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# The Protection of Scientific Freedom

WHEN the Academic Assistance Council was formed in May of last year to assist scientific and other scholars who, on grounds of religion, race or opinion, were unable to continue their work in their own country, it was hoped that its work might be required for a temporary period only. In co-operation with other emergency organisations, the Council has succeeded in permanently re-establishing 363 of the 700 displaced scholars who left Germany, and in providing temporary support for 324 others in universities and other institutions of learning while continuing their research. A feature of this work has been the ready co-operation which the Council has secured from practically all university institutions in giving an opportunity to those displaced of continuing their scientific and learned pursuits.

It is now clear that some permanent body is needed to assist scholars who are victims of political and religious persecutions. The devastation of the German universities still continues, and in Russia and Italy freedom of study and teaching in large portions of the field of learning are still proscribed. Within the past year in Portugal, a number of university teachers in various faculties have been retired on grounds of political opinion, and the Council has offered its assistance to them. In these circumstances the Academic Assistance Council has decided to establish as its permanent successor a 'Society for the Protection of Science and Learning', which will continue its various forms of assistance to scholars of any country who on grounds of religion, race or opinion are unable to carry on the scientific work for which they are qualified. The Society will be incorporated as a company limited by guarantee, and one of its functions will be to build up an Academic Assistance Fund to award research fellowships tenable in the Universities of Great Britain and other countries by the most distinguished of the refugee scholars.

The issue of this appeal is a pertinent reminder of the dangers to civic freedom and responsibility existing in some countries at the present time. Political events of the last four years have, moreover, struck heavy blows at the international solidarity of science itself. It is not merely the displacement of many workers of outstanding ability from Germany and other countries and the consequent enrichment of intellectual life elsewhere. The resulting impoverishment of scientific life is less disquieting than the effect of lopsided development of science in one such country on developments elsewhere. The prostitution of scientific effort on war purposes to the extent and intensity which we have been witnessing in Germany and Italy, for example, constitutes exactly that threat to peace which Major Lefebure pointed out in the "Riddle of the Rhine" in 1919 was to be found in the uneven development of chemical industry.

The position of the scientific worker under a dictatorship is in fact one of the greatest difficulties in the way of the formulation and acceptance of a code of professional ethics in such matters as the application of scientific effort in warfare. Even in Great Britain and in France, however, professional organisations have largely still to acquire the sense of civic or social responsibility which can inspire either the formulation of such codes or ensure their observance in practice. Scientific workers are rapidly becoming aware of the extent to which political organisations can affect the direction of scientific research, and even frustrate its efforts, but they have shown little sign collectively that they are aware of what is

demanded of them even in the interests of science itself.

The reason for this position lies in the failure to understand the nature of organised society and to recognise simple social truths which is a consequence of our neglect of training for citizenship. The scientific worker suffers on the whole more rather than less than other members of the community from this neglect. The very extent to which scientific factors enter into the problems of government and administration on any scale to-day make it as imperative that some training in citizenship should form a part of his training, as that the ordinary citizen should receive in his education at least a sufficient training in science to provide a background for the life he is called upon to live.

The task before us indeed is that of organising society from the civic or municipal through the national to the international plane, in accordance with a social policy which permits the fullest flow of creative thought and activity and the maximum enjoyment of the resources at our command. That task demands the fullest participation of the scientific worker, alike in ascertaining the facts upon which action must be based and in contributing to the vital creative thought which shapes new means and new policies adequate under the conditions of to-day. Unless he is prepared to co-operate, we may well see the gradual dying down of creative thought and activity no less in science than in the political and other fields.

The limiting influence of politics upon scientific work is in fact making itself felt at a time when the service men of science might render is of increasing magnitude and importance. Not merely are new fields of investigation opening up before him, such as the whole subject of population in its biological, statistical and social aspects, but also the spirit of disinterested inquiry, of unprejudiced search for truth and willingness to face and accept change which characterises the mind of science, are needed as never before. Until some of our major problems can be sifted out in this spirit, we are unlikely to regain our control over events.

Nowhere is this more true than of administration itself. The emergence of scientific management indicates that we are slowly coming to realise that organisation is a subject for scientific study and that there are definite principles which must be discovered and respected if we are to avoid the disintegration either of society or of industry under the influence of mechanisation and other forces. The science of management is as yet in its infancy, and probably no factor is more responsible for dissatisfaction, inefficiency and injustice either in industry or in society than the neglect of sound principles of management which have been discovered partly by experience and partly by deliberate investigation.

The knowledge that such principles exist and can be applied to overcome many of our difficulties is itself an inspiration to the scientific as to the social worker. Equally important with his contribution to the evolution of appropriate organisation is the stimulus which his willingness to accept and promote change can supply. It supplies a corrective to the inherent tendency to pay greater respect to the administration than to the creative function, and to the resistance to reintegration and adaptation of institutions which have outlived their utility or ceased to function. The kinship between the spirit of service and the spirit of science enhances the value of this contribution.

Moreover, with this willingness to face change, there is usually linked in the mind of science a capacity for continuous evolution by building on the past and modifying its institutions to meet the changed conditions, which offers a means of building a new social order without recourse to the violent and revolutionary measures adopted in some countries. Within our existing framework the continuous and impartial application of existing knowledge might do much to establish such an order and evolve new and more creative standards of life and thought.

The participation of the scientific worker in this task is not merely a matter for the individual. Education in citizenship may indeed make him more aware of his responsibilities and opportunities and lead him to participate more fully in civil and social life. It is, however, professionally that his major contribution will still be rendered, and professional organisations occupy a place in society of decisive importance. Without this assistance we may look in vain for the emergence of leadership of an adequate calibre or for that close relation between knowledge and power which alone can avert catastrophe. It is mainly from within their own rank that men of science will find the support that enables them still to maintain the vital freedom of thought and investigation without which assuredly our present civilisation is doomed. The Society for the Protection of Science and Learning should at least ensure that that support is maintained, and indeed augmented.

# A Treatment of Modern Physics

**A Treatise on Modern Physics:** Atoms, Molecules and Nuclei. By Prof. M. N. Saha and N. K. Saha. Vol. 1. Pp. xii + 856 + 12 plates. (Allahabad and Calcutta: The Indian Press, Ltd., 1934.) 30*s*.

THERE are two chief ways of writing a book on modern physics. Either an attempt may be made to include every piece of work of any interest, with the aim of enabling the reader to find out what has been going on in every corner of the subject, or one may endeavour to pick out, from the enormous mass of material, really significant and important threads, which guide the advances of the present and immediate future, and rely on references to monographs and books on special branches of the subject to supplement a small chosen body of reference to original papers. The former is the method of the German 'handbooks', and necessitates the allotting of the work to many hands, and, almost inevitably, a lack of balance, proportion and uniformity. The second, and probably harder, method is more the English and American tradition, as exemplified, in different ways, by the "X-rays and Crystal Structure" of the Braggs and Richtmyer's "Introduction to Modern Physics". It demands rigid selection, a strong critical sense, a personal style and, above all, a uniformity of treatment. This does not mean that all parts must necessarily be of the same standard of difficulty, but that a certain standard of equipment and accomplishment must be kept in mind as that of the supposed reader.

The book before us is intended, we suppose, to belong to the second class. It is based, according to the preface, on lectures to Indian B.Sc. (Hons.) and M.Sc. students, and aims at being "concise, up-to-date and self-contained". A second volume is in active preparation, which, if of equal bulk, will bring the work up to 1,700 large pages, or more than three times the size of Richtmyer, so that the conciseness is only relative to, say, a German 'handbook'. This matter of size is typical, perhaps, of what appears to be a great weakness of the book, in that it is neither one thing nor the other, a short readable treatise or a complete reference book. Further, the bulk is largely brought about by a lack of proportion and uniformity of treatment, for while some subjects, such as complex spectra, are treated on the 'handbook' scale, others, of undoubtedly greater importance, are only just touched. Up-to-date it is not; we must await the second volume before we can judge if it is self-contained.

The chapter on "Positive Rays", for example, consists of twenty-one pages, and practically all that is said about the method of anode rays, used by Aston for so much of his classic work, is that it has been used for sodium and potassium "on account of the ambiguity due to multiply charged ions which are very often present" in the ordinary method. Of the general method of anode rays, and of what really necessitates its use, nothing. The difficulties that necessitate the devices described are passed over, Bainbridge comes in for a passing reference only, nothing at all is said of Aston's methods of precision, first published in 1927, nor of the measurements of the departures from the whole number rule. There can be little doubt that this is one of the most important researches in modern physics, especially in connexion with the energies involved in atomic transmutations. Incidentally, in the account of the positive electron which closes the chapter it is, perhaps, scarcely just to say, in reference to Anderson's early work, "A repetition of these experiments by Blackett and Occhialini has fully confirmed this discovery".

This treatment of positive rays is, then, woefully incomplete, and what is there is not very good, for the stress is not laid on the right points. Again, taking the chapter on "Magnetism and its Theories", to which fifty pages are devoted, there is practically nothing on ferromagnetism, no mention is made of the magneto-caloric effect, or of magneto-striction, and the deduction of Langevin's diamagnetic formula is not as plain as the authors appear to think. It is clear that what interests the authors, to the exclusion of other fundamental matter, is the incidence of spectroscopic theory, as exemplified by the results on susceptibilities and on the gyromagnetic effect.

Against this grudging attention to positive rays and magnetism we have 449 pages devoted to line spectra, optical and X-rays; nothing at all is said in these pages of band spectra. The main treatment of bands is probably postponed to the next volume, but it would have been well to mention their existence in the introductory matter on spectra. Much of this part of the work is on a specialist scale: for example, nearly a hundred pages are devoted to the analysis of complex spectra, which is scarcely a subject for the ordinary honours

student at all, since success in it is, perhaps, a matter of the application of complicated empirical relations rather than of simple fundamental principles. The task—by no means an easy one—which the authors should have had before them in this part of the book is, starting from the beginning, to lead the reader up to the modern wave-mechanical view of the extranuclear structure of the atom. Since spectroscopic research has, during the last few years, been consolidating conquered ground rather than making sensational advances, there was an opportunity here to render a great service by subjecting our knowledge to a critical survey which should show the fundamental necessity and service of the different quantum numbers, in an ordered way. The general arrangement, however, does not make for simplicity of exposition, and principles are almost completely neglected in favour of detail.

We start with Bohr's original theory for hydrogen-like atoms, with circular orbits, and then go straight on to the fine structure of the Balmer lines with Sommerfeld's relativity correction considered at length. Here the selection principle is introduced in a few lines, with a reference to the Correspondence Principle which is never mentioned again. We are in the middle of a detailed discussion of the fine structure of helium lines, by the old method, without any explanation of the meaning of the $p$'s and $q$'s, or any mention of separable variables, before the significance of the second quantum number has ever been properly discussed; using the Russell-Saunders notation, which is here taken up after starting with the Paschen notation; and with intensity tables of which we are promised a subsequent explanation, not to be found in this volume, at any rate. This is, in fact, the only mention of intensities in the whole discussion of spectra. The student is then brought back to the doublet spectra, where he is introduced to the diffuse and sharp series, and told that some lines are not included in those two series, but will be dealt with in a later section.

The inner quantum number is first mentioned in the next chapter, which is devoted to Group II elements, on the ground that it is necessitated by the selection principle. After this we pass on to the Zeeman effect, and a detailed discussion of the Stern–Gerlach effect, still without any clear discussion of the elements of the quantum theory of spectra. The spinning, here called rotating, electron is then introduced for the first time, and so much reality is attributed to it that Abraham's old calculation of the ratio of mechanical to magnetic moment is quoted, without any indication to the student that this depends first of all upon an arbitrary distribution of electricity within the electron, and, secondly, upon the application of macroscopic methods to the electron, which is scarcely in accordance with modern ideas. The peripheral velocity is even worked out on these lines, and the absurd value which results is said to be unexplained. Surely the correct view is that expressed by Goudsmit himself, when he says: "The electron obtains a magnetic moment together with this rotation. How large this is cannot be predicted, since our information concerning the structure and properties of the electron must come from experiment." This is rather an essential point, since our authors tend to present many points as very much more a matter of deduction than they are, and frequently say that somebody "showed" something when they mean that he assumed it. From a didactic point of view this is particularly to be regretted.

The decisive points are, in fact, too often slurred over. Thus the $l$-$s$ coupling, and even $l=k-1$, are introduced without any explanation, and then dropped until the whole question is taken up again much later under the heading "Periodic Classification". We are given fourteen pages of the theory of the Stark effect, first by Epstein's method, and then by Bohr's method, but we have had no explanation of what is meant by angle variables, we have never been told, even roughly, what Bohr's perturbation theory is, or had Bohr's method of quantising contrasted with Sommerfeld's, or even been told what is meant by a degenerate system. We have, in fact, a mass of detail that can be found, if required, in the old books, and no exposition of the fundamentals, designed to help the reader to understand it. As further examples of how fundamental matters are treated we note that while there is a great deal about Schrödinger's and Van Urk's work on penetrating and non-penetrating orbits, there is only a passing mention of Schrödinger's wave mechanics equation, and no mention at all of the modern methods of estimating electron distribution, as exemplified by Hartree's self-consistent field, for instance. The Uncertainty Principle is only once mentioned, in small type. There is no attempt to discuss the methods of wave mechanics.

When we turn to such matters as the chapter on Röntgen rays, we have a good exposition of the elementary work on crystal structure, but little attention is paid to the work of the last ten years or so. The chapter on elementary radioactivity is good in many respects, but here again we note omissions of important matter. Possibly many points that we should have expected to find here are dealt with in the chapter on nuclear physics in the volume that has not yet been published.

I cannot help feeling that this book is on wrong lines, and, with Prof. Saha's name and fame to recommend it, may do much to further in India a method of teaching which I hold to be pernicious, the piling up of masses of complicated and imperfectly explained detail and the neglect of general principles and fundamental difficulties. We all rejoice in the rapid strides which Indian science is making, and I wish that I could greet this new evidence of activity with more encouraging words. The learned authors have perhaps wished to undertake too much. A more vigorous pruning and more attention to balance, and to the fundamentals of experiment and theory, would have sufficed to make the book easier to read, and this notice easier to write for a well-wisher.

E. N. da C. A.

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# Tungus Shamanism

## Psychomental Complex of the Tungus

By S. M. Shirokogoroff. Pp. xvi+469. (London: Kegan Paul and Co., Ltd., 1935.) 50*s*.

THERE are some notable additions to our knowledge of Tungus culture, particularly in the sphere of Shamanism, in this work. It is the more regrettable that the author's valuable first-hand observations among Siberian and Manchurian tribes should be accompanied, and to a certain extent obscured, by long and rambling theoretical disquisitions, couched in a novel and often ambiguous terminology. Their elimination would have reduced an unwieldy volume, measuring 11in. × 14½ in. and weighing 8½ lb., to convenient proportions.

The title itself raises a number of questions. The author states that by the term "psychomental complex" he names "those cultural elements which consist of psychic and mental reactions on milieu", elements which "may be classified into two groups, namely, (1) a complex of reactions of a permanent and definite character, though they vary within a certain range, and (2) a complex of ideas which define certain mental attitudes and which may also be regarded as a theoretical system of the given unit (or even person)" (p. 1). Later, anticipating that the term "psychomental complex" is "likely to meet with opposition", he writes: "It is evident that we shall deal with a complex. I call it *psychomental* because the phenomena designated as *mental* may be regarded so only abstractly, while they are actually connected with the whole psychic complex of the ethnical units and individuals. This complex is functional complex", etc. (p. 46).

M. Shirokogoroff is very critical of psychological analysis as applied to ethnography, regarding it as "a technical method par excellence" which "must not be abused" (p. 8), but since the mental life of the Tungus forms the subject-matter of this book, a more conventional use of psychological terms would certainly have clarified both the argument and its exposition. The omnipresent term 'complex' is especially confusing; it may denote what is commonly called a culture, as in "alien complex" (p. 11), or a single element of material culture, as in "complex of winterfurcoats" (p. 21), or the psychological characteristics of individuals, as in references to an investigator's "own complex", "personal complexes" (p. 4) and "sympathy-complex" (p. 3). Linguistic shortcomings are easily forgiven an author writing in a language not his own, but M. Shirokogoroff invites a careful scrutiny by his frequent criticisms of generally accepted terms.

The foreword paints a gloomy picture of contemporary ethnography, and in the first chapter of the introduction there is a comprehensive indictment of the methods and theories of social anthropologists. Thus, Frazer and "L. Bruhl" are "mosaicists" (p. 8). The contributions of Malinowski and the "new psychological school" are dismissed in a paragraph (pp. 7–8), but with the following note: "It is clear that my use of the term 'functional' is much wider than that adopted by S. [sic] Malinowski and his followers . . . A full 'meaning' of my use of these terms will be clear after the reading of this work" (p. 8, n.**).

The author devotes the second chapter of the introduction to an outline of his "theory of ethnos", which he considers an indispensable "introduction to the psychomental complex" (p. 12). This theory is given a purely abstract formulation, with the aid of mathematical symbols and physical metaphors. The theory is not illustrated by any analysis of specific cultures and the thirty-three diagrams cannot be intended to represent even *hypothetical* communities, since the dots are concentrated along the outer margins of the areas assigned to the "ethnical units" in Series I, II and V.

Part One, "Positive Knowledge", deals chiefly with Tungus nature-lore. Anthropologists will regret that the author decided to confine himself "to the description and analysis of inferences without reproducing . . . the total amount of facts gathered" (p. 49), for the inferences are sometimes highly speculative, as in the paragraph about

"Animus" (p. 50), sometimes platitudinous, as in many of the remarks about paths (pp. 68–69). Much more could probably have been gleaned from a few verbatim native statements.

In Part Two, "Hypotheses", and Part Three, "Practical Consequences of Hypotheses", M. Shirokogoroff gives a valuable account of Tungus religious ideas and practices, although he will not countenance the terms 'religion' or 'magic' for Tungus phenomena (pp. 46–47). Chapter xvii, called "Souls and Their Managing", describes the disposal of the dead. The author regards Part Four, "Shamanism", as essentially a continuation of Part Three, both being concerned with "various methods of practical solution of problems resulting from the recognition of a series of hypotheses expounded in Part Two" (p. 241). Students of Shamanism, whether or not they endorse this theoretical approach, will find a great deal of useful information in this latter half of M. Shirokogoroff's work, particularly when the tribe to which the observations relate is indicated, as for example in the description of *chorea imitatoria* cases (p. 248), of occasions for shamanising (pp. 311–314) and of individual shamans (pp. 383–385). The absence of such indication for the greater part of the material in the book is apparently due to the underlying assumption that a Tungus "psychomental complex" exists, that there are combinations of traits and attitudes equally characteristic of these widely scattered tribes, living under varied conditions, whose only objectively established relationship is linguistic. Supporting this assumption there is only the author's subjective conviction that he "could directly penetrate into the Tungus complex", that "*all Tungus notions were understood in the Tungus system and mind, in the Tungus complex*" (p. 40). E. J. L.

