. Government has been so impressed by the high value of the Commissioners' educational schemes that it has agreed to release them from further liability, under an offer made by them before the general trend of their policy was changed in the direction already indicated, to contribute £100,000 (of which £35,000 has already been paid) towards the cost of new buildings for the Science Museum, South Kensington.

### East Anglian Herring\*

THE Buckland Lectures for 1933 were given by Dr. W. C. Hodgson and forecast the publication of researches of great scientific interest relating to the East Anglian herring. They are the result of the team work of the scientific staff of the Ministry of Agriculture and Fisheries, and are quite sufficient in themselves to justify the foresight of the Ministry in the establishment of its laboratory at Lowestoft, in which such team work could be developed.

The working out of ring groups in the herring catch, as shown in the rings of the scales, is carried much further and furnishes exact percentages,

\* The Natural History of the Herring of the Southern North Sea being the Buckland Lectures for 1933. By Dr. William C. Hodgson. Pp. 120. (London: Edward Arnold and Co., 1934.) 3s. 6d. net.



founded at last on sufficiently large samples. The group of each year, estimated on its year of birth, is charted, and the fish are measured, thus giving a complete record of the changes in size of the herrings from year to year. There was a rich brood born in 1915, and this richness continued every third year, until there were lapses in 1930 and 1933. A good crop of certain small crustaceans (especially *Calanus*) as food, concentrated in a small area, was found to produce a good fishery, the drift net method of fishing requiring a concentration of fish. A plankton indicator, showing the presence of these copepods, in the hands of one experienced master mariner, became a catch indicator, the presence of *Calanus* meaning a trebling of the catch. On the other hand, the presence of a flagellate (*Phaeocystis*) or of certain diatoms (*Rhizosolenia*, *Biddulphia*, etc.) drove away the herrings from the ground, and even altered their line of migration. Thus in 1933 the East Coast drifters had to make long voyages to the north-east to find the herrings, and the cause proved to be an enormous belt of phytoplankton across the southern bight of the North Sea, *Rhizosolenia* to the west and *Biddulphia* to the east, both equally distributed from the surface to the bottom of these shallow waters.

Other interesting observations relate to the correlation of the heaviest commercial catches with the periods of full moon, thus obviously not tidal phenomena. Between the peaks of the curves are very definite troughs, the difference in the average landings varying from 60 to about 15 crans (see NATURE, 135, 157, Jan. 12, 1935).

There is much more, the indication being that the North Sea will be farmed internationally, if human population increases. For this the British team is obviously supplying data, while contemporaneously producing scientific results of a class of which the lone research student can never dream. At the same time the lack of a market for the herring, our most valuable and cheapest food fish, discourages further research. Here is another team work job, this time for the Food Production Division of the Department of Scientific and Industrial Research, so that the herring may be proffered to the public in a good variety of palatable forms throughout the whole of the calendar year.

### University and Educational Intelligence

CAMBRIDGE.—The Managers of the Balfour Fund have made a grant of £50 to G. J. Kerrich, of Christ's College, for researches on the palæarctic fauna of the north of Finland.

The General Board recommends that an assistant directorship of research in physics be established from October 1 in view of the reorganisation of the teaching staff in the Department of Physics at the end of the present academical year.

Graces will be submitted to the Senate recommending the conferment of the degree of M.A. (*honoris causa*) on Mr. E. A. B. Barnard and Dr. W. M. Palmer. Mr. Barnard is secretary of the Cambridge Antiquarian Society. He has rendered great service to the Corporation of Cambridge by calendaring in collaboration with Dr. Palmer its collection of medieval manuscripts.

Dr. A. C. Haddon's eightieth birthday was marked by the presentation by his friends of a cabinet containing his collection of ethnographical photographs. Dr. Haddon is handing over the collection

to the Board of Archaeology and Ethnology to make it available for instruction and research.

