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Vol. 145, No. 3677

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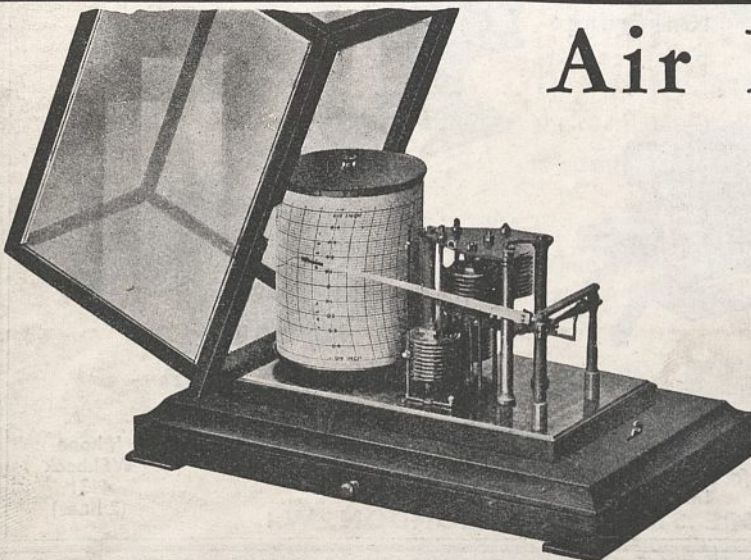
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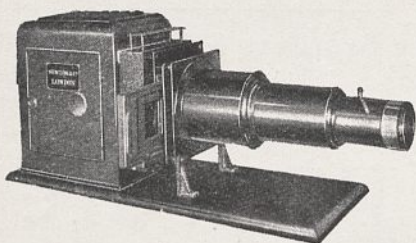
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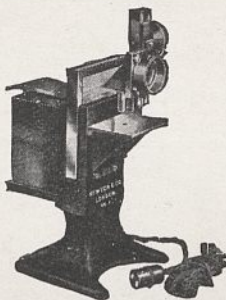
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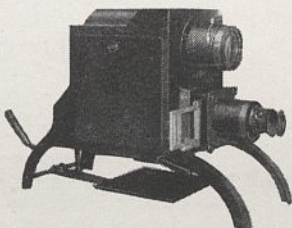


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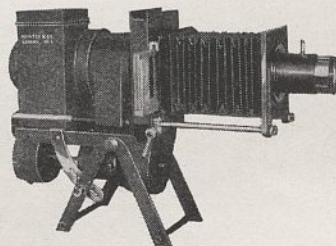


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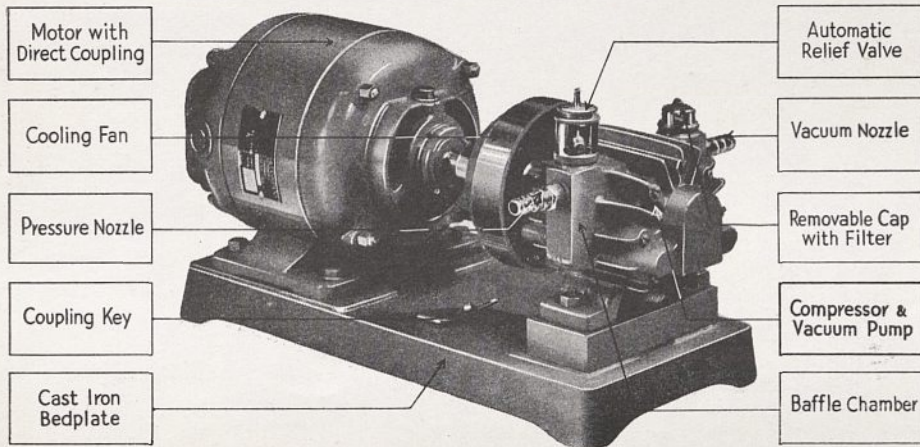
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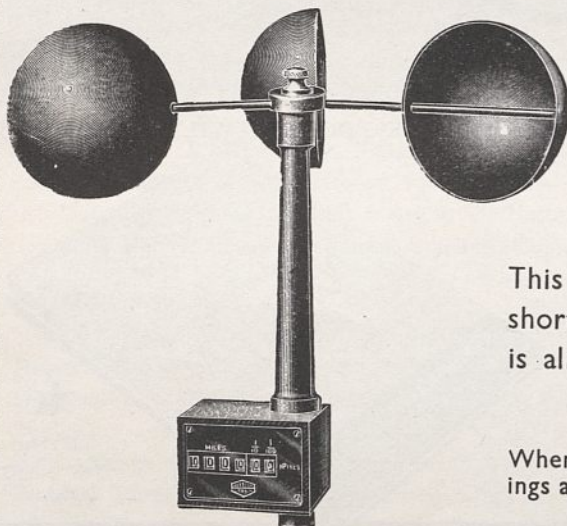
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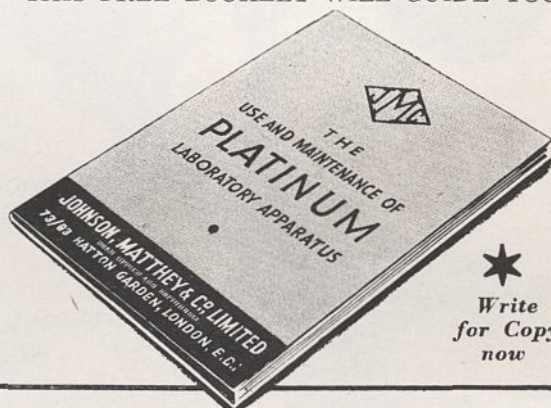
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LOCATION OF INDUSTRY IN GREAT BRITAIN

THE Royal Commission on the Distribution of the Industrial Population, under the chairmanship of Sir Montague Barlow, was appointed in July 1937, mainly in consequence of the concern at the slow recovery of the Depressed Areas and the steady drift of population to London and the Home Counties. The views so strongly expressed by successive Commissioners for the Special Areas, without apparent effect, had by then been powerfully reinforced by defence considerations. The strategical dangers to which the whole country was exposed by over-development in its most vulnerable part could no longer be ignored, and the possibility of experimenting in national planning had at last to be considered seriously by the Government.

When the Royal Commission was appointed, an inquiry into the location of industry undertaken by a group of Political and Economic Planning had already reached an advanced stage. The latter inquiry, in view of its relation to the work of other P E P groups, was nevertheless carried to a conclusion and its report was published in March of last year. It is not surprising, therefore, that the recently published report of the Royal Commission, a summary of which appears elsewhere in this issue, provides little additional information, but nevertheless it gives us an able and well-balanced survey of the situation.

Both in the basic facts which are set forth and in the conclusions and recommendations deduced from them, the two reports have much in common. Where the Planning Group of P E P recommends the creation of a permanent Industrial Development Commission for the specific purpose of guiding the location of industry and advising the Government on the subject, the majority report of the Royal Commission recommends the appoint-

ment of a National Industrial Board, with mainly advisory powers except in regard to regulation of industrial location in London and the Home Counties. There is, however, a wide divergence of opinion among the members of the Royal Commission in regard to the functions to be exercised by the central authority. Three of the ten members who sign the majority report do so with reservations which would bring the functions of the proposed Board closely into line with those of the Development Commission recommended in the P E P report. The remaining three members of the Commission go even beyond the P E P report, which suggested that a senior Cabinet Minister without departmental duties should be responsible to Parliament for the activities of the Commission, and recommend the establishment of a new ministry, taking over not only the functions of the Commissioners for the Special Areas, but also some of the functions of the Ministry of Health and Ministry of Transport.

This sense of urgency and note of conviction, which characterize both the reservations and the minority report, give a value and reality to the outcome of the Commission's labours which would otherwise be sadly lacking. Without them it could scarcely be said that the report does more than give us a fresh and convenient presentation of facts already widely known, leading to conclusions previously reached by many thoughtful observers and students of problems of industrial location or planning. The bare majority of the Commission appears to falter just where decision and action are most needed, and the ably argued reservations of Prof. J. H. Jones, Mr. G. W. Thomson and Sir William Whyte in the minority report are likely to carry much more conviction with scientific workers.

The signatories of the minority report regard the excessive concentration of population in London and other large conurbations as more a symptom of the main disease than as an evil in itself, although socially and strategically they agree with the other commissioners that it is an evil which requires remedying at the earliest possible moment. They urge, therefore, that positive action by way of regulating new industrial development throughout Great Britain is a more essential and effective way of treating the problem than simple restriction of the industrial growth of a particular area. A beginning must be made in treating the country as a social and economic unit as well as a political unit.

The logic of such a policy can scarcely be denied if there be agreement on the basic facts from which it is derived. Moreover, only continuous study by the new Board of the problem of achieving a well-balanced industrial society can obviate the creation or perpetuation of areas of great distress in the near future. The facts assembled in the report should finally dispose of any lingering contention that we can rely on unguided or uncontrolled private industry in such matters without detriment to the social, economic, and strategic interests or amenities of the nation. The unassailable fact demonstrated by this report, like that of the P E P report, is that apart altogether from the difficulties and complications of co-ordination and clashing of interests, neither the industrialist nor the individual Government department has usually anything like the amount of information required for a sound decision as to location. Decisions based on a partial knowledge of the facts have been invalidated by unforeseen developments elsewhere with consequences no less disastrous to the enterprise itself than to the district and community in which it was mistakenly placed.

For such reasons as these there is general agreement that a beginning should be made with London; but the experience gained with restrictive powers in that region should be used from the start as a guide in preparing a scheme to be applied to the whole of Great Britain. No district should be considered or dealt with other than as one part of a national problem, and the whole experience of the past few months of war endorses the urgency of the minority argument or reservation on this point in the report. Accordingly, once the necessity of conferring immediate executive powers on the proposed Board in respect of London and the Home Counties is admitted, it appears to be illogical to

withhold the general executive powers which are advocated by six out of the thirteen members of the Royal Commission.

The difference between the bare majority and the remaining members of the Royal Commission appears to be much more profound than is indicated by mere reservations. Having regard to the urgency of the problem, accentuated by all the disturbance of civil life which the War has since occasioned, the choice between advisory powers and executive powers may make all the difference between success or failure in the formulation and execution of an adequate plan.

This point of view is endorsed by the experience of the Commissioners for the Special Areas. Evidence submitted to the Royal Commission showed not only that the Commissioners had made the fullest use of their powers and opportunities, but also that their powers had been too rigidly defined and were too restricted in scope. The solution to the problem of the Special Areas does not necessarily lie within the defined geographical limits of such areas, any more than the problem of location of industry can be separated from the national problem of persistent unemployment. Moreover, the Commissioners for the Special Areas are not empowered to do more than endeavour to remedy—or mitigate—a serious evil that has already appeared. Anticipation and prevention lie outside their province.

These considerations led the minority of the Commissioners to recommend that the essential powers and responsibilities of the Commissioners for the Special Areas should be transferred either to the new Board recommended in the majority report, or to the new Ministry recommended in the minority report, and that they should be extended to cover the whole of Great Britain. The basic purpose of such extension is to provide preventive rather than curative action, so far as possible, and the intensity of armament production at the present time emphasizes the warning that, in the absence of such preparation for the future, the problems of the past will reappear, and become even more serious in extent and more difficult to solve.

This is indeed one of the dominant notes throughout the reservations and the minority report, and a basic consideration in putting forward recommendations for wider executive powers and immediate action. A policy of drift is likely now, even more than when the report was written, to lead to the perpetuation and exaggeration of existing evils. The continuance of ineffective

control may also result in irremediable damage to the countryside and amenities through unrestricted despoliation and haphazard development arising out of evacuation, decentralization and the building of camps, whether civil or military.

The salient feature in the existing situation is that little, or in any event insufficient, attention has been given to the problem of the best distribution of industry in Great Britain as a whole. Not only are the town planning schemes local by definition, but also much of the basic knowledge required to guide industry in the choice of sites is lacking. The necessity for unified research into the problem of distribution on a national scale is widely recognized. On this, and on the necessity for a unified plan of distribution based on the results of such research, and for effective control meanwhile of such changes in distribution as must continue to take place in the interests of trade, the Royal Commission is virtually unanimous. The minority only differs from the majority in considering that this task, which is both national and local, is of sufficient importance to call for the creation of a new separate Ministry, on the same principle as that on which separate Ministries have been created in the past for the partly national and partly local services of education and transport.

The divergence of views on the Commission in regard to the urgency and machinery of Government action should not be allowed to overshadow the basic fact that the Commission is unanimous in its nine main conclusions as to the objectives of that action. Moreover, the evidence demonstrated the existence of a large body of opinion in favour of some regulating action along national lines and in the national interest. It is indeed possible to regard the essential difference between the majority and minority recommendations as consisting in the greater regard had by the former to action which is immediately practicable, rather than to that which is theoretically desirable but would demand further educational effort to secure adequate support.

If, therefore, the wider vision and longer range objectives which characterize the minority recommendations are kept in mind, adoption of the majority report and action along the lines advocated by it is more likely than not to prove a stepping stone to the wider and more extensive powers contemplated by the remaining Commissioners. The task of education can proceed *pari passu* with such action, and the impetus to regionalism which the report can scarcely fail to give—which has indeed already been given by

civil defence and other emergency measures in war-time—should further assist in that process.

What has to be kept in mind is the importance of immediate action. The report must not be merely shelved until after the War. The nation cannot afford to leave great industrial areas of the country derelict and allow development to repeat the process elsewhere. There is no guarantee that the new and expanding industries of to-day will not be the depressed industries of to-morrow if allowed to develop without control. Moreover, developments proceeding in war-time require co-ordination and control if the problem is not to become even more intractable, with further waste of national assets, spoliation of amenities, injury to national health and destruction of the countryside.

The report has therefore the strongest claims on the attention of all who are concerned with the scientific utilization and conservation of national resources in the widest sense. The co-operation of scientific men is essential in much of the basic research work required and in the elaboration of the necessary plans for development. On a score of technical questions it will fall within their competence to give the appropriate data. Above all, the problem must be considered in relation to that task of reconstruction which will confront us urgently at the end of the War, and possibly the more imperatively the longer the War lasts. We cannot afford to wait until irreparable damage is done, and solutions have to be found urgently and decisions made under duress and with no sound basis. The extensive and realistic research and planning upon which peaceful change depends, whether in national or international affairs, cannot be improvized in a moment. The location of industry is typical of those problems which must be visualized and handled before they become chronic or acute, and before their reactions on other problems multiply. Already, as the report shows plainly, the maldistribution of the industrial population of Great Britain has reached a point when it may easily become intractable.

The problem is a vital part of our war effort, and if that is to attain its maximum efficiency and the subsequent task of reconstruction is not to be hindered, it must be faced at once. The report of the Barlow Commission points out certain possible lines of immediate advance, and provides fresh material with which to win the support of the community for progressive measures in dealing with the distribution of the industrial population of Great Britain.

VITAMIN E

Vitamin E

A Symposium held under the auspices of the Food Group (Nutrition Panel) of the Society of Chemical Industry on Saturday, 22nd April, 1939. Pp. viii + 88. (London: Society of Chemical Industry, 1939.) 5s.

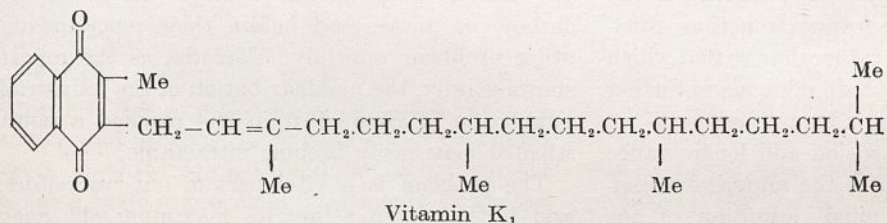
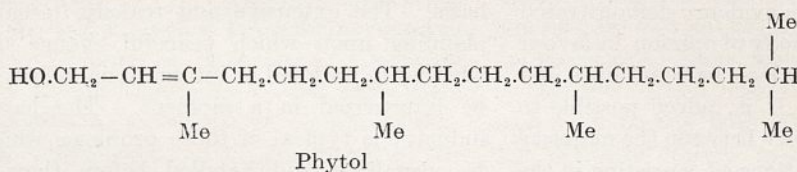
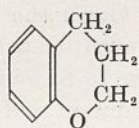
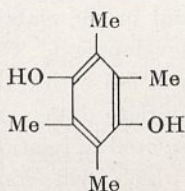
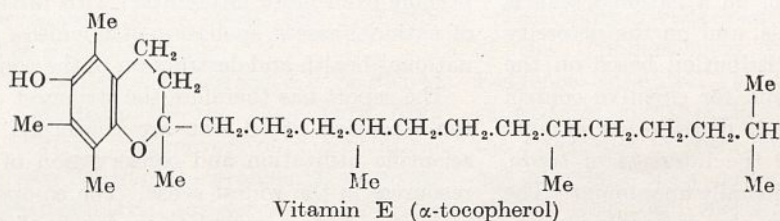
VITAMIN E was discovered in 1922. Experiments which had been conducted in three different laboratories in the United States revealed

The first detailed study of the vitamin was made by Evans and Burr. They showed that in the absence of the 'anti-sterility vitamin', as it was commonly called, gestation was terminated after about two weeks by the resorption of the foetus. This sterility of the female could be cured if vitamin E was restored to the diet. In the male rat a degeneration of the germ cells occurred, which was less readily curable, or even incurable. Evans and Burr found that the vitamin was

present in a number of natural vegetable oils such as those of wheat germ, rice germ, cotton seed and in lettuce leaf. It occurred in the unsaponifiable fraction of the oils. Animal products contained only traces.

For about a decade after the publication of Evans and Burr's monograph in 1927, there was little further advance to record. Then in 1936 Evans and his colleagues announced that they had at length succeeded in isolating from wheat-germ oil two substances which possessed the biological properties of the vitamin. These they named α -tocopherol and β -tocopherol, signifying 'alcohol promoting child-birth'.

In the past couple of years progress has been striking. Not only has the structure of α -tocopherol (and of related substances) been established, but also it has been



STRUCTURAL FORMULÆ, SHOWING RELATIONSHIPS BETWEEN VITAMIN E (α -TOCOPHEROL), DUROQUINOL, CHROMAN, PHYTOL AND VITAMIN K₁

that female rats failed to reproduce when kept on certain artificial diets, although these contained the four vitamins then recognized, A, B, C and D. Evans and Bishop of the University of California pointed out that another vitamin was involved. It was named first vitamin X and later vitamin E.

synthesized and the synthetic product has been proved to be as active as the natural one. α -Tocopherol is related structurally to duroquinol, and has a fused ring system of the chroman type, an interesting feature being the presence of the phytol residue which is found also

in chlorophyll and in vitamin K₁, the so-called coagulation factor. In other directions, too, there have been important developments. For example, we now know that a continued lack of vitamin E leads to a variety of ill-effects in addition to sterility. Then again, methods have lately been introduced for the chemical assay of the vitamin which in time may be able to replace the laborious biological test. Or, to take a third example, much interesting work has been done on the relation between chemical structure and biological specificity.

There was an obvious need to bring together and collate all these recent achievements, and the indefatigable officers of the Nutrition Panel of the Society of Chemical Industry put all biologists and chemists in their debt when they organized last spring a symposium on vitamin E, which many of the leading workers of the world attended and to which they contributed authoritative accounts of their investigations. The Society has done well to publish *in extenso* the proceedings of this symposium, and the booklet recently issued is virtually a monograph dealing with vitamin E from almost every angle. The editors, Mr. A. L. Bacharach and Prof. J. C. Drummond, have carried out their task conscientiously and effectively, and the value of the work is increased as a result of their efforts of co-ordination and particularly by the provision of the complete alphabetical bibliography.

The text is divided into three parts dealing with the chemical, physiological and clinical aspects respectively.

In the opening paper, Prof. A. R. Todd gives a valuable review of the organic chemistry of vitamin E and related substances. The question of biological specificity is next discussed, by Prof. P. Karrer of Zurich and Dr. F. Bergel. Their main conclusion is that for maximum biological activity the presence of the long aliphatic side chain is essential. In the aromatic nucleus the presence of all three methyl groups is most favourable, for with but one methyl group there is only a low degree of activity. Ethyl has an unfavourable influence. Drs. Emmerie and Engel, of the University of Utrecht, give an account of the promising chemical test which they have introduced, depending on the reduction of ferric chloride by the vitamin and the estimation of the resultant ferrous ion by means of 2 : 2'-dipyridyl. This reaction can apparently be made relatively specific, and will estimate as little as 5 μ gm. of tocopherol; it can probably be applied to blood. A critical comparison of this and other chemical and biological methods is given by Dr. E. Lester Smith and Mr. R. Bailey. They found that the chemical methods are prone to overestimate the activity of concentrates but to underestimate that of oils.

On the physiological side, one of the most interesting suggestions is that vitamin E is needed for the normal functioning of the anterior lobe of the pituitary gland. Evidence in favour of this theory is well set out by Dr. S. W. F. Underhill, but the connexion is by no means universally accepted. For example, Prof. J. C. Drummond in his lucid review prefers to take a more cautious line, and as he says: "We are still fumbling in the dark trying to find some clue to the hormonal disturbance responsible for the characteristic failures of the reproductive system in vitamin-E deficient rats." In this connexion Drummond alludes to the work of Karl Mason, another contributor to the symposium, who has cogently pointed out that the type of testicular degeneration seen in vitamin-E deficiency is unique and does not at all completely resemble that which can be produced by hypophysectomy or that following prolonged administration of oestrogenic substances.

A few years ago, vitamin E was known only by the effect of its deficiency on reproductive function. Now at least half a dozen further symptoms are recognized, of a rather ill-assorted character. These include muscular dystrophy, degeneration of muscle fibres leading to discoloration of uterus and seminal vesicles, a characteristic degeneration of the convoluted tubules of the kidney, a so-called 'alimentary exudative diathesis', subnormal growth, and failure to store vitamin A normally in the liver. Dr. Thomas Moore and his colleagues deal succinctly with some of these aspects of vitamin-E deficiency. It must be admitted that we are still without any explanation of the cause of these surprisingly varied manifestations. The physiological section of the symposium closes with an able contribution by Mr. A. L. Bacharach discussing the whole philosophy and application of biological standardization. He rightly condemns 'biological units', such as 'rat units', 'mouse units', etc., and remarks: "In the modern sense of the word this is not a unit at all; it is simply the reciprocal of a dose that had a certain effect on a certain animal at a certain time". The objection to 'biological units', of course, is that animals vary. "Animal variation is merely a polite term for the integrated incompetence of the investigator, its effect is to deprive the so-called 'biological unit' of even roughly quantitative significance." The moral, needless to say, is to use specified amounts of fixed standard preparations as units.

On the clinical side, it must be confessed that most will feel themselves forced, however unready, to agree with Prof. F. J. Browne that the claims which have been made remain unproved for the greater part. True, it has been contended that therapy with vitamin E has given 75 per cent of successes in habitual abortion, or 68 per cent

in threatened abortion, or 41 per cent in defective lactation. There is, perhaps, nothing inherently unlikely or even improbable in these claims. The only 'snag' is the absence of untreated negative controls. Browne points out, on the authority of Malpas, that after one, two or three spontaneous abortions, the chances of the next pregnancy being carried to term are 78, 62 and 27 per cent, *even in the absence of any specific treatment*. This has scarcely been taken into account in assessing the value of vitamin-E therapy. Browne, indeed, refers to a controlled test by Boycott in which the seven negative controls all 'responded' although receiving no treatment at all! Still more recently, vitamin E has been recommended for the treat-

ment of muscular dystrophies and even of tabes. The last-mentioned disease seems to be included more as a matter of faith than as a result of successful accomplishment. In the opinion of the present reviewer it would be a help for the future if the conjecture of a deficiency of vitamin E in a given disease, and the accompanying suggestion for therapy, could be backed up by chemical tests on the patient's blood to establish the actual occurrence of a low level of nutrition.