# Mammals of Ceylon

**Manual of the Mammals of Ceylon**
By W. W. A. Phillips. Pp. xxvii + 373 + 38 plates. (Colombo : Colombo Museum ; London : Dulau and Co., Ltd., 1935.) 10 rupees ; 15*s*.

THE author occupied his time, while a prisoner of war in Turkey, in collecting and observing the animals near his camp. Since his release, he has employed his leisure in a similar study of the mammals of Ceylon. A catalogue issued by a great museum enumerates all the species of the organisms belonging to a few or a single family, and is founded necessarily on the specimens in its own and in other museums ; it is hence largely morphological and classificatory. In contrast a 'local' monograph such as this requires of its reader a certain acquaintance with the locality and its environments, and lays its main stress on the adaptation of the described species to these.

In Ceylon there are 109 species of mammals, and they are briefly classified into sub-orders, families and genera. The fur, colour, sexual difference and variation in size of each species are described, so that they are easily recognisable. Then the reader is taken to the living animals and made to consider at greater length the distribution of each species in Ceylon and elsewhere, its food, breeding and habits. These sections show the author to be a naturalist of high attainment and great enthusiasm ; their value, since Ceylon like every other country is evolving, with consequent extension of human occupation and restriction of wild Nature, cannot be over-estimated. We venture to select at random those relating to the lorises, the sloth-bear, the mole-rat and the pangolin, feeling how aptly they may be used to illuminate many a dull lecture.

Of especial interest is the chapter dealing with the distribution. In Mesozoic times, Ceylon was part of Gondwanaland, which was broken up before the Tertiary period. Then there would seem to have been a temporary connexion in the late Eocene. In the Miocene, Ceylon was a much smaller island, and there may have been a renewed connexion in the Pliocene. In the early Pleistocene there was a subsequent invasion from India followed by subsidence, re-elevation and land connexion, finally the topography as we see it to-day. These four land connexions each provided its quota of mammals, which are now distributed in three climatic regions of Ceylon, namely, the dry zone influenced by the north-east monsoon, the wet zone by the south-west, and the wet central mountain zone. Each has its appropriate fauna, outside which it is seldom found, the mountains being the stronghold of the 'relics'. There are a very few forms common to all three, most of which have a local race in each zone. This is entirely contrary to the teaching of "Age and Area" (Willis), but 109 Ceylon mammals cannot be compared with about 2,800 species of plants, especially since the organisation of animals usually requires even minute adaptations to enable them to survive both varying physical conditions and the ravages of their carnivorous brethren and of other vertebrates.

### The Story of the Plant Kingdom

By Prof. Merle C. Coulter. Pp. ix+270. (Chicago: University of Chicago Press; London: Cambridge University Press, 1935.) 13*s*. 6*d*. net.

THIS book forms an eminently readable introduction to botanical science. It is intended primarily for the use of students at the University of Chicago, but should appeal equally to all those who are anxious to gain some knowledge of the structure and life-histories of representatives of the principal groups included in the plant kingdom. The American terminology and phraseology employed by the author may be found to be a drawback by students reading for examinations in Great Britain, but that should not deter those who are interested in the subject for its own sake.

After being introduced to the blue-green algæ, the reader is able to follow the various forms of internal and external differentiation of the plant thallus and the reproductive processes exhibited by selected members of first the green, and then the more complex brown and red algæ. Typical saprophytic and parasitic fungi are next described, after which the author gives an account of the life-histories and increasingly elaborate plant bodies of typical Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

Special emphasis is laid on the various specialisations of the higher plants by means of which they are particularly adapted for life on land. The phylogenetic treatment is, however, interrupted by a very clear account of the principal physiological processes in plants, and a chapter dealing with bacteria and the part they play in the nitrogen and carbon cycles. There are also chapters dealing with "The Process of Organic Evolution", "Classification" and "Seed Distribution and Germination".

The book is profusely illustrated by excellent line drawings and photographs. Minor errors worthy of attention are: (1) the term "spore" is inappropriate when applied to the asexual reproductive bodies of *Phytophthora infestans*, because these bodies, which are commonly referred to as 'conidia' or 'sporangia', sometimes give rise to zoospores instead of germinating directly; (2) the word 'tube' on p. 202 and the headline on p. 153 contain misprints. These points, however, do not seriously detract from an otherwise excellent book. C. R. M.

### Annual Reports on the Progress of Chemistry for 1935

Vol. 32. Pp. 527. (London: Chemical Society, 1936.) 10*s*. 6*d*.

THE Annual Reports for 1935 fully justify anticipation; and this is an attainment of substance, since the standard which has been set by previous annual issues is indeed high. The whole field of chemistry cannot, of course, be covered; hence the selection of groups of topics is related to the interests of the reporters, and the volume catches something of the charm of personal commentaries.

Dr. H. J. J. Braddick discusses radioactivity and sub-atomic phenomena, and includes a section on cosmic radiation. Dr. C. B. Allsopp, Dr. S. Glasstone, Dr. E. B. Maxted, Dr. E. A. Moelwyn-Hughes and Dr. G. B. B. M. Sutherland deal with a number of problems in general and physical chemistry; a good deal of attention is given to the behaviour of deuterium and its oxide, 'heavy water'. Inorganic chemistry is discussed by Dr. S. R. Carter, Dr. E. S. Hedges and Dr. W. Wardlaw, who start by examining the evidence on which claims to the discovery of new elements have in recent years been made, and then turn their attention to the chemistry of certain selected elements and compounds, and to a review of non-ferrous alloy systems. The progress of crystallography over a period of two years is described by Dr. J. D. Bernal, Miss D. M. Crowfoot, Dr. R. C. Evans and Mr. A. F. Wells. Organic chemistry is entrusted to Dr. E. H. Farmer, Dr. E. L. Hirst, Dr. R. P. Linstead, Dr. S. Peat, Dr. F. S. Spring and Dr. E. E. Turner. The chapter on biochemistry is written by Mr. A. G. Pollard, Dr. C. P. Stewart and Miss J. Stewart, while analytical chemistry is reviewed by Mr. G. U. Houghton, Mr. L. S. Theobald and Dr. R. W. West.

It would be easy, but not very profitable, to list a number of intriguing matters which catch the eye as the pages are turned over; the development of spot tests, the accumulation of knowledge concerning vitamins and hormones, the phenomena of polymerisation, the problems of illinium, masurium, virginium, and alabamine. It must, however, suffice to repeat what has often before been said: that these are reports which chemists study as a matter of course, and that others will find in them an acceptable picture of progress in that branch of science. A. A. E.

### Z Dziedziny Nauki i Techniki

Tom 6: W Poszukiwaniu istoty Życia: Historja naturalna Jednego Pierwotniaka. Napisał Prof. Dr. Jan Dembowski. Pp. xii+356+8 plates. (Warszawa: "Mathesis Polska", 1934.) zł. 14.

PROF. DEMBOWSKI'S "In Search of the Nature of Life" is a second edition, greatly enlarged and brought up to date, of his book "The Natural History of a Protozoon", published about twelve years ago. The author tries to describe the problems of general biology, taking *Paramecium* as his example. In a series of chapters he discusses some technical problems of culture, the structure of *Paramecium*, movements, tropisms, the uptake of food and excretion, respiration, reproduction, variability and heredity, psychological phenomena.

The author has the very unusual gift of expressing complicated problems in a simple and attractive way, with a fine sense of humour, and moreover he never distorts the scientific truth. His dramatically written story of *Paramecium*, which "belongs to an old, aristocratic family, whose ancestors lived in times when man did not yet exist", is delightful reading for a scientific worker, who will find some new and interesting points of view. The layman and the student of biology will learn of many interesting problems and facts. W. W. N.

**The Annual Register:**
a Review of Public Events at Home and Abroad for the Year 1935. Edited by Dr. M. Epstein. Pp. xiv+319+190. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 30*s*. net.

To condense into some three hundred pages the history of the world in such a troubled year as 1935 can have been no easy task, but it has been achieved in this invaluable book of reference.

About a third of that space is occupied with the story of events in Great Britain told admirably in narrative form, not lacking in colour and relief but wholly free from bias. This is followed by a short section on Imperial history and a section on foreign history, including a review of the work of the League of Nations during the year. Nothing of importance in political history appears to be omitted, and the whole is readable as a continued story.

The second half of the book opens with a chronicle of important events in social history, followed by a lengthy retrospect of literature, art and science with mention of the more important books of the year and extended reviews of about two dozen. Art, drama, cinema and music receive ample notice and science is condensed into fourteen pages, a terse summary of research and discovery grouped under biological and physical branches. Then comes a review of finance, commerce and law and finally many pages of obituary notices of prominent men and women.

Certain public documents are, as usual, given in full: they include Herr Hitler's announcement of military conscription in Germany, the British, French and Italian notes relating thereto, and the Franco-Soviet Treaty of Mutual Assistance. The value of the volume is enhanced by a detailed index.

**Communication Networks**
By Prof. Ernst A. Guillemin. Vol. 2: The Classical Theory of Long Lines, Filters and related Networks. Pp. vii+587. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 37*s*. 6*d*. net.

THE latest developments of the filter question are now made available in English, together with the most useful parts of the more difficult classical treatments by Zobel. It will be recalled that, starting with Campbell, the properties of filter sections of specified patterns were tabulated for procedure in design, which, after all, is the important aspect for the communication engineer; the actual design along these lines was, however, an art, in that many tries were often necessary for a satisfactory solution to the problem. Starting again with Cauer, the procedure previously based on deductions from transmission line conceptions gave way to conceptions based on obtaining network structures having specified impedances, using a theorem by Foster and the most general of filter structures, the lattice. Guillemin's second volume is therefore of considerable practical importance. Transient phenomena in filters are adequately dealt with, together with Bode's methods of impedance control. L. E. C. H.

**British Calendar Customs**
England, Vol. 1: Movable Festivals. By A. R. Wright. Edited by Dr. T. E. Lones. (Published for the Folk-lore Society.) Pp. xvi+212+8 plates. (London: William Glaisher, Ltd., 1936.) 12*s*. 6*d*. net.

THAT eminent folklorist, the late A. R. Wright, had made the collection of evidence relating to British calendar customs a lifelong pursuit. The much desired publication of a selection from this material has now been made possible through the Folk-lore Society by the generous assistance of his widow. The editor, with wise judgment, has elected to deal with the movable feasts as a whole in chronological order, thus avoiding the complications and difficulties which arise when an attempt is made to fit them into the framework of the ceremonies of a fixed calendar. At the same time, it is obvious that this method of dealing with the material has the disadvantage of detaching from one another seasonal practices, which are clearly related. This, however, is an inconvenience in critical study which will be reduced to a minimum when the later volume covering the fixed festivals appears. It will, therefore, be an advantage to postpone the more detailed examination of the material until this is available. Meanwhile, it may be noted for the information of the student that this volume, in addition to Shrovetide, Easter and attendant observances, Ascensiontide and Whitsuntide, covers movable festivals not dependent on Easter, and also some harvest customs.

**Evans' Recent Advances in Physiology**
Fifth edition, revised by Dr. W. H. Newton. Pp. xii+500. (London: J. and A. Churchill, Ltd., 1936.) 15*s*.

SUCCESSIVE editions of a successful text-book are apt to lose something of their freshness. New wine is added to the dregs of the old, and though the store of knowledge grows, its flavour deteriorates. Books which deal with the recent advances of science cannot be compounded in this way, and each new edition must represent a fresh vintage.

"Recent Advances in Physiology" was first written by Lovatt Evans in 1925, and three new editions have been written by the same author. W. H. Newton has written the fifth edition. There is very little left in the book that has survived from the first edition. One of the chapters has the same title and some of the same figures, but the rest of the book is the new wine of physiological advance. Lovatt Evans has contributed an introduction, and a chapter on the metabolism of cardiac muscle. Newton has written new chapters on carbonic anhydrase, the oxygen supply of the fœtus, the sex hormones, chemical transmission at nerve endings, the spinal reflex, the secretion of urine, and the nervous control of micturition and defæcation. He has rewritten the chapters on the coronary circulation, the carotid sinus, carbon dioxide in the blood, and on conduction and excitation in nerve. The publishers are to be congratulated on having discovered a physiologist with the gifts, and the energy, to prolong the vigorous life of this well-known text-book for advanced students.

# Light and Temperature and the Reproduction of Plants*

By Prof. V. H. Blackman, F.R.S.

## Effect of Temperature

THE thermal effect, that of chilling, now to be considered, is one which is being closely investigated by numerous biologists. It is truly cryptic in nature, for the effect of the temperature change may long remain hidden, only showing itself at the time of flowering many weeks later. The process of chilling young plants in order to accelerate flowering appears to have been used by an investigator in the United States before 1857 to secure the early flowering of wheat; but it was first investigated by Gassner in 1918 in his study of the differences between spring and winter cereals. It is well known that a winter variety of wheat or rye if sown in the spring will usually not flower, that is, will not produce an ear at all during that season or will ear so late that no satisfactory crop can be harvested. Spring cereals, however, have not this disability. Gassner conceived the idea that delay in flowering of the spring-sown winter wheat might be due to the lack of exposure to chilling which the winter sowing ensures. Accordingly he exposed seedling plants of winter wheat for thirty days to a temperature a little above freezing point, with the result that they flowered about the same time as the spring varieties. The effect that may be produced is shown in Table II.

Table II

Winter Cereals and Temperature of Germination

| Sowing date | Date of ear appearance 15–20° C. | Date of ear appearance 2–3° C. | Days early |
|---|---|---|---|
| | Wheat | | |
| December 18 | June 16 | June 9 | 7 |
| March 3 | August 13 | July 23 | 21 |
| April 15 | September 18 | August 10 | 39 |
| April 25 | No earing | August 11 | (infinite) |
| | Rye | | |
| January 9 | June 2 | June 2 | 0 |
| February 6 | June 9 | June 9 | 0 |
| April 15 | August 4 | June 18 | 47 |

The method of chilling seedlings employed by Gassner is of course quite impracticable on an agricultural scale, since the delicate seedlings could only be sown with the most careful individual handling. It is evident that if the method is to be of any practical use some modification is essential. Such a successful modification has recently been achieved in Russia. There the growing season may be short, not only from delay in sowing owing to the lateness in the rise of the soil temperature, but also owing to excessive heat. In the semi-arid zones of the Ukrainian steppes, for example, a period of great heat sets in during summer, and if the crop has not then ripened the plants are damaged, and the yield is very small. The modification in the chilling process which has been introduced by Russian botanists consists in exposure to the low temperature at a very early stage and under conditions which prevent almost entirely the growth of the embryo of the grain.

* *Continued from p.* 934.

The grain is not fully soaked, but enough water is supplied to bring its moisture content up to fifty per cent of the dry weight of the seed. The amount of water must not be much less or the life processes in the embryo will not be sufficiently active to respond to chilling; the amount must not be much more or the embryo of the grain will develop too far. After the grain has been allowed to take up during twenty-four hours the appropriate amount of water at an ordinary indoor temperature, the grain is chilled by exposure to a temperature a little above freezing point (34°–36° F.) for a period of 10–15 days. Since the temperature is low and the grain not fully swollen, the development of the embryo is so slight that the grain after treatment can be sown in the ordinary way. In fact, it can be dried and stored and sown many weeks later.

The process is known as *vernalisation*, that is, bringing to the spring state. The plants by this treatment are brought into the condition which a winter-sown wheat would have in the spring. The effect of the chilling is *to hasten the occurrence of flowering*. It reduces the length of the non-reproductive, the purely vegetative, part of the life-cycle of the plant. The similarity of this to the photo-periodic effect, with its control of flowering by length of day, is noticeable. We shall see later that the two effects are closely related.

Table III

| Variety | Date of ear formation | Days early (−) or late (+) | Comparative yield |
|---|---|---|---|
| Odessa Girka | July 14 | — | 100 |
| *T. erythrospermum* | | | |
| Vernalised | June 5 | − 9 | 111·7 |
| Untreated | July 1 | + 17 | 4·7 |
| *T. ferrugineum* | | | |
| Vernalised | June 12 | − 2 | 141·1 |
| Untreated | July 1 | + 17 | 7·9 |

The effect of vernalisation on two wheats grown at Odessa which are exceptionally late in producing the ear, and so in the ordinary state are useless in the Ukraine, is shown in Table III, where they are compared with a Girka wheat which is

especially suited to the local conditions. All were sown on April 11.

Unvernalised, these two wheats were 17 days later in earing than Girka, so that they gave an inconsiderable crop. By vernalisation, both varieties were ahead of the Girka variety in ripening and gave higher yields.

The facts of vernalisation are definite, but, as is the case with photo-periodism, the physiological processes in the plant which are responsible for the phenomena remain for the most part to be discovered. The two phenomena can scarcely be considered separately, for in the absence either of chilling or of the appropriate day-length, flowering may be long delayed or fail altogether. What is to be explained in each case is the manner in which the treatment—chilling or alternation of light and darkness—endows the plant with a potentiality for earlier flowering.

A theory has been put forward by Lysenko which attempts to provide a physiological basis for both the processes. It lays stress on the distinction between vegetative growth and the developmental stages associated with flowering. On this hypothesis the plant must pass through a number of stages before it reaches the stage necessary for flowering. Of these stages two are supposed to be sharply defined, first the heat-stage (thermo-stage) and second, the light-stage (photo-stage), though these stages are not necessarily associated with actual growth. In this view, the external conditions are different for the two stages. For transition through the first stage winter cereals, for example, require a low temperature and a sufficiency of moisture and oxygen to allow of sufficient activity for response of the embryo to the low temperature ; illumination is, however, not important. The later light-stage only begins after the completion of the heat-stage ; it requires not a low but a moderate temperature, and in the case of the cereals an illumination of more than 10 hours a day, and as an optimum condition, continuous light. With a day shorter than 10 hours this stage cannot be completed and vegetative growth continues indefinitely. In this view, vernalisation by chilling results in the completion of the heat-stage without which the light-stage cannot begin and flowering cannot be achieved ; long days then complete the work.