GLASGOW.—Prof. Thomas Alty, research professor of physics in the University of Saskatchewan, has been appointed Cargill professor of applied physics. The Cargill chair is the junior chair in the Department of Physics, or Natural Philosophy as it is still termed in the Scottish Universities, and is concerned with the instruction of students proceeding to the various degrees involving applied science such as engineering, applied chemistry, pharmacy, medicine and agriculture. Prof. Alty received his early training in the University of Liverpool, where he had a distinguished career, and thereafter worked at Cambridge under Sir J. J. Thomson. While at the Cavendish Laboratory he carried through the admirable research on the cataphoresis of gas bubbles in water which gained him his degree of Ph.D. His subsequent published work deals with such subjects as the surface structure of liquids, the interchange of molecules and energy between a liquid and its vapour, the electric properties of surfaces and the theory of surface diffusion; while as regards industrial applications of physics he has interested himself especially in the application of electrical methods to the location of underground accumulations of oil, water, metals, rocksalt, etc. Prof. Alty takes with him to Glasgow a high reputation as a teacher both in the laboratory and the lecture room.

The University Court has now, after long but unavoidable delay, been able to bring into being the Tennent chair of ophthalmology to which it was decided in 1916 to devote a bequest of £25,000 by the late Dr. Gavin P. Tennent. As first holder of the chair, Dr. A. J. Ballantyne has been appointed, after a distinguished tenure of the University lectureship on ophthalmology since 1920.

LIVERPOOL.—Associate Professor James Rice has been appointed to a readership in theoretical physics. Mr. Rice was one of the first men in England to grasp the significance of Einstein's principle of relativity and theory of gravitation, and his academic work on this subject was one of the earliest expositions in English. He has interested himself in the theoretical aspects of atomic physics and the quantum hypothesis, while his book "Statistical Mechanics" is a standard work dealing with the fundamental theoretical methods by means of which the complex phenomena of the atomic world are rendered amenable to mathematical treatment.

Dr. Norman Feather has been appointed to a lectureship and Leverhulme Foundation fellowship in the Department of Physics as from October next. Dr. Feather was a scholar of Trinity College, Cambridge and is at present attached to the Cavendish Laboratory, Cambridge. He is already well-known for investigations on neutrons and related topics in atomic physics.

At a Congregation on May 24 the honorary degree of LL.D. was conferred upon the following, among others: Prof. Arthur Harden, formerly director of biochemistry at the Lister Institute, London; Mr. C. Thurstan Holland, formerly lecturer in radiology, University of Liverpool, president of the first International Congress of Radiology; Dr. N. V. Sidgwick, president of the Chemical Society; and Prof. Alan J. B. Wace, professor of classical archaeology, University of Cambridge.

LONDON.—Prof. J. A. S. Ritson, professor of mining in the University of Leeds, has been appointed to the University chair of mining tenable at the Imperial College (Royal School of Mines) from January 1, 1936.

OXFORD.—Prof. Julian Huxley has been granted the degree of D.Sc.

Mr. A. J. Ayer has been elected to a research studentship (that is, fellowship) at Christ Church. In addition to problems in formal logic, Mr. Ayer is working on the philosophy of science.

## Science News a Century Ago

### An Inventor of the Screw Propeller

On June 1, 1835, Thomas Charles Auguste Dallery, one of the inventors of the screw propeller, died at Jouy-en-Josas, near Versailles. Born at Amiens on September 4, 1754, he showed a great aptitude for mechanics, and succeeded to his father's business of an organ builder. Just before the French Revolution, he was commissioned to build an organ worth 400,000 francs for the cathedral of his native city, but the order was cancelled. He afterwards turned his attention to steam navigation, and in 1803 constructed at his own expense a steam-boat driven by a screw or *escargot* as he called it. The vessel was launched on the Seine at Bercy; but, like the attempts of so many other pioneers, Dallery's efforts proved a failure. His patent included several innovations besides the screw, among them being a boiler with vertical tubes. Nine years after his death a commission of the Paris Academy of Sciences, composed of Arago, Dupin, Morin and Poncelet, examined the claims of the Dallery family in regard to his inventions, and reported favourably on them.