It has not been possible in this review to touch on all the varied ground covered in the symposium, but it must be evident that no worker on vitamins and nutrition can afford to be without it.

LESLIE J. HARRIS.

THE DOMAIN THEORY OF MAGNETIZATION

Ferromagnetismus

Von Prof. Dr. R. Becker und Dr. W. Döring. Pp. vii + 440. (Berlin: Julius Springer, 1939.) 42.60 gold marks.

IT is very unfortunate that this important work should have appeared at such an inopportune moment in the world's history, when it will be difficult for most of the English-speaking peoples to obtain copies of it. Those of us who had the pleasure of meeting Prof. R. Becker at the 1939 Conferences on Magnetism in Bristol and in Strasbourg must sympathize with him in no small measure. In this work Dr. Döring and he have put forward in a very complete manner the whole series of interesting ideas on the processes of magnetization which have emanated from Göttingen during the present decade.

Prof. Becker gave a series of lectures in the winter of 1934-35 under the auspices of the Technische Hochschule at Berlin to an audience consisting in the main of technicians, who, no doubt, keenly appreciated accounts of the work of Becker and his collaborators on the relation between stress, magnetostriction and direction of magnetization as exemplified by experiments on nickel under tension.

The present book owes its origin to the success of those lectures. Its scope may be summarized as follows. It seeks to give a brief survey of the Weiss conception of domains in a ferromagnetic which are spontaneously magnetized more or less to saturation, and of those problems of academic interest, such as the variation of spontaneous magnetization with temperature, upon which the conception bears. It seeks mainly, however, taking the Weiss conception for granted, to explain

those magnetic properties of ferromagnetics which are of great technical importance, such as the shape of the hysteresis curve, in terms of the alignment or growth of Weiss domains in favoured directions. In fact, the book might almost be described as a treatise on the technical aspects of the domain theory of magnetism. The reviewer was therefore a little surprised to find no mention in the book of Stoner's stimulating discussion of the effects of domain size, although it is only fair to add that the effects of domain size are at present of less interest in technical than in academic work on magnetic saturation, and the reviewer has noticed no other omission of any import.

The book does not avoid mathematical arguments whenever necessary, and although these are profusely supported with experimental results, the book requires some power of concentration of the reader if it is to be read with profit. However, a fundamental discussion of the different processes which play a part in technical magnetization, in magnetostriction, in the determination of high initial permeability, in Barkhausen discontinuities, in permeability at high frequencies and so on, cannot be treated with ease. The authors have indeed performed a most useful service in placing the present theory before us in such a complete manner and in correlating so many experimental facts with the theory. Some of the theory clearly needs amplification; for example, what may be termed the Döring theory of large Barkhausen discontinuities is really a theory for a metal in two dimensions only, and, as Stoner pointed out at the Bristol Conference, it is difficult to picture what happens when we think of the domains in the three dimensions of the solid material. Again, in spite of all that has been written in the publications of

learned societies about the heat liberated in hysteresis processes being equal to $\int H.dI$, we still cannot calculate the quantity of heat which is dissipated in a piece of iron when it is subjected to a partial change in magnetization, as distinct from a complete cycle, under normal experimental conditions.

A valuable section of some fifty pages is devoted to commercial ferromagnetic materials and their

applications, wherein the problems of precipitation hardening and the effects of tempering in the presence of a magnetic field are discussed. The book is of definite interest to all concerned with technical applications or the production of ferromagnetics. It deserves every success, and one cannot but deplore that the increase of our knowledge which the authors have tried to bring about should be so unfortunately held up by others of their tongue but not of their spirit. L. F. BATES.

A THEORY OF PROBABILITY

Theory of Probability

By Dr. Harold Jeffreys (International Series of Monographs on Physics.) Pp. vii + 380. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 21s. net.

IN his "Scientific Inference", Dr. Jeffreys has already adumbrated his approach to the theory of probability. The present book is a more systematic presentation of his views, beginning with the formulation of axioms, developing a theory of probability, describing and illustrating its use in testing significance and in estimation, and concluding with two chapters on the weaknesses of other theories and on some general scientific questions.

Probability to Dr. Jeffreys means something more than the proportion of events of a certain type in a series or an aggregate; he takes it in the wider sense of a measure of degrees of reasonable confidence in the truth of a proposition. His principal problem in his treatment of the foundations is accordingly to establish the validity of representing degrees of reasonable confidence by numbers. He overcomes it by an axiom to the effect that for any three propositions, p , q , r , the statement "on data p , q is more probable than r " has a meaning—in other words that probabilities are orderable. Now, most statisticians would accept this axiom without question, because their probabilities are defined as numbers; but one may fairly hesitate over the claim that Dr. Jeffreys' probabilities, which relate to attitudes of uncertainty of mind, can be ordered. There does not seem to be much in our present knowledge of mental states to support an assumption that judgments in probability are linear.

If Dr. Jeffreys' first axiom is accepted, the rest of his foundational material follows naturally enough. Having got his probabilities ordered in a straight line, he succeeds in imposing a metric on them, and in deriving the ordinary rules for

addition and multiplication. He also obtains as a theorem the result which has caused so much trouble since Bayes gave it in 1763,

$$P(q_r | pH) \propto P(q_r | H) P(p | q_r H),$$

that is, the probability of q_r given p and H is proportional to the probability of q_r given H multiplied by the probability of p given q_r and H . Dr. Jeffreys calls the factor on the left in this expression the *posterior probability*, the first factor on the right the *prior probability* and the remaining factor the *likelihood*. This result is the foundation stone of his theory. It is, he says, the chief rule involved in learning from experience.

In order to make any practical use of Bayes' theorem it is essential to decide on the values to be assigned to the prior probabilities. Bayes and Laplace postulated that in the absence of definite knowledge they were to be assumed equal. This "equidistribution of ignorance" has been relentlessly attacked in recent years, chiefly by statisticians; but Dr. Jeffreys defends it in a novel and interesting approach. The statistician's criticism is misconceived because he insists on thinking in terms of frequencies. But when Dr. Jeffreys, considering a parameter θ which may vary from $-\infty$ to $+\infty$, writes for the prior probability $P(d\theta | H) \propto d\theta$, he does not mean that an assumption is being made about the equidistribution of θ in the universe. He merely means "I know nothing about θ ". It is his way of giving to airy nothing a local habitation and a name. This avoids most of the statistician's criticisms; but it gets Dr. Jeffreys into some new difficulties. For example, when θ is known to lie between zero and infinity, the corresponding way of saying nothing about its prior probability is $P(d\theta | H) \propto d\theta/\theta$. Why it should be necessary to use the notion of a reciprocal in order to express ignorance about a parameter is far from clear to me, although Dr. Jeffreys puts up a long case for the formula.

In his treatment of estimation and significance tests Dr. Jeffreys is concerned with laws containing a certain number of unknown parameters. A significance test is a method of deciding whether any given law is adequate to express observational data, or whether further parameters are required. Estimation is the determination of the most probable values of such parameters as are shown by significance tests to be necessary. Dr. Jeffreys' discussion of the many problems involved is difficult to describe succinctly; but his methods all involve a comparison of the probability of a hypothesis q with that of not- q . The ratio of these two probabilities is denoted by K . It corresponds to what the orthodox would describe as the odds in favour of q .

For the expression of K in numerical terms it is necessary to determine the prior probabilities of hypotheses. Suppose, for example, a test is being made whether a given law fits given data. It is assumed that any new parameter α which might be required is so chosen that the given law is reproduced if $\alpha = 0$. In such a case Dr. Jeffreys would assign half the prior probability to the hypothesis $\alpha = 0$, and distribute the remainder equally over the range of α . Thus $K = P(\alpha | pH)/P(\text{not-}\alpha | pH)$ where p is the observational data. By Bayes' theorem the probabilities of α and not- α are expressible in terms of the assumed prior probabilities and the calculable likelihoods; and hence K results.

Anyone who rejects this approach can console himself with some comparisons made by Dr. Jeffreys with alternative procedures in use by statisticians, particularly the method of maximum likelihood. It is shown that for large samples the latter method gives much the same results as

Dr. Jeffreys'. The hypothesis which maximizes the likelihood will, within permissible limits, be the one with the greatest posterior probability. And so the bridge between Dr. Jeffreys and Prof. R. A. Fisher is built—for large samples.

Dr. Jeffreys' criticisms of the frequency theories of probability centre around the necessity of justifying the application of the frequency definition to practical series by an appeal to probability itself. Dr. Jeffreys rejects such theories; and indeed it is hard to see how any writer on fundamentals can tolerate the intellectual discomfort which some of them arouse. But there is a Scylla to this Charybdis. Dr. Jeffreys' probabilities are measures of belief, not frequencies. Why, then, should he accept them as the basis of rational action? By assuming that, on the whole, what we believe is right, or as the author has put it elsewhere, "It is possible to learn from experience". It is essential for his theory that, notwithstanding, the expected usually happens. What is the basis for our ready acceptance of this postulate? The adherent to frequency theories will claim that it is an extrapolation of experience of the frequencies of events.

The reactions of one writer on probability to another being naturally exothermic, it is to be expected that Dr. Jeffreys' strictures on the naiver theories of probability will not pass unchallenged. It would be a great pity if the importance of the issues at stake were to be fogged by ill-considered criticism. Dr. Jeffreys' views deserve the most serious study. They may not be right; but they are more tenable than many statisticians have been willing to concede in the past, and it is hoped that this book will be widely read.

M. G. KENDALL.

PLANT PERSONALITIES

Plants with Personality

By Patrick M. Syngé. Illustrated with Plates from Dr. Thornton's Temple of Flora and with Drawings by John Nash. Pp. 244 + 20 plates. (London: Lindsay Drummond, Ltd., 1939.) 12s. 6d. net.

THIS is not everyone's book. Mr. Syngé is a mystic and looks at the world of plants through metaphysical spectacles. His introduction would do credit to a treatise on Hegelian idealism. Plants, for him, "live, they grow; they are real, yet they are something more than real and we can all see it". The reader who accepts this approach, and the rather highly coloured writing

to which it leads, will find much in the volume to entertain him.

Mr. Syngé has selected a series of plants which appeal to him as possessing "definite personalities", and has described his reaction to them under such chapter headings as "Sun Lovers of South Africa", "Fierce Wonders from Chile", "Children of the Mexican Sun", etc.

Mixed with the purple patches, the author contrives to convey a considerable amount of valuable information on the history, distribution and horticultural treatment of his subjects. Mr. Syngé's facts are usually accurate. In his section on the *Victoria regia*, however, he does not describe the remarkable change of colour from pure white

to deep rose as the flower fades, and there are a number of misprints, including *Enothera taraxicifolia* for *taraxicifolia*, despite a note on the derivation of the word.

The author has seen many of the plants mentioned himself in their native countries, and the best chapter in the book is, perhaps, that on the giant plants of the East African mountains which he visited recently with the Natural History Museum expedition.

One of the most striking features of the book are the illustrations. These are taken partly from

Thornton's "Temple of Flora", partly from other botanical works, partly from original drawings by John Nash and partly from photographs. It is a pity that the source of each illustration is not more clearly indicated. John Nash's drawings are delightful, that of *Puya alpestris* being a masterpiece of its kind. Mention might have been made of Miss North's painting of *Puya* in her gallery at Kew.

As a bedside book for gardeners and botanists, Mr. Synge's volume will no doubt appeal to a wide circle of readers.

J. S. L. GILMOUR.

PHOTOCHEMISTRY

Photochemistry and the Mechanism of Chemical Reactions

By Prof. Gerhard K. Rollefson and Dr. Milton Burton. (Prentice-Hall Chemistry Series.) Pp. xiv + 445. (New York: Prentice-Hall, Inc., 1939.) 5.75 dollars.

THE task of writing a modern text-book of photochemistry is no easy one. To keep the volume within reasonable confines is almost as difficult a problem, since the limits to which the author must work are not readily defined. If the author does not presuppose it, a considerable discussion must be devoted to physical principles, especially on the spectroscopic side. Again, photochemistry now reaches far into biology, and the question arises as to whether such a topic should be included in a book mainly compiled for use by physical chemists. Another subject with which it is indissolubly linked is reaction kinetics, for it is difficult to dissociate photochemistry from kinetics, having regard to the fact that there are scarcely any simple photo reactions in the sense that the primary process represents the chemistry of the whole reaction. It is not going too far to say that a large part of photochemistry is now a branch of general reaction kinetics.

In this volume Prof. Rollefson and Dr. Burton have steered a careful middle course. They open with three chapters giving a sufficient account of spectroscopy, yet not enough to frighten off the reader who is concerned only with the more purely chemical aspects of photo-reactions. Similarly, the chapter on reaction kinetics leads the reader without difficulty into the more detailed discussions in the later parts of the book. Then follow the chapters forming the substantial fraction of the book. Nowadays the arrangement is largely a matter of personal choice, for there is no sufficiently rigid framework within which can be fitted the

descriptions of the individual types of reaction. The simplest photo-reaction is probably that occurring in alkali halide crystals. Here recent work has added a new and important chapter to photochemistry. Then follow chapters on the photolysis of inorganic compounds, organic molecules, molecular rearrangements, photosensitization and typical chain reactions—all in the gas phase. In these chapters much of the older material is eliminated and only the more recent papers discussed. This is region of great difficulty since there are many reactions to be discussed, but each gets its due quota of space. Even in 200 pages only superficial discussion of any one may be given. It would have been a better plan to have discussed thoroughly and completely a few well-known examples at the expense of the omission of less well-investigated systems. The adoption of a more critical attitude would have done photochemistry no disservice. The specialist would welcome such discussion even though he might not agree with the conclusions. The beginner would be made to realize that the subject is more difficult than he is led to suppose.

The last four chapters of the book deal with topics which are only now in an early stage of development. Addition reactions, the oxidation of aldehydes, polymerization reactions in liquids and heterogeneous photo-reactions are all fairly extensive fields of research in which there is much to be done before a really coherent account may be put in a text-book. A very useful practical appendix completes the volume.

Here then is a book which allows anyone with no specialist knowledge easy access to photochemistry. Those who wish to find what is known about an individual reaction will discover the required information. Those who are already familiar with the subject will find much food for further thought and experiment.

H. W. MELVILLE.

PEACE-MAKING AFTER WAR*

BY THE RIGHT HON. LORD EUSTACE PERCY, P.C.

I AM to discourse on peace-making, but this does not mean that I am going to formulate what are generally called 'peace terms'. On the contrary, I must begin by a warning against programmes of that kind. Peace-making is a process, not an act. It is a process which has been interrupted by war and must be resumed after the so-called 'treaty of peace' is concluded. For such a treaty can do little more than record the desire of the parties to adjust their interests and their ideals in future by peaceful, rather than by war-like, means. The adjustment itself must occupy years. The peace terms may hinder it, if they inflict serious injury, moral or material, on one party; but they cannot do much to further it. The attempt to take advantage of war-weariness, or of a peace congress representing a number of nations, in order to formulate far-reaching safeguards for future peace, has seldom, if ever, been successful.

It follows that the first condition of successful peace-making is that the statesman who attempts it should be left doubly free. He should be left free by his own people from precise pledges as to the contents of the peace treaty; he should be left free by the peace treaty from hampering commitments as to his future policy. He must have behind him the public opinion of his people; but it must be an opinion about the contribution which his people should make to peace, rather than about the kind of peace they would like to have. In peace, as in war, the 'wishing-well' temper of mind is useless. In war, a will to victory is a determination to keep armies in the field, not the dream of seeing them march into the enemy's capital. Peace-making requires a no less continuous effort, no less readiness both to sacrifice immediate advantages and to forgo ultimate dreams. The only sound purpose of discussions about peace-making in time of war is to form a public opinion of this kind, by indicating what are the real causes of the particular war and what, consequently, are the sacrifices which peace-making may demand.

The historian's first, and most obvious, contribution to such a discussion is to remind men of the facts of yesterday, which are in large measure the facts of to-day and to-morrow. From the historian's point of view, the chief evil of war or revolution is not so much its crude immediate effect in human misery as its tendency to produce

in the human mind an illusion of emancipation from the quite recent past. Of course, war does change facts; it may kill an old institution, for example, and stimulate a new movement. But, broadly speaking, it kills only what is already decayed, and stimulates only what is already alive. There is no release from the past; the facts of 1942 will not be materially different from the facts of 1938.

What may, we hope, be different in 1942 is our power of understanding what the facts really are; and for this we need to be reminded of a remoter past. In this lies the historian's second, and most important, contribution to the discussions of the hour. The point I chiefly want to make, and to illustrate, is the importance of reckoning our present position in the world's history by reference to a past remote enough to dwarf our contemporary assumptions into their true proportions, and to prepare us for the unexpected forms in which history repeats itself over long periods. If there is anything more dangerous than the illusion of emancipation from the *facts* of the immediate past, it is the tendency to attribute eternal validity to the *ideas* of the last century or two—to measure the whole 'march of mankind' by the eighteenth-century standard of 'enlightenment' and the nineteenth-century standard of 'utility'. It is, no doubt, comforting to compare modern knowledge with that of Aristotle or Seneca or Aquinas; it is not so comforting to reflect that an increase in knowledge may mean only an increase in crude power, that it may fit us only to tutor more ambitious conquerors than Alexander, to advise worse tyrants than Nero, and to herald a more complete collapse of civilization than that which overtook Papacy and Empire in the fourteenth century.

Let me then try to suggest another possible view of European history in relation to present problems.

A dweller on the Roman Wall may, perhaps, be forgiven if he takes as his starting-point the death of the Emperor Hadrian in the year 138. The Rhine-Danube frontier of the Roman Empire, as he left it, has become to-day almost the frontier of Christian civilization—pushed back in the west on the middle Rhine and between the Rhine and the Upper Danube, pushed forward a little in the east between the Danube and the Theiss, but only seriously breached at its centre in Austria. It was there that, twenty-three years after Hadrian's death, the Marcomanni first broke through to the Adriatic; it was there that, exactly eighteen hundred years after his death,

* From the Friday evening discourse delivered at the Royal Institution on March 1.

another Germanic invasion carried paganism south from the Danube to the Drave. This threatened frontier is to-day the frontier of the British, as it was of the Roman Empire, as the gathering on it of distant armies has reminded us. It would be fanciful to press the analogy, and tedious to qualify it; but it may serve as a point of departure.

During all these eighteen hundred years, the history of Western civilization has been the history of folk wanderings. For the first nine hundred, down to the establishment, in the second half of the eleventh century, of Norman rule in England and Sicily, of Seljuk rule in Asia Minor, and of Teutonic colonization among the Slavs on the eastern marches of Germany, the sequence of migratory conquest and settlement was almost unbroken. There was an interval of some two hundred and fifty years between the last Teutonic and the first Scandinavian waves of conquest, between the end of the sixth century, when the Lombard Kingdom had been established in Italy, and the middle of the ninth, when the Danes invaded England and the Varangars threatened Constantinople. But midway in that interval the high tide of Arab conquest almost reached the Bosphorus and the Loire, and the age of Charlemagne was but a 'gap between two lightnings'.

The first real interval of consolidation came at the end of the eleventh century. It, too, lasted for about two hundred and fifty years, from the First Crusade to the first Ottoman landing on Gallipoli in 1356. Again, it was broken midway by the Tartar raids; the frontiers of Christian civilization were still hotly contested in Spain, North Africa and Palestine; internally the old Teutonic and Scandinavian tradition of the 'southward thrust' took a new political form in the two great struggles for ascendancy, between Empire and Papacy in Italy and between Plantagenet and Capetian in France. But this troubled interval, especially the thirteenth century, did mark the consolidation of the new peoples of Europe into one society with its own distinctive culture, a single *Kulturgebiet*; it did give freedom of movement, within that society, to the cleric, the merchant, the craftsman and the scholar; it did give opportunity to the rising cities of Italy and Germany to translate old migratory instincts into terms of international commerce. By the end of the period, Genoese ships had attempted the circumnavigation of Africa and a Genoese trading station had been established in South China; population had begun once more to outgrow the resources of medieval agriculture; and, now that the safety valve of the Crusades and the Moorish wars was closed, and Papacy and Empire had fought each other to a standstill, the fighting class was looking for new opportunities of adventure.

The next one hundred and seventy-three years were perhaps the darkest of European history. The resumption of migration was postponed by the Black Death, which nearly halved the population of the Continent. Simultaneously, Europe became the victim, instead of the agent, of a new migratory conquest. Between 1356 and 1529 the Ottoman invasion crept, in successive waves, to its high-water mark beneath the walls of Vienna. The last, and most destructive, decade of its advance was the decade which saw also the first circumnavigation of the globe, the Spanish conquest of Mexico, and the discovery of Peru.

From that moment, for four hundred years, until in 1929 a general economic collapse seemed to have finally closed the New World to European migration, the history of Western civilization has been a history of colonization and trade expansion—of a gradual advance westward to the Pacific, southward over Africa and Australasia, and eastward to India and China. Though that movement reached its culmination with the rapid growth of European population in the nineteenth century, it was already well launched by the middle of the seventeenth. Of the total increase of the English stock between 1600 and 1700, one fifth were probably settled on the Atlantic coast of America by the latter date. What does mark the nineteenth century is that it was then that Europe generally first awoke to what had already been the real trend of Western civilization for two centuries. Is it far from the truth to say that the only lasting effect of all the internal wars of Europe from 1618 to 1815 was to keep down the stock which would otherwise have migrated, to ruin the industries which would otherwise have nourished that migration, and to leave to England and Holland the opportunities of American and Asiatic settlement and trade? Alone among all these wars, the long frontier struggle in the east with the Ottoman Empire was fought for a lasting issue.

If this has been the character of the wars of Europe, what has been the character of its peace-making? If one had to give an answer for the whole eighteen hundred years in one rough formula, one would say, I think, the reconciliation of land hunger with culture. That formula does fit, almost exactly, the first nine hundred years. During most of this period, peace-making was largely in the hands of the Christian Church, as the guardian of a faith and a way of life, and as the successor of the Cæsars. To her, territory was a trifle, as culture was, perhaps, a trifle to the barbarian invader; and her peace-making could therefore be a real bargain—the bargain that Walter Scott put in the mouth of Count Witikind:

"Give me broad lands on the Wear and the Tyne,
My faith I will leave and I'll cleave unto thine".

That was the basis of the bargain between Pope and Emperor, and it broke down only when, eventually, the two sides of the bargain lost their contrast—when faith became institutionalized by Hildebrand into an *imperium in imperio*, and when, under the feudal system, the Emperor's authority over the broad lands of Europe was reduced to an indistinct overlordship. The resulting conflict of like with like—of two non-territorial universals—admitted of no compromise; by the end of the thirteenth century it had destroyed both contestants.