This theory may seem plausible at first sight, but living organisms are so complex that with them, unfortunately, a simple explanation is almost certain to be wrong. At the Imperial College, Gregory and Purvis for some years have been studying the behaviour of the winter cereals in relation both to the vernalisation and the photo-periodic effect. In the first place, it is unlikely on general grounds that such stages should be sharply differentiated—if they do occur one would expect them to merge into one another. In fact, however, the work of Purvis has shown that chilling is not essential for flowering. If winter cereals are grown throughout the winter in the greenhouse, flowering occurs *without chilling* in the lengthening days of spring ; there is thus no sharply marked heat-stage.

The weakness of the earlier theoretical considerations of photo-periodism and vernalisation, as has been pointed out by Gregory, lies in concentrating attention on the later and less essential stages of development. In the earlier work on photo-periodism the opening of the flower bud was considered as the test of flowering. The bud, however, is initiated much earlier in the life of the plant, and when regarding the effect of previous external conditions upon flowering, attention would seem most properly to be focused on the stage of initiation of the flowers. This is usually very much earlier than the actual opening of the buds.

Klebs, many years ago, held that the stage of "ripeness to flower" had to be reached before the rudiments of the flowers were laid down, this being followed later by the stage of flower development and of expansion of the floral organs. The photo-periodic effect may be concerned mainly with the last stage. If attention is focused on flower initiation, the morphology of the plant cannot be neglected, as Gregory has insisted. The only plants which have been closely investigated from this morphological point of view are the temperate cereals, rye, barley, wheat, by Purvis at the Imperial College. These, as is well known, have a terminal inflorescence, a certain number of leaves being produced on the main axis before the rudiments of the flowers appear. It has been shown that the number of leaves produced before flowers are formed is dependent upon external conditions. Purvis has demonstrated that the effect of chilling is to reduce the number of leaves formed ; thus flower formation begins earlier and so flowering is accelerated. By vernalisation at 1° C. for six weeks the number can be reduced to 13 in rye and recently 9 has been achieved ; by very prolonged vernalisation for six months the number in wheat has also been reduced to 9.

It has also been shown that vernalisation is a process which takes place by degrees ; even a few days' chilling produces some effect. In an experiment by Gregory and Purvis in which vernalisation was applied to rye for 4, 7, 11, 14, 21, 28, 35, 42 and 49 days, there was some effect at 7 days and the effect was progressive up to 49 days. A further and most suggestive result has been obtained by Gregory and Purvis from these experiments. The number of days of vernalisation added to the number of days between placing the plant under

growing conditions and the opening of the flowers (anthesis) tends to be constant. It would appear then that vernalisation produces no actual acceleration of flowering, since there is no reduction in the time elapsing between the moistening of the grain and the occurrence of flowering. The apparent acceleration is due to the reduction in the number of days in the growing post-vernalisation period.

There is a further interesting point. The number of leaves formed not only responds to chilling but also to length of day. The temperate cereals are described as long-day plants, for their ears emerge in long days. In the winter forms, however, *flower-formation takes place much more rapidly in short days*, while spring forms do not exhibit this need. The effect of chilling winter forms is to make them independent of short days, so that, like the spring forms, they will flower rapidly in long days.

We are still ignorant as to the action of vernalisation by cold. Is it a primary temperature effect on the plant processes, or does the low temperature merely act indirectly by keeping growth in check and so inducing a kind of semi-dormancy in which slow maturation processes go on without any morphological change ?

### Dark Vernalisation

As has been already stated, the sub-tropical cereals, such as maize, sorghum and other millets, are attuned to the short days of the tropics, as are also cotton and the soybean, and have their flowering much delayed in long days. It has been discovered, however, that if the grain of sorghum or millet is kept in darkness for a period, the need for short-day illumination of the plant is removed. The grain must of course be soaked, but in contrast with the vernalisation of winter cereals a high temperature is required. The grain is given about 25 per cent of its weight of water and then kept in the dark for 5–10 days at a temperature of 27°–29° C. After this treatment the plants will flower in long days or even in continuous light ; their cultivation can thus be extended to regions of long summer days. This is a considerable achievement and suggests that in such plants the absence of light is necessary for the occurrence of certain changes. What seems to be important is a certain 'dose of darkness' ; when a sufficient measure has been given the plant is independent of further periods of night.

Some light has thus been thrown on the nature of photoperiodism and vernalisation by these studies of winter cereals, but the nature of the changes in the plant during the periods of darkness and chilling are still in the greatest obscurity. Two results of general interest, however, have come from these investigations of duckweed and winter cereals. One, the fact that physiological changes, which it is difficult to describe as other than development, can go on in a swollen, 'cold-dormant' seed incapable of growth. Secondly, there has been demonstrated the need for change if the plant is to run its full life-cycle. Duckweed may multiply best at a constant high temperature and continuous light, but for many plants when flowering is concerned, variation in the environment is essential. To them, one may say, uniformity is anathema. It is evident that this need for variety greatly complicates the physiological analysis of plant responses, for the effect of not one but many environments has to be investigated.

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# Medical Research in 1935

AS in previous years, perusal of the report of the Medical Research Council* provides the reader with a broad view of the research work carried out in Great Britain in medicine and its allied subjects : from its pages, the trend of recent investigations can be quickly and easily followed. The increase in the grant-in-aid provided by Parliament enabled the Council to restore the cuts in salaries and to proceed with plans for new research work which had been temporarily in abeyance, and to undertake additional investigations required for the purposes of administrative departments. Lord Dawson of Penn and Prof. A. E. Boycott retired from the Council, and Prof. J. A. Ryle and Prof. M. J. Stewart were appointed to succeed them. Towards the close of the period under review, the Council learnt of the impending retirement of its chairman, the Marquess of Linlithgow, on his appointment as Viceroy of India. The funds of the Council have been augmented as in previous years by sums of money for the promotion of particular schemes of research, provided by a number of different bodies. The Council is also responsible for the award of Rockefeller medical fellowships and Dorothy Temple Cross research fellowships in tuberculosis ; the arrange-

* Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the year 1934–1935. (Cmd. 5079.) Pp. 183. (London : H.M. Stationery Office, 1936.) 3s. net.

ment with the Rockefeller Foundation of New York will not, however, be renewed at the end of the present academic year, the fellows who are now abroad being the last to be appointed. The change is not due to any doubts as to the value of the scheme, or to any dissatisfaction with the results which have been achieved ; but is due entirely to a fundamental change in policy of the Foundation, which involves abandonment of its present system of international fellowships in favour of concentration upon a more restricted programme for the promotion of research. The Council is concerned with the question of filling the gap in the system of higher medical education caused by the withdrawal of these fellowships ; meanwhile, the trustees of the late Viscount Leverhulme are providing funds, for the next five years in the first instance, for the award of one travelling fellowship annually.

The report refers to the practical application of the newer facts of nutrition, and emphasises that, at any rate until recently, the public was unaware of the importance of proper feeding as a factor in preventive medicine. It reviews some of the more practical discoveries which the Council has assisted during the period of its existence. Of these, probably the most important is the discovery and finally the isolation of vitamin D, with the proof of its curative and preventive action in rickets and dental disease. Other investigations have shown the good effects of supplementing the diet of growing children with milk and other substances, and have demonstrated the incidence of nutritional anæmia in pregnant and lactating women and in their infants, and shown how the condition can be avoided or mitigated. Still, even at the present time, only a small fraction of the people have reaped the benefits that modern knowledge of nutrition can offer : the essential teachings can, however, be reduced to a few simple statements. The first is that the younger the child the more essential is correct feeding for proper growth and health : and the second, that much more milk, cheese, butter, eggs and green vegetables ought to be consumed ; milk ought to be the chief drink for children, while bread and other cereals should in these early years be greatly reduced.

Among the new substances which have been examined during the past year have been ergometrine, Dakin and West's hæmatopoietic agent (anahæmin) and androsterone. The report reviews briefly the history of the chemistry and pharmacology of ergot ; the apparent disparity between pharmacological evidence and clinical practice was not solved until Chassar Moir demonstrated the presence in a watery extract of the drug of a substance stimulating, when given by the mouth, the human puerperal uterus ; none of the known constituents of ergot had this effect, and the new alkaloid was finally isolated by Dudley and himself in crystalline form and called ergometrine. The substance prepared from liver by Dakin and West, which has a complex protein structure made up of amino-acid and other groups, has been manufactured in Great Britain, and submitted to clinical trial by Davidson, Wayne and Ungley on cases of pernicious anæmia. The substance thus prepared is extremely potent : injections of from 0·1 gm. to 0·2 gm., once weekly, brought about a large increase in the red blood corpuscles of the patients and in the course of a few weeks restored them to health. Analysis of the death-rates from this disease shows that the therapy has appreciably extended the lives of patients suffering from it.

Viruses and virus-like infective agents have continued to occupy a prominent position in the programme of research at the National Institute for Medical Research. The possibility of obtaining from human cases of epidemic influenza a virus infecting the ferret, and transmissible then to other ferrets and to mice, as mentioned in last year's report, has been abundantly confirmed, although direct transmission from man to mouse has not yet been attained. A certain method of producing complete immunity to the experimental infection has not yet been found, although resistance can be significantly enhanced in either ferrets or mice, by subcutaneous injection of the living virus, which is not infective when thus applied, or of a formolised vaccine prepared from it. A serum neutralising the infective activity of the virus has been prepared by immunising a horse : injections into infected mice have given results which suggest that such a serum might have some value in the treatment of influenzal pneumonia. The virus has been shown to multiply on the chorio-allantoic membrane of the developing chicken and in a saline medium containing fragments of surviving tissue from a chicken embryo. The latter method has also been successfully employed in the cultivation of the viruses of psittacosis, ectromelia, vaccinia and louping ill.

Among other researches which have a close relationship to the public health may be mentioned the work on methods of preventing puerperal sepsis, on industrial pulmonary disease and the toxicity of industrial solvents and on methods of eradicating bed-bug infestation. The use of the new technical procedures which have been developed in recent years for differentiating the hæmolytic streptococci has led to the conclusion that the organisms which are occasionally found in the genital tract of healthy parturient women are not, as was formerly supposed, identical with those causing puerperal fever, and are indeed

usually harmless to their human hosts. The pathogenic types which do invade the genital tract have therefore been conveyed to it from some outside source, for example, the respiratory tract, either of the mother or that of her attendants: familial sources have been incriminated in not a few instances. The results and lessons of that work, if rightly applied, should achieve a reduction in the incidence of hæmolytic streptococcus infection following childbirth.

In conclusion, reference may be made to the work of the Department of Biological Standards at the National Institute for Medical Research. Standards for gas gangrene antitoxins (vibrion septique and *B. œdematiens*), staphylococcus antitoxin and antipneumococcus serum (Types I and II) have been brought into official use under the Therapeutic Substances Act. A new sample of diphtheria antitoxin standard has been prepared. The British standard for pituitary posterior lobe extract has now been adopted formally for international use. The Institute has also accepted responsibility for the preparation and distribution of the international standards for the arsphenamine group of drugs. New standards for a number of other compounds have been adopted for international use and have been distributed, or will be distributed as soon as prepared, namely, insulin, the vitamins (A, C and D) and the sex hormones (œstradiol benzoate, androsterone and progesterone). The supply of progesterone is being undertaken by the Institute: it is being prepared from pregnandiol and stigmasterol, and extracted from the corpora lutea of whales.

# Obituary

## Dr. Arthur Eastwood

ON May 6, after a few hours of illness, Arthur Eastwood, formerly of the Laboratory of the Ministry of Health, died in London in his sixty-ninth year. He was born in Manchester, was educated in its Grammar School and graduated in Lit. Hum. at Oxford in 1893. Deeply read in moral philosophy, with the Bar as the obvious place for his acute intellect and power of lucid exposition, Eastwood at this time fell under the spell of Michael Foster as the 'philosopher in medicine', migrated to Cambridge to sit at Foster's feet and finally qualified M.D. (London) in 1902, after clinical studies at St. Bartholomew's Hospital. His distinguished work in the histology of malignant tumours led the Royal Commission on Tuberculosis to invite him to examine its experimental material. At the Commission's experimental farm in Stansted, Essex, in 1902–9, Eastwood spent seven busy and happy years, making with Cobbett and the brothers Griffith a highly successful 'team', one of the first to show how valuable team-work can be in *ad hoc* research.

The Commission's final report left undecided the question of tubercle bacilli of bovine origin as the cause of tuberculosis in children and, in 1909, Eastwood, at Newsholme's suggestion, was given the post of Inspector to the Local Government Board and asked to establish for the Board its first pathological laboratory, with the duty of investigating this question. The Board's laboratory, later the Laboratory of the Ministry of Health, begun thus as an almost accidental afterthought, developed under Eastwood's direction into a valued branch of the Ministry's medical department. Its activities were recounted and accorded due recognition in the Annual Report of the Chief Medical Officer for 1932. They can be summarised as studies in the bacteriology of epidemics, ranging from bubonic plague (the epizootic in East Anglia in 1910) and cerebrospinal fever (the epidemics of the War years) to pneumococcus and streptococcus infections and directing attention to the significance, practical and theoretical, of serological 'types' in pathogenic bacterial species.

In all these researches Eastwood's clear vision and gift of lucid expression were put at the service of his colleagues. He himself, though, of course, convinced of the prime necessity of experiment in scientific medicine, felt his own true bent to be the philosophical examination of first principles, the synthesis of experimental data into theory and the enunciation of hypotheses worthy of experimental test. A long series of articles, published as Reports to the Ministry or in the *Journal of Hygiene*, was the result. In these, he discussed infection and immunity as parts of the physiology of bacterial cells on one hand and animal hosts on the other. His method was almost Socratic in its simplicity and reliance on pure logic: his articles, whatever may be their ultimate value in advancing knowledge, will continue to delight all who take pleasure in intellectual disquisition. Perhaps the most notable example is his treatment of bacterial variation and transmissible autolysis (Reports on Pub. Health and Med. Subjects, 1923, No. 18) in which he put forward the hypothesis of non-viable mutants as the explanation for the phenomena associated with bacteriophage.

Eastwood's three years of leisure after retirement were devoted to the preparation of a conspectus of immunity in general; he felt that the importance of a unifying hypothesis for the great body of disparate data was not sufficiently appreciated by post-Ehrlich pathologists. It is to be hoped that this had reached a stage permitting of its publication as a final example of Eastwood's method.

# News and Views

### Mme. Joliot-Curie and Scientific Research in France

MME. JOLIOT-CURIE has been appointed Secretary of State for Scientific Research in the new Government just formed in France by M. Blum. Her name will be familiar to scientific readers as that of the daughter of Prof. and Mme. Curie, discoverers of radium, and herself a distinguished worker in the field of artificial radioactivity. M. and Mme. Joliot-Curie have carried out important investigations in various branches of radioactivity which were fittingly crowned by the award to them in 1935 of the Nobel Prize in Chemistry. When the discovery was announced of the positive electron, M. and Mme. Joliot-Curie took up the examination of methods by which it could be produced, and found that positive electrons appeared with neutrons during the disintegration of certain light elements by $\alpha$-rays. It appeared on further investigation that whereas the neutrons were emitted during the $\alpha$-particle bombardment, the positive electrons were due to an entirely separate process, and continued to appear after the bombardment had ceased. The new process thus recognised was then shown to be due to the presence of unstable isotopes with radioactive properties, a discovery which was immediately found to be of wide importance. The preparation and examination of these radioactive bodies of short life period, by investigators in numerous laboratories, have afforded valuable additions to our knowledge of atomic structure and the mechanism of atomic disintegration.

### Dr. C. N. H. Long

DR. C. N. H. LONG, until recently director of the Cox Medical Research Institute in the University of Pennsylvania, has been appointed to the chair of physiological chemistry in Yale University, in succession to the late Prof. L. B. Mendel. This chair was previously held by another famous American physiological chemist, namely, Prof. Chittenden. Dr. Long took a first-class honours degree in chemistry at Manchester in 1921 and then worked in the physiological laboratory there and at University College, London, for a number of years, particularly on matters relating to the physiology and physiological chemistry of muscular activity in man and the higher animals. The work was done on behalf of the Medical Research Council. From University College, he went to McGill University, Montreal, where he was attached to the Medical Unit of Prof. Jonathan Meakins. There he continued his research, and qualified in medicine. From Montreal he went to the Cox Medical Research Institute at Philadelphia, and now he is going to Yale. Dr. Long thus started as a chemist, then became a physiologist, then a professor of research in medicine, and is now going back again to physiological chemistry.

### Mr. W. Dallimore

MR. WILLIAM DALLIMORE retired from the post of keeper of the Museums at the Royal Botanic Gardens, Kew, on March 31, having reached the age-limit after more than forty-five years' connexion with Kew. Mr. Dallimore entered Kew as a student gardener in 1891. He was appointed propagator in the Arboretum in 1892 and assistant curator (at that time called foreman) in 1896. In 1908 he was transferred to the Museums as assistant, and became keeper in 1926. Mr. Dallimore's exceptionally wide knowledge of arboriculture has been of great service to Kew, especially in connexion with the planning and administration of the National Pinetum at Bedgebury, which he will continue to supervise during his retirement. Dr. John Hutchinson, botanist in the Herbarium, has been appointed by the Minister of Agriculture and Fisheries to be keeper of the Museums in succession to Mr. Dallimore.

### Bicentenary of Coulomb (1736-1806)

ON June 14 the bicentenary occurs of the birth of Charles-Augustin de Coulomb, the French military engineer and physicist, who is remembered for his work on friction, machines and electricity and magnetism. Born at Angoulême, he was educated in Paris, and entering the corps of military engineers served successively at Martinique, Rôchefort, the Isle of Aix, Cherbourg and in Paris. He rose to the rank of lieutenant-colonel, was a member of the Royal Academy of Sciences, and after the Revolution, of the National Institute, and was made a chevalier of the Order of St. Louis and a member of the Legion of Honour. He was intimately acquainted with the civil engineering of his day, and his various memoirs were the result of long and refined experiments combined with mathematical inquiries. He counted many eminent men of science among his contemporaries, such as Laplace, Lavoisier, Lalande, Borda, Messier, Monge, Charles, Berthollet and Mechain, but, wrote Thomas Young, "among all the men of science who have done honour to France, it would be difficult to point out a single individual, who, with regard to the cultivation of terrestrial physics, could at all be put in competition with M. Coulomb". Towards the end of his life, Coulomb suffered much from ill-health, and his death took place on August 23, 1806, when he was seventy years of age.