### South American Deserts

In his "Journal" of his journey northward from Coquimbo to Copiapó, where Capt. FitzRoy had offered to pick him up, Darwin records on June 3, 1835: "Yerba Buena to Carizal. During the first part of the day we crossed a mountainous rocky desert, and afterwards a long deep sandy plain, strewn with broken sea-shells. There was very little water, and that little saline; the whole country, from the coast to the Cordillera, is an uninhabited desert. I saw traces only of one living animal in abundance, namely, the shells of a *Bulimus*, which were collected together in extraordinary numbers on the driest spots. In the spring one humble little plant sends out a few leaves, and on these the snails feed. As they are seen only very early in the morning, when the ground is slightly damp with dew, the Guasos believe that they are bred from it. I have observed in other places that extremely dry and sterile districts, where the soil is calcareous, are extraordinarily favourable to land shells".

### Earthquakes in Sussex

At a meeting of the Royal Society on June 4, 1835, the secretary, Dr. P. M. Roget, read a "Report of a Committee for collecting Information respecting the Occurrence of, and the more remarkable Phenomena connected with, the Earthquakes lately felt in the Neighbourhood of Chichester", which had been sent to him by J. P. Gruggen. "This paper," said the *Philosophical Magazine*, "contains an authentic report of several shocks of earthquake

which, during the last two years, have been felt at Chichester and the surrounding country; drawn up from accounts given by various correspondents, in answer to printed queries extensively circulated. The first shock occurred on the 18th of September and the second on the 13th of November 1833. Another and more severe shock was felt on the 23rd of January 1834, and in the latter end of the same year two slighter shocks were experienced, namely, one on the 27th of August, and the next on the 21st of September; the last, which was less than any of the former, took place on the 12th of January 1835."

### The Process of Malting

Among the original contributions to the *Records of General Science* of June 1835 was an article by Prof. Thomas Thomson and Dr. Andrew Steel on the "Chemical Analysis of Gadolinite together with an Examination of some of the Salts of Yttria and Cerium", and another "On Malt", by the editor, Dr. R. D. Thomson. In the course of his article, Dr. Thomson said: "The process of malting consists essentially 1st in producing a change in the constituents of grain by inducing germination; and 2nd in stopping the vegetation when it has been carried to a certain extent by exposure to heat". The subject was one which was exciting some interest at the time and Dr. Thomson added: "A knowledge of the peculiarities of this interesting process is important in a double point of view, because it affords a remarkably beautiful specimen of the chemistry of nature, and because its product forms a staple commodity of British manufacture, no less than forty millions of bushels of malt being annually consumed in the United Kingdom, which at 60s. per quarter, exceeds in value the large sum of £24,000,000 and contributes to the Government at 2s. 7d. per bushel more than £5,000,000 per annum".

## Societies and Academies

### DUBLIN

Royal Irish Academy, May 13. WILLIAM J. McCALLIEN: The metaphorphic rocks of Inishowen, Co. Donegal. The nature and distribution of the following subdivisions of the Dalradian rocks of Ireland were described; Malin Head quartzite (oldest), Glengad schists, Linsfort black schists, Stragill calcareous schists, Crana quartzite, Culdaff limestone, Inch Island limestone group, Fahan slates and grits, Inishowen green schists, grits and phyllites. The suggested correlations with the Scottish Dalradians indicate that the first four of these divisions belong to the Islay sequence and that the overlying groups belong to the Lough Awe succession.

### PARIS

Academy of Sciences, April 15 (*C.R.*, 200, 1373-1444). MARCEL DELÉPINE: The trichlorides of III. iridium-aquo-dipyridine,  $\text{Ir}(\text{H}_2\text{O})\text{Py}_2\text{Cl}_3$ . LAUGE KOCH was elected *Correspondant* for the Section of Geography and Navigation. MAX SERRUYS: The extension of the theory of nuclear inflammation to the case of injection motors. VINCENT NECHVILE: The dissymmetry of stellar movements and a method for the determination of the apex of the sun and of the vertex of the ellipsoid of velocities. SANTIAGO ANTUNEZ DE MAYOLO: The electromagnetic field and quanta. JEAN VILLEY: The classification of energy losses according to the types of irreversibility.