During the fourteenth and fifteenth centuries Europe moved slowly towards a new idea: that civilized society is not a single cultural unit within which its members possess territorial rights, but is composed of a number of territorial units, each asserting its own culture. For two centuries the nature of the new territorial units remained in doubt. The Italian city struggled to assert its economic culture against its fellow cities; the French and English monarchies their new conception of territorial sovereignty and 'civil dominion'; the Swiss and the Hussites of Bohemia (with very different fortunes) their ideal of democratic independence. It was not until the new sects of the Reformation were forced to seek protectors powerful enough to save them from both persecution and from disintegration that the territorial sovereigns won. The principle *cujus regio, ejus religio* finally identified culture with large territorial units—but, before that principle was fully established, there had been a last attempt to recreate the wider cultural society of the Middle Ages. The empire of Charles V, combining, in the last two years of his rule, the main bulk of Europe with the new colonies of the Spanish Main, had an unequalled opportunity of uniting the whole civilized world in the enjoyment of unimagined natural resources, unprecedented freedom of movement, and the common heritage of the Renaissance—subject only to the compromise of toleration for differing forms of Christian worship. That opportunity was lost in a blind striving after institutional uniformity, and the tragic waste of that futile struggle left the territorial Culture State in undisputed possession of the field.

Since then, for nearly four hundred years, territorial frontiers have remained the staple issue of both war and peacemaking. The Culture State has long outlasted the assumption which originated it: that one State could accommodate within its frontiers only one form of religion. As toleration has taken the place of religious uniformity, the State has substituted new uniformities of its own. In the last hundred years, the consciousness of nationality, the progress of social reform and the

growth of industry have combined to multiply the points at which the authority of law and the claims of freedom may conflict and can be reconciled only by like-mindedness between Government and people. So universal has become the identification of culture with nationality, and of nationality with territorial sovereignty, that Britain's sanguine attempt, after the War of 1914–18, to establish a 'Jewish national home' in Palestine, which should be a culture and not a sovereignty, has ended, for the moment, in a despairing proposal for territorial partition.

Until the very end of these four hundred years, however, the organization of the Culture State offered little obstacle to the free movement of the European peoples. The European Culture States, with their high birth-rates, their racial minorities and their political controversies, were glad enough to see their potential unemployed and their potential rebels become citizens of the United States, the British Empire or Brazil. These new overseas nations, on their side, still unhardened to their function as Culture States, were glad enough to give these immigrants work and the opportunity of wealth, in return for no more than a formal salute to the Stars and Stripes or the National Anthem. So the Count Witikind formula was revived as a bargain between the receiving State and the individual, and might, with a little more imagination, have been translated, in the post-War distresses of twenty years ago, into bargains between Governments. Instead of this, the bargain began to break down, much as it had broken down in the Middle Ages. Already, towards the end of the nineteenth century, the German Empire had begun to discourage emigration, and the last twenty years have seen a hardening of European cultural nationalism into that kind of cultural imperialism which demands that the national flag shall follow the emigrant, carrying with it both national culture and national territorial sovereignty. At the same time, the States of the New World began to adopt, not only the policy of deliberate 'assimilation', but also the policy of restricted immigration in the interests of their economic culture; and, as their economic culture began increasingly to break down, restriction has hardened into prohibition. Cultural nationalism has frozen the peoples of the civilized world into something approaching immobility.

Let us understand clearly what this means. We live in a world of cultural nationalism; but we have reached a point in the world's history where such nationalism can no longer offer any basis for a lasting European peace, because it can no longer offer freedom of movement to the European peoples. Demands for 'colonies' on the basis of sovereignty can only end, like the irreconcilable

claims of Papacy and Empire in the thirteenth century, in the mutual destruction of the claimants and in a period of chaos which will last until some new Renaissance and Reformation bring us a change of mind. *That* is our position in the world's history. Migration is as necessary to-day to the peoples of Europe as it has been at every stage of European history, save when the European stock has been depleted by pestilence and internecine war. The falling birth- and death-rates of northern and western Europe do not materially affect that need; for, while they diminish the number of those who are too young, and increase the number of those who are too old, to work, they leave almost unaltered the proportion of able-bodied producers to dependent consumers. For example, if the present trend of population in Great Britain continues, the age group 20-59, which now constitutes nearly 57 per cent of the total population, will still constitute 55 per cent in 1985. On the other hand, the need for a constant redistribution of population between industrial and primary-producing countries is greater to-day than ever before, by reason of the over-specialization of these two types of economic units.

But the time is utterly and for ever past when the flag can follow the migrant. If he retains his culture, it must be by virtue of its affinity to the general culture of the country to which he migrates. That truth is obvious to the Briton, but it is so far from obvious to the National Socialist and the Fascist that they have staked their all on a policy of cultural nationalism which can lead nowhere but to blind and fruitless war. Until that mood gives place to a sense of reality, and until the real need for freedom of movement can be met by international agreement, Europe will remain in a state of dangerous unrest, and it will be more important that her future frontiers should be strategically defensible than that they should conform exactly to racial or linguistic boundaries.

Though, for the sake of simplicity, I have spoken of migration, it is important to remember that this is an over-simplification. Over the last six hundred years at least, the rise of international commerce has offered a partial alternative to migration, which did not exist in earlier ages; and when, in the nineteenth century, international commerce took increasingly the form of capital exports from Europe for overseas development, it powerfully nourished migration. The overseas assets thus created were European assets, shared by all European nations, even when they were owned principally by a single nation. English investments in the Argentine promoted the migration to that country of harvest labourers from Italy, and so on. But here, too, our economic culture has been frozen into immobility during the last twenty

years. Interest on English capital assets in primary-producing countries, brought to England and distributed by taxation, has still relieved the distresses of unemployed Englishmen who could not seek employment by emigration; but it has not been transferable to other nations by the old processes of re-lending and circular trade. In these circumstances, the concentration of such assets in the hands of English investors has had much the same effect on Europe as the unequal distribution of her population in relation to her natural resources. It has damaged the agricultural economy of England and has starved the industrial economy of Central Europe. Under such extraordinary conditions, the direct conversion of sterling debt in Canada, South America and Australasia into mark or lira debt would have been a rational policy. Unfortunately, an international capital levy of this kind was too simple an idea for those who still use the political and economic language of the last two centuries, who still assume that territory is the only asset that one nation can cede to another, and who still think of economic relations in terms of the circuitous self-adjustments of nineteenth century trade and banking.

It is easier for the historian to suggest analogies than to draw conclusions, but the conclusion of this survey is surely plain.

Peace can no longer be made by bartering territories or adjusting tariffs. The Culture State has run its course. It has worked itself out through all its phases—religious, political, linguistic, racial and economic—and it is now becoming that worst of all human things: a conservative anarchy. The problem of peace-making is how to destroy it peacefully; for if it is not destroyed by peace it will be destroyed by war, by the exhaustion of drawn battle or by successful conquest. If by conquest, it will be a barbarian conquest; the Culture State has created no Hellenism, even if it were to produce an Alexander. It has created, instead, the international culture of Marxism—a culture civilized in its origins but barbaric in its effects, whether it take the form of communism or of national socialism.

But it has created one other thing. It has created a British Commonwealth of Nations, now intimately allied with a French Empire, closely related by political and religious tradition to the five small nations of Scandinavia and the Low Countries, and occupying an extraordinary position in the Middle East. This great political partnership possesses vast economic resources which in the nineteenth century promoted the prosperity of all nations and can now be placed more deliberately at their service. Its chief partners have acquired a high degree of technical skill in the handling of these resources; above all, in their exercise of

both political and economic power, they acknowledge, dimly no doubt but genuinely, certain standards of moral duty, derived from a common faith and a common way of life. The wheel of history has not turned full-circle—perhaps it never does; but it has brought back to us something like the same opportunity as was offered four hundred years ago to the empire of Charles V, the opportunity of embracing diverse territorial sovereignties and races, diverse religious and political creeds, in a wider community, where all men can, at least, find a growing freedom of access both to spiritual and to material wealth. That opportunity may, all too easily, be lost once more—lost in the particularist selfishness of the Culture State or in a blind striving again after the institutional uniformities of a League of Nations or a Federal Union. But if it is lost, we shall be more guilty than Charles V or Philip II, for now the swing of the wheel is with us. It is moving away from, not towards, the Culture State; it is moving towards, not away from, the greater Culture Society.

Our success or failure will depend mainly on the shrewdness with which we judge what really matters in civilization—what is unimportant enough to be surrendered, and what is valuable enough to be purchased. The civilized man always gets the best of his bargains, not because he has the greater power of compulsion or persuasion, but because he has outgrown his taste for toys and does not mind parting with them—whether he is the trader bartering glass beads for rubber, or the medieval churchman granting land in exchange for repentance. Our danger is that so many trifles have still a superstitious value to one section or other of our democratic electorates: to the nationalist, mere territory; to the capitalist, his overseas investments; to the trade unionist, his control of the labour market by restriction of apprenticeship and prohibition of immigration. After the War such problems cannot, of course, be solved by an abrupt abolition of controls and an unconsidered return to freedom. In many of the most important spheres of economic policy, freedom is, indeed, meaningless; free access to raw materials may mean only freedom to covet them if the purchaser cannot find enough foreign exchange to buy them in sufficient quantities. Nationally, there may be legitimate differences of opinion as to the scope and merits of economic planning; but internationally we have already a misplanned economy, which must be deliberately replanned if it is not to lapse into chaos. The question for us is whether, in approaching this task, labour and capital in all the democracies of the British Commonwealth can so free themselves from old vested superstitions as to give the necessary discretion for replanning, and the

necessary mandate for mutual help and toleration, to international bodies.

That, at least, is one of the two questions that we have to prepare ourselves now to answer—now, above all, when our old toys look so small in the setting of life and death. The other is a greater question still, but I can do no more than mention it. It is the other side of the peace bargain. Having decided what is unimportant enough to be surrendered, what is it that is valuable enough to be purchased at this price? For the sacrifice will be real, even though it will be mainly a sacrifice of prejudices. What are we to ask in exchange?

Simply, I think, the recognition of one fact, which we ourselves have almost ceased consciously to recognize. All European civilization for sixteen hundred years has been based on one fundamental assumption: that State law must conform to moral standards which it cannot itself originate. These standards are the measure both of the powers of government and of the duties of citizenship. They are so absolute that their authority has been most accurately described in terms of revelation. But it is of the essence of this conception of civilization that these absolute standards are primarily standards, not for the State, but for the individual. Absolute as they are, every application of them to organized social action involves some compromise, and this debatable land of compromise has been, throughout European history, the scene of all the conflicts and entanglements of Church and State. On this paradox the whole fabric of our civilization rests. Democracy, in the only real sense of that word, is simply the extreme assertion of it—the claim that any exercise of political power must be measured by the individual citizen's sense of right and wrong, even though that measure must always be, to some extent, incompatible with the most efficient exercise of such power. Every effort to evolve a special political morality on the basis of 'reason of State', 'natural law', the 'rights of man' or the rights of nations, has ended in disaster, as it is ending in disaster to-day.

In other words, every conception of government ever formed by Europeans, but above all the conception of democracy, assumes the social recognition of a personal religion, and is meaningless without that assumption. To convert that assumption into the conscious and deliberate assertion of a faith is the other, and greater, half of peace-making. If we are to make peace by merging the Culture State in a wider union, the only possible name for that union is Christendom, and its success or failure will depend on its convinced acceptance of the essential implications of that name.

WORK OF THE MEDICAL RESEARCH COUNCIL

THE recently issued report of the Medical Research Council for the year October 1, 1938–September 30, 1939*, covers a period of some difficulty owing to the disturbed condition of world politics, culminating in the outbreak of war. Nevertheless, a perusal of the report suggests that the progress of the research work pursued under the Council suffered little, if at all, from the state of war expectancy, except for some readjustments towards the close of the Council's year.

With regard to special war emergency services, the Council undertook the organization and supply of antitoxins, in particular tetanus and gas-gangrene antitoxins, that might be required for war casualties, and sera and vaccines that might be needed in dealing with outbreaks of epidemic disease. The organization of an emergency laboratory service and of depots in the Home Counties for the collection, storage and supply of blood for transfusion purposes was also undertaken, and the Council frequently advised many Government departments which sought its assistance.

Nutrition in time of war, both as affecting the population as a whole under conditions of rationing, and the armed forces in respect of the great use of tinned foodstuffs in Service rations, were also the subject of investigation by the Council's staff. Government departments sought the assistance of the Council and of its Industrial Health Research Board on problems of industrial health, particularly in the production of war material, and special war problems are in course of investigation, such as shock occurring after serious wounds, sepsis complicating war wounds and physiological problems of aviation.

Passing to investigations on more general medical problems, a Committee on Preventive Medicine has studied methods of immunization against diseases such as diphtheria and whooping-cough with the view of evaluating their efficiency and determining the best technique, and has inquired into the problem of cross-infection in hospital wards. The causes of the high mortality rates due to broncho-pneumonia, to enteritis in children, and to respiratory diseases during winter have also been investigated.

The chemistry of brain reactions has been the subject of much research, and one of the facts established is the key position held by glucose as the main fuel of nerve tissue. It is also well established that substances normally present in the body perform specific functions in relation to

the nervous system. In this connexion, Sir Charles Martin, Dr. Harriette Chick and their colleagues, working at Cambridge, have shown that when pigs are reared on a diet deficient in vitamin B₆ they suffer from epileptic fits similar to those occurring in human epilepsy, and that when this vitamin is then added to the diet the fits cease. Prof. R. A. Peters and his colleagues at Oxford have likewise shown that when vitamin B₁ is deficient in the diet, both man and animals develop characteristic abnormalities of the nervous system. It was shown that, in the absence of this vitamin, the brain cells cannot make proper use of glucose as a food.

At the National Institute for Medical Research, Hampstead and Mill Hill, Dr. Stuart-Harris, Dr. Andrewes and Dr. Wilson Smith have conducted studies upon influenza. An epidemic occurred in the early part of 1939 which clinically resembled influenza, and attempts were made to isolate the influenza virus, which has a characteristic property in being transmissible to ferrets. Even with material from typical cases, all attempts to transmit a virus infection to ferrets failed, and only seven throat washings of patients, out of fifty-nine tested, yielded virus infective for ferrets. The outbreak, as a whole, appears to have been one in which the known influenza virus played a subordinate part, suggesting that other virus strains are capable of causing influenza-like attacks. Drs. Andrewes and Wilson Smith have also continued their experimental inquiry into the factors influencing the immunizing effect of the influenza vaccine.

The relation between human leprosy and rat leprosy was the subject of an interesting research by the late Sir Patrick Laidlaw. The rat disease, caused by an organism very similar to the human leprosy bacillus, is readily transmitted from rat to rat, but there is only one record of the successful transmission of human leprosy to the rat. Syrian hamsters, found by Adler of Jerusalem to be susceptible to infection with the human leprosy bacillus, were inoculated with human leprosy material, and one of the animals developed an infection with typical bacilli. With this material Sir Patrick Laidlaw found it easy to transmit infection not only to hamsters but also to white rats. A critical investigation by Sir Patrick suggested that the original material was derived from a case of human infection with the rat organism and not with the organism of human leprosy. The suggestion is made that human leprosy in the past may have arisen from the rat

* Report of the Medical Research Council for the Year 1938–1939. (H.M. Stationery Office, 1940.) 3s. net.

disease, the bacilli afterwards losing their infectivity for the rat with adaptation to the human tissues.

Work on biological standards, under the direction of Dr. Hartley, is also conducted at the National Institute, and various standards already established are maintained there. A British standard for a gas-gangrene antitoxin (*histolyticus*) has now been made available, and the British standard for diphtheria antitoxin has been placed on regular issue. Much work has also been done on the standardization of tuberculin, various other antitoxins, vitamins and insulin. The work of producing, standardizing and distributing bacterial

suspensions and sera for diagnostic purposes has been continued at the Standards Laboratory, Oxford.

The work of clinical research units, of external staffs, wholly or partly financed by the Council, and of individual research workers receiving grants, are summarized in the report, and many valuable contributions have been made to medical knowledge.

It is the intention to move the National Institute at Hampstead to Mill Hill, in association with the Farm Laboratories there, but this has been delayed by the war emergency. Some of the ancillary buildings are, however, ready for occupation, and the shell of the main building is nearing completion.

OBITUARIES

Prof. J. H. Michell, F.R.S.

THE death on February 3 of Prof. J. H. Michell, at the age of seventy-six, is a severe loss to Australia, and the great value of his work both as mathematician and teacher cannot be easily overestimated. His modesty was such that proper appreciation of his real worth was often confined to the fortunate few who were in close contact with him, either through his undergraduate lectures or some research problem.

After an early education in Melbourne, Michell proceeded to Cambridge, where his performance at the Mathematical Tripos and afterwards led to his early election as a fellow of Trinity College. Here he devoted himself to research in elasticity and hydrodynamics, and a remarkable number of important papers in both subjects resulted. He was largely responsible for the introduction of stress equations of equilibrium of an elastic solid which did not involve explicit introduction of the displacement-equations and provided a formal solution of the equations for an isotropic solid with a plane face under given surface tractions. The important theory of that type of deformation known as dislocation was first developed by Michell and he was also one of the first to make use of inversion in solving problems of plane strain and the bending of plates. His work in elasticity included very valuable discussions of the general theory of bending of beams and plates under various loads, besides the detailed solution of a number of special problems such as the elastic equilibrium of conical bodies, the calculation of strains due to concentrated loads, the deformation of naturally curved rods, etc. On the dynamical side of the subject Michell was responsible for the theory of the vibrations of a helical rod and of a circular ring. Perhaps his most interesting contribution to hydrodynamics is the theory of the 'highest' wave in water, but he also published work on discontinuous fluid motion and on wave resistance to ships.

As a just recognition of this excellent work, Michell was elected a fellow of the Royal Society in 1902. A few years later he was appointed lecturer in mathematics in the University of Melbourne and began a long career of devotion to the teaching of the subject. In 1923 he was appointed professor of mathematics and his influence became still more pronounced. To his honours students, among whom I had the privilege to be numbered, Michell was the very personification of mathematical erudition. An hour's lecture by him was an intellectual treat and a whole course of lectures something to look forward to with keen anticipation.

Michell was a great exponent of vector methods and was remarkably facile in their manipulation. He was undoubtedly one of the few mathematicians of his time who really thought in terms of vectors, and he was at pains to educate his students also to think in this way, which is, after all, the natural one for mathematical physics. His influence in spreading a proper appreciation of vector methods represents alone a very important contribution to applied mathematics.

When Michell retired from his chair in 1928 his valuable services were partly retained as honorary research professor. Despite the heavy calls on his time from his academic duties, Michell kept well abreast of all developments in his special subjects and gave several courses of lectures on modern hydrodynamics after his retirement. In 1937 he also published, with his colleague, Mr. M. H. Belz, a treatise on the elements of analysis which is an excellent illustration of the combination of vigour and clarity which characterized his approach to all mathematical problems.

Prof. Michell's modesty and good nature, combined with his remarkable intellectual qualities and willingness to assist in the smoothing-out of difficulties, however trivial, endeared him to his students, all of whom will remember him with affection and admiration.

H. S. W. MASSEY.

Prof. Otto Toeplitz

PROF. OTTO TOEPLITZ, who died on March 15 in Jerusalem, was one of that rare type of scholars who combine with a high standard of specialized research a deep interest in the history of their science and its bearing on general questions. Toeplitz, born at Breslau in 1881, studied mathematics in Breslau and Berlin, became *Privatdozent* at Göttingen in 1907, professor of mathematics at Kiel in 1920 and at Bonn in 1928. In 1935 he was dismissed in consequence of the racial laws of the Nazi Government and went in 1939 to Palestine as scientific adviser to the administration of the Hebrew University.

Toeplitz's mathematical interest was wide and covered all branches of research, but was deeply rooted in algebra. He liked to consider analysis as an algebra of an infinite number of variables, an example of which was given by Hilbert's treatment of integral equations as special cases of linear equations and quadratic forms of infinite sets of variables. Most of his papers deal with problems of this type—infinite matrices and the corresponding bilinear and quadratic forms. His great knowledge and thorough insight in this subject is testified by the article on integral equations in the "Mathematical Encyclopædia" (1928) written in collaboration with E. Hellinger. But Toeplitz's general attitude to mathematics, which he preferred to consider more as an art than as a science, is more clearly visible in his quasi-popular book "Von Zahlen und Figuren", written with Rademacher in 1930, which seems to me a masterpiece of that class of scientific literature which attempts to instruct a wider public in the fundamental ideas of science. It is not easy, but certainly fascinating reading.

In later years Toeplitz's interest went more and more to the history of mathematics. He was a classical scholar able to read Greek texts and he knew his Plato just as well as his Gauss and Weierstrass. Together with Neugebauer and Stenzel, he founded the periodical *Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik*, to which he contributed several articles, chiefly concerned with mathematical ideas in Plato's work.

Toeplitz had no intimate relation to physics, but had nevertheless some indirect influence in its development, the present writer being the link. As a student in Breslau, I was much under the influence of Toeplitz, who was my senior by one year, and though my interest in algebra was not great he insisted on my learning matrix calculus properly and occasionally refreshed my knowledge when we were together again as young teachers in Göttingen. This turned out to be a great advantage to me, first in developing Minkowski's form of relativity, then for the study of vibrations in crystals, which are determined, indeed, by a quadratic form of a (practically) infinite number of variables, but decidedly at the birth of quantum mechanics. When Heisenberg expressed the relations between the quantized amplitudes of atomic vibrations as a kind of symbolic product, the recollection of Toeplitz's instructions enabled me to recognize them as matrix products and (with Jordan)

to work out the principal features of quantum mechanics. Though this is only a purely formal step beyond Heisenberg's idea it is perhaps not quite trivial, as shown by the fact that Dirac, in independently developing Heisenberg's idea, invented a new formalism, his q -number calculus, without immediately recognizing the identity of Heisenberg's process with matrix products. Toeplitz himself regarded this unexpected application of his beloved matrices with some suspicion, and rightly from the point of view of the conscientious rigorous mathematician. But he nevertheless continued to give me his advice on special questions.

Toeplitz was devoted to teaching and spent much time and work on it. He was a faithful friend, a man of extreme kindness, but also of strong character and courage. This he amply proved during the hard years of Nazi rule, when he worked with all his force on the problem of saving young non-Aryans from Nazi persecution.

M. BORN.

Prof. Alexandre Besredka

THE recent death of Prof. A. Besredka at the age of seventy deprives France of yet another member of that sadly diminished group of scientific workers whose names are associated with the brilliant and provocative work produced in the early days of the Pasteur Institute. The mention of Besredka's name immediately evokes the whole conception of local as opposed to general or humoral immunity; a conception which has given rise to considerable controversy and thus provoked much fruitful experimental work on the nature of inflammation and the reaction of the body to infection. No memoir would, however, be complete which failed to pay tribute to Besredka's pioneer work in many fields of bacteriology and immunology. During his early days in Paris he was assistant to Metchnikoff. He applied the methods of this master to an illuminating study of the reaction of phagocytes to bacterial exotoxins and endotoxins and to the injection of mineral poisons. Later, Besredka made important contributions to the development of specific immunization against infection, notably in his studies on streptolysin and the use of sensitized vaccines. Anaphylactic shock, which is an abnormal and sometimes disastrous immune response to the injection of foreign protein, also claimed Besredka's attention.