COULOMB'S original investigations fall into two groups, those relating to mechanical subjects and those dealing with electricity and magnetism. It was while he was in Martinique that in 1773 he sent his first paper to the Academy of Sciences. This was on statical problems relating to architecture, and in it he dealt with the strength of blocks of stone, masonry

columns and arches, and embankments. In 1781 he was awarded a prize for his paper on the theory of simple machines, comprehending the effects of friction, and of the stiffness of ropes. He determined the friction between a great variety of substances and applied the results to the study of the launching of ships, ships' capstans and ships' blocks. His "Theoretical and Experimental Researches on the Force of Torsion" was published in 1784, and six years later he dealt with the "Friction of Pivots". Quite early he had turned his attention to magnetism and the compass, and between the years 1785 and 1789 he published seven memoirs on electricity and magnetism. It was in these that he described his well-known torsion balance and enunciated the laws of attraction and repulsion in electricity and magnetism. These memoirs furnished the data on which Poisson later on founded his mathematical theory of electricity. Like many of his contemporaries, Coulomb lost his post in the Revolution, but in the more settled times which followed he became one of the inspectors of public instruction and as such was known for his generosity and kindliness. So far as we know, France possesses no monument to this worthy man.

### "World Fellowship"

ARRANGEMENTS are now approaching completion for the World Congress of Faiths, which from July 3 until July 18 will meet in London to discuss "World Fellowship". The sessions of the Congress, to which only members will be admitted, will take place at University College, Gower Street, W.C.1; but there will also be a series of public meetings at Queen's Hall, Langham Place, W.1, to which the general public will be admitted by tickets, which may be purchased. The main objective of the Congress is to be neither the appraisement of the various religions of the world, nor any attempt to bring about their fusion, but the discussion of ways and means by which the chief religions of the world, each retaining its individuality, may co-operate in a fellowship of the closest unity to eliminate the passions leading to war, economic injustice and racial and religious antagonisms. Communications dealing with various aspects of the problems which arise will be presented in twenty sessions of the Congress by representatives of the Christian, Jewish, Hindu, Buddhist, Moslem and independent faiths. Among those who have promised their co-operation either from the chair, as readers of papers or by opening debate are H.H. the Aga Khan, Sir E. Denison Ross, the Chief Rabbi, Prof. Nicolas Berdaieff, Prof. S. N. Das Gupta, Dr. Cyril Bailey, H. E. Sheikh Al-Maraghi and Sir Abdul Qadir. A paper by the late Prof. J. S. Haldane on "Science and Religion" will be read. Of the public meetings, the first will be a meeting of welcome and the last a retrospect and summation of results, while the remaining two will be devoted to expositions of "The Supreme Spiritual Ideal" as viewed in Jewish, Hindu, Buddhist, Christian, Muslim and independent thought. The international president of the Congress is H.H. the Maharaja Gaekwar of Baroda, and the chairman of the British National Council Sir Francis Younghusband. The members of the Congress will be received by the Marquis of Zetland on behalf of His Majesty's Government at Lancaster House, St. James's, on July 8, and a reception will be given by Sir Francis Younghusband in the garden of the Royal Geographical Society on July 4. Particulars of membership, etc., may be obtained from the Organising Secretary, 17 Bedford Square, London, W.C.1.

### Exhibition of Historic Scientific Apparatus at Cambridge

THE Cambridge Philosophical Society has been responsible for the arrangement of a large and interesting exhibition of historic instruments and records which was opened by Lord Rutherford on June 8 and will be on view until June 20. Acting on the suggestion and with the unstinted help of Dr. R. T. Gunther, of Oxford, an attempt has been made to collect together old apparatus illustrating the work of well-known Cambridge men, as well as some of the equipment used by students of natural knowledge in former days. The collection gives an idea of the material instruments by the aid of which scientific progress has been made in the University, and it establishes contact with the present day by the inclusion of series showing the progress in the design of certain important pieces of apparatus like electrometers, electroscopes, galvanometers, air pumps, slide rules, microscopes and microtomes. Among the pieces of special interest are the fourteenth century astrolabe believed to have belonged to Dr. Caius, a circular slide-rule designed by William Oughtred and made about 1640, Pepys' Musarithmica, the instruments used by W. H. Miller in making the Standard Pound, and the microscopes of Charles Darwin and of his grandfather Erasmus. The remains of the equipment of the observatories of Trinity and St. John's Colleges, and a number of Maxwell's instruments form important features, while the cabinets of materia medica preserved since the early eighteenth century in the libraries of Queens', St. Catherine's and St. John's Colleges are now shown together for the first time. The microscopes used by Francis Maitland Balfour form another exhibit interesting to biologists.

### Population and Production in the U.S.S.R.

PROF. M. POLANYI'S article on "U.S.S.R. Economics", originally printed in "The Manchester School", has now been republished by the Manchester University Press in pamphlet form. This article, which is based on the study of official documents and on observations made by the author during numerous visits to Soviet Russia, gives an interesting account of recent trends besides providing a sketch of the development of the Soviet economy. In dealing with the economic background, Prof. Polanyi points out that the 165 million inhabitants of the U.S.S.R. are sharply divided into a rural and urban population. Of the 40 millions living in the towns, the vast majority are Government employees. They form the basis of its power and are engaged in administration,

banking, trade, industry, the postal, tramway and railway services, teaching, health protection, journalism, science and art. About 125 millions live in villages, and of these about 10 millions are State-paid workers, and their dependants are employed on State-farms or in forestry or fishing.

POPULATION has expanded by 30 per cent since pre-War days, but the production of food has failed to increase in a like proportion. Grain crops during the first five years period fell off owing to internal struggles, but in 1933 and 1934 they increased to about 12 per cent over pre-War production. Grain consumption per head of the population, however, has now reached pre-War level, as export has ceased, whereas in pre-War days about 10 million tons of grain were exported annually. The production of potatoes has increased, but this is offset by a decrease in meat and milk. Housing in both towns and villages is very poor, and as yet little headway has been made. The lack of transport facilities is also very apparent. The European parts of the U.S.S.R. have 1·3 km. of railways per sq. kilometre, whereas in the United States there are 4·3 km. per sq. km., despite the fact that the population density in that part of the U.S.S.R. is 30 per cent greater. The most developed part of the country, namely, the Ukraine, has a density of population nearly equal to that of France, but its railway system is less than one third the length. Moreover, all the railways are in poor condition, and the country is practically roadless.

### Rearmament in Germany

THE question of the extent of Germany's rearmament has recently taken a prominent place in Parliamentary debates and in the public mind, and a number of exaggerated views have been put forward. In one case, for example, it was stated in the House of Commons that no less than £1,500,000,000 had been spent upon warlike preparation during Herr Hitler's regime, and that, in the year 1935 alone, 600–800 millions sterling was spent on armaments in Germany. It is undoubted that Germany has been rearming since 1934, but it is essential that Herr Hitler's programme should be viewed in its true setting and perspective, and to this end Prof. W. A. Bone has prepared a critical examination of the position in Germany based on financial and industrial statistics. This survey, which appeared in *The Nineteenth Century and After* of May, sets out the facts of Germany's industrial activity in the years 1929–35, and shows clearly that the output of those materials upon which armament manufacture chiefly depends—iron and steel, nickel, copper, chromium, tungsten and other non-ferrous metals—merely reflects the slump between 1929 and 1932 followed by the regaining of lost ground to an extent slightly less than that which has taken place in Great Britain. From the analysis given, it is clear that Germany's rearmament, while a factor to be reckoned with, does not account for more than a fraction of the very large monetary sums which have been alleged to be involved.

### Indian Population of North America

UNTIL recently, it would appear that little attention has been given to certain facts relating to the Indian population of North America, which are disclosed in the census returns. It has generally been accepted that the Indian is a dying race; but it is now indicated that, while certain Indian peoples have undoubtedly become extinct, and the Indians of Mexico to a considerable extent have been fused in the general population, the Indian population north of Mexico as a whole is on the up grade. The problem of the future will be, not the arrest of a decrease, but the provision in the reservations of land adequate to support an increased population. This, at least, it is thought at the moment, is the form which the problem will take in the United States. Data relating to the population statistics were examined by Dr. Clark Wissler recently in a communication on the birth-rate among the Plains Indians, which was presented to the American Association of Physical Anthropologists meeting at New Haven, Conn., on April 30–May 2. Dr. Wissler then stated that the birth-rate of the Plains Indians would appear to be the highest in the world, being 48 per thousand. The white birth-rate, even before the depression, had sunk to 20 per thousand. He went on to point out that when the Indian was first placed on reservations, there was a rapid decline in numbers, but this had been checked. This was not due to the birth-rate, which apparently has not changed much since 1800, but arose from a death-rate which reached its peak about 1890 and had since declined.

AN even more marked increase is shown by the figures relating to the Indian population of Canada, where between 1931, the census year, and 1934 when a rough count was made, the numbers rose from 108,000 to 112,000. This high rate of increase is no doubt to be attributed largely to the vigilance in matters of hygiene, exercised by the Department of Indian Affairs, which, it is announced in a communication from the Ottawa correspondent of *The Times* in the issue of June 6, is to become a subordinate branch of the new Ministry of Natural Resources. It is also stated that the trust fund which was created for the benefit of the Indians with whom treaties were made at the time of the acquisition from the Hudson Bay Company of the western territory beyond the Great Lakes, now amounts to 14,000,000 dollars, while between 4,500,000 dollars and 6,000,000 dollars is spent on them annually out of public funds. These Indians live on reservations, and their affairs are managed by chiefs and councillors, who have certain restricted legislative rights. In Ontario and Quebec, however, most of the Indians live the life of ordinary Canadian citizens, being sometimes completely merged in the general population, with farms on the reserves. West of the Great Lakes where two thirds of the Indians live, and they have been less affected by the impact of white civilisation, they are much more dependent on the Government, owing to the

inadequacy of their food supply now that the game, which was formerly their subsistence, has become scarce. Here the Department has embarked on an extensive educational programme in agriculture with a scheme of assistance, for which great success is claimed. Through it some hundreds of Indians have become entirely self-supporting by agriculture within two generations. About one third of the Indians still live the traditional nomadic life in the northern hinterland with the easily moved tepee as their home and hunting and trapping as their means of subsistence.

### Archæological Excavations in Syria

SIR LEONARD WOOLLEY'S account of the first month's work on the British Museum's new archæological site in Syria fully confirms anticipation of the nature of the evidence likely to be obtained at such a point as the mouth of the Orontes, which must have been an important centre of international and commercial intercourse from early times. Tel Sheikh Yusuf el Gharib, a low mound, so called after a local saint, on the right bank of the Orontes, he reports in *The Times* of June 4, has produced evidence of nine occupation levels. As virgin soil has been reached just below deposits which are dated at about the twelfth century B.C., it is evident that the mound begins with what can only be a later extension of the main settlement. Although in consequence no material of Mycenæan age or earlier is forthcoming, it has yielded finds of considerable interest and no little importance. The pottery, for example, includes possibly the finest example of Proto-Corinthian ware yet known, while the so-called 'Cypriote' ware, a class of ceramics appearing in Cyprus in the Early Iron Age without known local antecedents, occurs here rather earlier in the eighth level in such sudden abundance as to suggest a violent occupation, and possibly may eventually afford a clue to the cultural origins of this type in Asia. Especially fine examples of orientalising Ægean wares of the best sorts from the sixth and fifth levels, and innumerable fine fragments of Attic wares, belonging to the late sixth and fifth centuries B.C., some of which can be recognised as by known artists, from the fourth level point, in Sir Leonard's opinion, not only to a flourishing luxury trade with the Ægean, but also to great enterprise on the part of the Athenians in establishing a flourishing commercial centre on this Asiatic coast at a time of tension with the great imperial power of Persia. Evidence was also obtained of intercourse with the Asiatic interior, the occurrence of a basalt bowl, showing a debased Hittite style in decoration, being noted. Such results in a restricted area afford abundant promise from future excavation.

### British Standards Institution

THE annual general meeting of the British Standards Institution was held at the Institution of Mechanical Engineers on June 4, under the chairmanship of Mr. W. Reavell. In reporting on the progress of the work during his year of office, Mr. Reavell made reference to the arbitration in connexion with the standards to be adopted in Great Britain for the 16-mm. sound films which, at the invitation of the General Council, Lord Riverdale had undertaken in February last, and the decision of which is now being loyally adopted throughout the industry. Mention was also made of the forthcoming visit of the director to New York and the Argentine in connexion with the work of the newly formed Argentine Institute for the Rationalisation of Materials. At the luncheon which followed the meeting, Lord Riverdale referred to the very economic manner in which the work is carried out, dealing as it now does with some eight hundred committees and more than a thousand meetings a year. Some people fear that standardisation means stagnation, but this is provided against in the precautions the B.S.I. takes when standards are brought into being and in the frequent review and revision of those standards. Industry does not fully appreciate the value of standardisation in the matter of capital expenditure. It means the possibility of reduction of stocks which in turn means liberating capital, and this might amount to millions of pounds in the British Empire.

MR. E. J. ELFORD, the chairman for the forthcoming year, said that the British Standards Institution is greatly indebted not only to the Government for its continued financial support, to the many technical officers of the various Government departments for their assistance on the technical work, but also to the hundreds of representatives of industry—using that word in the widest sense—who give their time and experience so willingly to this work of growing national importance. Mr. S. Tatchell, chairman of the Building Industries National Council, stressed the great importance to the building industry of the closest co-operation between his Council and the B.S.I., and referred to the agreements recently come to which have been set out in their Report on Standardisation Policy. Colonel Briggs, of Messrs. Unilevers, expressed the satisfaction of the chemical industry at the work already undertaken by the Institution in the chemical field and its desire to co-operate in future work of the Institution.

### The Development Fund

THE twenty-fifth report of the Development Commissioners for the year ending March 1935 has now been published (London: H.M. Stationery Office. 2*s*. 6*d*. net). The function of the Commissioners is to make a thorough examination of applications for grants from the fund, amending or vetoing the schemes submitted if necessary, and afterwards to recommend to the Treasury what advances shall be made. The majority of the schemes aided call for recurrent expenditure, and as advances are made annually the progress of the work is kept under continuous review. Agriculture and rural economy comprise the main bulk of the expenditure, as under this heading come the regular grants to research institutes, advisory centres and rural industries, as well as the special grants, research scholarships and studentships. A short account of each institute is given, describing the type of work undertaken and

the number of staff employed. Under the fisheries section, grants are made towards both 'directed' and 'free' research, as it is recognised that much useful information would be lost if only specified lines of research were encouraged. The Development Fund also makes regular advances towards the construction and improvement of harbours and the acquisition of land for road improvements. The total sum recommended in 1934–35 was £490,968, compared with £343,636 in the preceding year, and the report concludes with a detailed summarised schedule of the expenditure.

### New Electrical Devices

IN *A.E.G. Progress* for the first quarter of 1936, which is published by the foreign department of the Allgemeine Elektricitäts Gesellschaft of Berlin, the company gives its annual general review of novel electrical devices which are being increasingly used in Germany. One of these is an automatic sequence indicator and timer. In ceramic, chemical and foodstuffs industries, many machines are employed to stir or knead the various ingredients. It is often necessary that these materials be added to the mixture in a definite sequence of time. The new indicator consists of a case containing a number of transparent plates, suitably engraved for each process and lighted up from behind in a predetermined sequence. The attendant is thus warned at the right moment without being obliged to watch the clock. A warning bell is sometimes added to the plate lights. For all kinds of mixing operations this indicator gives useful results. Another device is a 'fan heater' used in conjunction with an electric fire. A silent running fan mounted behind the heating elements circulates the hot air without producing any noticeable draught. The room is quickly and evenly warmed and the hot air can be directed to any point where rapid heating is desired. It is stated that the occupants of a room with a fan heater feel a comfortable warmth on all sides. A switch worked by the foot operates as follows. In position 1 the fan runs cold, operating as a ventilator and using as much power as a small lamp (20 watts); in position 2, warm air is emitted, the heater now taking 1,500 watts; and in position 3, it is switched off.

### Mineral Development in Canada

IN a recent series of broadcast addresses, the Minister of Mines at Ottawa emphasised that Canada's vast new mineral wealth is being derived from a line of mining camps extending for 2,400 miles from northern Quebec to Great Bear Lake. Ten years ago, gold production in this belt came from only two districts, whereas to-day mining developments are in progress in a score of separate localities in a region of the Pre-Cambrian shield which is quite unsuitable for agriculture. Thus a new metallic link has been forged between eastern and western Canada which is awakening a new community of interests. The mining camps look to the west for food supplies and to the east for machinery, chemicals, clothing and other factory products. At present the most important section of the new economic frontier is the area including eastern Manitoba, northern Ontario and northern Quebec. Excluding the famous Porcupine, Kirkland Lake and Cobalt centres, the Sudbury nickel-copper district, and the eastern Manitoba gold belt, the oldest of the new mines began production only eight years ago. Now there are twenty-eight new mines, and these have given Canada an additional yearly output of gold and copper worth £7,000,000, a production value more than the annual gold output of Kirkland Lake. The value of the metals produced from this narrow belt alone now exceeds £20,000,000, while that from Sudbury adds a further £12,000,000.

### Physics at Harvard

THE new volume of *Contributions from the Physical Laboratories of Harvard University* consists of reprints of sixty-five papers which have been issued from the laboratories during the years 1933–34. It forms the first volume of Series 2, and its pages are half an inch higher and wider than those of its predecessors. This increase allows papers from double column periodicals like the *Physical Review* and the *Journal of Chemical Physics* to be included without change of form, but papers from the one-column proceedings of the American Academy of Arts and Sciences look insignificant on so large a page. The work represented covers almost every branch of physics—general and atomic physics being the theme of about twenty papers, light and electricity about fifteen each, heat about seven and sound and supersonics three, the classification being approximate only. One paper sketches an interesting course of laboratory work for senior students taking up atomic physics. The subjects which appear most often in the titles are—the effects of high pressures on the physical properties of materials, and the line and band spectra of substances.