GASTON DUPOUY : The constitution of paramagnetic bodies. Points of transformation. P. GOLDFINGER and W. JEUNEHOMME : The hydration of the  $D^+$  ion in heavy water and the dissociation of the deuteroacids. SERGIO DE BENEDETTI : The production of positrons in different elements. HENRI MULLER : The lowering of the eutectic point of ice - potassium sulphate. PIERRE BRUN : The electrical phenomena accompanying the formation of organo-magnesium compounds. The solution of a metal in an alkyl halide, leading to the formation of an organo-metallic compound, is a phenomenon comparable with the solution of a metal in an electrolyte. STÉPHAN PROCOPIU and D. UMANSCHI : The existence of superficial layers on iron shown by the electromotive force of the metal plunged in water. JEAN CHÉDIN : The Raman effect in mixtures of sulphuric and nitric acids. HENRI FOURNIER : The variations of mechanical properties observed in an aluminium-magnesium alloy as a function of the refining. MLLÉ. MARIE LOUISE DELWAULLE : The system bismuth iodide, sodium iodide, water. ANDRÉ BOULLÉ : The action of water on the anhydrous sodium metaphosphates. OSIAS BINDER and PIERRE SPACU : Contribution to the study of some complex sulphocyanides of iron with pyridine. HENRI MOUREU and PAUL ROCQUET : The mechanism of the action of liquid ammonia on phosphorus pentachloride. The primary product is the pentamide,  $P(NH_2)_5$ . This has not been isolated but its existence and constitution have been proved. MARCEL FRÈREJACQUE : The polarimetric determination of mannitol. The process is based on the formation of the molybdate acid complex with the resulting increase in rotatory power. PAUL CORDIER : Phenylpyruvic acid: the study of its condensation product with benzyl cyanide. LOUIS BLANCHARD and RAYMOND PAUL : The symmetrical pentanetriol,  $OH.CH_2.CH(OH).CH_2.CH_2(OH)$ . ANDRÉ GUILLEMONAT : Oxidations of 1.ethyl.1.cyclohexene and 2.methyl.2.butene by selenium dioxide. MARCEL TUOT : Some bromine derivatives of the  $C_8$  to  $C_{11}$  olefines. HENRI VINCIEU : The extension and the stratigraphic position of banks with Stromatoporoids in the west of the southern Jura, in the neighbourhood of Villereversure. MARCEL GESLIN : The partition coefficient of radon between the spontaneous gases and the water of the springs. MLLÉS. EDNA HARDE and ANNIS E. THOMSON : Vitamin C and alexin. Evidence suggesting that alexin may be a compound of ascorbic acid and proteins and perhaps also of lipoids. JEAN RÉGNIER and ROBERT DAVID : The influence of the anion combined with the base cocaine on the anæsthetic activity of this alkaloid. The anæsthetic values found range from 0.2 for the citrate to 12 for the phenylacetate, the chlorhydrate being taken as unity. DANIEL GARDNER and MLLÉ. MARIA LUCIANA CASELLI : The biological properties of carvacrol. PAUL WINTREBERT : The unity of development and birth of individuality in the physiological epigenesis of Amphibians. FRED VLÈS and ANDRÉ DE COULON : The appearances of spontaneous cancers in raising mice on the ground, in relation with the differences of cage and earth potential. RAYMOND LATARJET : The influence of variations of atmospheric ozone on the biological activity of solar radiation. In treatment with sunlight it is not sufficient to base the calculations on hours of exposure. Owing to the variations in solar activity, some kind of physical measurement, such as a photo-electric cell, is necessary. YERVANTE

MANOUÉLIAN : Syphilitic placentas: small forms of the treponeme and syphilitic ultra-virus. BARUCH SAMUEL LEVIN : The purification of lymph with the aid of X-rays. The virus used in vaccination against small-pox resists X-ray doses many times larger than those killing *Staphylococcus*. Experiments are described showing that ordinary lymph can be rendered free from organisms by X-rays in suitable doses without losing its physiological properties. GEORGES DJIAN : A method of kinematographic radioscopy.