The later years of Besredka's life were devoted to the study of local immunity to infection. He believed that immunity depends upon a state of resistance residing locally in those tissues that are attacked by an infection, and denied the importance of the general immune response of the body and the antibodies circulating in the blood stream. According to Besredka, all attempts at immunization should be applied locally to the susceptible tissue and should aim at modifying the reaction to the noxious agent. His experimental work was mainly confined to infections of the skin, such as anthrax and the staphylococcus, and to intestinal infections, such as typhoid and dysentery. In order to obtain immunity

to skin infections Besredka advocated intracutaneous vaccination, inunction or the application of poultices containing the products of bacterial metabolism. It is true that the local resistance of the skin can be raised by these measures, but there is considerable evidence that a similar result can be obtained by non-specific stimulation and that, apart from any question of a general immune response to these procedures, the increased resistance to infection may be due to a non-specific inflammatory response.

In order to combat intestinal infections Besredka advocated the oral administration of bacterial vaccines combined with bile to increase the permeability of the intestinal mucosa. These vaccines have been extensively used in France; but it is difficult to express any final verdict on their efficacy, or to disentangle the local protective effect from the part played by the serum-antibodies which are undoubtedly produced.

If the contribution of a man of science can be measured not only by those discoveries or 'lucky shots' which command universal and immediate acceptance, but also by the skilful presentation of ideas which lead to original experimental work and to the exploration of fresh avenues of approach to intricate problems, then Besredka should be assured of an eminent place in the calendar of bacteriologists.

We regret to announce the following deaths:

Prof. Heinrich Bonhoff, formerly professor of hygiene in the University of Marburg, aged seventy-six

Prof. G. Gallerani, emeritus professor of physiology in the University of Carnerino, aged seventy-six.

Prof. V. I. Sihvonen, professor of chemistry in the University of Helsinki, killed in an air raid on November 30.

NEWS AND VIEWS

Education in the Royal Air Force

IN NATURE of April 6, p. 526, we discussed at some length the urgent case for the provision of adequate educational services by the departments responsible for the Armed Forces. This discussion was mainly in terms of Army organization. The War Office, however, was not alone in showing a lack of regard for educational matters. The general education scheme of the Air Force, which had been carefully built up over many years, seems to have been virtually scrapped overnight on the outbreak of the War—the educational staff dispersed and the premises appropriated to other purposes. Even in the R.A.F. schools of technical training, of which the educational branch has been an essential component, there appears to have been a noticeable educational set-back. This is surely evidence of a regrettable failure to give educational values their proper place in a modern fighting service, manned (as the Air Force conspicuously is) by the finest types of young men the nation possesses. In the treatment meted out by the Air Ministry to its educational staff—the great majority of whom are officers with considerable scientific or technical qualifications—there is further indication of an unfortunate attitude towards education. The civilian status which these educational officers have hitherto had has always made their task an extremely onerous one. For, disregarding the experience of the Navy and the Army—the officers of the education branches of which are commissioned officers on the same footing as executive officers, medical officers and so on—the Air Ministry has continued to impose a civilian status on its educational staff.

Nevertheless, we understand that, before the outbreak of the War, it was accepted by the Air Ministry that whilst this arrangement might be adhered to in peace, it could not work under 'active service' con-

ditions. The education officers were invited to accept commissions in the Royal Air Force Volunteer Reserve, under definite conditions as to pay, rank, promotion, etc. In accordance with this scheme, all educational posts to be retained on the outbreak of war were ranked and education officers were earmarked to fill them. Uniform allowances were granted and all other necessary arrangements were made to enable the scheme to work as smoothly as possible if and when hostilities should begin. In this way, at the beginning of last September, the Air Force education officers assumed their new status. Without warning, however, education officers were informed a few months later that they had been demobilized and must revert to civilian status. That the Air Ministry now realizes something of the invidious position in which this decision has placed its education officers may be inferred from an instruction recently issued that the education officers are to wear uniform as Air Force officers notwithstanding that they have been demobilized and are no longer technically on 'active service'.

The Air Council should see to it that this state of affairs is put right without delay. The reason given for demobilizing the education officers was, we believe, that some (but by no means all) of them were receiving emoluments as Air Force officers greater than those they had received as civilians before the War—though the extent to which this would happen must surely have been known to the Air Ministry when the conditions of the scheme were drawn up. In any event, on any reasonable basis of computation, the sum involved is a mere trifle. Probably it could be eliminated entirely by an adjustment of ranks (and perhaps by other means) acceptable to the education officers, without prejudicing the Air Force status of these officers as has been done by the ill-advised steps recently taken.

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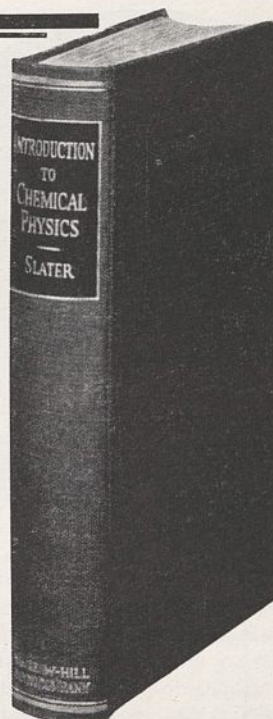
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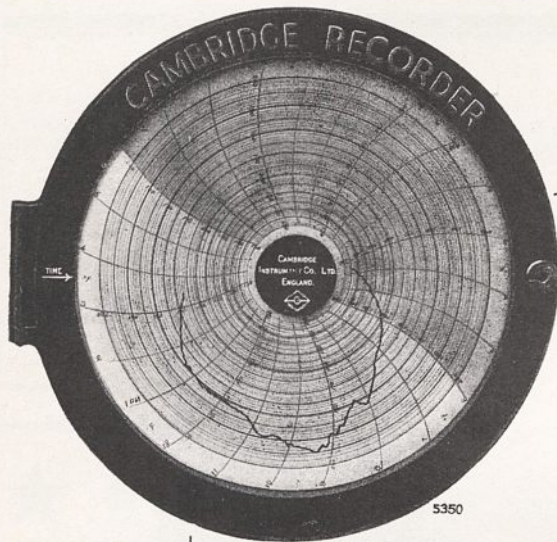
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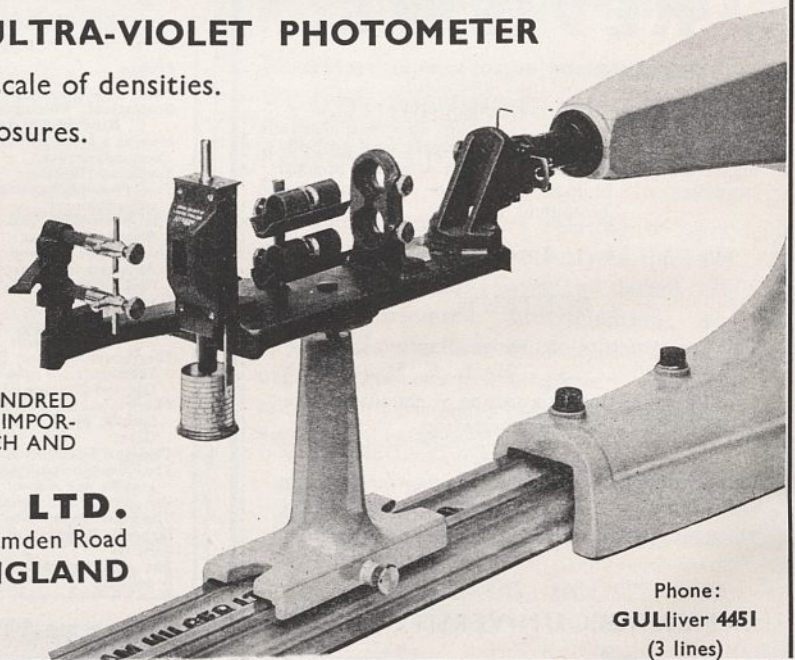
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The British Association

THE British Association intends, unless unforeseen events intervene, to hold a conference in the University of Reading, by kind permission of the Council of the University, during July 25-27. The general reference will be to science in national and international aspects, and Sir Richard Gregory, president of the Association, will open the conference as chairman. Thereafter there will be meetings in four groups, dealing respectively with international intellectual co-operation; natural resources and national needs; social aspects of human nutrition; and scientific discovery and progressive industry. The preliminary programme for the conference is taking shape, and already a number of distinguished speakers have consented to participate, if circumstances permit, in the various group-discussions. The programme should be ready for issue in the early part of next month. Considerations of finance and the restriction of paper supplies will prohibit its distribution on the usual extensive scale, and any interested persons who do not receive it by the middle of May are requested to ask for it to be sent from the office of the Association at Burlington House, London, W.1.

Admission to the conference will be by tickets, the number of which will be restricted to some seven hundred by the available accommodation. The tickets will be free, but members of the Association will be urged to maintain their subscriptions, and others will be invited either to become members or to contribute by donation to the funds of the Association. Arrangements for the lodging of visitors in the University halls of residence are in hand. The Council of the University will hold an informal evening conversation for members of the Association and guests.

Siméon Denis Poisson, For.Mem.R.S. (1781-1840)

ON April 25, 1840, the distinguished mathematician Siméon Denis Poisson died at Sceaux at the comparatively early age of fifty-eight. Born at Pithiviers on June 21, 1811, he was the son of a soldier who had served in the Seven Years War, but was brought up by an uncle at Fontainebleau. At the local school he attracted attention by his gift for mathematics, and at the age of seventeen gained admittance to the *École Polytechnique*, with which he remained connected for practically all the rest of his life. In 1800 he presented to the Paris Academy of Sciences his first mathematical memoir, gaining thereby the interest of Lacroix and Legendre. He was appointed to the chair of analytical mechanics in the *École Polytechnique*, held the chair of mechanics in the Faculty of Sciences of Paris, was given a seat on Bureau des Longitudes, and became an examiner to both the *École Polytechnique* and the *École d'Artillerie* at Metz.

Altogether Poisson wrote more than three hundred memoirs on mathematical, astronomical and physical subjects. His most notable book was his "*Traité de Mécanique*", published in two volumes in 1811. His work on capillary attraction appeared in 1831 and

that on the mathematical theory of heat in 1833. A man of deep convictions, he took no part in political life, finding in mathematical pursuits his work and recreation. When enjoined to spare himself, his reply was "*La vie c'est le travail*". Among a great number of remarkably able men of science, he stood out as one of the foremost. He was buried in Paris, and a memorial notice was afterwards written by Arago. Napoleon had raised him to the rank of baron, and a few years before his death he was made a peer of France.

Sir Thomas Clouston (1840-1915)

SIR THOMAS SMITH CLOUSTON, a leading Edinburgh psychiatrist, was born on April 22, 1840, at Nist House, Orkney. He was educated first at Aberdeen Grammar School and then at the University of Edinburgh under Goodsir, Syme, Simpson and Laycock. He graduated M.D. in 1861, when he received a gold medal for his thesis on the nervous system of the lobster. After serving four years as assistant physician to the Morningside Asylum, Edinburgh, he was appointed medical superintendent of the Cumberland and Westmorland asylum at Carlisle, where he remained until 1873, when he succeeded Skae as medical superintendent at Morningside and continued in this post until his retirement in 1908. During his period of office he carried out many reforms in the asylum, including rebuilding and the introduction of humane and efficient methods in the treatment of the patients, in addition to making a large number of clinical and pathological observations. Besides being in great demand as a consultant not only in mental disease but also as an expert in forensic medicine, Clouston took an active part in municipal affairs at Edinburgh.

In addition to his principal work entitled "*Clinical Lectures on Mental Diseases*", which went through six editions between 1883 and 1904 and was for many years a standard text-book, Clouston was the author of "*Neuroses of Development*", which formed the Morison Lectures for 1890, "*Hygiene of Mind*" (1906) and "*Unsoundness of Mind*" (1911). He also contributed an important article on "*The Epochal Insanities*" to Allbutt's "*System of Medicine*" (1899). He was the recipient of many honours. In 1911 he was knighted, in 1907 he was made Hon. D.C.L. of Aberdeen and in 1911 of Edinburgh. He was also president of the Medico-Psychological Association of Great Britain and Ireland, of which he was one of the founders, and of the Royal College of Physicians of Edinburgh, and editor of the *Journal of Medical Science*. He died on April 17, 1915.

Factory Hours for Women and Young Persons

A REPORT on hours of employment of women and young persons in factories during the first five months of the War, issued by the Home Office (Cmd. 6182. London: H.M.S.O.), reviews the experience of 1914-18 and the situation at the outbreak of war. It was necessary to agree freely to substantial overtime at the outset so as to meet immediate difficulties and afford time, without holding up urgent supplies, for

inquiries into the actual needs of the case. It is also essential, however, to make clear to employers and workpeople that the Factories Act has not gone by the board, and that hours must be regulated, through its machinery, in accordance with a considered policy. The policy was pursued of reviewing the position at individual factories at fairly short intervals, especially during the first months of the War. Orders authorizing extended hours have been made in respect of 2,459 factories, but the hours authorized were often shorter than those applied for, and some applications were refused altogether. Many factory occupiers to whom orders were granted in September and October allowing 57 hours for women have been able to maintain the necessary output with fewer working hours by means of re-organization, and in 239 cases on expiry of the order the occupiers have not desired renewal. A system of two day-shifts has been authorized for 299 factories, but applications to employ women at night have been relatively few and confined almost entirely to armament or allied factories; altogether 57 such orders have been made.

Orders have been made for thirty factories allowing the employment of male young persons more than sixteen years of age in a system of two day- and night-shifts or three eight-hour shifts. In the early weeks of the War many firms, particularly in the engineering industry, and firms engaged in making blinds and other articles urgently required owing to lighting restrictions, were permitted to employ young persons less than sixteen years old up to 47 or 48 hours a week for a short period, rarely longer than two months. Many factory occupiers took such effective measures during the period of the concession that when their orders expired it was unnecessary to employ these young persons beyond the statutory maximum of 44 hours. During the early months of the War, short-term orders permitting the employment of young persons under sixteen up to 48 hours a week were granted to 439 factories, of which 302 were engaged in general engineering and 48 in ship-building and marine engineering; 312 of these orders were not renewed, but at the end of the five months under review 133 such orders were in operation. The report states that it is the policy of the Government not to authorize hours which in the light of experience and of scientific investigation are detrimental to health or efficiency.

The Higher School Certificate Examination

THE Higher School Certificate Examination, about which there has recently been an investigation, has two functions: to provide a test of sixth form work and to help in the selection of State and local Education Authority scholars. For the latter purpose the investigators recently appointed to investigate the position of these examinations suggest that they are less suitable than the examinations for open scholarships at the universities, and they also say that the work of non-scholarship candidates is cramped by their association with the others. Yet they found that the exam-

ination achieves its double purpose with a fair measure of success and they have not recommended drastic changes. Points for and against two alternative proposals are discussed in a report recently issued (The Higher School Certificate Examination: being the Report of the Panel of Investigators appointed by the Secondary School Examinations Council to enquire into the Eight Approved Higher School Certificate Examinations held in the Summer of 1937. Pp. 93. London: H.M. Stationery Office, 1939. 1s. 6d. net). The first is that the task of recommending candidates for the award of State scholarships might be handed over to the universities. The second alternative is that the examination might be divided into two parts, one of which would serve for awards of certificates and as a qualifying test for candidates for scholarships, and the other would be entirely competitive. The competition itself would then be conducted by a new central examining body.

The investigators found that the regulations tended both to enrich the larger examining bodies and to impoverish the modern universities, and they have made a simple proposal about the distribution of scholarships which is designed to correct these tendencies. Although the investigators have stated the facts and explained the difficulties clearly, the report seems inconclusive in many respects. It may be no worse for that, yet it is all the more disquieting on nearing the end of the report to find four pages of almost unrelieved condemnation of the science syllabuses and papers, and by implication of the work of the science sixth forms in schools. It is impossible fairly to summarize the statements made on these concisely written pages, but the gist of the matter is that the training of these candidates is too remote from the ordinary affairs of life, that the humanistic and cultural aspects of science generally receive scant attention, and that pupils are not helped to realize how closely scientific discoveries affect human progress or their own life and work. Severe criticism of this sort calls for some response, and the first step towards reform is that those who are engaged in the teaching and examining of science at the Higher School Certificate stage should read this report in a spirit of self-examination. If they do so it is probable that only the unimaginative will award themselves very high marks for their work.

A Pioneer Wireless Station

A MEMORIAL stone in grey Cornish granite has been erected at Alum Bay in the Isle of Wight to mark the position occupied by the first permanent wireless station. The Needles Wireless Telegraph Station holds a place of honour in the history of wireless communication because it was here, in 1897, after a few experiments on Salisbury Plain and other places, that Marconi and the engineers of Marconi's Wireless Telegraph Co. carried out experiments which led to the great achievement of spanning the Atlantic by wireless from Poldhu in 1901. It is claimed that the Needles Station was the first from which a paid marconigram was transmitted on June 3, 1898. The

working of this Station was inspected by many prominent people, among them being Lord Tennyson and Lord Kelvin.

The first two paid wireless messages ever dispatched were sent by Lord Kelvin, one to Sir William Preece at the General Post Office on June 3, 1898, and the other to Sir George Stokes, the Cambridge physicist. Lord Kelvin insisted on paying for the messages as an indication of his belief in the possibilities of wireless communication at a time when there was much scepticism. A photograph of the memorial to Marconi on the cliffs of Alum Bay appears in *The Times* of April 11. Four bronze plaques are attached to the memorial; one pays tribute to "Marconi and his collaborators, who carried out from Dec. 6, 1897, to May 26, 1900, a series of experiments which constituted some of the most important phases of their early pioneer work in the development of wireless communication of all kinds". Another records the production of the *Transatlantic Times* in 1899, the first newspaper to be produced at sea, which received information by wireless telegraphy from the Needles Station and printed it in the United States liner *St. Paul*.

Croydon Natural History and Scientific Society

It was on April 6, 1870, that the Croydon Microscopical Club, the forerunner of the Croydon Natural History and Scientific Society, held its inaugural meeting, so the Society is practically a contemporary of NATURE. According to the early records, about a hundred and fifty were present at the meeting, "not all of the savantissime school, it is true—but the majority evincing an earnest desire for the pursuit of science in one of its most interesting branches". Microscopical demonstrations were arranged. The chair was taken by Mr. H. Lee, who reported that the Club included three fellows of the Royal Society, four of the Linnean Society, three of the Geological Society (one of whom was treasurer of the Club), and several members of the Royal Microscopical Society and the Quekett Microscopical Club. Among the speakers were Frank Buckland and Dr. J. S. Bowerbank, F.R.S.

Further meetings were held during 1870. On May 4, J. W. Flower read a paper on the microscopical organisms of the flints. On May 14, the Club formed a party with members of the Quekett to explore the River Wandle for freshwater organisms. The quest was apparently not very successful, but mention is made of the fact that the party managed to obtain adequate refreshment of bacon and eggs, cold beef, tea, etc., at the "Greyhound". On May 28, the Club visited the house and grounds, at Park Hill, of Mr. Flower, who "had provided 2 cart loads of Flints for them to crack" in search of fossil foraminifera, etc.; "the popping of champagne corks was frequently heard above the sound of the geological hammers". On July 30, Mr. H. W. Peek, M.P., entertained the Club, and on November 30, the Club's first soirée, with exhibits, was held in the Public Hall, Croydon. Lest it be thought that undue prominence was given to refreshment of the body

rather than the mind, we hasten to add that the Croydon Natural History and Scientific Society, the honorary secretary of which is Capt. B. V. Pring, 33 The Windings, Sanderstead, Surrey, has a distinguished scientific record and normally holds regular meetings twice a month at the Central Library, Croydon.

Bacteriological Warfare

In his inaugural thesis (*Thèse de Paris* 1940, No. 19) on the experimental production of epidemics and epizootics, Dr. Ernest Sarfati states that the question of bacteriological warfare formed the subject of an inquiry in 1923 by a committee of experts including Profs. Bordet of Brussels, Cannon of Harvard, Madsen of Copenhagen, and Pfeiffer of Leipzig. As the result of the inquiry a protocol was issued at Geneva on June 17, 1925, signed by representatives of Germany, the United States, Great Britain, France, Italy, and about forty other nations who undertook that their countries would not take part in bacteriological warfare, the possibility and dangers of which they fully recognized. The experts classified the mode of transmission of bacteria into an enemy country as follows: (1) transportation by aircraft or spies; (2) dispersal of microbial cultures in liquid or solid form; (3) transmission by intermediate hosts such as rats or lice, or the poisoning of projectiles or steel weapons.

The epidemics which theoretically might be produced artificially by these means include malaria, yellow fever, bacillary dysentery, diphtheria, typhus, plague, cholera, enteric fever, Malta fever, tuberculosis, smallpox, influenza, rabies, poliomyelitis and epidemic encephalitis, while the principal epizootics would be glanders, anthrax, foot-and-mouth disease, peri-pneumonia of cattle, and pernicious anaemia of horses. Special circumstances, however, are required to produce epidemics and epizootics, and attempts have repeatedly been made to destroy certain animal species, particularly locusts, without success. Dr. Sarfati comes to the conclusion that while bacteriological warfare is not impossible, it would only succeed in strictly localized areas, in which case the ordinary methods of prophylaxis, including the use of serums and vaccines, would prevent the spread of infection.

Sir Leonard Woolley and Indian Archæological Studies

As anticipated, the reception accorded by Indian opinion to Sir Leonard Woolley's report on the Archæological Department and the state of archæological research in India can only be described as mixed. To a great extent, criticism of its findings has been inspired by umbrage taken that his expert advice should have been invited by the authorities and his verdict received and published, without sufficient regard being paid to the views and opinions of those among the Indians themselves considered competent to judge. Thus it may be considered that it was to some extent a reaction against any attempt on the part of the Government to restrict existing archæological activities in the field that was responsible for the resolution of the Archaic and

Cultural Section of the Indian History Congress, which met at Calcutta on December 15-17, 1939, requesting the Government of India to reconsider the decision to stop further excavation work on account of financial stringency due to the War. A little discrimination in the terms of the resolution would have been indicative of a juster sense of proportion.

A less partial, though not entirely unbiased, view of the situation in archaeological studies under official control is taken in an analysis of Sir Leonard Woolley's report, which appears in *Science and Culture* (Calcutta) of January and February 1940. In summarizing his views on the recommendations, the author characterizes the proposals as to museum management, the use of museums for educational purposes, on the training of officers, long-period budgets, choice of sites for excavation, and co-operation between the department and educational institutions as being "very sound", and holds that they should be given immediate effect. At the same time he claims that they are neither new nor original, and suggests that the attacks on the work of the Archaeological Survey, excepting those relating to excavation and exploration, are largely unjustified and irrelevant, "probably due to his ignorance of Indian archaeology and the methods and practices of service followed by the Government of India". Sir Leonard needs no defender. To refute such charges, as well as much of the criticism to which it is not possible to refer here, it is unnecessary to go outside the pages of the report itself. Such views, however, if general, would not augur well for the future of scientific archaeology in India.

The National Physical Laboratory

A NEW Department of Light has been formed at the National Physical Laboratory, to comprise the former Optics Division of the Physics Department and the Photometry Division of the Electricity Department. Mr. T. Smith, head of the Optics Division, has been appointed superintendent of the new department as from April 1, 1940. Dr. E. H. Rayner retired from the post of superintendent of the Electricity Department on March 31, 1940, having attained the normal age limit. He has been succeeded by Mr. R. S. J. Spilsbury, formerly principal scientific officer in the Department.

Recent Earthquake Recordings

ACCORDING to a *Times* message, earth tremors were felt on April 12 on the south coast of Newfoundland at the settlements of François and Rencontre. No damage is reported. The earthquake of November 18, 1929, was felt in the same region though the greatest damage was done to submarine cables somewhat to the south, that is, between lat. 44° N. and 45° N. and between long. 55° W. and 57° W. (*NATURE*, 124, 859; 1939: 127, 609; 1931).