### Carnegie Endowment for International Peace

THE annual report for 1935 of the Division of Intercourse and Education of the Carnegie Endowment for International Peace issued over the signature of Dr. N. Murray Butler, the director, gives an impressive picture of work being done both in the United States and in Europe to develop an international mind and outlook, and particularly in regard to collective security. An unofficial international conference was arranged at Chatham House, London, on March 5–7, 1935, to consider what steps might be taken to restore confidence by promotion of trade and reduction of unemployment, stabilisation of national monetary systems and better organisation of the family of nations to give security and to strengthen the foundations of international peace. Through the organisation of meetings throughout the United States, lectures by visiting Carnegie professors and others, the distribution of books and pamphlets, the arrangement of 'international mind' alcoves in libraries, the international relations clubs, the League of Nations Association and in other ways, the Division has sought to make known the unanimous recommendations of the conference and the principles upon which collective security is based.

(*Continued on p.* 989.)

Supplement to "NATURE"

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# Science in a Changing World: Recollections and Reflections*

By Sir Richard Gregory, Bart., F.R.S.

"It only shows what Natur is, Sir," said Mr. Squeers. "She's a rum 'un, is Natur."

"She is a holy thing, Sir," remarked Snawley.

"I believe you," added Mr. Squeers, with a moral sigh. "I should like to know how we should ever get on without her. Natur," said Mr. Squeers, solemnly, "is more easier conceived than described. Oh what a blessed thing, Sir, to be in a state of natur!"

*Nicholas Nickleby*. Chap. xlv.

TWO curious coincidences are associated with the date of this discourse; and I do not think either of them was intentionally arranged by Sir William Bragg or the Managers of the Royal Institution. One is that the centenary of Sir Norman Lockyer's birth will be reached in two days' time, for he was born on May 17, 1836; and the other is that exactly forty-three years ago, on May 16, 1893, I was appointed sub-editor of NATURE. As I took a minor part in Sir Norman Lockyer's work of teaching and research at the Royal College of Science nearly fifty years ago, and was afterwards his assistant in the editing of the journal founded by him in 1869, my reminiscences will be mostly confined to these associations. This, indeed, was what I was asked to do when the honour of giving an address in this historic theatre was extended to me.

It is fortunately possible to associate NATURE with the first announcement of several scientific discoveries of prime importance; and it is to some of these that I propose particularly to refer. Without such a principle to limit and guide me, there would be no more reason for my reminiscences than for those of the editor of any other scientific periodical. It happens, however, that a new era of modern science began about fifty years ago, and that for most of the time I have been engaged in recording its triumphs.

The increase in the number of scientific workers at home and abroad during this period has been very great, and it is reflected in a corresponding increase in the number of original communications contributed to the correspondence columns of NATURE. As an indication of this development, and also of international activities in scientific fields, the following particulars of letters published in the years 1885 and 1935 may be of interest.

| | 1885 | 1935 |
|---|---|---|
| Numbers of letters during the year | 384 | 810 |
| Number of columns | 221 | 787 |
| Average number of letters weekly | 7 | 15 |
| Average number of columns | 4 | 15 |
| Number of countries abroad represented | 24 | 32 |
| Number of scientific centres abroad „ | 65 | 142 |

It was in the issue of NATURE for September 29, 1892, that Lord Rayleigh first directed attention to his experimental results which showed that nitrogen extracted from chemical compounds is about half per cent lighter than atmospheric nitrogen. In his letter he said:

"I am much puzzled by some recent results as to the density of *nitrogen*, and shall be obliged if any of your chemical readers can offer suggestions as to the cause. According to two methods of preparation I obtain quite distinct values. The relative difference, amounting to about $\frac{1}{1000}$ part, is small in itself; but it lies entirely outside the errors of experiment, and can only be attributed to a variation in the character of the gas."

In March of the following year, Lord Rayleigh described, in a paper read before the Royal Society, the methods and results of experiments having for their object the determination of the absolute densities of air, oxygen, nitrogen and hydrogen; and he then again pointed out that nitrogen prepared from certain chemical substances was decidedly lighter than nitrogen derived from air in the usual manner by the removal of oxygen with heated copper. This difference was the subject of a further paper "On an Anomaly encountered in Determinations of the Density of Nitrogen Gas" read before the Society on April 19, 1894: and Lord Rayleigh then recorded that a globe filled with the lighter nitrogen had been weighed and re-weighed after an interval of eight months but

* From a discourse delivered at the Royal Institution on Friday, May 15.

no change in weight had been found. As is now common knowledge, Sir William Ramsay was afterwards associated with Lord Rayleigh in the inquiry into the nature and cause of the discrepancies observed, and the result of the co-operative research was the paper on argon, "The New Constituent of the Atmosphere", read at a special meeting of the Royal Society, held on January 31, 1895, in the Hall of the University of London, then in Burlington Gardens.

The day after the reading of the paper on argon before the Royal Society, Sir Henry Miers, then Keeper of the Mineral Department of the British Museum (Natural History), directed Ramsay's attention to Hillebrand's observations, made five years earlier, of the frequent presence of what was believed to be nitrogen in the mineral cleveite and other natural uranates. Ramsay was unable to examine the gas obtained by him from cleveite until the middle of March 1895, when he found a new gas which he thought at first was a gas, crypton or krypton, for which he was looking. He sent some of this gas to Sir William Crookes for spectroscopic examination and on the morning of March 24 received from Crookes a telegram saying "Crypton is helium. Come and see it." Four days later the following announcement of this discovery appeared in NATURE.

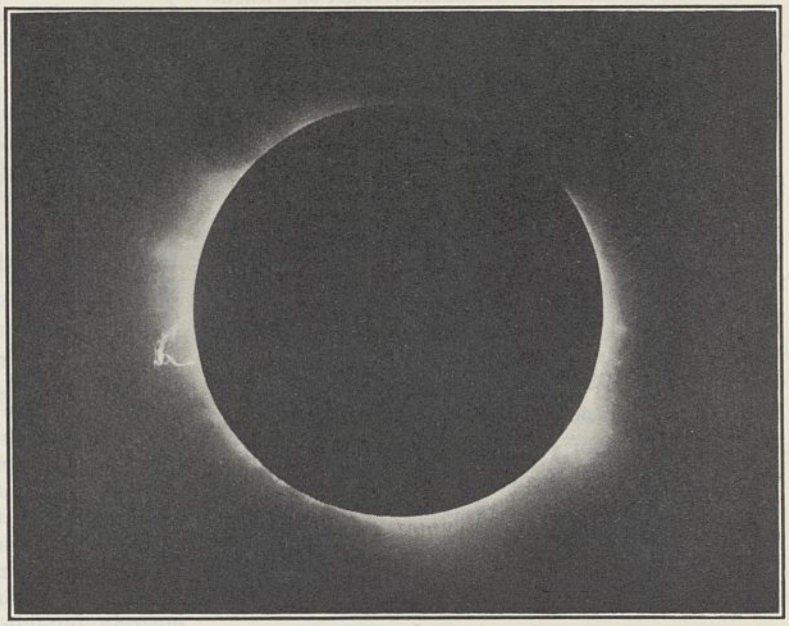

FIG. 1. TOTAL SOLAR ECLIPSE OF MAY 9, 1929, PHOTOGRAPHED BY DR. J. JACKSON AT ALOR STAR. A LARGE PROMINENCE APPEARS ON THE EAST LIMB (LEFT HAND SIDE) OF THE SUN. SUCH PROMINENCES ARE NOW OBSERVED AND PHOTOGRAPHED DAILY IN ORDINARY SUNLIGHT.

### TERRESTRIAL HELIUM (?).

We have received the following statement from Prof. Ramsay :—

"I have been trying for clues to compounds of argon. Mr. Miers, of the British Museum, called my attention to Hillebrand's paper on Cleveite, a rare Norwegian mineral, which Hillebrand said gave off 2 per cent. of nitrogen on warming with weak sulphuric acid. Cleveite consists chiefly of uranate of lead, with rare earths. My idea was, if the so-called nitrogen turned out to be argon, to try if uranium could be induced to combine with argon.

"The gas, on sparking with oxygen in presence of soda loses a trace of nitrogen, probably introduced during its extraction ; the residue consists of a mixture of Argon and Helium ! The brilliant yellow line, of which Mr. Crookes makes the wave-length 587·49, is identical with the Helium line. I am collecting the gas, and shall shortly publish regarding its properties."

The identification of helium in terrestrial minerals, twenty-seven years after it had been observed to exist in the sun, is one of the most romantic incidents in the history of science. In November 1866, Sir Norman Lockyer, in the course of a paper read before the Royal Society, suggested that the solar prominences seen around the sun's limb during total eclipses (Fig. 1) might be examined at other times by the use of the spectroscope. As soon as he was in possession of an instrument with sufficient dispersive power, on October 16, 1868, Lockyer found that he was able to observe these solar flames, and that they were local disturbances in the continuous luminous layer which he called the chromosphere. A bright yellow line seen in the spectra of prominences could not, however, be identified with any element then known on the earth. In Lockyer's words : "We had to do with an element which we could not get in our laboratories, and therefore I took upon myself the responsibility of coining the word *helium*."

It must not be supposed that Lockyer hastily came to the conclusion that the strong yellow line seen by him in the spectrum of the chromosphere was due to the presence of an element then unknown on the earth. His chemist friends thought

that the line was due to hydrogen, and it was not until after many experiments had been made to reproduce it in hydrogen that Lockyer came to the conclusion that the line was really due to an element then unknown in terrestrial chemistry.

When Lockyer saw with his spectroscope a solar prominence in ordinary daylight, he believed he was the first to make this observation. The distinguished French astronomer, Dr. Jules Janssen, had, however, seen the bright line two months earlier, on the day after a total solar eclipse which he had been sent to India to observe. The spectroscopic principles which led him to look for the prominences when the sun was not obscured were the same as those stated by Lockyer two years earlier: and they are now used daily to observe and photograph these solar eruptions. By a remarkable coincidence, the communications from Lockyer and Janssen were received by the Paris Academy of Sciences on the same day and within a few minutes of one another. Unlike the discovery of the planet Neptune, which led to bitter controversy over the rival claims of Adams and Leverrier, no question of priority arose between Lockyer and Janssen, and the French Government had a special medal struck in honour of the joint discovery, bearing in profile the portraits of the two astronomers.

It would take a course of several lectures to trace the scientific and practical developments made possible by the isolation of helium. Precise studies of helium spectra in comparison with stellar spectra showed that many lines of which the origins were previously unknown are due to the presence of the new gas. Helium is formed by the disintegration of radium and other radioactive elements, and the alpha particles emitted by them are the nuclei of its atoms. By its use the lowest temperature yet attained on the earth has been reached, and the astonishing phenomenon of supra-conductivity has been studied. It is prepared in immense quantities from natural gas in the United States and is used for many industrial purposes, from the inflation of great airships to the filling of thermionic valves and incandescent filament lamps and arc lamps. For an element first discovered by an astronomer in the sun to prove in time to have so many contacts with pure and applied science is a reward which few investigators can hope to attain.

Early in the year 1896, telegrams from Vienna were published in the daily press reporting that Prof. W. C. Röntgen, of the University of Würzburg, had discovered a new kind of rays, which he called X-rays, which would penetrate many substances opaque to the visible rays of light. He was working with a Crookes' tube covered by a shield of black cardboard when he noticed that a piece of paper coated on one side with barium platino-cyanide became luminescent when an electric current was passed through the tube. This observation was made on November 8, 1895. Following up this discovery, Röntgen made a number of experiments on the properties of these new rays emitted by the Crookes' tube and the resemblances and differences between them and the cathode rays which Crookes, Hertz and Lenard had previously studied.

Prof. Röntgen's paper describing his investigations and the results obtained was communicated to the Würzburg Physical Medical Society towards the end of 1895, and a full translation of it appeared in NATURE of January 23, 1896, and also in the *Electrician* of the following day. In the same issue of NATURE, Mr. A. A. Campbell Swinton told how he had repeated Prof. Röntgen's experiments with complete success, using a Crookes' tube he happened to possess, and with his article was reproduced a shadowgraph of a complete human hand showing the bones distinctly darker than the flesh and muscles surrounding them. This was the first X-ray photograph of a human hand reproduced in Great Britain.

Many other investigators who possessed Crookes' tubes repeated Röntgen's experiments immediately the discovery of X-rays was announced. In the Science Museum, South Kensington, is a tube made for Crookes so long ago as 1879, and used in his laboratory to take an X-ray photograph on January 20, 1896, to test the transparency of various metals in the rays. The keen scientific activity aroused by the publication of Röntgen's discovery may be judged by the fact that between the end of January and the end of June 1896, about 150 papers and other communications dealing with various aspects of the subject were recorded in the columns of NATURE.

Immediately after the announcement of Röntgen's discovery, the Prussian Minister of War caused experiments to be made on its use in army surgery; and it was soon found to be a most valuable aid in the diagnosis of obscure fractures and internal lesions generally. It was also soon noticed that long exposure to the rays resulted in inflammation of the skin. In those early days no precautions against such effects were taken by

radiographers, with the sad result that many pioneer workers suffered serious injury and sometimes death due to working with the rays. It was recently announced that at St. George's Hospital, Hamburg, a stone memorial was unveiled to one hundred and sixty such martyrs of science—medical men, physicists, chemists, laboratory workers, and nurses—and among the names inscribed upon the memorial are those of ten British workers.

For several years before Röntgen observed the fluorescence produced by rays from a Crookes' tube, Sir William Crookes, Sir Herbert Jackson and others had carried out investigations on the phenomena of the fluorescence or phosphorescence of substances in a vacuum under the influence of the electric discharge. Jackson had also noticed that certain substances *outside* the vacuum tubes fluoresced when the current was on, but he was anticipated by Röntgen in finding the explanation of this effect. It was only a few weeks later, on March 5, 1896, that he described in a paper to the Chemical Society an improved form of vacuum tube for producing X-rays and examining their effects. This 'focus' tube contained a concave aluminium cathode and an inclined platinum–iridium anode upon which the rays from the cathode would impinge and produce X-rays. The concave cathode had been used by Crookes, but the mounting of the target or anti-cathode at an angle of forty-five degrees to the axis of the cathode beam was due to Sir Herbert Jackson, and the principle is still used in the Coolidge and other standard forms of X-ray tubes. I remember that, at the time, he was urged by a scientific instrument maker to protect his invention, and if he had done so he would have held the master patent of all such tubes and made a fortune from it. He decided deliberately to leave the device unprotected in order to encourage the scientific study of X-rays and their service to the human race. He thus sacrificed personal profit on the altar of knowledge and manifested a spirit of which the world of science may well be proud.

Modern systems of television depend for their success upon the use of cathode ray oscillograph tubes for the transmission and reception of images ; and it is of interest to record that the first suggestion for the application of cathode rays for this purpose was made by Mr. Campbell Swinton in a letter in NATURE of June 18, 1908. At that time success had been achieved in the telegraphic transmission of photographs, and it was thought that distant electric vision was an easy natural step in the development of the process. Thirty years earlier, Profs. Ayrton and Perry worked out a system of television based upon the use of a mosaic of minute sensitive selenium cells, on the lines first suggested by G. R. Carey, but all such plans were impracticable. It was shown by Mr. Shelford Bidwell, who had given much attention to the subject, that on this system of transmitting simultaneously all the rays forming a picture, the number of separate cells, wires and lamps required to obtain a good image on a screen only two inches square, would be no less than 150,000.

Instead, however, of trying to transmit in one moment the enormous number of separate signals required to deal with the various parts of the transmitted picture, the signals may be sent in succession provided that the time taken to scan the picture, and transmit a complete set, does not occupy more than one-tenth of a second. Many attempts were made to solve the problem of distant electric vision on this principle. In Mr. J. L. Baird's early demonstrations of the simultaneous reproduction, at a distance, of images of moving objects, a disk with apertures arranged in a spiral revolved rapidly between the object and photo-electric cells. The varying current thus transmitted modified the light of a neon tube at the receiving end, where a similar disc revolved synchronously with that at the transmitting station. With a sufficiently rapid revolution of the disk, a recognisable image of the object was produced.

To secure satisfactory television by any device involving mechanical movements of this kind, a very intense light source is necessary at the transmitting end, and some method of amplifying the light signals at the receiving end. Experiments with these objects in view are still being carried on and the prospects of success are promising. For the time, however, and especially for home receivers, these mechanical methods have been superseded by methods which are independent of the momentum of the moving parts. This was the principle suggested by Mr. Campbell Swinton in his letter to NATURE twenty-eight years ago. After pointing out that the moving extremities of two beams of cathode rays—one at the transmitting and the other at the receiving end—might be caused to sweep synchronously over the whole required surface, he added :

"Indeed, so far as the receiving apparatus is concerned, the moving kathode beam has only to be arranged to impinge on a sufficiently sensitive

fluorescent screen, and given suitable variations in its intensity, to obtain the desired result.

"The real difficulties lie in devising an efficient transmitter which, under the influence of light and shade, shall sufficiently vary the transmitted electric current so as to produce the necessary alterations in the intensity of the kathode beam of the receiver, and further in making this transmitter sufficiently rapid in its action to respond to the 160,000 variations per second that are necessary as a minimum.

"Possibly no photoelectric phenomenon at present known will provide what is required in this respect, but should something suitable be discovered, distant electric vision will, I think, come within the region of possibility."

It was not until twenty-two years later that Baron von Ardenne in Germany made use of cathode ray oscillograph tubes for the transmission and reception of television images, and gave a public demonstration comparable with that obtained by Baird with his apparatus. Since then many improvements have been made in cathode ray oscillographs, and these, with ingenious mechanical devices, have brought television systems to a remarkable state of perfection.

The principles used are conveniently and instructively shown in apparatus devised for demonstration purposes by Mr. T. E. Bray, of the Baird Television Laboratories (Fig. 2). In this apparatus the intermediate film method is used by which television pictures can be projected to large audiences in cinema theatres and elsewhere. For the direct transmission of television programmes, the principal parts are essentially the same, though some details of the apparatus, particularly at the transmitting end, are different.

In the intermediate film method the scanner is a cathode ray oscillograph the light from which passes through a lens on to an ordinary cinematograph film and then to a photo-electric cell where the light impulses are transformed into equivalent electrical impulses and then amplified. In turn these are received, amplified and excite a cathode ray tube, on the fluorescent end of which the film picture is reproduced. The detail reproduced is a function of the intensity of the light of the scanning lines in the cathode ray tube at the transmitter and of the number of those lines. Though this apparatus illustrates the principles of the use of cathode ray oscillograph in television, actually the light of the oscillograph is not intense enough for transmission. What is used in the Baird system is either the moving spot or the electron camera in conjunction with a fixed light source.