## BRUSSELS

Royal Academy (*Bull. Classe. Sci.*, 31, No. 3, March 2, 1935). G. CESÀRO : Some remarks on hyperbolic arcs. Elementary relations between hyperbolic and circular functions are discussed. P. STROOBANT : Report on the work of the National Astronomical Committee during 1934. G. BOULINGAND : Stability of mathematical propositions. The logic of mathematical propositions; definitions of the terms 'stable' and 'unstable' and applications. M. WINANTS : Hyperbolic equation of the third order with constant coefficients and of category III: solution of Cauchy's problem by the method of successive approximations. L. MARTIN : On the exchange property of Riemannian functions relative to linear systems of the second order of two independent variables and referred to their characteristics parallel to the axes. L. LACREMANS : On a birational transformation of space considered by Caporali. H. GEIRINGER : A new method of theoretical statistics (problem of two dimensions) (2). H. SELIGMAN : Report on the work of the National Committee for Geodesy and Geophysics during the years 1931-34. MARIA J. LEJEUNE : First trials of a radiographic study of the skeleton of actual Hexacoralla. X-ray photographs furnish information on the skeletons of these animals without the necessity of first removing and so destroying the soft parts.

## VIENNA

Academy of Sciences, March 14. OTHMAR RUTHNER and JULIUS ZELLNER : Chemistry of the higher fungi (23). *Geaster fimbriatus*, Fr. and *Polystictus velutinus*, Pers. The first of these contains ergosterol, fatty acids, mannitol, traces of urea, and a polysaccharide; the second contains the magnesium salt of a new, crystalline acid, a cerebrin-like substance, ergosterol, mycose, solid and liquid fatty acids, a tannoid material, glucose, choline and a water-soluble polysaccharide. JULIUS ZELLNER : Chemistry of the lichens (4). *Gyrophora Dillenii*, Müll. Arg. and *Parmelia furfuracea*, L. The first of these, an American lichen, contains ergosterol, carotene-like substances, fatty acids, gyrophoric acid (probably also lecanoric acid), mannitol, glucose, lichenin and another similar polysaccharide. From the second, ergosterol, fatty acids, atranorin, physodic acid, resinous materials, erythritol, lichenin and another similar polysaccharide were obtained. WILLIBALD JENTSCHKE : Ionisation measurements on separate  $\alpha$ -rays. By means of the double tube electrometer, which allows of the measurement of the ionisation of separate corpuscular rays, the ionisation per mm. of air for polonium and thorium  $C'$   $\alpha$ -particles has been determined. By simultaneous double registration of a single ray, the range and specific ionisation at the relevant point of the path were ascertained independently of one another. RAIMUND SCHIEDT : Method of counting the  $\alpha$ -particles emitted by uranium. The arrangement used is based on the

principle of the tube electrometer, and permits of proportional strengthening of the primary ion quantities. EUGEN GUTH and HERMANN MARK: Application of inner-molecular statistics to the properties of long-chain, especially highly polymeric, substances. Consideration of the stretch curve and the thermodynamic behaviour of rubber indicates that the extraordinary reversible elasticity of rubber is a consequence of the flexible long chains of which it is composed. The elasticity of aliphatic chain-like compounds, especially long-chain oils, disappears on passing to structures with numerous side-chains, which prevent free rotation, and is lacking also with systems consisting mainly of aromatic components. The elasticity of sulphur is also explainable by the presence of chain-like molecules; solid crystalline sulphur, on the other hand, consists of ring-shaped molecules of the formula  $S_8$ .