During March, sixteen earthquakes were registered at Kew Observatory, the greatest number on any one day being two on March 28. Most of the earthquakes registered were small, and there appears to

have been a good deal of disturbance due to micro-seisms. The greatest shock recorded was also on March 28 at 16h. 2m. 4s. G.M.T.

At the Dutch Observatory at De Bilt prominent earthquake shocks were registered on March 27 and 28. The former was apparently not registered at Kew, but the latter may have been the one showing the greatest amplitudes of the month at Kew. Dr. G. van Dyk is of the opinion that the *P* waves arrived at De Bilt at 16h. 1m. 57s. G.M.T. and the *S* waves at 16h. 12m. 5s. G.M.T., giving an epicentral distance from De Bilt of approximately 84.2°, assuming a normal depth of focus.

Announcements

THE following recent appointments and promotions in the Colonial Service have recently been made: E. O. Longley, veterinary research officer, Nigeria; A. B. S. Boswell, assistant conservator of forests, conservator of forests, Malaya; W. J. Eggeling, assistant conservator of forests, senior assistant conservator of forests, Uganda.

THE World Congress of Faiths will hold its fifth annual meeting at Bedford College, University of London, during July 5-10. The Marquis of Zetland, Secretary of State for India, will preside at the inaugural meeting at 5 p.m. on July 5. The main theme for the Congress will be "The Common Spiritual Basis for International Order". Further information can be obtained from the Secretary, Mr. Arthur Jackman, Room 336, Abbey House, 2-8 Victoria Street, London, S.W.1.

A MEDICAL building belonging to the Hebrew University has recently been completed in the Garden of Olives in Jerusalem. It will serve as a medical centre for diseases of all kinds, not only for Palestine but also for the rest of the Near East.

OWING to the need for economy in the use of paper, the Council of the Royal Sanitary Institute has decided that after the completion of the present volume in June, the *Journal of the Royal Sanitary Institute* will be issued quarterly instead of monthly.

A CORRESPONDENT has pointed out that the radiographic contrast medium for urography referred to in a paragraph entitled "X-Ray Photography of the Renal System" in *NATURE* of March 23, p. 459, is the same substance as the German preparation marketed before the War as 'Uroselectan B'. It is being manufactured in Great Britain and sold as 'Pyelectan' by the Glaxo Laboratories, Ltd., and as 'Uropac' by Pharmaceutical Specialities (May and Baker).

ERRATUM.—In *NATURE* of April 6, p. 529, col. 1, line 15, the reference to the paper by Prof. E. Schrödinger should read "Preuss. Akad., 1930" instead of "Preuss. Akad., 1936".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They 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.

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 630. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Atmospheric Layer from which the Yellow Line in Twilight originates

THROUGH measurements at the Pic-du-Midi, Garrigue¹ found that the average intensity of the yellow line in the night sky 10° above the horizon is about 2.8 times that at the zenith, from which Cabannes, Dufay and Gauzit² found the altitude of the layer emitting the yellow line to be about 130 km.

Bernard observed at Tromsø the time at which the intensity of the yellow line in twilight suddenly drops. Assuming the excitation to be restricted to a region exposed to ordinary sunlight, and that, therefore, the disappearance of the yellow line takes place when the shadow of the solid earth exceeds a certain height (H_B), Bernard concludes³ that the emission of the yellow twilight line is restricted to a layer below 60 km.

Bernard regards this result as in conflict with that of Cabannes, Dufay and Gauzit, which he considers to be based on unreliable data; but as he is dealing with a different light phenomenon, for which the distribution with altitude of the excitation agency will be different from that of the night sky luminescence, there is not necessarily any conflict between the results.

On the basis of extensive observational material from Oslo, I have been able to show that the yellow line is also emitted in twilight from a layer situated at the lower part of the auroral region. By means of a small spectrograph of great light power, we took a series of twilight spectrograms, partly in the zenith and partly in a nearly horizontal direction. If, with Bernard, we assume that the emission of the yellow line is determined by the shadow formed of visible sunlight by the solid earth, then the observations near the horizon would give a greater upper limit (59 km.) of the effective emission layer than the spectra from the zenith (45 km.).

Assuming, however, that the yellow line is excited by some easily absorbed, probably ultra-violet solar radiation, and that the atmosphere below a certain height (H_s) acts as a screen for the effective solar rays, then this screening height may be found from the condition that the spectra from the zenith and from the near horizon must give the same upper limit (H_u) for the emission of the yellow line.

The observations from Oslo give for the effective screening height $H_s = 55$ km. and for the upper limit of effective excitation $H_u = 115$ km.

It is of interest to notice that the screening height is just above the region of relatively large ozone concentration. The effective height is found to be about the same in the evening and in the morning, showing that there is no noticeable time-lag in the emission process.

These results indicate an extra-terrestrial origin of the sodium from which the yellow line is emitted. It is possible that, in addition to the hydrogen showers previously dealt with⁴, showers of sodium coming from the sun may enter the atmosphere. Possibly the hydrogen showers, in connexion with sodium and atmospheric oxygen, may account for the luminous night clouds. Our results regarding the position of the effective sodium layer also enable us to make certain estimates regarding the effective solar radiation. If it is ultra-violet light, it should be found somewhere in the interval 1900–3100 Å. The screening limit (H_s) is due to ozone absorption, the maximum of which lies at about $\lambda = 2500$, or near the wave-length ($\lambda = 2412$) corresponding to the ionization potential of the sodium atom.

L. VEGARD.

Physical Institute,
Oslo.
March 11.

¹ Garrigue, *C.R.*, 205, 591 (1937).

² Cabannes, Dufay and Gauzit, *C.R.*, 206, 1525 (1938); *NATURE*, 141, 1054 (1938); *Astro. J.*, 88, 164 (1938).

³ Bernard, *C.R.*, 206, 448, 928 (1938).

⁴ Vegard, *NATURE*, 144, 1089 (1939).

Absorption of the Hydrogen Line
1215.7 Å. by Air

IN a recent letter¹, S. E. Williams reports measurement of the absorption in air and oxygen of the first line of the Lyman series of hydrogen, Ly_α , at 1215.7 Å. This problem is of interest because of the suggestion by Martyn *et al.*² that Ly_α radiation from solar eruptive areas may be responsible for radio fade-outs. Williams's result was that a path length of 0.04 cm. of oxygen reduces the intensity of Ly_α by a factor of one half. This represents an absorption coefficient about fifty times as large as that found in a recent determination of mine³.

Without details of his experimental method, it is difficult to suggest any explanation for this startling disagreement. Since water vapour, carbon dioxide, and most organic vapours have relatively much larger absorption coefficients at this wave-length, small traces of impurities would be sufficient to explain a result that was much too high.

It is more difficult to imagine a source of error which would give too low a value for the oxygen absorption. Williams suggests that the absorbing oxygen in my experiment may have been largely dissociated. Ladenburg and Van Voorhis⁴ were bothered by dissociation when measuring oxygen absorption in the 1350 Å. region. The oxygen in their

cell disappeared rather rapidly, probably as a result of the adsorption of atomic oxygen on the cell walls. I was aware of this possible source of error. However, my source was a largely 'atomic' hydrogen discharge, with very low intensity in the spectral region responsible for oxygen dissociation. In addition, observation of the pressure in the absorption cell during a prolonged run showed that it did not perceptibly decrease. It is therefore felt that no considerable error could have arisen from dissociation, and that the lower value for the absorption coefficient of oxygen, which is in agreement with previous estimates⁵, is the more reliable.

It should be pointed out that a law of absorption $\log I_0/I = \mu x + C$ (where I_0/I is the ratio of incident to transmitted intensity, μ the absorption coefficient, x the equivalent path length at N.T.P., and C a constant found by Williams to have a negative value) can scarcely be called 'usual', as stated by Williams. It presumably predicts zero absorption for the range $0 < \mu x < |C|$, and I can find no record of the actual observance of such a phenomenon. Williams refers to Shalow and Steiner⁶ as having described a case in which the absorption coefficient μ (attributed to O_2-O_2 molecules) varies with the square of the pressure p . Reference to their article indicates that they found that $\log I_0/I = ap^2$ (where a is a constant). The usual law of absorption, which can be written as $\log I_0/I = \frac{\mu l p}{76}$ (where μ is the coefficient of absorption, l the actual path length, and p the pressure in cm.), then shows that μ is directly proportional to p , not to p^2 . They found no evidence of zero absorption over a finite pressure range.

Harvard University,
Cambridge, Mass.
March 9.

W. M. PRESTON.

¹ Williams, S. E., NATURE, 145, 68 (1940).

² Martyn, Munro, Higgs and Williams, NATURE, 140, 603 (1937).

³ Preston, W. M., Phys. Rev., 43, 315 (1939) abstract only; complete report shortly to be published in the Physical Review.

⁴ Ladenburg and Van Voorhis, Phys. Rev., 43, 315 (1933).

⁵ Chapman and Price, Rep. Prog. Phys., 3, 58 (1936) quote Hopfield, that a 10 cm. path of oxygen at N.T.P. is necessary to "completely absorb" Ly_a .

⁶ Shalow and Steiner, Z. Phys., 99, 137 (1936).

Rotational Analysis of the Band Spectrum of Boron Monobromide

THE ${}^1\pi \rightarrow {}^1\Sigma$ spectrum of the molecule BBr has been photographed in the second order of a 6.5 m. concave grating. The light source was an uncondensed discharge through BBr_3 -vapour in a pyrex H-type tube fitted with quartz window and nickel electrodes. The rotational structure of the (0,0)-band at 2950 Å. is partially resolved into lines. Measurements in the P-, Q- and R-branches, where lines up to $J \sim 90$ can be observed, make a complete analysis of this band possible. The constants of the BBr -molecule are found to be:

$${}^1\Sigma^+ : \begin{array}{l} B'_0 = 0.487 \text{ cm.}^{-1} \\ D'_0 = -0.90 \times 10^{-6} \text{ ,,} \\ r'_0 = 1.890 \text{ Å.} \end{array} \quad \left| \quad \begin{array}{l} {}^1\pi : B'_0 = 0.496 \text{ cm.}^{-1} \\ D'_0 = -1.25 \times 10^{-6} \text{ ,,} \\ r'_0 = 1.875 \text{ Å.} \end{array} \right.$$

Owing to the small difference of the constants B' and B'' , the constants D' and D'' determine the form

of the branches, which are rather unusual, the Q-branch forming two heads, one at the zero line, the other at $J \sim 100$. The value $B'' = 0.487$ of the ground state together with the ground frequency $\omega_e'' = 684.0 \text{ cm.}^{-1}$ gives for Mecke's bounding constant $k = \omega_e''/4B$ the value $240,000 \text{ cm.}^{-1}$, confirming very strikingly the value calculated formerly from $AlCl_3$ data for the group of halides of metals of the third group in the periodic system.

The full paper will appear shortly in *Helv. phys. Acta*.

E. MIESCHER.

E. ROSENTHALER.

Physical Institute,
University of Basle.
March 18.

¹ *Helv. phys. Acta*, 8, 279 (1935).

A Photographic Method of Studying β -Ray Absorption by ${}^{32}_{15}P$

IN a previous communication¹, I pointed out the photographic action of artificial radio-elements; as an application of this, it has been possible to study the β -ray absorption of radiophosphorus through aluminium. Radiophosphorus was prepared by irradiating carbon disulphide by means of the neutrons emitted from 900 mgm. radium plus beryllium; its concentration was effected by means of an electric field². The solutions containing ${}^{32}_{15}P$ ($20-200 \times 10^3$ kicks per minute) were evaporated to dryness on a water-bath in leaden vessels 1.5 cm. \times 12 cm. \times 0.3 cm. In order to establish the absorption curve, a series of aluminium absorption screens of increasing thickness (0.1-1.06 mm. and every 0.1 mm. up to 1 mm.) were placed between a Kodak X-ray film and each of these vessels. The photographs obtained were checked by means of a Zeiss microphotometer.

According to Bothe³, who studied the blackening of a photographic plate as a function of the β -ray intensity, the photographic density D is proportional to the number of impinging electrons up to $D = 1$. The mass absorption coefficient can be deduced from the logarithmic absorption curve.

On the other hand, the results of measurements with a Geiger-Müller counter show, from 1.5 mm. aluminium onward, an incurvation of the logarithmic absorption curve toward the thickness axis. However, the curve is linear between 0 and 1 mm. aluminium, and it is possible to calculate the mass absorption coefficient μ/ρ .

Microphotometer deductions yield $\mu/\rho = 9.27 \pm 0.11$, whereas Geiger-Müller counter and electrometer methods give $\mu/\rho = 8.55 \pm 0.20$ and $\mu/\rho = 8.51 \pm 0.02$ respectively.

Thus the intensity of β -rays emitted from an artificial radioelement can be determined by a photographic method.

J. GOVAERTS.

Laboratory of Radioactivity,
Institute of Physical Chemistry,
University of Liège.
March 14.

¹ Groven, Ch., Govaerts, J., and Guéhen, G., NATURE, 141, 916 (1938).

² Govaerts, J., Bull. Soc. Roy. Sci. Liège, 121 (1939).

³ Bothe, W., Z. Phys., 8, 243 (1922).

Resonance in the Chloroacetic Acids

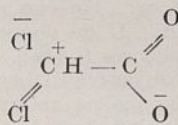
IN addition to heat data, internuclear distances, and electric dipole moments, dissociation constants are now being used to determine whether or not possible valence bond structures contribute to the actual state of a molecule¹.

It is suggested that the dissociation constants of the three chloroacetic acids furnish such information. These acids present an interesting problem. The relevant data^{2,3} are: CH_3COOH , $K = 1.7 \times 10^{-5}$; CH_2ClCOOH , $K = 1.4 \times 10^{-3}$; CHCl_2COOH , $K = 5.1 \times 10^{-2}$; CCl_3COOH , $K = 1.2$. Now monochloroacetic acid has a dissociation constant about eighty times that of the unsubstituted acid, the reasonable explanation being that the strong

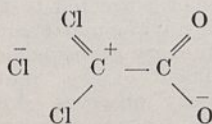
dipole $\overset{+}{\text{C}} - \overset{-}{\text{Cl}}$ ($\mu_{\text{Cl}} = 1.5 D$) has been substituted for the weak dipole $\overset{+}{\text{H}} - \overset{-}{\text{C}}$ ($\mu_{\text{H}} = 0.4 D$). Di- and trisubstitution, however, lead to dissociation constants 3,000 and 100,000 times that of the parent acid.

Let μ_{Cl} be the moment of the C—Cl link in chloroacetic acid. The resultant moment (μ_{R}) of the two C—Cl links in dichloroacetic acid is $2\mu_{\text{Cl}} \cos \theta/2$, and for the three C—Cl links in trichloroacetic acid it is $\mu_{\text{Cl}} (6 \cos \theta + 3)^{1/2}$, θ being the tetrahedral angle, and neglecting dipole interaction. It is clear that no functional relationship can be traced between μ_{R} and K , since the μ_{R} 's are all of the same order of magnitude, being in the ratios 1 : 1.2 : 1. It is also probable that dipole interaction reduces the resultant moments of the dichloro and trichloro groups, as shown by the dipole moments of methyl chloride, methylene chloride, and chloroform⁴.

Some other factor must thus enter and succeed in strongly enhancing the dissociation constants of the di- and tri-substituted acids. It is suggested that this additional factor is resonance, which preferentially stabilizes the ionic forms. In the mono-substituted acid, the inductive effect of the C—Cl dipole is the enhancing influence, but in the case of the di-substituted compound, four conjugated structures of equal energy of the type



contribute to the actual state of the ion, the energy of resonance effecting stabilization. With trichloroacetic acid, twelve structures of the type



contribute, quantum mechanics leading also to the conclusion that each C—Cl bond length will be equal to and approach the double bond value⁵. Because of the separation of charge, these structures would not be expected to be as stable as the normal structures, but a linear relation does exist between $\log n$ and $\log K$ for the three chloro acids with $n = 2, 6$, and 14. It may be mentioned that electron diffraction investigations have established the facts⁶ that the

C—F bond distance in methyl fluoride is 1.42 Å., whereas it is 1.36 Å. in methylene fluoride, indicating the existence of structures of the type now postulated.
H. O. JENKINS.

35 Grand Avenue,
Ely, Cardiff.
March 1.

¹ Jenkins, H. O., *NATURE*, **145**, 149 (1940).

² Dippy, J. F. J., *Chem. Rev.*, **25**, 204 (1939).

³ Cohen, "Organic Chemistry", Part 1, p. 341 (Arnold).

⁴ Sutton, L. E., and Brockway, L. O., *J. Amer. Chem. Soc.*, **57**, 473 (1935).

⁵ See numerous publications of Linus Pauling.

⁶ Brockway, L. O., *J. Phys. Chem.*, **41**, 747 (1937).

History of the Vacuum Flask

SIR WILLIAM BRAGG, in the brief account of his lectures on Dewar's research published in *NATURE* of March 16, mentions that vacuum vessels were made in the early days by C. E. Muller, who was a German glassblower settled in London. Though this is undoubtedly correct so far as it goes, I think that it may leave the wrong impression that Muller made the first vacuum vessels. Such an impression would be unjust to the memory of Dewar's assistant, R. N. Lennox, who actually made the first vessels. They were pointed out to me by my father a few weeks afterwards, on Lennox's bench as Lennox's work. My father's assistant, George Gordon, who had seen Lennox making them, showed me the method which he had seen Lennox use, making a small cylindrical vessel as a demonstration for me. To make spherical vessels was rather beyond Gordon's skill, and later he got Lennox to show me this. The early vessels used by Dewar for some time were of Lennox's make, and if I am not mistaken, some of them are still preserved at the Royal Institution. I should recognize them without doubt. It is likely that Muller was the first to make such vessels outside the Royal Institution, but I do not think that he had arrived in London when Lennox first made them. I was in the habit of frequenting his shop as soon as I learnt of its existence.

RAYLEIGH.

Terling Place,
Chelmsford.
March 27.

Aurora and Magnetic Storm of March 24-25

THE aurora and great magnetic storm of March 24-25 was followed by a second display and storm of only slightly less intensity on March 29-30. The first storm began 24d. 13h. 45m., and ended abruptly 25d. 13h., the later phase from 5h. being characterized by unusually large and rapid oscillations. This storm was greater than that of the great aurora of January 25, 1938, the range in declination being more than 150', and in horizontal force more than 750 γ , being beyond the limits of registration in both elements. It was preceded by definite disturbances of moderate intensity from 20h. to 23h. on March 22, and from 20h. 30m. on March 23 to 1h. on March 24, and was followed by a notable disturbance from 20h. on March 25 to 3h. on March 26, the series forming a well-marked sequence at about one day's interval.

The second storm began on March 29 at 16h., and was dying down when the record was taken off the instruments at 10h. on March 30. The range in declination was 127' and in horizontal force again more than 750 γ , being beyond the limits of registration, but apparently to a less extent than in the previous storm.

This second storm could easily be attributed to the influence of the large sunspot which crossed the central meridian on March 26.3, but it is difficult to assign this spot as the cause of the earlier storm, as in this case, allowing for time of transmission, any emanation from this area would have had to be emitted at a very great angle to the solar radius, which is not easily accounted for.

J. P. ROWLAND.
(Director).

Stonyhurst College Observatory,
Near Blackburn,
Lancashire.
March 31.

Relativity of Time

IN Prof. H. Dingle's article on "The Relativity of Time"¹ and the correspondence that has followed, it is taken for granted that, while the Fitzgerald contraction can be detected experimentally, the slowing up of a moving clock cannot. Prof. J. W. Campbell², while disagreeing with Prof. Dingle on other points, is in agreement on this point. This, if it were true, would indicate a surprising lack of symmetry between time and space; but the following considerations show that there is in fact no such lack of symmetry.

The Lorentz transformation relates the space and time measures adopted by two observers in relative motion on the assumption that the observers use *independent* and *indistinguishable* experimental procedures and apparatus. If a stationary observer determines the time by measuring the rest-mass of sand flowing through an hour-glass at rest at the origin, then the moving observer must be assumed to determine the time as the *rest-mass* of sand flowing through an hour-glass, indistinguishable from that used by the stationary observer, and moving with the moving observer's origin.

The slowing down of a moving clock is deduced from the Lorentz transformation on the supposition that the readings of the moving clock could be used by an observer moving with it so as to satisfy the above requirements: in other words, the clock could be used by an observer moving with it without his knowing that it was moving. The predicted slowing down does not, therefore, apply to the moving clock suggested by Prof. Dingle in which the mass of sand flowing through an hour-glass is measured in the *stationary* co-ordinate system; for, if the observer moving with the clock does not know that it is moving, he cannot recognize the stationary co-ordinate system in which the mass is to be measured.

Now consider a uniformly moving clock *A* that satisfies these conditions, and let *B* be a stationary clock that is indistinguishable from *A*. Suppose that the positions of the clocks coincide when the reading of *A* is t_0 . Let light signals be sent out from *A* when its readings are $t_0 - t_1$ and $t_0 + t_1$, and let these signals reach *B* when its (that is *B*'s) readings are t_2 and t_3 . The slowing up of the moving clock is demonstrated by the inequality $2t_1 < t_3 - t_2$. This

experiment is closely analogous with that suggested by Prof. Dingle to detect the Fitzgerald contraction.
F. C. POWELL.

Gonville and Caius College,
Cambridge.
March 18.

¹ NATURE, 144, 888 (1939).

² NATURE, 145, 426 (1940).

I THINK Dr. Powell's letter is based on a misunderstanding. I did not say that it was impossible to detect experimentally the slowing-down of a moving clock. My point was that whatever slowing-down was detected would not necessarily be in the Fitzgerald ratio unless the clock was an 'ideal' one, and that we could not check the relativity requirement with regard to time measurement by experimenting on actual clocks, because if they did not confirm it, the proper deduction would be simply that they were not ideal. The "lack of symmetry between time and space" thus implied is not at all "surprising". It exists because we can make an 'ideal' measuring rod but not an 'ideal' clock. You cannot, in fact, define the standard unit of length without implying the existence of the measuring instrument—the material bar. The unit of time, on the other hand, cannot be embodied in a material instrument. The best we have, the rotating earth, itself needs slight correction, and experiments on relatively moving earths are, to say the least, difficult. (Incidentally, I wonder if Dr. Powell and Prof. Campbell have considered the case of relatively moving sundials?)

Much confusion is introduced into the subject by multiplying observers. The special theory of relativity can be completely deduced by re-defining length as $l\sqrt{1-v^2/c^2}$ instead of l (where l is the length of a body measured by a relatively stationary rod and v is whatever velocity the body may have in the arbitrary co-ordinate system chosen), and following out the logical implications of the change in all other measurements. This can be done by a single observer, who can choose two co-ordinate systems and compare them. Suppose he has two measuring instruments (say clocks), *A* and *B*, one moving with velocity v relatively to the other. He can choose which he pleases to be at rest. If he chooses *A*, then *B* is running slow: if he chooses *B*, then *A* is running slow. That is how much "objective reality" there is in the slowing-down. If he makes an experiment to see which is "really" running slow, he must make some calculations from his observations to get his result, and the formulæ he must use will depend on his choice of co-ordinate system. They are such that he will always find the "moving" clock, whichever it is, to be running slow, when corrected to the "ideal".