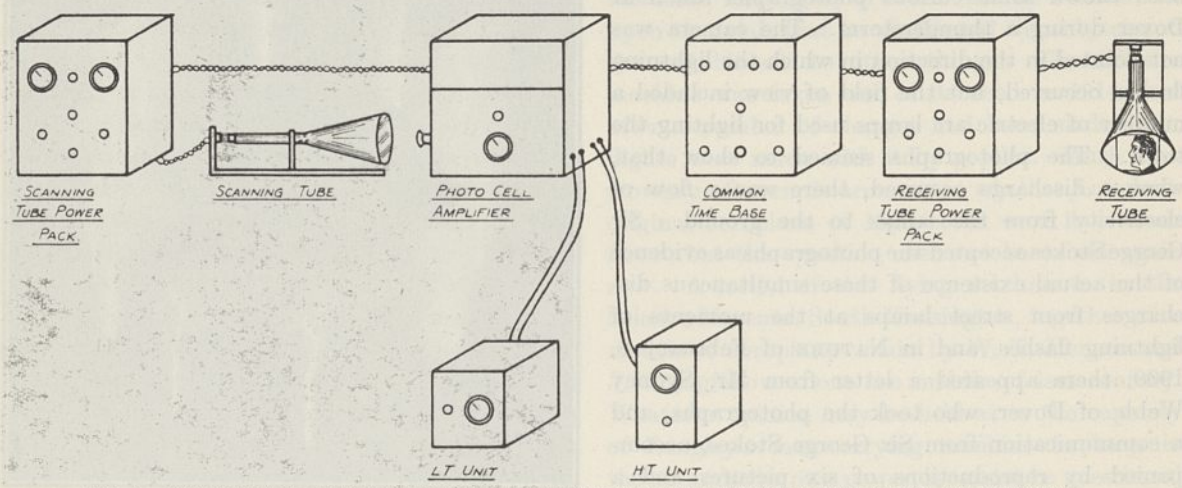


Fig. 2. Demonstration apparatus to illustrate intermediate film television transmission and reception. (By courtesy of Baird Television, Ltd.)

There was a natural transition from cathode and Röntgen rays to Becquerel's discovery in 1896 of penetrating rays from uranium compounds, which laid the foundation of the new science of radioactivity, and to Sir J. J. Thomson's brilliant experimental researches which showed a year later that the cathode rays consisted of swiftly moving particles of small mass carrying a negative charge and constituting electron units of the structure of all atoms. This discovery was itself followed by the isolation of radium by Madame Curie in 1898, and then by the theory, put forward by Rutherford and Soddy in 1903, that radioactive matter is continually undergoing spontaneous transformation of its atoms, the different stages of disintegration being represented by a succession of new radioactive bodies. All these developments have

been fully recorded in scientific periodicals and other publications, and NATURE cannot claim to have been associated with them more closely than any other journal.

Science in a changing world involves, of course, the revision of theories when new evidence is adduced which renders them untenable. Caution in arriving at conclusions is rightly regarded as an essential attribute of the scientific spirit, and it should be accompanied by readiness to acknowledge error. Original communications to a journal or to a scientific society may, therefore, have afterwards to be retracted, because the conclusions reached are found to be based upon imperfect observations. A remarkable example of this occurred in the year 1900. Sir George Stokes had been shown some curious photographs taken at Dover during a thunderstorm. The camera was not pointed in the direction in which the lightning flashes occurred, but the field of view included a number of electric arc lamps used for lighting the town. The photographs seemed to show that, when a discharge occurred, there was a flow of electricity from the lamps to the ground. Sir George Stokes accepted the photographs as evidence of the actual existence of these simultaneous discharges from street lamps at the moments of lightning flashes, and in NATURE of February 8, 1900, there appeared a letter from Mr. Sydney Webb, of Dover, who took the photographs, and a communication from Sir George Stokes, accompanied by reproductions of six pictures and a detailed "explanation of the discharges which took place, simultaneously with lightning flashes in the sky, in the neighbourhood of the electric lamps". The two letters, with the illustrations, occupied more than six columns in the correspondence columns of NATURE. Prof. R. W. Wood was in London at the time, and he pointed out at once that all the effects shown in the photographs, and for which Sir George Stokes had put forward theoretical explanations, were probably due to the camera having been moved during exposure. This proved to have been so. Though the camera was stationary, it was lifted up before the cap was put over the lens, and the trails shown on the photographs were produced during the short interval between lifting and capping. Further photographs with a moving camera confirmed this conclusion, and showed that the effects described and explained were not real.

It happens that in the same year, namely 1900, that these deceptive photographs of secondary effects of lightning discharges were under discussion, Sir Charles Boys designed and made his ingenious camera with the view of obtaining experimental evidence of the progress of a lightning flash. Ten years earlier there had been a controversy as to whether a flash was single or multiple, two or three flashes succeeding one another very rapidly along exactly the same path. To test this point obviously requires a means of obtaining pictures in very quick succession. In Sir Charles Boys's instrument a pair of identical camera lenses is mounted on a disk which can

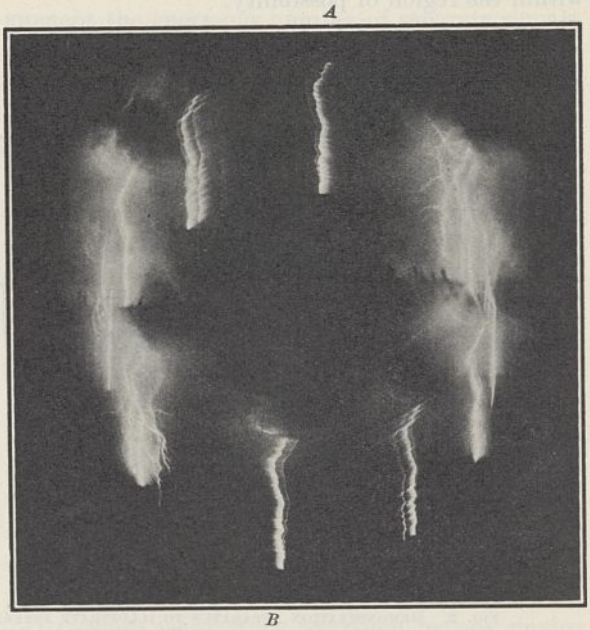


FIG. 3. PHOTOGRAPHS OF LIGHTNING OBTAINED WITH A BOYS' CAMERA. *A* AND *B* ARE PHOTOGRAPHS OF THE SAME FLASH; AND THE IMAGES ON THE LEFT AND RIGHT INDICATE DIFFERENCES IN TIME OF DIFFERENT PARTS OF THE FLASH.

be rotated so rapidly that two images of a flash can be obtained at so short an interval as about one forty-thousandth of a second. This apparatus was made in 1900, and Sir Charles Boys carried it about with him to various places in the hope of finding favourable opportunities to use it, but without success. Twenty-six years later, in NATURE of November 20, 1926, he again directed attention to the problem and described the apparatus he had designed to obtain experimental evidence to assist in solving it. Two years afterwards he obtained a photograph of a suitable lightning flash while visiting the Loomis Laboratory, Tuxedo Park, New York. This, with a letter upon it, appeared in NATURE of September 1, 1928; and it showed clearly that, even with the simple instrument used, the method of

oppositely moving lenses was capable of giving two images of a lightning flash definitely different in form.

Improvements of the apparatus were afterwards made; and by the use of a Boys' camera many photographic studies of lightning flashes have been made in South Africa by Dr. E. C. Halliday, Dr. B. F. J. Schonland, Mr. H. Collens and Mr. D. J. Malan (Fig. 3). It has thus been shown that each separate lightning flash begins with a dart-like downward moving tongue of light, which is usually repeated several times until the ground is reached, and is then followed by the main discharge consisting of a return stroke from ground to cloud moving along the thermally ionised track of the leader stroke. Since 1752, when Franklin proved that lightning was an electrical discharge, practically no experimental work on the subject had been done until Sir Charles Boys, who may well be described as the Franklin of our time, devised his revolving lens camera for the study of the propagation of the discharge. That NATURE was given the privilege of making the apparatus and its development known to the scientific world is something to recall with pride.

It may similarly be remembered with satisfaction that, at a time when the possibilities of achieving mechanical flight were either disputed on theoretical grounds or derided by practical men, NATURE gave prominence to all Prof. S. P. Langley's experiments in aerodynamics. Langley began his experiments in 1887, and his work provided precise knowledge as to the resistance offered to planes moving through air at different speeds and inclinations. He communicated a paper on "Experimental Researches on Mechanical Flight" to the Paris Academy of Sciences on July 13, 1891, and a translation of it appeared in NATURE of July 23, 1891. In the course of this paper, Langley said:

"I have been carrying out some researches intimately connected with the subject of mechanical flight, the results of which appear to me to be worthy of attention. They will be published shortly in detail in a memoir. Meanwhile I wish to state the principal conclusions arrived at.

"In this memoir I do not pretend to develop an art of mechanical flight; but I demonstrate that, with motors having the same weights as those actually constructed, we possess at present the necessary force for sustaining, with very rapid motion, heavy bodies in the air; for example, inclined planes more than a thousand times denser than the medium in which they move."

Guided by his results, Langley had model aeroplanes made, or 'aerodromes' as he called them; and he demonstrated in 1896 that mechanical flight was possible by actually performing it with steel flying machines nearly a thousand times heavier than the air, driven by steam, and employing as a rule curved sustaining surfaces. These machines weighed from thirty to forty pounds, and arose and descended in safety, their flight being limited to distances of from half a mile to three-quarters of a mile, at speeds varying from twenty to thirty miles an hour.

Langley's experiments were regarded at the time as the trivial amusements of an astronomer; and when, in 1903, a man-carrying aeroplane designed and constructed by him failed to attain sustained free flight, so much ridicule was thrown upon the trials that he abandoned the subject and devoted himself to other things. The full-size machine was taken out of its shed in 1914, and after a number of changes had been made in it, flights were made with it by a pilot. Much controversy afterwards arose as to whether Langley's original aeroplane of 1903 could ever have been flown, but this question need not be raised again now. A model of this flying machine is in the Science Museum, South Kensington, together with models of aeroplanes made by W. T. Henson and J. Stringfellow about the middle of last century. Whatever opinion may be held as to the capacity of Langley's man-carrying machine to keep in the air under its own power, it cannot be questioned that his experiments with models demonstrated the possibility of mechanical flight at a time when anyone who gave attention to the subject received nothing but derision for his pains, and that NATURE was one of the very few journals in which his experimental work was recorded at every stage.

It would be easy to mention many other instances in which important discoveries and developments have been first announced in the pages of this periodical and in which their significance has been subjected to critical discussion. Consideration of only a few of these belonging to a short period has almost exhausted the opportunity given me of presenting some of my recollections and has filled me with an acute sense of dissatisfaction in the treatment of a theme which might have comprehended advances in many other scientific fields, particularly those of biology and anthropology. For example, in the great advance of knowledge of early man which has followed on the discovery of Piltdown man in

1912, NATURE may fairly claim to have played an important part, both in the announcement of new finds and in the first publication of the scientific description of recent discoveries, such as that of the famous Rhodesian skull found in the Broken Hill mine, and of the Taungs skull, described by Prof. Raymond Dart and named by him *Australopithecus*. All discoveries of this kind, throwing light on the origin of man, always create wide public interest, as do those studies in social sciences which are concerned with the responsibilities of man for controlling his own environment and shaping his own destiny.

Science in a changing world means science adapting itself to the new conditions of life which have resulted from the application of its discoveries; and assisting in the solution of the problems created by them. Though the pursuit of natural knowledge must go forward whatever the consequences, the man of science cannot disregard the social effects of his discoveries. If he creates a Frankenstein monster which becomes the terror of the human race, he may himself end in being shunned by civilised society or his passion for truth be put under control because of the dangers to which it may lead.

The services which science can render to the modern State are now widely recognised, and they are used for evil as well as for good. Forty years ago, the expenditure of the British Government on scientific investigation, as shown in the Civil Estimates, was, excluding expenditure on museums, £45,378; in 1935–36 the total in the Estimates is about £1,300,000, and of this amount the Department of Scientific and Industrial Research is credited with nearly £700,000 for grants for investigation and research and for research establishments. There can be no question that expenditure on scientific and industrial research even on this scale is a profitable national investment, but the greater the extent of such activities, the more urgent is the need to see that they are used to promote progressive human welfare instead of its degradation. Scientific workers have now to pause and consider whether they should be content to let others be responsible for the use or misuse of their contributions to knowledge. When the object of research is the command of natural forces, without regard to their relation to human life, it can become a social danger and an excuse for scientific barbarity. It is the duty of men of science to assist in promoting more worthy uses of the new powers they are continually placing in the hands of the community, for otherwise the world seems likely to be reduced to a place of dust and ashes. The impacts of science with society are now so numerous that scientific studies in the realm of social biology are even more necessary for civilised life than researches in the physical sciences.

It is an ironical comment upon modern civilisation that the social reaction to the gifts of plenty made possible by the progress of scientific knowledge is not a corresponding increase of human welfare but distress and unemployment and the prostitution of scientific effort to purposes of destruction. In so far as science has brought about increased control over the forces of Nature, it accepts responsibility for these conditions. It insists, however, that such deplorable consequences are not essential, but are due to the neglect of the application of scientific methods to the solution of social problems. Our distributive and economic system remains on the basis of a pre-scientific age, wholly unadjusted to the needs of a changing world, and unable to bear the burdens placed upon it by the problem of new and almost incredible abundance.

Science can provide the world with everything required for the maintenance of a growing population in a rising standard of comfort; but there are no accepted principles for the right use of the new powers, and international agreements are mainly adjustments of national interests conceived in confined political atmospheres and determined by expediency. While this spirit prevails, the prospect of finding a formula which will unite civilised peoples for the general well-being of humanity seems almost hopeless. A regenerative influence is required to save civilisation from disaster, and the mission of science in the changing world of to-day should be to introduce it into the field of social biology, and thus enable us still to believe in the highest destiny of man.

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### The Scenery of New Zealand

NEW ZEALAND has long been careful of State protection of natural features of outstanding value on the grounds both of scientific interest and of scenic beauty. The Annual Report on Scenery Preservation for the year ending March 31, 1935, records additional reserves of 2,027 acres, making a present total of 671,000 acres in 965 reserves. Many of the reserves aim at preserving areas of characteristic vegetation, and it is to be noted that the Native Plants Protection Act came into force in 1935. By this Act, all native plants, except a few species commonly regarded as weeds, are protected throughout the Dominion. There are, however, provisions for taking plants in reasonable numbers for scientific study or medicinal purposes. The larger reserves seem to have paid wardens, but many of the smaller ones are cared for by honorary inspectors.

### Announcements

THE Brazilian Government has recently founded an international centre for the study of leprosy at Rio de Janeiro.

THE fifteenth Japanese Congress of Physiology will be held next August at the Ohara Institute of Kurashihi, Oyama, and will last three days.

THE International Federation of Eugenic Societies will hold a congress on July 16–21 at Scheveningen and The Hague. Further information can be obtained from the vice-president, Dr. Georges Schreiber, Avenue du Recteur Poincaré 26, Paris XVI$^{e}$.

THE Institute for Investigation of the Brain, at Leningrad, which contains 180 cerebral hemispheres of adults, 300 of children and 470 of lower animals, is engaged in the preparation of a microscopical atlas of the cerebral hemispheres of man and the lower animals. It is also occupied with the study of the brains of the most eminent representatives of science, art and politics.

THE first International Conference on Fever Therapy will be held at Columbia University, New York City on September 29–October 3, its aim being to collect and crystallise data connected with fever induced by physical or other agencies as a therapeutic procedure. The subscription is 15 dollars. Further information can be obtained from the secretary, Dr. William Bierman, 471 Park Avenue, New York City.

DR. HELLMUT DE TERRA informs us that a mistake has been made in the first column of the table accompanying his article "Late Cenozoic History in India" in NATURE of April 25, p. 686. The Upper Pleistocene period covers the stages of column 2 named Redeposited silt, Erosion and *Potwar*; the Middle Pleistocene covers the stages named Erosion and *Boulder Conglomerate*; the Lower Pleistocene covers the stages named *Pinjaur* and *Tatrot*. The broken line indicating an unconformity which appears between the Boulder Conglomerate and the Pinjaur should extend across the column to the left between "Middle" and "Lower".

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

A teacher of electrical engineering in the Newton Heath Branch Technical School—The Director of Education, Education Offices, Deansgate, Manchester, 3 (June 15).

A teacher of chemistry and mathematics in the North-Western Polytechnic, Prince of Wales Road, Kentish Town, London, N.W.5—The Secretary (June 17).

A teacher of mechanical engineering in the Rugby College of Technology and Arts—The Principal and Organizer of Further Education in Rugby, 61 Clifton Road, Rugby (June 18).

A lecturer in charge of the Department of Civil Engineering in the University of Sheffield—The Registrar (June 18).

A lecturer in biochemistry and a lecturer in physiology in the University of Leeds—The Registrar (June 19).

A scientific officer (*A*.4) for research in chemical problems, a scientific officer (*A*.40) for research in strength of aircraft structures and materials, an assistant (Grade I, *A*.48) for research in aeronautical electrical equipment, and assistants (Grade III, *A*.58/83) for tests in the Aerodynamics Department, of the Air Ministry Scientific Research Pool for service at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (June 19).

A head of the Department of Electrical Engineering in the Rutherford Technical College, Newcastle-upon-Tyne—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne, 2 (June 20).

A teacher of mathematics and a teacher of technical drawing in the Wandsworth Technical Institute, London, S.W.18—The Secretary (June 22).

A lecturer and an assistant lecturer in engineering (civil or municipal) in University College, London, W.C.1—The Secretary (June 25).

An assistant (Grade II) in the Admiralty Scientific and Technical Pools (physics or electrical engineering)—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (June 26).

A scientific officer for research on internal combustion engines at the Royal Aircraft Establishment, South Farnborough, Hants (Royal Aircraft Scientific Research Pool)—The Chief Superintendent (June 26).

An assistant lecturer in physics in University College, Southampton—The Registrar (June 30).

A chemist in a War Department at Woolwich—The Under-Secretary of State (C. 5), The War Office, London, S.W.1 (June 30).