March 21. KARL METZ: Choristites from the Carinthian Alps. Several species of this sub-genus of the brachiopod family Spirifer from the upper carbonaceous of the Carinthian Alps are described. RAIMUND SCHIEDT: The number of  $\alpha$ -particles emitted by radium. Counts were made with two  $U_3O_8$  preparations of different uranium contents by means of the arrangement recently described. FRIEDRICH HECHT: The uranium contents of the  $U_3O_8$  preparations were determined. FRIEDRICH HERNEGGER and BERTA KARLIK: The determination of very small amounts of uranium, and the uranium content of sea-water. A spectrographic method, making use of the fluorescence of uranium in sodium fluoride, was used. The water of the Scandinavian coasts contains from  $3.6 \times 10^{-7}$  to  $2.3 \times 10^{-6}$  gm. uranium per litre. LAMBRECHT WISSGOTT: Mass spectrum of the positive rays of radium C'. OSWALD RICHTER: Induction of the destruction and maintenance of chlorophyll and of assimilation by ultraviolet rays of less than  $300m\mu$  from very powerful quartz mercury lamps. RUDOLF INZINGER: Geometry of torsos. ERNST PETER PICK: Transference of high and low blood-pressures. ARMIN DADIEU and HANS KOPPER: Raman spectra of heavy hydrocyanic acid and heavy hydrogen sulphide. The frequency of the C:N band falls from  $2,094 \text{ cm.}^{-1}$  in HCN to  $1,906 \text{ cm.}^{-1}$  in DCN; that of the D-C band in DCN remains to be determined.  $D_2S$  shows a single strong Raman line at  $1,875 \text{ cm.}^{-1}$ . VIKTOR PIETSCHMANN: A new family of eels from Hawaiian waters. *Heteromyrus atolli*, nov. gen., nov. spec., is described.

### Forthcoming Events

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

Sunday, June 2

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "British Birds".

Wednesday, June 5

GEOLOGICAL SOCIETY, at 5.30.—Prof. J. S. Lee: "The Tectonic Pattern of China and its Bearing upon the Problem of Continental Movement".

Thursday, June 6

ST. MARY'S HOSPITAL, LONDON, at 5.—Sir Henry H. Dale: "The Active Substances in Ergot: a Thirty Years' Review".\*

CHADWICK PUBLIC LECTURE, at 5.—(at The Chelsea Physic Garden, Swan Walk, S.W.3).—Sir E. John Russell: "Modern Changes in Food Production".\*

### Official Publications Received

#### GREAT BRITAIN AND IRELAND

The Entrance to Industry: a Survey of Contact between Education and Industry in Great Britain, together with Proposals for raising the School Leaving Age and for Part Time Continued Education until 18, presented as a Contribution towards a New Employment Policy by P.E.P. (Political and Economic Planning). Pp. 56. (London: P.E.P.) 1s.

The Exit from Industry: a Survey of the Provision for Old Age and for Retirement from Gain Occupation in the United Kingdom, together with Proposals for a National Retirement Pensions Scheme, presented as a Contribution towards a New Employment Policy by P.E.P. (Political and Economic Planning). Pp. 52. (London: P.E.P.) 1s.

Public Museum, Gloucester. Occasional Papers, No. 2: Second Catalogue of Potters' Stamps on Terra Sigillata found in Gloucester. By Charles Green. Pp. 12+1 plate. (Gloucester: Public Museum.) 6d.

Society for the Preservation of the Fauna of the Empire. Occasional Paper No. 4: Report on the Vertebrate Fauna of the Owerri Province of Nigeria. By I. R. P. Heslop. Pp. 82+iv. (London: Society for the Preservation of the Fauna of the Empire.) 4s. 6d.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1619 (Strut. 197): Torsion of a Rectangular Tube with Axial Constraints. By D. Williams. Pp. 30+8 plates. 1s. 6d. net. No. 1622 (T. 3535): Flow in the Boundary Layer of Streamline Bodies. By H. M. Lyon. Pp. 54+26 plates. 3s. net. No. 1628 (F.M. 153 and 'a'): Direct Calibration of Compensated Hot-Wire Recording Anemometer. By C. Salter and W. G. Raymer. Pp. 9+7 plates. 9d. net. (London: H.M. Stationery Office.)