This way of looking at the matter should dispose of the question, which every correspondent has raised, about the measurement of the "moving" mass of sand by the "stationary" observer. A single observer, given the definition of mass (a definition which is not satisfied by "rest-mass", for that is not conserved), has to measure the mass of a body according to that definition, whether it is moving or stationary with respect to himself. If he has to move with it every time, then the mass of a moving body has no meaning, for the whole point of the relativity theory is that there is no absolute, but there is relative, motion. Further, all observers, however they are moving relatively to each other, will obtain the same measurements of similar bodies at rest with respect to

themselves. There is no significance in an observer of an object "knowing that it was moving"; what he should have known was that it was moving or not, according to his choice.

Imperial College,
London, S.W.7.
March 27.

HERBERT DINGLE.

Production of Tumours in Mice by Deoxycholic Acid

J. W. COOK¹ pointed out that the sterols and bile acids contain in their molecules condensed carbon-ring systems to which are attached a side-chain in such a position that a new 6-membered ring can be formed so as to give the 1:2-benzanthracene ring system without molecular rearrangement or group migration. The bile acids of the higher vertebrates are all mono-, di-, or tri-hydroxy derivatives of cholanic acid, which compound can be obtained *in vitro* from sterols by degradation, and the principal bile acids bear the names of lithocholic acid (3-hydroxy-cholanic acid), deoxycholic acid (3:12-dihydroxy-cholanic acid) and cholic acid (3:7:12-trihydroxy-cholanic acid). J. W. Cook and G. A. D. Haslewood in 1934² showed that, in the formation of dehydronor-cholene from deoxycholic acid by the procedure of Wieland, such a ring-closure to the 1:2-benzanthracene ring system had actually occurred. Dehydronor-cholene gave on dehydrogenation the benzanthracene hydrocarbon methylcholanthrene, which was found to be strongly carcinogenic. Afterwards, Fieser and Newman³ showed that methylcholanthrene could be obtained also from cholic acid, which is the chief acid of human bile, and the parent hydrocarbon cholanthrene was synthesized by J. W. Cook, G. A. D. Haslewood and A. M. Robinson⁴ and shown to be carcinogenic.

The discovery that a carcinogenic compound could be obtained from deoxycholic acid led us to test for possible action of this kind the acid itself, which was applied in solution in a mixture of alcohol and benzene to the skin of 20 mice in the ordinary way. An epithelioma at the site of application developed in a single mouse in 776 days. The experiment was repeated upon, in all, 80 mice, of which some lived more than 800 days, but no more tumours were obtained. Afterwards, deoxycholic acid was injected in sesame oil into the right flank of 10 mice of mixed stock, of which 5 lived for more than 6 months. Of these five, three developed at the site of injection spindle-celled tumours of the type usually produced by carcinogenic compounds and were killed on the 351st, 355th, and 367th days. The tumours were regarded as malignant on histological grounds, but did not grow when transplanted into other mice of mixed stock. These mice had received 15 injections containing in all 70 mgm. of deoxycholic acid in 300 days. This is, of course, a large amount, and the time required for the development of tumours is long. However, the experiment was repeated using 10 mice of the strain C₃H which, of eight strains examined by Andervont⁵, is placed first in the order of susceptibility to subcutaneous tumours induced by carcinogenic hydrocarbons, and of these mice one has now developed a spindle-celled tumour in 155 days (that is, a period less by 200 days than that required by the stock mice) after receiving a total of 28 mgm. in the course of six injections. These results confirm those of Vittorio Ghiron⁶, announced at the Third

International Cancer Congress at Atlantic City in September 1939, who says "Desoxycholic acid elicited transplantable subcutaneous fibro-sarcomas in a high proportion of the mice and rats injected. This is believed to be the first experimental production of malignant growths with a compound that exists under some conditions in the human body". We have not found any more detailed publication by Ghiron of his results.

Occasionally, tumours are produced in mice by sesame oil alone (W. U. Gardner, personal communication to Dr. Hieger) but we have obtained negative results with many compounds in this solvent, and we do not think that the incidence of tumours recorded above could be attributed to it. We have no evidence that deoxycholic acid can be converted *in vivo* into methylcholanthrene, but at the same time the slow action and large amount required of the acid, and the superiority of injection over external application, are compatible with conversion into some more active compound. Shear⁷ obtained negative results by injection of deoxycholic acid, and cholic acid, *sub cutem* in mice, but a single injection only, in glycerol, was given. We are carrying out further experiments with deoxycholic and cholic acids.

Several other investigations in progress here are concerned with the liver in relation to carcinogenesis. Thus Dr. L. D. Parsons⁸ has described the increased flow of bile in some tumour-bearing mice, and the use of bile in preparing cell-free filtrates from tumours; Dr. Hieger has confirmed the discovery of Schabad⁹ that some extracts of human livers will produce sarcomas in mice, and is preparing these results for publication; and J. W. Cook¹⁰ has described compounds (2:2'-azonaphthalene and its transformation product 2:2'-diamino-1:1'-dinaphthyl) which have a specific action in producing malignant tumours of the liver.

We are indebted to the British Empire Cancer Campaign for a grant which has supported this work.

J. W. COOK.

E. L. KENNAWAY.

N. M. KENNAWAY.

Chester Beatty Research Institute,
Royal Cancer Hospital (Free),
London, S.W.3. March 31.

¹ Cook, J. W., and Kennaway, E. L., *Chem. and Ind.*, 10, 521 (1932).

² Cook, J. W., and Haslewood, G. A. D., *J. Chem. Soc.*, 428 (1934).

³ Fieser, L. F., and Newman, M. S., *J. Amer. Chem. Soc.*, 57, 961 (1935).

⁴ Cook, J. W., Haslewood, G. A. D., and Robinson, A. M., *J. Chem. Soc.*, 667 (1935).

⁵ Andervont, H. B., *Public Health Reports*, 53, 1647 (1938).

⁶ Ghiron, V., *Summary of Communications*, 3rd International Cancer Congress, p. 116 (1939).

⁷ Shear, M. J., *Amer. J. Cancer*, 36, 211 (1939).

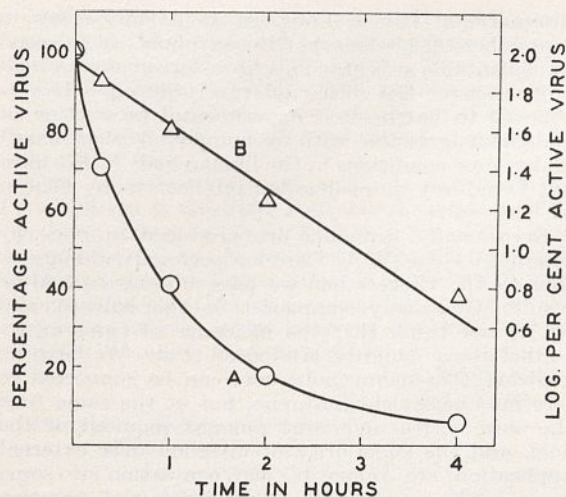
⁸ Parsons, L. D., *NATURE*, 144, 75 (1939).

⁹ Schabad, L., *C.R. Soc. Biol.*, 124, 213 (1937).

¹⁰ Cook, J. W., *NATURE*, 145, 335 (1940).

Some Effects of Salicylate on Plant Viruses

DURING an investigation into the effects of various anions on the precipitation of the paracrystalline solid phase of tobacco mosaic virus nucleoprotein (*Marmor tabaci*, var. *vulgare*, Holmes) from its solution in water, the salicylate ion was found to behave differently from other anions. For each salt there was found a critical concentration at and above which the virus was precipitated from solution in the form of spontaneously birefringent microtactoids or fibres. The white precipitate of virus nucleoprotein



GRAPH ILLUSTRATING THE RATE OF INACTIVATION OF PURE TOBACCO MOSAIC VIRUS BY POTASSIUM SALICYLATE (1.0 M.) AT pH 7 AND 30° C.

is still fully infective and may be redispersed to give a clear solution by mechanical agitation or dilution as described previously¹. However, the precipitate produced by solutions of potassium salicylate at concentrations above 0.46M. is very different in character from that obtained with other salts. It consists of an insoluble, amorphous, white, granular solid deposit of denatured protein. Mechanical agitation or dilution does not cause re-solution. At the same time the virus loses its infectivity irreversibly. The accompanying graph illustrates the rate of inactivation of a 0.2 per cent solution of the pure virus by 1.0M. potassium salicylate at pH 7 and 30° C. The straight line nature of curve B indicates that the rate of inactivation is logarithmic. The rate of inactivation is greater the greater the concentration of salicylate and is markedly influenced by the temperature. With solutions of salicylate of the order of half molar there is only a partial inactivation, and a steady state appears to be set up after a few hours. At a concentration of 0.1M. there is no loss of infectivity, of stream double refraction or solubility after a contact of forty-eight hours. Denaturation, loss of stream double refraction and of infectivity all run parallel.

The virus of tomato spotted wilt (*Lethum Australiense*, var. *typicum*, Holmes) is very much more susceptible to the inactivating action of salicylates. Suspensions of it are rendered inactive in one hour (at pH 7 and 30°) by a 0.1M. solution of potassium salicylate. In this case cystein was used to arrest oxidative inactivation of both control and test suspensions.

Salicylates are known to cause denaturation of haemoglobin^{2,3}, but the action appears to be reversible and of a different nature from that just described. It is likely that a study of the reaction of salicylates and related compounds on viruses will throw some light on the structure of virus proteins.

RUPERT J. BEST.

Waite Research Institute,
University of Adelaide.
Feb. 17.

¹ Best, Rupert J., NATURE, 139, 628 (1937).

² Anson, M. L., and Mirsky, A. E., J. Gen. Physiol., 17, 399 (1933).

³ Holden, H. F., Austral. J. Exp. Biol., 14, 291 (1936).

Coprophagy in the Rabbit: Origin of 'Night' Faeces

IN a previous communication¹ it was mentioned that there were significant differences in ash content between the ordinary 'day' faeces of the rabbit and the softer 'night' type obtained when coprophagy was prevented by collaring. Further investigation has shown even more striking differences in respect of other constituents, notably in protein and fibre.

A rabbit was fed for a week on a diet consisting of equal proportions of bran and oats at the rate of 50 gm. per day and the ordinary faeces collected. It was then provided with a large wooden collar and 'day' and 'night' faeces collected separately. Analysis showed that the 'day' faeces were very similar to the ordinary faeces of the uncollared period but very different from the 'night' faeces. Data on the food and on the two types of faeces, all referred to a dry matter basis, are as follows:

	Food (per cent)	'Day' faeces (per cent)	'Night' faeces (per cent)
Crude Protein ..	14.7	9.2	28.5
Ether Extract ..	5.2	1.7	1.1
Crude Fibre ..	11.7	28.9	15.5
N-free Extractives	63.6	52.0	43.7
Total Ash ..	4.8	8.2	11.2
P ₂ O ₅ ..	2.1	2.9	5.0
Na ₂ O ..	—	0.15	0.3
K ₂ O ..	—	0.65	2.1

Of the 28.5 per cent so-called 'crude protein' (total N × 6.25), 25.8 per cent was insoluble after treatment with copper hydroxide, as in the method for determining 'true protein', and about half was readily soluble when incubated with pepsin-HCl at 37° C., and the suggestion is that it is largely bacterial debris. This rise in protein nitrogen, in conjunction with reduction in fibre content as compared with 'day' faeces, suggested caecal origin of 'night' faeces and a further experiment was carried out to test this point.

A rabbit was collared and fed as before on a bran-oats mixture, 50 gm. being supplied at 9 a.m. each morning. Of this about two thirds was consumed by 5 p.m., the remaining third being cleaned up before the following morning. 'Night' faeces were collected for four days and the rabbit was killed at 9 a.m. on the fifth morning. Considerable food residues were found in the stomach, but very little in the intestines or rectum. The caecum contained a little fluid material the dry matter of which corresponded to only 4 gm., compared with more than 15 gm. for an uncollared rabbit killed later in the day. Analyses of caecal contents and of 'night' faeces collected prior to killing were as follows:

	Caecal Contents (% dry matter)	'Night' faeces (% dry matter)
Crude Protein ..	39.9	30.0
Total Ash ..	11.2	11.1
P ₂ O ₅ ..	4.4	4.2
Na ₂ O ..	1.9	0.5
K ₂ O ..	1.2	1.7

The close similarity in composition of the 'night' faeces with residual caecal contents strongly suggests a long sojourn of the former in the deeper regions of the caecum and subjection of material from the small intestine to prolonged bacterial action, resulting in increased percentage of protein associated with concomitant reduction of fibre and other non-nitrogenous dry matter. The composition of the 'day' faeces, particularly their higher fibre content and

correspondingly lower 'crude protein' (including any undigested nitrogenous debris), suggests more direct passage through the gut with limited sojourn at the sacculus end of the caecum.

The broad statement by Madsen² and by Taylor² that the two types of faeces are due to variations in "intestinal rhythm" provides no explanation of the actual sequence of events. The sequence now suggested is a partial filling of the deeper regions of the caecum as the food contents pass on from the small intestine, associated with a partial more direct passage of digested material into the colon during the day, followed by extensive emptying of the deeper regions of the caecum at night. The more regular passage of 'day' material presumably gives time for greater inspissation and a drier residue, the wetter 'night' faeces being accounted for by more rapid discharge of the deeper caecal contents.

According to this view, the 'day' faeces would represent less completely digested food debris and this might be expected to be the portion more readily re-eaten. Although some 'day' faeces are reconsumed, the striking feature is the total disappearance of the more fully digested 'night' faeces when the inhibiting collar is removed. The 'night' faeces, however, are rich in protein and presumably swarming with bacteria capable of attacking cellulose. Is this of any advantage to the rabbit?

A. EDEN.

Veterinary Laboratory,
New Haw,
Weybridge, Surrey.
March 26.

¹ NATURE, 145, 36 (1940).

² NATURE, 143, 981-982 (1939).

Male Behaviour of the Female Starling (*Sturnus v. vulgaris*, L.) in Autumn

Witschi and Miller¹ have shown experimentally that the yellow bill colour of the starling in the breeding season is induced by male sex hormone. This yellow colour does not develop after the removal of the ovary or the testes, but in such castrated animals it may be induced in either sex by injections of androgenic substances. Oestrogenic substances have no effect on bill colour. It is concluded that the ovary produces male sex hormone, and that the most prominent secondary sexual character of the female starling is in fact a male character.

It has now been observed that the bills of adult British starlings of both sexes begin to turn yellow at the end of October, the time when the testes first show signs of activity. As the change in bill colour is a specific indication of the presence of androgenic substances, it is clear that in autumn both ovaries and testes are secreting male sex hormone. This has been found to have a marked effect on behaviour. At this time of year there is a burst of song which continues throughout November, and although in the breeding season the male alone sings, in autumn the habit is also developed by the female. This has been established partly by observation and partly by the examination of birds shot while singing. A similar effect has been produced experimentally by Leonard², who showed that the female canary, *Serinus c. canarius* (L.), when injected with male sex hormone, sings like the male. The song of the starling decreases in volume in December and January, particularly in severe weather, and when,

in late February, it again increases it is produced by the male alone. At this time the ovary is growing and is probably secreting female sex hormone in such quantity that any effect on behaviour due to the presence of male sex hormone is obscured. The continued yellow coloration of the bill is proof, however, that male sex hormone is still being produced in the female bird.

The autumn change in bill colour, with its associated behaviour, occurs only in the British starling. The Continental birds present in the British Isles in autumn and winter retain the dark bill until January, and there is no autumn song by either sex. It has already been shown (Bullough and Carrick³; and unpublished) that the gonads of these immigrant starlings mature later in the season than those of the British birds.

The occurrence of male behaviour in autumn has been observed in the females of several other species of birds, and it is probable that these, like the female British starling, are under the influence of male sex hormone. In the robin, *Erithacus rubecula melophilus*, Hart., for example, Lack⁴ has shown that in autumn individuals of each sex stake out territories and hold them with fighting and song. In this species, as in the starling, normal female behaviour reasserts itself early in the year when the female birds abandon their own territories and enter those of the males. This apparently widespread phenomenon of male behaviour on the part of female birds in autumn has proved difficult to explain in terms of ecological factors alone, and it is probable that other aspects of animal behaviour will be better understood when it becomes possible to correlate them with the condition of the endocrine balance.

University of Leeds.
March 9.

W. S. BULLOUGH.
R. CARRICK.

¹ Witschi, E., and Miller, R. A., *J. Exp. Zool.*, 79, 475 (1938).

² Leonard, S. L., *Proc. Soc. Exp. Biol. Med.*, 41, 229 (1939).

³ Bullough, W. S., and Carrick, R., *NATURE*, 144, 33 (1939).

⁴ Lack, D., *Proc. Zool. Soc.*, A, 109, 169 (1939).

Chalk Landscape

THE communication of Lord Kennet of the Dene¹ reminds me of a note I wrote recently in an account of the ice storm of the end of January and of the thaw that occurred a week later. On the evening of February 3 rain began and by the morning of February 4 there was a strong thaw. But the ice below the snow and the frozen ground did not let the water soak away, with the result that there was much flooding. In the Cotswolds water poured over the frozen slopes, and at Bagendon the valley became a raging torrent four to five feet deep. Even here, 700 ft. above the sea, there was much flooding and for a time some roads were impassable. It has occurred to me more than once when watching the run off of water in a thaw after the ground has been frozen that such scenes must have occurred in the south of England on a much larger scale every spring during the Ice Age, and I have wondered whether this may not have contributed, or may not have been the chief cause, in the formation of the dry valleys of the chalk country.

C. J. P. CAVE.

Stoner Hill,
Petersfield.
March 24.

¹ NATURE, 145, 466 (March 23, 1940).

Government Recruitment of Scientific Workers

THE recent valuable leading articles to NATURE have stressed the need for a scientific approach to many of our present national problems. Experienced men of science are necessary to ensure that scientific knowledge is properly applied and any developments which affect the recruitment of scientific workers should be critically considered.

It has come to the notice of the Association of Scientific Workers that certain Government departments have, since the beginning of the War, engaged scientific workers on a temporary basis at very low salaries. Both the temporary nature of the appointment and the low remuneration demand urgent attention. It is true that many civil service posts are now described as temporary appointments although they carry the same salary and pension rights as before the War; but the new feature of the appointments to which I refer is the absence of pension rights and the unreasonably low level of the salaries.

It appears that new low grades are being created without any reference to the scheme of the Carpenter Report, which formed the basis of the conditions of employment of men of science in Government departments, and which was accepted by the Department of Scientific and Industrial Research. In urging the necessity for an early revision of these temporary 'extraordinary' posts, I would recall the fact that after the War of 1914-18 certain men of science were kept in such temporary posts for periods up to ten years. The second aspect of the matter, namely,

the poor remuneration, is perhaps even more important. In the cases referred to above the personnel was drawn from the Central Register, and possessed qualifications which would normally command a much higher salary than that offered. It appears that there may be two explanations of this state of affairs: either a number of highly qualified people have by mischance been appointed to junior posts, or else it may be a definite policy of the Treasury to recruit men of science to Government service at unusually low salaries. In either case, the matter should receive the attention of all professional scientific bodies.

Lastly, the difficulty of learning the conditions under which appointments are at present being made should be emphasized. The normal practice of advertising scientific posts has been largely replaced by direct approach through the Central Register. The greater facility with which suitable personnel can thus be found is an obvious advantage; but some means should be found whereby scientists in general can take cognizance of the new conditions of employment which are being imposed on them. Since so many of these new appointments are in Government service, it might suffice if there was a regular publication from time to time of the terms of employment. Such information should be pressed for by the Parliamentary and Science Committee.

W. A. WOOSTER.
(Hon. General Secretary.)

Association of Scientific Workers,
30 Bedford Row,
London, W.C.1.
April 5.

Points from Foregoing Letters

FROM spectrograms of twilight, taken in the zenith and horizontally, L. Vegard concludes that the yellow line of twilight comes from the lower part of the auroral region, and is due to extra-terrestrial sodium, possibly emitted by the sun.

J. Govaerts finds it possible to study the β -ray absorption of ^{32}P through aluminium by means of a photographic method. The results are in good accord with those obtained by other methods.

The inductive effect of the substituted dipoles does not completely account for the dissociation constants of mono-, di-, and trichloroacetic acids. An explanation is put forward by H. O. Jenkins in terms of resonating structures involving C-Cl bonds of partial double-bond character. A linear relation exists between $\log n$, where n is the number of possible valence bond structures, and $\log K$, where K is the dissociation constant.

Lord Rayleigh writes to point out that the first vacuum vessels were made for Sir James Dewar by his assistant R. N. Lennox, and that they were only made later by C. E. Muller.

It has been asserted that the slowing up of a moving clock cannot be detected experimentally. F. C. Powell describes an experiment that appears to contradict this assertion. In his reply, H. Dingle says that such experiments are possible, but that they cannot confirm or deny the relativity requirement. He still maintains that his 'mass-clock' is a valid instrument.

Deoxycholic acid, one of the acids present in the bile of the higher vertebrates, including man, has been shown by J. W. Cook, E. L. Kennaway and N. M. Kennaway to produce spindle-celled tumours when injected *sub cutem* in sesame oil into mice. Deoxycholic acid has been shown previously to be convertible *in vitro* into the cancer-producing compound methylcholanthrene.

R. J. Best has found that neutral solutions of potassium salicylate inactivate the viruses of tobacco mosaic and of tomato spotted wilt. In the presence of potassium salicylate at suitable concentrations, solutions of tobacco mosaic virus deposit a solid, insoluble, denatured, inactive virus protein, the solution at the same time losing its anisotropy of flow. The rate of inactivation is logarithmic.

A. Eden reports that there are pronounced differences in chemical composition between the 'day' and 'night' faeces of the rabbit, chiefly in crude protein, fibre and mineral content. The close similarity in composition between the dry matter of the 'night' faeces and the caecal contents suggests that the former are derived from material which has been subjected to prolonged bacterial action in the caecum.

It has been observed by W. S. Bullough and R. Carrick that in autumn the bills of female British starlings start to turn yellow, a fact which indicates that the ovary is secreting male sex hormone. Under the influence of this hormone the female bird sings like the male.

RESEARCH ITEMS

Removal of Front Teeth in Man

THE non-curative removal of two or more of the front teeth in man is a practice which has an almost world-wide distribution in space, while in time it has been observed in skulls dating from so far back as palaeolithic times, occurring at this period both in Palestine and in Africa. Dr. Aleš Hrdlička, in a study of the practice (*Smithsonian Inst. Miscell. Coll.*, 99, 3; 1940), points out that the teeth, usually the incisors, but sometimes the canines, were not removed on account of dental caries or other pathological condition. By Neolithic times the custom was widespread over Africa, Australia, continental Asia and Japan, and had reached some parts of Europe. It still survives in parts of Africa, Australia, possibly Mongolia, and parts of South America. In America the custom had not been observed among either Eskimo or Indians, as it had died out entirely, while in the skeletal evidence, which was scanty, the loss of teeth was likely to be overlooked. The first record of it comes from the material obtained by Dr. Hrdlička himself in the Aleutian Islands and Kodiak Island. He has now listed a large number of instances from American and Siberian collections, his conclusion being that "there is ample evidence that non-curative removal of some to all of the front teeth has been a widespread procedure since Neolithic times in northern Asia and since the oldest known times in America. . . . It shows features indicating strongly that it was essentially a ritual sacrificial observance".