A technical officer in the Meteorological Office—The Secretary (S. 2. e.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (July 3).

A chief mechanical engineer at the Royal Naval Cordite Factory, Halton Heath, Dorset—The Secretary of the Admiralty (C.E. Branch), London, S.W.1.

An assistant lecturer in geology and geography in King's College, Strand, London, W.C.2—The Secretary.

# Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 998.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Sensitivity of Insects to Sound

IN the course of experiments directed to another end, we have had occasion to determine the sensitivity at different stimulus frequencies of certain structures in the cricket (*Gryllus domesticus*) and the locust (*Locusta migratoria migratorioides*). These structures are (*a*) the long hair-sensilla on the *cercus* of the cricket, recently shown to subserve a partially acoustic function[1], (*b*) the tympanal organ of the locust and (*c*) receptor organs which we believe to be identical with the short hair-sensilla generally distributed over the body of the locust.

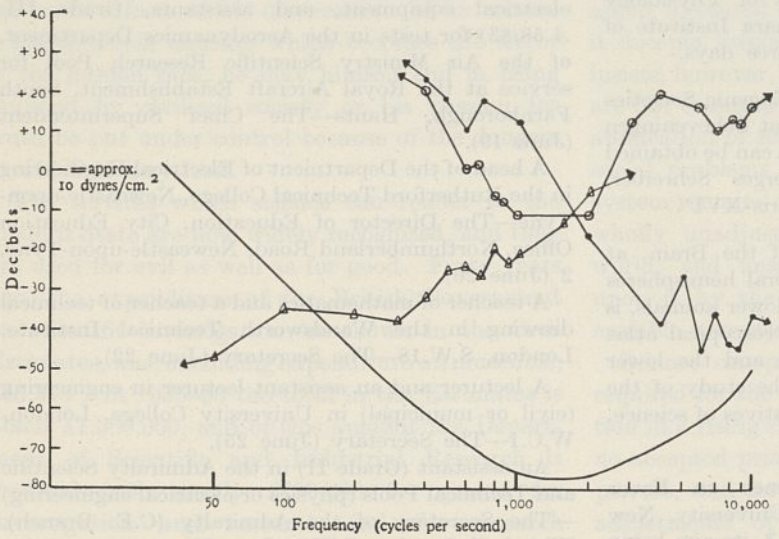


FIG. 1. Graphs showing the threshold of the electrical response in the associated nerve as a function of frequency of stimulation, for three typical insect receptor mechanisms. Wegel's figures for the normal human threshold are shown for comparison. △—△, *Gryllus*, anal cercus; ● — ●, *Locusta*, tympanum; o — o, *Locusta*, sensilla; ——, Wegel's figures (1932) for the normal human threshold.

The audiograms shown in the accompanying graph (Fig. 1) were obtained by a method somewhat similar to that of Derbyshire and Davis[2]. The decapitated insect was enclosed in a sound-proof room, and the appropriate nerve was connected by means of fine electrodes to an amplifier feeding a cathode ray oscillograph and loudspeaker, so that the activity in the nerve could be made to give both a visible and an audible sign of its occurrence. The acoustic organ was stimulated by pure tones from a loudspeaker fed from a beat oscillator and amplifier. The output from the former could be varied over a frequency range of 50–10,000 cycles per second, and could be attenuated by 130 db. in 2 db. steps below a maximum of about 100 microwatts per sq. cm. at the point of stimulation. This stimulator was previously calibrated with sufficient accuracy for our purpose by reference to five 'normal' ears. Waveform and frequency monitoring was carried out with a cathode ray oscillograph, the time-controlled 50-cycle A.C. mains forming the primary frequency standard. The threshold of the organ under investigation at any given frequency was taken to be that intensity which produced a just perceptible activity in the associated nerve. The records of two observers were found to agree within ±2 db.

In Fig. 1 the threshold intensities of representative animals have been plotted in decibels above and below a sound pressure of 10 dynes per sq. cm., and, in order to emphasise the relatively high sensitivity of two of the groups of receptors at the two extremes of the human auditory spectrum, the readings on the five human observers, reduced to Wegel's classical figures[3], have been plotted on the same graph. The curves clearly indicate that the significance of a sound to these insects cannot possibly be judged by its apparent loudness to the human ear; a response from the cercus may be readily elicited by a low-frequency stimulus quite inaudible to man, whilst the slope of the curve for the tympanal organ appears to show that its sensitivity would very greatly exceed that of the human ear at frequencies above 10,000 c.p.s., the present limit of our apparatus.

The presence of scattered receptors sensitive to sound at quite low intensities in an insect which is also provided with a specialised acoustic organ is a matter of some interest, though their existence has been indicated in insects of certain other orders. We believe, however, that no quantitative measurements have previously been made on any of these receptors, with the exception of those of Wever[4] on the tympanal organ of the grasshopper. These are in fair agreement with ours on the similar organ of the locust.

R. J. PUMPHREY.
A. F. RAWDON-SMITH.

Laboratories of Zoology and Psychology, Cambridge.

[1] R. J. Pumphrey and A. F. Rawdon-Smith, *J. Physiol.*, **86** (1936). (*Proc. Physiol. Soc.*, March 14, 1936.)
[2] A. J. Derbyshire and H. Davis, *Amer. J. Physiol.*, **113**, 2, 476 (1935).
[3] R. L. Wegel, *Ann. Otol.*, **41**, 770 (1932).
[4] E. G. Wever, *J. Comp. Psychol.*, **20**, 17 (1935).

## A Simple Relation between the Quantities *e*, *c* and *h*

IF *e* is the negative electron charge, which reckoned in C.G.S. is $4{\cdot}7755 \times 10^{-10}$ of an electrostatic unit, and if *c* is the velocity of light *in vacuo* ($2{\cdot}9986 \times 10^{10}$ cm./sec.) and *h* is Planck's Constant of Action which is $6{\cdot}55 \times 10^{-27}$ erg-seconds, then, as is well known, the quantity $hc/2\pi e^2$ is a pure numeric generally given as equal to 137, or perhaps, 137·3.

If we absorb the $2\pi$ we can express the relation of *e*, *c* and *h* as follows: The quantity $e^2 = 22{\cdot}805 \times 10^{-20}$ is of the dimensions of energy multiplied by length or erg-centimetres. The quantity *h* (which I venture to name 1 acton) is of the dimensions of energy multiplied by time or erg-seconds. Hence the quantity $e^2/h$ is of the dimensions of a velocity and is equal to $22{\cdot}805 \times 10^7 \div 6{\cdot}55 = 34{\cdot}82 \times 10^6$ cm./sec. Also the velocity of light, *c*, is $29{,}986 \times 10^6$ cm./sec. and $29{,}986 \div 34{\cdot}82 = 861$. But the number 861 is the product of three prime numbers, namely, 3, 7 and 41, the first, third and twelfth primes—omitting to count 1 and 2 as primes.

Also 861 is a triangular number of the form $n(n + 1)/2$ or $(41 \times 42)/2$, and in addition it is the sum of the natural integers $1 + 2 + 3 +$ etc. up to 41. A triangular number denotes the number of equidistant dots which can be arranged in an equilateral triangle, namely, 3, 6, 10, 15, 21, etc. Also approximately $\pi = 3\frac{1}{7}$.

Hence we can write the equation

$$\frac{h \times c}{e^2} = 3 \times 7 \times 41 = 861;$$
$$= 3 \times 7 \times 37 + 3 \times 7 \times (3 + 1);$$
$$= (3\tfrac{1}{7} + 3\tfrac{1}{7})\ 137.$$

The numbers 1, 3 and 7 are trinal numbers of the form $n^2 + n + 1$, where *n* is given values of 0, 1 or 2. The velocity represented by $e^2/h$ is nearly 1/861 of that of light *in vacuo*.

AMBROSE FLEMING.

"Greenfield", Manor Road,
Sidmouth, S. Devon.

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## Electrodynamics of Macroscopic Fields in Supraconductors

THE conception of a 'pure supraconducting state' has proved to be useful for the description of those phenomena of supraconductivity in which no phase transitions into the non-supraconducting state are implicated. In the pure supraconducting state the supraconductor shows no macroscopic electromagnetic field ($E = 0$, $B = 0$). It has been shown[1] that this state can be described by a consistent theory in which the idea of an infinite conductivity is replaced by the conception that, by a general relation, the supracurrents are connected with the magnetic field. The latter penetrates into the supraconductor only as deep as the supracurrents flow.

On the basis of this theory of the pure supraconducting state, a magnetostatics of the so-called 'intermediate state' has recently been developed[2] of which the characteristic feature is the appearance of a macroscopic magnetic induction *B*. In the intermediate state, the supraconductor is imagined as consisting of many separated microscopic pure supraconducting elementary regions, in an analogous way to the elementary regions of spontaneous magnetisation in a ferromagnet. The free energy density *f* of such an intermediate state has been calculated as a function of the magnetic induction, and it has been found, for $|B| \leqslant H_T$, where $H_T$ is the magnetic threshold value, that

$$f = -\tfrac{1}{2}H_T^2 + H_T|B| \quad . \ . \ . \quad (1)$$

A generalisation of this theory is wanted for the case where an *electric* field is also present. While the general case still presents some difficulties, a very elementary conception can be developed for the special case, in which:

(*a*) the direction of the electric field *E* is everywhere perpendicular to the magnetic induction *B* and parallel to the macroscopic current *J*;

(*b*) the actual surface energy of the supraconducting state appreciably exceeds the lower limit derived from thermodynamics[3].

Possibly the result that follows has a more general validity than can be ascertained at present.

From (*b*) one can infer that the dimensions of the supraconducting regions into which the supraconductor as a whole splits up are big compared with the depth to which the magnetic field can penetrate into these regions, and that therefore all macroscopic fields are chiefly due to the normally conducting inclusions. Then to a first approximation we are justified in neglecting all 'penetration' effects and may simply set the microscopic magnetic field equal to 0 in the pure supraconducting regions (whereas the microscopic electric field vanishes there exactly). The normally conducting regions may be assumed to have the form of gaps with nearly equidistant boundaries; they will, according to (*a*), contain the electric field orientated perpendicular to the boundaries and the magnetic field parallel to them.

Let *e* and *h* be the microscopic field strength in such a gap, and let $\xi$ be the volume of the gaps per unit volume of the supraconductor; then the macroscopic *E* and *B* are given by

$$E = \xi e \quad \text{and} \quad B = \xi h \quad . \ . \ . \quad (2)$$

On the boundary between the two phases the Maxwell pressure $\frac{1}{2}(h^2 - e^2)$ will be in equilibrium with the pressure $\frac{1}{2}H_T^2$ due to the free energy of transition into the supraconducting state (which amounts to $-\frac{1}{2}H_T^2$ per unit volume):

$$\tfrac{1}{2}(h^2 - e^2) = \tfrac{1}{2}H_T^2 \quad . \ . \ . \ . \quad (3)$$

or introducing the macroscopic quantities (2) into (3), we obtain the following equation, which determines $\xi$:

$$\xi = \frac{\sqrt{B^2 - E^2}}{H_T} \quad . \ . \ . \ . \quad (4)$$

The free energy *f* per unit volume consists of two parts:

(i) the 'electromagnetic energy' $f_1$ localised in the normally conducting gaps:

$$f_1 = \xi\,\tfrac{1}{2}(h^2 + e^2).$$

(ii) the 'internal free energy' $f_2$ of the pure supraconducting part, which comprises a fraction $1 - \xi$ of the total volume:

$$f_2 = (1 - \xi)\,.\,(-\tfrac{1}{2}H_T^2).$$

For the total free energy $f = f_1 + f_2$ we obtain, using (2) and (4):

$$f = H_T \frac{B^2}{\sqrt{B^2 - E^2}} - \tfrac{1}{2} H_T^2, \quad . \quad . \quad (5)$$

which is valid for $0 \leqslant B^2 - E^2 \leqslant H_T^2$ or $\xi \leqslant 1$.

This expression is a generalisation of formula (1) obtained for the pure magnetostatic case. It can be derived from a Lagrangian

$$\mathrm{L}(E, B) = H_T\sqrt{B^2 - E^2} - \tfrac{1}{2} H_T^2, \quad . \quad . (6)$$

which is connected with the free energy $f$ by the well-known relation

$$f = \mathrm{L} - E \frac{\partial \mathrm{L}}{\partial E}.$$

By its derivatives, L defines the quantities $D$ and $H$ as functions of $B$ and $E$:

$$\left.\begin{aligned} D &= -\frac{\partial \mathrm{L}}{\partial E} = \frac{E}{\sqrt{B^2 - E^2}} H_T \\ H &= \frac{\partial \mathrm{L}}{\partial B} = \frac{B}{\sqrt{B^2 - E^2}} H_T \end{aligned}\right\} \quad . \quad . \quad (7)$$

As to the connexion between the macroscopic current density $J$ and the field, an independent statement is still required. In the normally conducting regions $e$ will be accompanied by a current $j$ according to Ohm's law:

$$j = \sigma e,$$

where $\sigma$ is the conductivity of the normal phase. This current is to be continued into the supraconducting regions without an accompanying electric field. The component of the macroscopic current $J$ parallel to $E$ will therefore be given by

$$J = \sigma e = \frac{\sigma E}{\sqrt{B^2 - E^2}} H_T = \sigma D \quad . \quad . \quad (8)$$

Finally, we assume the macroscopic Maxwell equations and the customary boundary conditions: $H_{tg}$, $B_n$, $E_{tg}$, $D_n + J_n$ continuous.

Though this reasoning cannot, of course, claim to be more than a first and quite provisional attempt, and hysteresis and other disturbing effects will certainly complicate the real state of affairs appreciably, it seems that on the basis of the equations communicated above a consistent theory can be built up. Formally it may be considered as a kind of limiting or degenerate case of the Born–Infeld field theory. There a Lagrangian of the form $a^2\sqrt{1 + b^{-2}(B^2 - E^2)}$ or $a^2\sqrt{1 + b^{-2}(B^2 - E^2) + b^{-4}(BE)^2}$ with $a = b$ forms the basis; the Lagrangian (6) corresponds to the limiting case $b \to 0$, $a^2/b = H_T$.

I have succeeded in applying this theory to the phase transition in a supraconducting wire caused by the magnetic field of a current through the wire, and to other problems which I hope to discuss *in extenso* elsewhere.

F. LONDON.

Clarendon Laboratory,
Oxford.
May 26.

[1] F. and H. London, *Proc. Roy. Soc.*, A, **149**, 71 (1935); *Physica*, **2**, 341 (1935). M. v. Laue, F. und H. London, *Z. Phys.*, **96**, 539 (1935). F. London, *Proc. Roy. Soc.*, A, **152**, 25 (1935). E. Schrödinger, NATURE, **137**, 824 (1936). H. London, *Proc. Roy. Soc.*, A, **155**, 102 (1936)
[2] F. London, *Physica*, **3** (in the press).
[3] C. J. Gorter, *Physica*, **2**, 449 (1935). H. London, *Proc. Roy. Soc.* A, **152**, 650 (1935).

## Nebular Spectra due to Elements of the Second Period

MEASUREMENTS of the hot spark spectrum of sulphur in the Schumann region have enabled me to classify partially the singlet system of S III and to locate the new terms with respect to the known triplet system by means of numerous intercombinations. It has been possible to find two singlet terms in K VI from Ekefors'[1] data and to locate them with respect to the known triplets by intercombinations. The new terms are listed in Table I.

Table I

| S III | | K VI | |
|---|---|---|---|
| $s^2p^2\,{}^3P_0$ | 0·00 | $s^2p^2\,{}^3P_0$ | 0·00 |
| $^3P_1$ | 297·2 | $^3P_1$ | 1,131 |
| $^3P_2$ | 832·5 | $^3P_2$ | 2,927 |
| $s^2p^2\,{}^1D_2$ | 11,320 | $s^2p^2\,{}^1D_2$ | 18,973 |
| $s^2p^2\,{}^1S_0$ | 27,163 | | |
| $s\,p^3\,{}^1P_1$ | 136,839 | $s\,p^2\,{}^1P_1$ | 223,840 |
| $4s\ {}^1P_1$ | 148,398 | | |
| $5s\ {}^1P_1$ | 211,327 | | |

The isoelectronic sequences from Si I for the forbidden transitions which might be expected in nebulæ obey the irregular doublet law very accurately. Interpolated values for the 'nebular pair' in Ar V (ground $^3P_1$, $^3P_2 - {}^1D_2$) accurate to a few cm.$^{-1}$ may be found. Table II lists the computed wave-lengths for these forbidden transitions together with the name commonly assigned them.

Table II

| Element | Nebular pair ($3p\,{}^3P_{1,2} - 3p\,{}^1D_2$) | Transauroral line ($3p\,{}^3P_1 - 3p\,{}^1S_0$) | Auroral line ($3p\,{}^1D_2 - 3p\,{}^1S_0$) |
|---|---|---|---|
| S III | 9535<br>9069 | 3721·1 | 6310·2 |
| Ar V | 7008<br>6436·5 | 2694 ± 65 | 4610 ± 50 |
| K VI | 6229<br>5603 | 2375 ± 65 | 4097 ± 75 |

Lists of unknown spectrum lines found in nebulæ or novæ have been published by Swings[2] and amended by Stoy[3]. In those lists we find λλ 6311, 6435 and 7007 A. These lines have all been very tentatively proposed as being due to Ar V. Prof. Bowen suggested to me last summer as a result of my data on P II that the first line might be the auroral line of S III. These data now confirm this and show, as well, that the last two lines form the nebular pair of Ar V. The S III transauroral transition, if present, coincides with $H_\mu$. The K VI nebular pair correspond to no lines in Swings' list. The two unknown lines, 4571·5 and 4064, are possibilities for the auroral transition in Ar V and K VI respectively, but if either one can be thus correctly identified, the other cannot be considered.

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American Scandinavian Foundation).
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[1] Ekefors, Inaugural Dissertation. Uppsala, 1931.
[2] Swings, Act. Scien. et Indus., 241; Exp. d'Astron. Stel V. Les Spectres des Neb. Gaz. Hermann et Cie, Paris, 1935.
[3] Stoy, Lick Obs. Bull., 480, Dec. 1935.