Imperial Institute. Annual Report 1934, by the Director, Sir Harry A. F. Lindsay, to the Board of Governors. Pp. 56. (London: Imperial Institute.) 2s.

Report of the Conference of Representatives nominated by the Universities of Oxford, Cambridge and London, the Royal College of Physicians of London, the Royal College of Surgeons of England, and the Society of Apothecaries of London, on the Medical Curriculum. Pp. ii+34. (London: University of London.)

#### OTHER COUNTRIES

Publikationer fra det Danske Meteorologiske Institut. Aarboeg. Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1934. Pp. 15+5 plates. (København: G. E. C. Gad.)

Koninklijk Nederlandsch Meteorologisch Instituut. No. 106A: Ergebnisse Aerologischer Beobachtungen, 22, 1933. Pp. iv+40+3 plates. 1.50 fl. 22A: Aerologische Beobachtungen und Terminbeobachtungen in Angmagssalik während des Internationalen Polarjahres 1932-1933. Pp. v+19+1 plate. 0.70 fl. No. 108: Seismische Registrierungen in De Bilt, 20, 1932; mit einem Anhang: Die Erdbeben in Noordbrabant von 20-28 November 1932. Pp. viii+52. 0.70 fl. ('s Gravenhage: Rijksuitgeverij.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87. Descriptions of Middle American Land and Freshwater Mollusca. By Henry A. Pilsbry. Pp. 6+1 plate. Tertiary Freshwater Mollusks of the Magdalena Embayment, Colombia. By Henry A. Pilsbry and Axel A. Olsson; with Tertiary Stratigraphy of the Middle Magdalena Valley, by O. C. Wheeler. Pp. 7-39+plates 2-5. Description of a New Scorpaenoid Fish (*Neomerinthe hemingwayi*) from off New Jersey. By Henry W. Fowler. Pp. 41-43. (Philadelphia: Academy of Natural Sciences.)

Division of Fish and Game of California: Bureau of Commercial Fisheries. Fish Bulletin No. 43: The Sizes of California Sardines caught by the different Fishing Gear and in the different Localities of the Monterey and San Pedro Regions. (Contributions No. 113-114 from the California State Fisheries Laboratory.) Pp. 59. (Terminal Island, Calif.: California State Fisheries Laboratory.)

U.S. Department of the Interior: Office of Education. Pamphlet No. 59: Legislation concerning Free Textbooks. By Ward W. Keeseecker. Pp. 16. (Washington, D.C.: Government Printing Office.) 5 cents.

Fifty-first Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1933-1934. Pp. 8. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture. Circular No. 332: General Information about the Japanese Beetle in the United States. By C. H. Hadley and I. M. Hawley. Pp. 23. (Washington, D.C.: Government Printing Office.) 5 cents.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 118: JS-Diagrams for Combustion Gases of Rich Mixture. By Keikichi Tanaka and Seichi Awano. Pp. 495-528+11 plates. (Tôkyô: Kôgyô Tôsho Kabushiki Kaisha.) 1.35 yen.

The Parliament of the Commonwealth of Australia. Eighth Annual Report of the Council for Scientific and Industrial Research for the Year ended 30th June 1934. Pp. 77. (Canberra: Government Printer.) 3s. 4d.

#### CATALOGUES

Sotheran's Price Current of Literature. No. 843: Annotated Catalogue of Works on Mathematics, Astronomy and Physics. Pp. 160. (London: Henry Sotheran, Ltd.)

Aceetylcholine B.D.H. Pp. 8. (London: The British Drug Houses, Ltd.)

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