Fossil Man of Monte Circeo, Italy

AN account of the palaeolithic caves of Monte Circeo on the borders of the Pontine Marshes, Italy, and of the fossil remains of Neanderthal man discovered there by A. C. Blanc in February, 1939, is contributed by him to the *Revue Scientifique*, 78, 1 (1940); it contains further particulars of the remains and of the circumstances of the find. These caves, of which there is a large number, are situated in a calcareous limestone ridge at the edge of the plain. Some have been known as the source of a fossil fauna and worked flints for a considerable period; but although visited in 1817, no systematic examination of them was made until 1883. Between 1936 and the discovery of Neanderthal man in the Guattari Cave in 1939, M. Blanc had investigated thirty-one caves, in twenty of which the removal of the contents by wave action and other agencies had left traces of the pleistocene filling, making it possible in many instances to reconstruct the stratification even before excavation began; while in ten were the remains of a fossil fauna and flora as well as of palaeolithic industries. Up to the time of the discovery investigation had revealed that a cold fauna associated with Aurignacian was superimposed upon a warm fauna (*R. Mercki* and *E. caballus*) and a Mousterian industry. The present find of a Neanderthal skull was made in the third of a series of three communicating chambers in the cave, in which the floor of the first was covered with a heterogeneous collection of bones of a fossil fauna. The skull lay on the surface, completely free and surrounded by a ring of stones disposed in an oval. Bones of Bovidae and Cervidae were scattered about the chamber. Deposits on the walls pointed to a prolonged period of inunda-

tion. Staining indicates that the skull itself had also been half-submerged at the same time. The disposition of the skull and the evidently intentional enlargement of the foramen, which has been completely destroyed, point to funerary and magical rites, possibly a ritual feast. This would account for the absence of skeletal bones. In date, Monte Circeo man stands later than the Sacchopastore skull; and probably when rockfalls closed the cave to occupation Würm II had already begun.

Causation of Silicosis

ALL dusts produced in industrial processes in excessive amount are injurious to the air-passages and lungs, but certain mineral dusts are the most harmful. These are liable to cause the condition known as 'silicosis', in which fibrosis and other changes occur in the lungs, frequently terminating in secondary tuberculous infection. Industrial experience pointed to those dusts containing a large proportion of free silica, such as quartz and flint, as being the most dangerous, and the material must be in the form of fine particles less than 10 μ in size, but not ultra-microscopic. In a recent publication, F. W. Simson and A. S. Strachan have tested the silicosis-producing action of a number of mineral specimens (*Pub. South Afr. Inst. Med-Res.*, 9, 95-122; 1940). These included sillimanite, orthoclase, muscovite, rutile, quartz and several mine dusts, glass and a residue from human silicotic lung; all were reduced to particles of an appropriate size distribution. Several doses of suspensions of these dusts were injected intravenously into rabbits. The animals mostly survived at least a year before examination, when the tissues chiefly affected were found to be those of the liver, spleen, lymph-nodes and bone-marrow. Cellular nodules were formed with giant cells, the process culminating in dense fibrosis. The lungs were unaffected, as dust particles introduced intravenously do not reach the alveoli. Only the quartz, the mine dusts and the lung residue were active in causing the lesions, the inactive dusts—sillimanite, orthoclase, rutile, muscovite and powdered glass—producing no inflammatory reaction and no fibrosis. The experiments seem to conform with the current belief that quartz, flint, and other forms of free silica are the noxious elements in active dusts. The paper is illustrated with a number of plates of photographs of the affected organs and photomicrographs of the lesions present.

Glycolysis in Embryos

By thorough freezing and grinding of the tissue, Meyerhof and Perdigon (*C.R. Soc. Biol.*, 132, 186; 1939) have prepared extracts of rat and chick embryo which produce lactic acid from glucose. The glycolytic power of the extracts after addition of cozymase is of the same order as that of the original tissues. The extracts also produce phosphoglyceric acid and lactic acid from hexose diphosphoric acid and pyruvic acid. These experiments support the idea that the reactions of glycolysis in all tissues involve phosphorylation and that the intermediate stages are similar to the processes occurring in alcoholic fermentation which were first revealed by Harden and Young.

Mosquitoes and Filariasis

IN 1924 Yamada reported that the mosquito common in Shanghai, *Anopheles hyrcanus* var. *sinensis*, was capable of acting as an intermediate host of *Wuchereria bancrofti*, although certain Culicines were more important as carriers. A series of tests have been carried out by Stephen M. K. Hu to determine the susceptibility of the *Anopheles* mentioned to experimental infections with the parasite (*Peking Nat. Hist. Bull.*, 14, 83; 1939-40). Specimens of *Anopheles* to the number of 381 were fed on a heavily infected case of *Wuchereria bancrofti*. They were allowed to live sufficiently long to permit the filarial larvæ to complete their development to the infective stage, and when dissected 80, or 20.9 per cent, were found with infective larvæ, to the number of 3.6 on an average to each mosquito. When *Anopheles* along with *Culex pipiens* var. *pallens* and *Culex vagans* were allowed to feed on an infected case, subsequent examination showed that the latter species had a higher percentage of positive infection as well as a larger number of infective larvæ to each individual. Natural infection shows the same result. Of 87 *Anopheles* and 245 *Culex pipiens* var. *pallens* collected at the same time in a filarial house in Woosung, 4.6 per cent of the former and 17.2 per cent of the latter were found with filarial larvæ.

Young Caranx in the Western North Atlantic

J. T. NICHOLS (*Bull. Bingham Oceanograph. Coll.*, Peabody Museum of Natural History, Yale University, 7, Art. 2; 1939) gives a key to the young Caranx of the West Indian Region. The distribution of these young fishes is interesting, both *Caranx ruber* and *C. crysos* occurring in the Gulf Stream, *C. bartholomæi* inhabiting the drifting Sargassum weed, usually at or beyond the edge of the current and not actually in the Stream itself. The Gulf Stream appears to be the nursery ground for *C. ruber* and *C. crysos*, the latter occurring far to the north-east, and it is shown that the young are of such a small size that they must drift far to the east before reaching a stage in which they can swim independently of the current. These two species with their young most confined to the Stream, grow into the slenderest and swiftest of the Caranx in this region, and, presumably, they have the widest range. A good series of the young of *C. crysos*, less than 50 mm. in length, shows that the character of pigment spots, some of which are large and conspicuous, are useful in distinguishing this species from its relatives at so small a size.

Purification of Insect-transmitted Viruses

SPECIFIC nucleo-proteins have been isolated from plants infected with the more stable viruses, but those pathogens which are only transmitted biologically, by grafting or insects, have not been so purified. F. C. Bawden and N. W. Pirie show, however, that this is possible (*Brit. J. Exp. Path.*, 20, 322-329; 1939). They used potato virus 'Y' and Hyoscyamus virus 3, and succeeded in obtaining yields of liquid crystalline nucleo-protein between 0.5 mgm. and 3 mgm. per litre of infective sap. Such preparations were infectious, but the methods used in purification seemed to lower the infectivity without destroying the serological activity. The physico-chemical properties of the preparations closely resembled those of potato virus X.

Intranuclear Inclusions in Virus-infected Plants

INCLUSIONS which occur in the tissues of host plants infected with virus diseases have all been described as intracellular. Animal viruses, however, induce, in addition, intranuclear bodies in the cells of their hosts. Basilio Kassanis has now described (*Ann. Appl. Biol.*, 26, No. 4, 705-709; 1939) two kinds of body in the cells of solanaceous plants infected with severe etch virus. One type of inclusion occurs in the cytoplasm and is similar to the common X-bodies; the other occurs only in the nuclei. This type appears to be crystalline in the form of thin rectangular plates, and to resemble the inclusions associated with the polyhedral disease of silkworms.

Rooting of the Olive Tree

J. VIEIRA NATIVIDADE has published (*Agronomia Lusitana*, 2, 25-73; 1940) a very interesting note upon a method of root production in the olive which seems so far to have escaped attention. Excrecences on the base of the trunk have been known for centuries and used for purposes of propagation; they contain much parenchyma with stored food reserves and possess dormant buds. Natividade's anatomical study now shows these excrecences also contain a number of root initials; these arise near the vascular cambium and, as they enlarge, the root cap may often be cut off by the phellogen and buried in the cork. These excrecences may be formed at various levels in the trunk but are invariably linked with the ground by a cord-like strand on the trunk surface. These cords seem to represent aerial roots fused with the trunk and when they reach the ground they give rise to a root system. The accumulation of these excrecences and their linked basipetal cords form the typical fluted bole of the olive, and the whole original root system of the tree is replaced by the later root system developed from these superficial cords. This is true whether the original root system was that of a seedling, a cutting or a root stock. Thus the textbook instruction to propagate the olive by grafting in order to obtain a deep root system rests on a fallacious argument.

Carbohydrate Manuring

INDIAN soils normally contain much less nitrogen and organic matter than those of more temperate regions, and the use of molasses as a fertilizer has received considerable attention and met with some success. Recently, N. R. Dhar of Allahabad has claimed remarkable increases in nitrogen fixation by the use of molasses and other energy-rich materials, including fats. An account of this work was presented at the First International Fertilizer Congress in Rome in 1938 and is summarized by H. E. Z. Raczkowski in *Hadar* (Nov. 1938), the Palestine citrus journal. According to Prof. Dhar, carbohydrates, glycerol, paper, straw, sawdust, etc., increased nitrogen fixation. Light is said to be utilized as in photosynthesis. In field trials, 3 tons of molasses added 112 lb. of nitrogen per acre, and 10 tons fixed 270 lb. of nitrogen. The nitrogen thus fixed was retained in the soil much longer than when ammonium sulphate was added. In sterilized soil nitrogen fixation occurred in the complete absence of micro-organisms, provided light was available. It is thus claimed to be a photo-chemical process. Contrary to the general belief, Prof. Dhar says that fats are readily oxidized in tropical soils and provide considerable energy for nitrogen fixation.

Zea-Euchlæna Hybrids

D. S. LANGHAM (*Genetics*, 25, 82-108; 1940) shows that three out of the five characteristic differences between maize and teosinte are inherited as unifactorial characters. These are weak response: strong response to length of day, paired female spikelets: single spikelet and many ranked: single-ranked ear. The dominant character is given first in each case. The results support the theory that maize arose from teosinte by a few large-scale mutations and disagree with the view that maize and teosinte differ in thousands of genes.

Recent Trends in Earthquake Insurance

A. C. CHICK considered this subject in a paper presented to the annual meeting of the Eastern Section of the Seismological Society of America on June 9, 1939 (*Earthquake Notes*, 11, No. 3; Jan. 1940). Attention was directed to the strong motion seismograph developed by the Coast and Geodetic Survey, and the model experiments of Prof. Ruge to determine earthquake effects on structural designs. In particular, the volume of earthquake insurance became greater in the United States after the Long Beach earthquake, but decreased after the emotional effects of the earthquake had worn off. Soon after the Santa Barbara earthquake in 1925, the premium on earthquake insurance in California amounted to approximately three million dollars, but by 1928 this had dropped to approximately two million dollars, and by 1932 it had further fallen to three-quarters of a million dollars. In June 1939 the total premium on earthquake insurance written in the United States, as reported to insurance commissioners, amounted to about one million dollars. The large earthquakes in various parts of the world have had little influence on this, but quite a little activity in the United States was stimulated by the New England hurricane of September 1938. Chick concluded that the rates for earthquake insurance were still high compared with fire insurance rates, but that this must necessarily be so as long as the requests for this type of coverage came chiefly from those areas which were recognized as being seismically active.

Atomic Weight of Holmium

THE investigation of holmium with the mass-spectrograph has shown that the element is composed of one type of atom only, with a mass of 165. It is difficult to determine the chemical atomic weight with accuracy from this figure, as the packing fractions of the rare earth elements have not been directly determined, but can only be estimated from Dempster's packing fraction curve. If, however, the value -0.8 is taken for this, and Smythe's correction factor (0.999725) is used, the value obtained for the chemical atomic weight is 164.94 . O. Hönigschmid (*Naturwiss.*, 27, 855; 1939) points out that this is considerably higher than the international value of 163.5 at present accepted, the latter being probably too low in consequence of the presence of impurities, chiefly yttrium, in the holmium preparations used for analysis. A holmium preparation of a high degree of purity has now been obtained. X-ray methods show that it contained only 0.013 ± 0.004 at. per cent of yttrium, about 0.04 at. per cent of erbium, and 0.03 at. per cent of dysprosium, and less than 0.02 at. per cent of other elements. Analysis of the holmium trichloride obtained from this preparation gave as

a mean the value 164.935 for the atomic weight. When corrected for the amount of yttrium present, the value becomes 164.944 , which is almost identical with the value calculated from mass-spectrograph data.

Proton-attracting Properties of Liquids

RECENTLY many investigations in infra-red spectroscopy have been concerned with the properties arising from the formation of 'hydrogen bonds'. If a common solute, which can act as a proton donor, is dissolved in various proton-acceptor solvents (bases), the tendency to form hydrogen bonds should be governed by the strength of the base. To test this, Gordy and Stanford (*J. Chem. Phys.*, 7, 93; 1939 and 8, 170; 1940) have examined the OD band of CH_3OD in some fifty solvents. In benzene CH_3OD is monomeric and the OD band is at 2681 cm^{-1} . The extent to which this band is shifted to longer wave-lengths on solution is taken as a measure of the strength of the 'hydrogen bond', and hence the stronger the bond the more basic the solvent. The power of solvents to form hydrogen bonds is in the order: esters < aldehydes and ketones < ethers < amines. The effects of substitution and unsaturation on the proton-attracting power of the oxygen or nitrogen atom with which the OD forms a bond are discussed. Comparison of the observed shifts in location of OD bands with the dipole moments of the solvents shows no correlation between the magnitude of the moment and the extent of the shift. Thus the complexes are not formed entirely as a result of dipolar attraction. When the basicity constants are plotted against the wave-length shift a linear relationship is established from which, by extrapolation, the basicity constants of several solvents have been evaluated. A linear relationship exists also between the OD wave-length shift and the rate of semi-carbazone formation of some aldehydes and ketones. There is, too, close concordance between the shift and the solubility of monofluorodichloromethane (a proton donor) in various solvents.

Nuclear Reactions with Bismuth

THE Cambridge cyclotron has been used by D. G. Hurst, R. Latham and W. B. Lewis (*Proc. Roy. Soc. A*, 174, 126) to investigate the reactions of bismuth bombarded with deuterons. The reaction $^{209}\text{Bi}(d, p)^{210}\text{RaE}$ was previously known from the work of Livingood, and the production of polonium by the reaction $^{207}\text{Bi}(d, n)^{210}\text{RaF}$ was found for the first time. The RaE decays to polonium with a half period about 5 days, so that the measurement of the polonium activity over a period of days provides a method for investigating the relative probability of the two nuclear reactions. A stack of aluminium foils thinly coated with bismuth was bombarded with deuterons, and the processes thus investigated for a range of deuteron energies. It is to be expected that the (d, n) reaction will occur if the deuteron enters the nucleus, while the $(d; p)$ reaction is due to the Oppenheimer-Phillips process, in which the deuteron splits up on the surface of the nucleus and the neutron alone enters the latter. This view is, on the whole, borne out by the results of the measurements. The $(d; p)$ reaction is apparently more probable than the other for all the energies studied, that is, up to 8 m.e.v.

DISTRIBUTION OF BRITAIN'S INDUSTRIAL POPULATION*

ALTHOUGH the Royal Commission on the Distribution of the Industrial Population, under the chairmanship of Sir Montague Barlow, completed its report in August 1938, the report was not signed and printed, owing to the international situation, until December 1939. The appointment of the Commission arose out of recommendations in a report of the Commissioner for the Special Areas, afterwards debated in the House of Commons, and its terms of reference covered the causes of the present distribution of the industrial population and the probable direction of any change in that distribution in the future; the social, economic or strategical disadvantages of concentration; and the remedial measures, if any, to be taken in the national interest. The minutes of evidence taken before the Commission have already been published independently, but the report includes among the appendices a memorandum on the location of industry by Prof. J. H. Jones, analysing factors in location as well as post-War trends; some notes on garden cities, satellite towns and trading estates; and a memorandum on planning in some other countries by Mr. G. L. Pepler.

Consideration of the causes of the present distribution leads the Commission to conclude that in the absence of decisive natural factors such as the existence of coal or of an adequate supply of suitable water, industries tend to be located within easy reach of the market. The industries that have shown a relative expansion since 1918 are either local industries or industries in the location of which natural factors have not been decisive. The cost of power and transport is relatively low; in the past, such industries tended to settle in places like London and Birmingham, which were not suitable for the development of those 'basic' industries that are now declining; such places, therefore, became the legates of the remainder of the industrial estate, particularly as they constituted or were near large markets. Moreover, the existence of cognate industries or common subsidiary industries, of industrial atmosphere and of a large and growing market, have accelerated a growth that was already taking place long before 1914.

In present conditions, it is difficult to predict the probable future course of trade or industry in Great Britain or elsewhere. Once normal and reasonable stable international conditions are established, however, it may be expected that the importance of the old 'basic' industries in the national economy may decline and that of other industries increase. Industrial areas containing the former will only be able to keep up with the national rate of general industrial progress if they stimulate within themselves a growth of the miscellaneous light industries in excess of the rate of growth of such industries in the country as a whole. While the attraction of London and the Home Counties may lose some of its force owing to the greater vulnerability of the area to attack from the air, the Commission sees no reason to suppose that, apart from this factor, and in the absence of some restrictive regulation by the Government, the trend to the south-east of England will be per-

manently checked when the rearmament policy has accomplished its purpose.

The Commission considers that the concentration of industry or of the industrial population in a large town or particular area should not, of itself, give rise to higher mortality rates than elsewhere or to other social disadvantages, provided that the town or area is well planned. The bad planning of the existing large towns and areas of industrial concentration in Great Britain, however, inflicts certain disadvantages on their inhabitants through bad housing, lack of space for recreation, difficulties of transport, congestion, smoke and noise, which are often accentuated by unsatisfactory economic conditions. These disadvantages are the result of the haphazard manner in which urban development has proceeded in the past, and could be remedied or greatly reduced by good planning. Accordingly, policy should be directed to the continued and further redevelopment of congested urban areas, where necessary, having due regard to the retention of the advantages of a well-planned town and the addition, so far as possible, of the cultural and physical aspects of the country; decentralization and dispersal of both industries and industrial population from such areas, and provision of checks to the further growth of London.

The economic advantages of concentration of industry in proximity to market, reduction of transport costs and availability of a supply of suitable labour are accompanied by disadvantages such as heavy charges on account of high site values, loss of time through street traffic congestion in the very large towns and the adverse effects on efficiency and output of the fatigue incurred by workpeople through long daily journeys between home and workplace, often under considerable discomfort. Strategical considerations further support a policy of decentralization or dispersal of industry from overcrowded areas, which is already desirable to counteract the social and economic disadvantages of concentration.

The report then reviews in turn related questions of town planning, garden cities, satellite towns and trading estates. The well-considered development of garden cities, satellite towns and trading estates should offer a useful contribution to the relief of overcrowded and congested urban areas, but such development is unlikely to be successful if left entirely to private enterprise on account of the magnitude of the financial commitments involved. Accordingly, the Commission recommends that the proposed National Industrial Board should examine and formulate the policy to be adopted in relation to the development or encouragement of such methods where decentralization or dispersal is desirable, including adequate provision for the requirements of industry, social and amenity requirements, avoidance of unnecessary competition, and due regard to strategical considerations.

Further chapters deal with population trends, the problem of the special and depressed areas in relation to the balance of industry throughout the country, different types of cities and the problem of congestion and some aspects of the problem of London. In regard to the special areas, the Commission recommends that the National Industrial Board should, in the light of the experience of the Special Areas

* Royal Commission on the Distribution of the Industrial Population. Report. (Cmd. 6153.) Pp. x+320. (London: H.M. Stationery Office, 1940.) 5s. net.

legislation, study the location of industry throughout Great Britain with the dual object of anticipating cases where depression may occur in the future and encouraging before a depression crisis arises the development of other industries or public undertakings, and of encouraging a reasonable balance of industrial development throughout the various divisions or regions of Great Britain. Adoption of a regional system, it is considered, would materially facilitate several of the problems before the Commission.

From the evidence submitted, the Commission has reached the unanimous conclusion that the disadvantages in many, if not in most, of the great industrial concentrations constitute serious handicaps and in some respects dangers to the nation's life and development, and that definite action should be taken by the Government towards remedying them. The problems of the location of industry are national in character, touching on and overlapping those of agriculture, land, water, transport, roads, amenities, etc., and the solution must be sought along the lines of national inquiry and guidance. For the national action necessary in view of the nature and urgency of the problems, the Commission is of the unanimous opinion that a central national authority is required, the activities of which should be distinct from and extend beyond those within the powers of any existing Government department. The objectives of national action should be : continued and further development of congested urban areas where necessary ; decentralization or dispersal both of industries and population from such areas ; and encouragement of a reasonable balance of industrial development with appropriate diversification of industry throughout the country. The Commission is also agreed that the continued drift of the industrial population to London and the Home Counties constitutes a social, economic and strategical problem demanding immediate attention, and that the central authority, whether advisory or executive, should examine forthwith and formulate the policy or plan to be adopted in furtherance of the objectives indicated. The central authority should have the right to inspect all existing and future planning schemes and to consider the modification or correlation of such plans, where necessary, in the national interest. Appointment of a body of experts to examine the questions of compensation, betterment and development is also recommended, and the powers of the authority should include the collection and co-ordination of information relating to location of industry ; research ; collection of information as to the various natural resources which may be affected by industrial location ; advisory functions on problems of location ; and publicity and annual reports.

Differences of opinion are revealed in regard to the machinery of Government action. The majority report recommends that a National Industrial Board should be appointed by the President of the Board of Trade after consultation with the Ministers of Health, Labour and Transport and the Secretary of State for Scotland, for making research into, advising upon and regulating the location of industry. In addition to the functions already outlined, the Board should have power to establish regional bodies to study problems of industrial location, and it should be required to report what executive powers it requires generally for giving effect to the agreed objectives of national action. The Board should also from the

outset be invested with power to regulate the establishment of additional industrial undertakings in London and the Home Counties, including power to refuse consent to the establishment of a new industrial undertaking unless it is established to the Board's satisfaction that the undertaking cannot be conducted on an economic basis elsewhere. Provision should be made, moreover, for the application by Order in Council of similar regulation to other specified areas.

These recommendations are signed with reservations by three signatories, Prof. J. H. Jones, Mr. G. W. Thomson and Sir William E. Whyte, who consider it should be the duty of the proposed new Board to give continuous study to the problem of achieving a well-balanced industrial society, and that the problem of location cannot be separated from the national problem of persistent unemployment. Accordingly, they recommend that the establishment of divisional or regional bodies should not be optional but a definite requirement of the scheme of regulation or control. They also insist that the Board should be required to report on the further powers required at the earliest possible moment ; that the powers of negative control apply equally to the whole country ; that the powers of the Commissioners for the Special Areas, so far as they bear upon the work and functions of the Board, should be transferred to the latter ; and that the Board should be in a position to offer the inducements they consider necessary to secure a better balance and greater diversification of industry throughout the country.

The minority report, which is signed by Prof. Patrick Abercrombie, Mr. M. H. Elvin and Mrs. Hichens, differs from the majority report in the stress it lays on the urgency of the problem and upon the necessity for granting far-reaching executive powers to a new Government department or one evolved from an existing department. The signatories consider that the unprecedented amount of new factory location taking place and the altered character of war risks with re-location involved make the problem an immediate one. The new ministry should take over some of the planning functions of the Ministry of Transport and possibly of the housing functions of the Ministry of Health, and the powers and functions of the Commissioners for the Special Areas should be transferred to it, with general application. Its functions would be inquiry and research to lead up to a systematized plan for distribution of industry on a national scale, with a better balance in the distribution of population, and, pending the evolution of such a national plan, control of changes in the present distribution of industry. The ministry would be assisted by a strong central advisory commission as well as by regional boards. The minister would be empowered to exercise negative control over the establishment and location of new industrial undertakings or extensions of existing ones, and to schedule areas in which development would be permitted or prohibited. He would be empowered to impose the requirements of the general development plan, prepared by the commission of research, upon regional and local planning schemes, as well as to authorize financial assistance to encourage desirable industrial location and proper planning, including the assistance of projects of national importance such as national parks. A dissentient memorandum in criticism of present planning powers and practice is contributed by Prof. Abercrombie.

PHYLOGENY AND TAXONOMY

A JOINT meeting of the Linnean Society and the Association for the Study of Systematics in relation to General Biology was held in the rooms of the Linnean Society on April 11, at which a discussion took place on phylogeny and taxonomy.

Mr. J. S. L. Gilmour, opening the discussion, distinguished between 'general' classifications, based on a maximum correlation of attributes, and 'special' classifications, based on selected attributes. Taxonomy has a clear aim of its own, apart from phylogeny, namely, the construction of a 'general' classification of living things for the purpose of conveniently summarizing empirically discovered correlations and of making predictions based on them.

The concept or 'relationship' was defined in terms of genealogical lineages and was regarded as only one of the factors making up phylogeny or the "history of the origin and development of groups". Relationship, thus defined, cannot be regarded as the *basis* of taxonomy, but rather as the *explanation* of the possibility of making a 'general' classification of living things with a high degree of correlation. A lineage classification, based on relationship, is really a special classification made for the purpose of correlating relationship with other attributes. The view that taxonomy is necessarily phylogenetic is an error due to a misunderstanding of the nature and aim of a 'general' classification.

Dr. O. W. Richards pointed out that, if evolution is a fact, a phylogenetic classification must exist. In addition, however, a classification can be made in which a large number and varied assortment of characters are correlated. Is such a classification the same as a phylogenetic one? Pre-Darwinian and present-day taxonomic methods are, broadly speaking, very similar, but nevertheless evolutionary theory has had a profound effect on post-Darwinian taxonomy in two main ways: (1) series of groups showing progressive change are held to have some relation to evolutionary change, and this affects the taxonomic treatment of the groups; (2) our general knowledge of the cause of evolution enables us to orientate such series. Whether these changes have always brought our classifications nearer the true phylogenetic one is often difficult to decide and must await crucial palaeontological evidence. In the long run, a classification approximating as nearly as possible to phylogeny will prove practically the most successful.

Dr. T. A. Sprague agreed with Mr. Gilmour that a natural classification in biology is based on degrees of resemblance and difference, but not necessarily on maximum agreement in total characters. He pointed out that, apart from the difficulty of deciding what are unit characters, general plan of structure far outweighs details, and that greater weight should be assigned to non-adaptive than to adaptive characters. The natural classification in botany has been developed synthetically by a process of trial and error, and the characters eventually employed in the resulting groups have been observed, not arbitrarily selected. The fact that so many groups of the Angiospermæ, large and small, originally based only on external morphology, have been confirmed by independent consideration of their anatomical, cyto-

logical and biochemical characters, suggests that a high proportion of the recognized groups, from species to families inclusive, is monophyletic. In the absence of relevant fossil evidence, however, the general inter-relationships of the orders cannot be determined. Most phylogenetic trees of the Angiospermæ are based on hypothetical evolutionary floral progressions, and are essentially morphogenetic diagrams, representing postulated stages in general floral evolution. Agreement in general plan and non-adaptive characters between particular orders makes phylogenetic relationship between them seem highly probable, but the greater part of such phylogenetic trees seems to be purely speculative.

Dr. E. I. White stated that, primarily, taxonomy and the study of phylogeny are distinct and not necessarily interrelated. The former deals with the arrangement of organisms into groups determined by the number and nature of common characters, which might be arbitrary, while the latter is concerned only with the ancestry of organisms, that is, their true relationships, determined by the appraisal of characters common to the several organisms the selection of which cannot be arbitrary. Were all facts known, a phylogenetic tree and a sound taxonomic arrangement would coincide, but this postulates evidence in both space and time. It is the work of palaeontologists to provide such evidence, and to them a taxonomic arrangement without a phylogenetic basis is only a temporary expedient due to lack of evidence.

Dr. Hamshaw Thomas, in a written communication, puts forward the view that, if phylogeny is to be built on a firm foundation, we must replace the present deductive methods by inductive reasoning based on the statistical investigation of empirically discovered correlations. We are at the parting of the ways; the rejection of the classical concepts of floral morphology has reduced current phylogeny to a mass of ruins, and a century may elapse before it can be rebuilt. Meanwhile, supposed phyletic series based on typological morphology have no place in taxonomy, which should follow the principles of a natural classification laid down by Lindley more than a hundred years ago. If eventually such a classification suggests a course of evolution agreeing with that discovered by phylogenetic studies, so much the better, but at present taxonomy and phylogeny should develop independently.

Space will allow of no more than a few brief abstracts from the remarks made by speakers in the somewhat lively discussion that followed the reading of the main papers. Dr. Julian Huxley pointed out that there are two main trends of thought: that accepting phylogenetic facts or inferences as the basis of taxonomy, and that contending that classification should be based on correlation of characters with the possibility of explaining the results of such classification phylogenetically. He did not think the two points of view are irreconcilable. Dr. W. B. Turrill considered that much so-called phylogeny is, for the Angiosperms, pseudo-phylogeny. He particularly emphasized the danger of including phylogenetic facts or assumptions, however concealed, in a classification if that classification is later to be used

as furnishing proof for a given phylogenetic scheme. Sir William Wright Smith was convinced that it is impossible to establish a phylogenetic system for plants that can be more than highly speculative, in the absence of relevant fossil evidence.

Dr. R. Melville stated that the papers and discussion showed the need for a thorough revision of the logical basis of both taxonomy and phylogeny. Mr. B. L. Burttt said that Dr. Sprague claimed no more than that taxonomic groups are monophyletic, members of a logically 'natural' group being of common origin. A phylogenetic classification does not seem possible in the absence of fossil evidence. Dr. J. Burttt Davy said that in teaching taxonomy a phylogenetic basis is a great help. Mr. M. J. D. White said that it is evident that very different points of view are held by those who work with different groups of organisms. He believed that cyto-genetics will have much to contribute to the subject in the future. The president (Dr. J. Ramsbottom) said, in closing the discussion, that in the fungi the fossil evidence is quite unreliable and that the so-called phylogenetic trees from time to time published for this group are based on such superficial evidence as to be sheer nonsense.

RELATIONSHIPS OF THE FUCALES

AS recently as 1937 Kylin expressed the view that the Fucales occupy an isolated position and have not been derived from the Phaeosporae. Dr. M. Delf has reviewed the basis for this conception in the light of recent work on the higher Ectocarpales (*New Phyt.*, 38; 1939) and shows that Kylin's view cannot be too easily accepted.

The apical growth, which has been regarded as a difficulty in relating the Fucales to the Ectocarpales, has been shown by Nienburg to be preceded in the sporeling by an apical tuft of hairs, and the apical cell is derived from the basal cell of the intercalary growing zone of one of these. A rather similar development of conceptacles and cryptostomata in Fucales from growth originating from the base of a hair has some resemblance with the slightly sunken tufts of hairs of *Colpomenia*, *Leathesia*, etc.

The problem of the differences in ciliation of motile cells, the longer cilium, anterior in *Fucus*, usually posterior in Ectocarpales, seems a point of doubtful value and apparently liable to greater variation than was formerly realized.

Dr. Delf points out that the structure of the *Fucus* thallus could be derived from such a type as *Eudesme*, as described by Parke. She suggests that in place of the alternation of generations shown by the higher Ectocarpales, the Fucales have developed a perennial macrosporophyte and, possibly associated with adaptation to the intertidal zone, the gametophyte has suffered extreme reduction. It is of interest in this connexion that the Fucales of warmer waters remain submerged, and in *Cystoseira* and *Sargassum*, etc., the contents of the oogonium may be extruded in the 8-nucleate condition, which is in effect equivalent to a small haploid gametophyte, and from this the single oosphere is derived by degeneration of the remaining nuclei.

SEVENTY YEARS AGO

NATURE, vol. 1, April 21, 1870

Experimental Research and Unemployment

AN essay by George Gore, F.R.S., entitled "On Original Experimental Research in Relation to Employment for Workmen", shows that the struggle for recognition of the significance of scientific discovery for social progress had already begun.

"The variety and extent of the employments which have resulted from scientific research are so great that they ramify in some form or other through nearly all our manufacturing, artistic, and commercial occupations, our social relations, and our everyday life. . . . In many instances the application of original experimental science in new inventions had superseded, and in a limited sense diminished, manual labour, but it has in such cases either substituted more intellectual occupation for it, or has opened up new sources of employment to a far greater extent by increasing trade and manufacture. . . .

"The extension of physical and chemical knowledge by means of experiments and observations is *national* work: it benefits the nation, but does not pay the investigator. . . . Has it been wise in our Governments thus to overlook a great source of the nation's wealth, to disregard a most important means of national economy, to neglect the great fountain-head of industry?"

Channel Railways

THE third of the series of articles on direct communication with France across the English Channel appears. It is devoted to discussion of "submerged roadways" or "tubes" of iron or concrete constructed on the sea bed.

Among the designs considered is that due to the late Mr. Chalmers, who proposed to have a gigantic tower or ventilator in mid-Channel, to which would be attached 400 ft. lengths of wrought-iron tube floated into position and drawn down by chains to the sea bottom.

Another scheme, considered in more detail, is that of Messrs. Bateman and Révy, who propose to lay a cast-iron tube on the sea bottom, starting from one shore and building it up inside a horizontal bell or chamber which is being constantly pushed forward. The tube would consist of cast-iron plates 4 in. thick lined with brick in cement, and carried on screw piles; its inside diameter when completed would be 13 ft. The propulsive power for trains in such a tube would be pneumatic; that is, the trains would be propelled by air forced into the tunnel by powerful pumps of large capacity in the form of gasometers.

ACCORDING to the *Photographic News*, the oft-reiterated statement that the eye of a dead animal has impressed upon it an image of the last object seen in life has been the subject of serious investigation in Germany. Americans have gone so far as to state that the eye of a murdered man had been found in which a portrait of the murderer was distinctly traceable. In the investigation in question the eyes of thirty different animals, all of which had been killed with a view to subsequent examination, were carefully inspected, but in no case was there any evidence discovered to warrant the statement referred to.

FORTHCOMING EVENTS

Saturday, April 20

ASSOCIATION OF SCIENTIFIC WORKERS (at the Guild of Undergraduates Union, Birmingham), at 3 p.m.—Conference of Industrial Scientists. (Speakers: J. S. Hunter: "Salaries, Cost-of-Living Adjustments, Overtime"; Dr. C. J. Milner: "Holidays and the Five-day Week"; J. Skeel: "The Problems of Assistants, (a) General and Economic Problems"; A. G. Ward: "The Problems of Assistants, (b) Problems of Technical Education"; Dr. R. E. Priestley: "Science as a Reserved Occupation").

Tuesday, April 23

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION), at 6 p.m.—Discussion on "War-Time Standardisation" (to be opened by P. R. Coursey).

Thursday, April 25

INSTITUTION OF ELECTRICAL ENGINEERS, at 6 p.m.—Dr. C. G. Darwin, F.R.S.: "Thermodynamics and the Coldest Temperatures" (Thirty-first Kelvin Lecture).

Friday, April 26

ROYAL INSTITUTION, at 9 p.m.—Dr. E. C. Bullard: "The Geophysical Study of Submarine Geology".

APPOINTMENTS VACANT

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

BOROUGH ELECTRICAL ENGINEER AND GENERAL MANAGER—The Town Clerk, Guildhall, Oswestry (April 26).

PRINCIPAL OF THE Burnley Municipal College—The Director of Education, Education Offices, Burnley (April 26).

LECTURER IN THE DEPARTMENT OF PURE AND APPLIED SCIENCE—The Registrar, Loughborough College, Loughborough (April 27).

ASSISTANT LIVESTOCK EXPERT for Animal Husbandry work in Bengal—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 9/2F) (April 27).

MALE TEACHER OF ENGLISH FOR BRITISH INSTITUTE, GENOA—The British Council, 3 Hanover Street, W.1 (quoting 'Italy') (April 27).

UNIVERSITY GRADUATE AS TEACHER OF ENGLISH for British-Peruvian Cultural Association, Lima, Peru—The British Council, 3 Hanover Street, W.1 (quoting 'Lima') (April 30).

TEMPORARY ADVISER (male or female) IN HORTICULTURE—The Agricultural Organizer, Berkeley House, Berkeley Street, Gloucester (April 30).

PRINCIPAL of the Ceylon University College—The Director of Recruitment (Colonial Service), Colonial Office, 29 Queen Anne's Gate, S.W.1 (April 30).

ASSISTANT LECTURER IN GEOGRAPHY—The Registrar, University, Manchester 13 (May 1).

HEADMASTER of Alley's School—The Clerk to the Governors, Dulwich College, S.E.21 (May 3).

LECTURER IN SINHALESE—The Secretary, School of Oriental and African Studies (University of London), at Christ's College, Cambridge (July 1).

ASSISTANT ENGINEER for the Public Works Department of the Government of Nyasaland—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9202).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Sheffield City Libraries. Research Bulletin No. 3: A Select Bibliography on the Production of Steel Sheets and Strip. Part 1: Ingot—Slab—Sheet. Pp. ii+11. (Sheffield: Central Library.) Free. [14]

Economic Proceedings of the Royal Dublin Society. Vol. 3, No. 7: A Method of Doubling the Yield per Unit Area of Lettuce Plants grown in Nutrient Solution. By R. J. Hayes. Pp. 83-90. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 6d. [14]

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 21: Stabilised Diazo Complexes with Piperazine and other Bases. By P. J. Drumm, W. F. O'Connor and J. Reilly. Pp. 223-228. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 6d. [14]

South-West Essex Technical College and School of Art. Annual Report, Session 1938-9. Pp. 36. (Walthamstow, London: South-West Essex Technical College and School of Art.) [14]

Other Countries

Report of the Institute of Scientific Research, Manchoukuo. Vol. 3, Appendix 1: Lineamenta Florae Manshuricae, or an Enumeration of all the Indigenous Vascular Plants hitherto known from Manchurian Empire, together with their Synonymy, Distribution and Utility. By Dr. Masao Kitagawa. Pp. vi+488+12 plates. (Hsinking: Institute of Scientific Research.) [273]

Canada: Department of Mines and Resources, Mines and Geology Branch: Geological Survey. Paper 39-1: Preliminary Report—Beaulieu River Area, Northwest Territories. By J. F. Henderson. Pp. ii+16+1 map. 10 cents. Paper 39-3: Preliminary Report—Mackay Lake Area, Saskatchewan. By M. L. Keith. Pp. ii+8+1 map. 10 cents. Paper 39-5: Preliminary Report—Snake River Area, Northwest Territories. By C. S. Lord. Pp. ii+18+1 map. 10 cents. Paper 39-6: Preliminary Maps—Quya Lake and Parts of Fishing Lake and Prosperous Lake Areas, Northwest Territories. By A. W. Jolliffe. 3 maps. 10 cents. Paper 39-7: Preliminary Map—Cléry Map-area, Abitibi and Témiscamingue Counties, Quebec. By W. C. Gussow, J. W. Ambrose and H. C. Gunning. 1 map. 10 cents. Paper 39-8: Preliminary Report—Reindeer Lake and Spalding Lake Map-areas, Saskatchewan. By L. J. Weeks. Pp. ii+4+2 maps. 10 cents. Paper 39-9: Preliminary Map—Waconichi Map-area, Abitibi and Mistassini Territories, Quebec. By G. Shaw. 1 map. 10 cents. Paper 39-10: Preliminary Map—Nelson Area, East Half, British Columbia. By H. M. A. Rice. 1 map. 10 cents. Paper 39-12: Preliminary Map—La Pause Area, Abitibi and Témiscamingue Counties, Quebec. By J. W. Ambrose and H. C. Gunning. 1 map. 10 cents. (Ottawa: King's Printer.) [273]

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 192: The Different Factors affecting the Temperature of a Heap of Grain in the Open. By Rizk Attia. Pp. ii+50+43 plates. (Cairo: Government Press.) P.T. 10. [273]

Annales scientifiques de l'Université de Jassy. Première section (Mathématiques, Physique, Chimie), Tome 26, Année 1940. Fasc. 1. Pp. iii+334. (Jassy: Université de Jassy.) 400 lei. [273]

Field Museum of Natural History. Botanical Series, Vol. 22, No. 1: Studies of American Plants, 9. By Paul C. Standley. (Publication 463.) Pp. 62. 50 cents. Zoological Series, Vol. 24, No. 11: A Tentative Classification of the Palearctic Unionids. By Fritz Haas. Pp. 115-142. 20 cents. (Chicago: Field Museum of Natural History.) [273]

Reports of the Japan Institute for Science of Labour, Inc. No. 44: How far Sensory Function Participates in Operations. By Kihati Huzimoto and Yosio Oeno. Pp. ii+24. (Tokyo: Japan Institute for Science of Labour, Inc.) 50 sen. [273]

University of California Publications in American Archaeology and Ethnology. Vol. 38: Cultural and Natural Areas of Native North America. By A. L. Kroeber. Pp. xi+242. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 3 dollars. [283]

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 26, No. 5 (Mathematics No. 42): Beiträge zur Geometrie der Kreise und Kugeln (34). Von Sôzi Matumura. Pp. 179-232. Vol. 26, No. 6 (Mathematics No. 43): Beiträge zur Geometrie der Kreise und Kugeln (35). Von Sôzi Matumura. Pp. 233-288. Vol. 26, No. 7 (Mathematics No. 44): Beiträge zur Geometrie der Kreise und Kugeln (36). Von Sôzi Matumura. Pp. 289-342. (Taihoku: Taihoku Imperial University.) [283]

Kungl. Svenska Vetenskapsakademien Handlingar. Serien 3, Band 18, No. 5: On Walkomia n.gen., a Genus of Upper Palaeozoic Conifers from Gondwanaland. By Rudolf Florin. Pp. 24+4 plates. (Stockholm: Almqvist and Wiksells Boktryckeri A.-B.) [283]

U.S. Department of the Interior: Office of Education. Bulletin, 1939, No. 16: A Review of Educational Legislation, 1937 and 1938. By Ward W. Keesecker. Pp. v+54. (Washington, D.C.: Government Printing Office.) 10 cents. [293]

National Research Council of Japan. Report, Vol. 2, No. 8, April 1938—March 1939. Pp. iii+609-728. (Tokyo: National Research Council of Japan.) [293]

Catalogues

The Book of Dunns Farm Seeds, 1940. Pp. 56. (Salisbury: Dunns Farm Seeds, Ltd.)

The Nivoc Supplement. Special War issue, No. 2, February 1940. Pp. 16. (London and Birmingham: W. and J. George, Ltd.)

Catalogue of Books on British and Foreign Birds. (No. 647.) Pp. 16. (London: Francis Edwards, Ltd.)

Old Oil Paintings, Drawings and Prints. (Catalogue No. 281.) Pp. 34. Old and Modern Books of Various Sorts. (Catalogue No. 282.) Pp. 40. (London: Dulau and Co., Ltd.)

A Catalogue of Books on Africa, Australasia and America. No. 572.) Pp. 32. (London: Bernard Quaritch, Ltd.)

'Girl' Calendar, 1940-1941. (Manchester: Metropolitan-Vickers Electrical Co., Ltd.)

Prokayvit. Pp. 2. (London: The British Drug Houses, Ltd.)

The Wild-Barfield Heat-Treatment Journal. Vol. 3, No. 24, March. Pp. 91-102+vi. (London: Wild-Barfield Electric Furnaces, Ltd.)

Boron in Agriculture. Pp. 36. (London: Boron Agricultural Bureau.)

Brush-Koela 'Duo-Draught' Gas Producer. Pp. 8. (Loughborough: Brush Electrical Engineering Co., Ltd.)

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"Preliminary Report on Photographic Investigations of Cosmic Radiation.

Experiments on 'Spontaneous Neutron Emission' and the Occurrence of Protons of Similar Paths, Corresponding to Several Metres in Air" by Marietta Blau and Hertha Wambacher.

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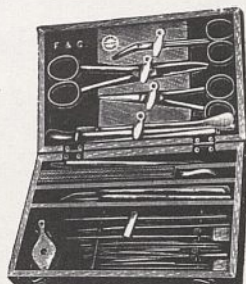
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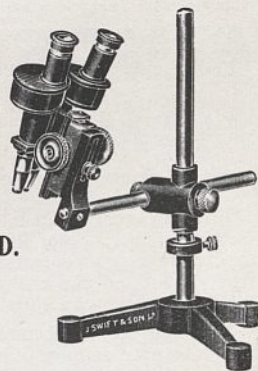
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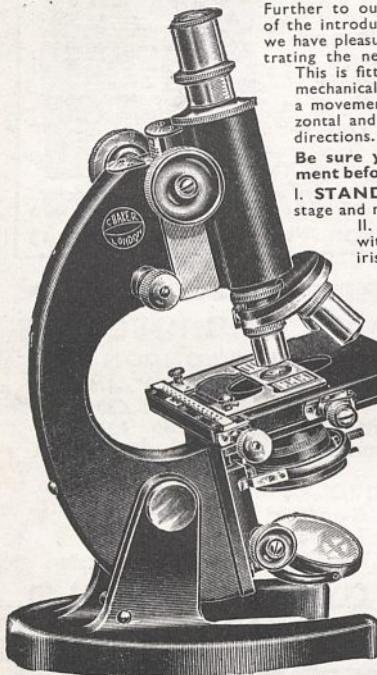
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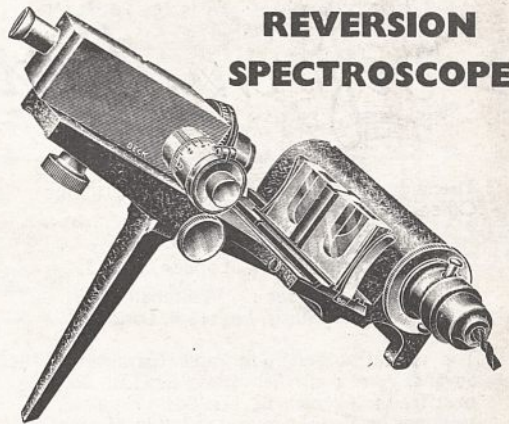
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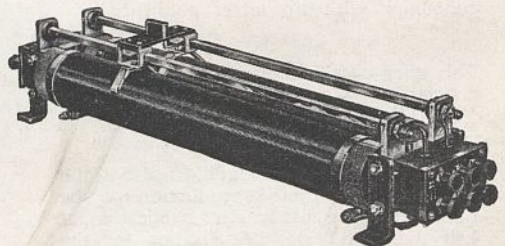
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