## Quantum Energy of γ-Rays Excited by Slow Neutrons

IN the course of investigation on γ-rays excited by neutrons, we have recently determined the absorption curves of the secondary electrons due to γ-rays emitted from 24 elements, namely, H, Al, Cl, K, Ti, Cr, Mn, Fe, Ni, Co, Cu, Zn, As, Se, Br, Y, Ag, Cd, Sb, I, Sm, W, Au and Hg, under the bombardment of slow neutrons, by means of the method of coincidence of two counters. The form of the curves obtained differs considerably from element to element,

and the ratio of the half-value thickness to the maximum range of the electrons is by no means a constant for different elements, indicating the inappropriateness of the use of the former as the measure of γ-ray energy. The difference in the form of absorption curves should, of course, be understood to be due to the different heterogeneity of γ-rays.

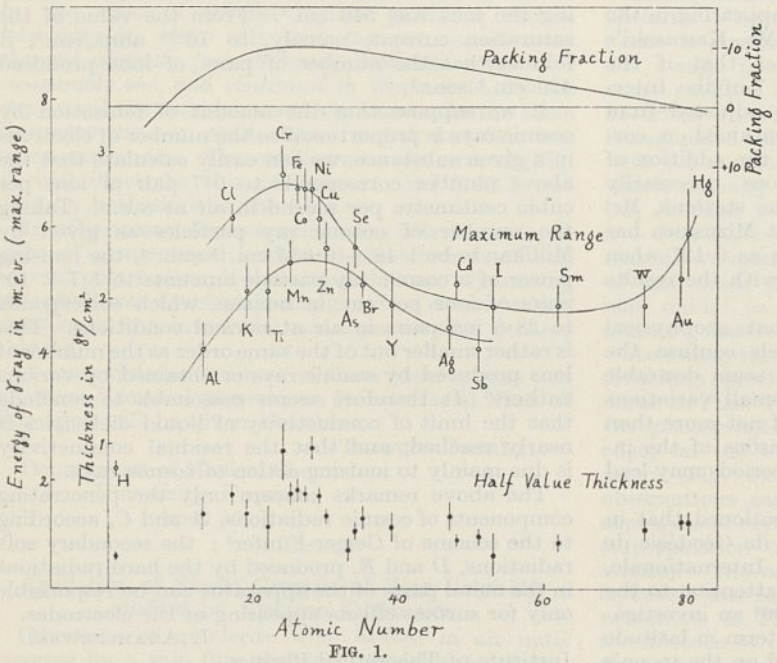


FIG. 1.

The energies of the hardest γ-rays obtained from the end points of the absorption curves are plotted in Fig. 1 against atomic number. The vertical lines attached to the points indicate the estimated errors. It is shown clearly that the points are distributed along two smooth curves, which are nearly parallel to each other, both of which have maxima at the atomic number near 26. On account of the scarcity of data for elements of higher atomic number, the behaviour of the curves in this region is not yet clear. But the tendency to rise again after attaining the minimum values near atomic number 65 cannot be overlooked. It is also quite noticeable that the elements belonging to the lower curve are mostly odd in atomic number, while those belonging to the upper one are mostly even.

For comparison, the packing fraction curve taken from Aston's data is plotted in the same figure. We notice at once the striking coincidence in the position of the maxima of these curves. The general form in other parts of the curves differs considerably; in particular, the probable existence of a minimum in the case of γ-rays cannot be recognised in the packing fraction curve.

We believe that these results may offer important information as to the structure of a nucleus, the atomic number of which is not too small.

A detailed communication on these and allied subjects will appear in the *Proc. Phys. Math. Soc. Japan* shortly, as the fourth of our series of reports on the excitation of γ-rays by neutrons.

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April 8.

## Variation in Latitude with the Moon's Position

IN an earlier communication to NATURE[1] brief results were presented on an investigation of small residuals in the latitude of three of the international latitude stations based on observations made in the years 1909, 1910, 1911. It was there pointed out that there appeared to be a lunar diurnal variation in latitude with a range amounting to so much as 0·07″, depending upon the hour angle and declination of the moon.

There has just come to my hand a paper by Mr. Kawasaki on "Variation in Latitude with the Moon's Position"[2]. From data contained in the last report of the International Latitude Service, vol. 7, covering the years 1922.7 to 1931.0, Mr. Kawasaki finds a lunar semi-diurnal variation for Mizusawa of $0{\cdot}011''\cos(2t - 349°)$, where $t$ is the hour angle of the moon. Comparable values are found for the stations Carloforte and Ukiah.

Mr. Kawasaki also expresses surprise at not finding so large results as those of my earlier investigations and particularly that the lunar diurnal variation is small. He followed nearly, although not quite, the procedure I have used in the treatment of such observations. In place of dividing his data into three groups corresponding to declinations, + 12° to + 28°, − 12° to + 12°, − 12° to − 28°, he makes only two groups, 0° to + 28°, 0° to − 28°. By so doing, he has lowered the mean declination for observations both north and south of the equator, thus tending to minimise the effect of changing declination in the results. He allows for the Chandlerian motion, including also such annual terms as presumably exist, by taking for the residuals of latitude the difference between the observed value for a given night and a mean curve which he has drawn through the mean observed values of latitude for each month.

In my treatment of the observations for discovering such a lunar effect as may exist, the day by day values were plotted for the three-year period 1909, 1910, 1911. The running means of these values of latitude and the corresponding dates were taken for five successive nights continuously through the series. A smooth curve was then drawn through the points representing the running means, and the variations of the latitude from this smooth curve were considered with respect to the moon's position. If, as Mr. Kawasaki states, the reversing in phase of the curves with declination of the moon is an annual effect, it would seem that such an annual effect would have come out from the smooth curve covering the daily values extending through the three-year period.

It so happened that prior to the receipt of Mr. Kawasaki's paper, I had just finished a similar analysis as before presented covering the years 1928–31 from data contained in the last report of the International Latitude Service, vol. 7. The variation obtained for these three years, which appears to correlate with the moon's position from my own results, I have found to be less than half of that previously obtained, although approximately the same

amount of data has been treated in precisely the same way. It would appear that such variations as may correlate with the moon are more apparent during some years than others. There is also some indication that there is a change of phase with lapse of time, so that the more years that are included in a single investigation for this effect the smaller is the resulting value.

An investigation by Mr. Kimura, appearing in the same number of the *Proceedings* as Mr. Kawasaki's paper, directs attention to the fact that if the declinations of the stars used in vol. 7 of the International Latitude Service are to be adjusted from the measures of latitude therein contained, a correction of + 0·11″ is needed. While the addition of this amount to all the declinations necessarily increases the mean latitude of all the stations, Mr. Kimura finds the surprising fact that Mizusawa has apparently shifted south by so much as 0·12″ when the results of vol. 7 were compared with the results of vol. 5.

It does not seem improbable that geophysical changes may be taking place which confuse the problem. In view of this, it would seem desirable to restrict investigations for these small variations of the moon's position to intervals of not more than three years at a time. Intercomparisons of the investigations of these relatively short periods may lead to further light on the question.

In this connexion it should be mentioned that in the latest report of the Association de Géodésie de l'Union Géodésique et Géophysique Internationale, Dr. Walter D. Lambert has directed attention to the fact that Schumann published in 1906[3] an investigation in which he found a large lunar term in latitude of the order of 0·03″, which depended on the moon's hour angle and not twice the hour angle. Schumann's earlier work would appear reasonably consistent with my findings from investigations of observations for the years 1909, 1910, 1911, and for Gaithersburg in 1913 and 1914[4].

HARLAN T. STETSON.

Cambridge, Massachusetts.
April 3.

[1] NATURE, 131, 437 (1933).
[2] *Proc. Imp. Acad., Tokyo*, 11, No. 10 (1935).
[3] Ergänzungshefte zu den Astronomischen Nachrichten No. 11.
[4] NATURE, 123, 127 (1929).

## Number of Ions produced in Dielectric Liquids by Cosmic Rays

THE electrical conductivity of liquid dielectrics in their normal state depends to a great degree on their purity. By a very careful purification, the conductivity of some liquids of this type can be lowered to about $10^{-19}\ \Omega^{-1}$ cm.$^{-1}$.

It is significant that a further reduction of conductivity cannot be obtained by means of any of the known methods of purification. Investigations on the conduction of electricity through liquid dielectrics show the existence of a close analogy between the properties of these liquids and those of ionised gases[1]. The residual conductivity may be attributed to (1) impurities which cannot be removed, (2) a small conductivity of the character proper to metals or semi-conductors, (3) lowering of the barrier of potential on the surfaces of metallic electrodes under the influence of the contact with liquids[2], (4) ionising action of cosmic rays. It may be noted that the ionising action of cosmic ray bursts in liquid dielectrics was studied recently by Prof. C. Białobrzeski and the author[3].

The purpose of this note is to show that the cosmic rays are responsible for the conductivity observed. The calculations are based on the results of my measurements with hexane ($C_6H_{14}$) filling a multiple parallel plate condenser. The volume of the liquid was 810 c.c. and the surface of the electrodes collecting the ions was 540 cm.$^2$. From the value of the saturation current, namely, to $10^{-16}$ amp./cm.$^2$, it follows that the number of pairs of ions produced 420 cm.$^3$ sec.$^{-1}$.

If we suppose that the amount of ionisation by cosmic rays is proportional to the number of electrons in a given substance, we can easily calculate that the above number corresponds to 0·7 pair of ions per cubic centimetre per second in air at N.T.P. Taking the number of cosmic ray particles as given by Millikan to be 1·48 ± 0·055 cm.$^{-2}$ min.$^{-1}$, the ionising power of a cosmic ray particle amounts to $1{\cdot}7 \times 10^4$ pairs of ions per cm. in hexane, which corresponds to 28·6 ion pairs in air at normal conditions. This is rather smaller but of the same order as the number of ions produced by cosmic rays or obtained by various authors[5]. It therefore seems reasonable to conclude that the limit of conductivity of liquid dielectrics is nearly reached, and that the residual conductivity is due mainly to ionising action of cosmic rays.

The above remarks concern only the penetrating components of cosmic radiations, *A* and *C*, according to the scheme of Geiger-Fünfer[5]; the secondary soft radiations, *D* and *E*, produced by the hard radiations in the metal parts of the apparatus can be responsible only for surface effects appearing at the electrodes.

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Warsaw. April 20.

[1] I. Adamczewski, *Acta Physica Polonica*, 3, 235 (1934).
[2] A. Nikuradse, "Das flüssige Dielektrikum". (Berlin: Springer, 1934.)
[3] C. Białobrzeski and I. Adamczewski, NATURE, 136, 109 (1935).
[4] I. Adamczewski, loc. cit.
[5] H. Geiger, "Ergebnisse der exakten Naturwissenschaften", 14, 1935.

## Electrical Changes in Interfacial Films

DURING the course of an investigation of the ionic permeability of *thin* non-aqueous films, some interesting observations were made in regard to the electrical conductance of the films.

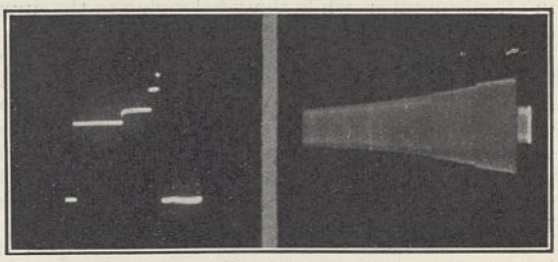

FIG. 1. Oscillograms on single bubble films of carbon tetrachloride. Ordinates: Input potential (parallel with the conductance). Abscissæ: Time axis (to be read from the left, total duration about 1 second). Left-hand figure: 50 mv. D.C. in the bubble circuit. Right-hand figure: constant A.C., 1,000 cycles, in the bubble circuit.

The arrangement was in principle as follows: Thin films of the non-aqueous liquids were formed using a technique somewhat similar to the blowing of a soap bubble, the inside and outside air being replaced by aqueous electrolyte solutions in which

non-polarisable electrodes were immersed. The electrodes were connected through a suitable amplifier to a cathode ray oscillograph. In the input circuit was included a high value of grid leak and a D.C. potentiometer or an A.C. oscillator. Occasionally, in place of the potentiometer two different solutions were employed, giving rise to a diffusion or phase boundary potential.

As the bubble film became thinner, it was observed in the case of several liquids (such as carbon tetrachloride, olive oil) that *the* D.C. *conductance changed abruptly from a barely detectable value to a measurable one, and continued to increase in definite steps* until the bubble eventually burst. In the same instances the A.C. conductance varied, but this was more continuous. The oscillograms reproduced (Fig. 1) will illustrate this behaviour. 0·1 *N* KCl was used on both sides of the film.

In other cases, for example, using nitrobenzene, in spite of symmetrical leads and the absence of any current polarisation, it was noted that an 'asymmetry potential' was developed, changing in a characteristic manner as the interfacial non-aqueous film became thinner.

A more detailed account of these observations and of other electrical phenomena in interfacial films of this type will be given elsewhere.

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## Oxidation of Single Crystals of Zinc Sulphide studied by Electron Diffraction

CRYSTALS of sphalerite were heated in air until covered by a thin film showing interference colours. These crystals were photographed in an electron diffraction camera, which will be described elsewhere. The angle between the incident beam and the crystal face was very small. The wave-length was 0·053 A. (calibrated from a powder photograph of MgO and a transmission photograph of $MoS_2$). The distance between the crystal edge and the photographic plate was 303·5 mm. Figs. 1, 2 and 3 represent the diffraction patterns in three different cases. In Figs. 1 and 2 the oxidised face was (111), and the incident beam was perpendicular (Fig. 1) and parallel (Fig. 2) to the octahedron edge. By photographing along two different octahedron edges the same pattern was obtained. In Fig. 3 the oxidised face was (110), and the incident beam was perpendicular to the cleavage edge [001]. This direction is in fact parallel to an octahedron edge. The diffraction patterns are all of the transmission type, on which is superposed a faint powder photograph. They form a series of photographs such as would be expected if we had photographed a single crystal structure in different directions, the crystal having for each direction of the incident beam the form and dimensions necessary for obtaining a point pattern.

The structure which has given rise to these point patterns is hexagonal and is so orientated that the *c*-axis is perpendicular to the octahedron face and the *a*-edge parallel to the octahedron edge. The same position in relation to the ZnS structure is observed on the cleavage plane (110), where the hexagonal *c*-axis should make an angle of 35° 16′ with the normal to the plane (110) (compare Fig. 3, which actually shows the same pattern as Fig. 2, but inclined to it at 35°). The dimensions are: $a = 3{\cdot}30$ A., $c = 5{\cdot}27$ A., $c/a = 1{\cdot}60$. For chemical reasons we assume the film photographed to consist of zinc oxide (ZnO). The dimensions of ordinary zinc oxide[1] ($a = 3{\cdot}24$ A., $c = 5{\cdot}19$ A., $c/a = 1{\cdot}60$) are, as a matter of fact, very near to those observed.

Assuming the structure to be ZnO, we observe that forbidden reflections (for example, (000*l*) in odd orders) occur in Figs. 2 and 3 (along the hexagonal *a*-axis). On photographs perpendicular to the octahedron edge, on the other hand, no forbidden reflections occur (Fig. 1). A discussion proves that these observations cannot be explained by assuming an aggregate of crystallites in slightly different positions (superposition of several planes of the reciprocal lattice). The assumption of 'repeated reflections'[2], however, can explain the presence of the forbidden reflections in Fig. 2 and is not incompatible with the absence of forbidden reflections in Fig. 1. This assumption seems to be the only one capable of explaining the striking fact that certain forbidden reflections are present in one type of photographs but absent in the other (odd orders of (000*l*) ).

It should be observed that in all the photographs (from different crystals) typical point patterns appear. There is consequently no reason to suppose that this is due to a few isolated small crystals, which are by chance hit by the incident beam. On the contrary, it seems necessary to assume that everywhere in the film the conditions requisite for the appearance of a point pattern exist.

FIG. 1.

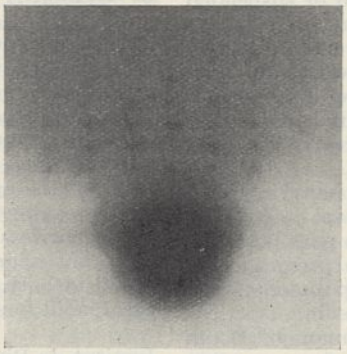

FIG. 2.

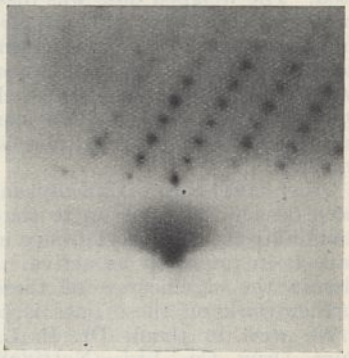

FIG. 3.

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B. BROOMÉ.

Swedish Museum of Natural History,
Mineralogical Department,
Stockholm. April 15.

[1] C. W. Bunn, *Proc. Phys. Soc. London*, **47**, 835 (1935).
[2] Compare H. Raether's application of Bethe's theory in *Z. Phys.*, **78**, 536 (1932).

## Synthetic Œstrogenic Agents without the Phenanthrene Nucleus

THE preparation and physiological properties of synthetic œstrogenic agents were first described in these columns and elsewhere[1,2,3]. The active compounds described in these publications were derivatives of phenanthrene or 1 : 2 : 5 : 6-dibenzanthracene, and it was noted that at the time of writing no active substances had been discovered which did not contain the phenanthrene nucleus.

Subsequent work has been directed towards an attempt to discover which portions of the molecule were responsible for the œstrogenic activity. It has been found that the phenanthrene condensed-ring structure is not necessary for this activity, and the accompanying table gives a number of these substances together with a measure of their activity.

| Substance | Dose in mgm. | Percentage positive |
|---|---|---|
| 1 : 2-Dihydroxy-1 : 2-di-α-naphthyl-acenaphthene | 100 | 100* |
| ,, ,, ,, | 10 | 100 |
| 1 : 1-Di-α-naphthyl acenaphthenone | 100 | 100 |
| α-Naphthyl benzoin | 100 | 40 |
| Diphenyl-α-naphthyl glycol | 100 | 60 |
| Diphenyl-α-naphthyl carbinol | 100 | 100 |
| 4-4-Dihydroxydiphenyl methane | 100 | 100 |
| Di-(p-Hydroxyphenyl) dimethyl methane | 100 | 100 |
| Di-(p-Hydroxyphenyl) methyl ethyl methane | 100 | 100 |
| Di-(p-Hydroxyphenyl) methyl propyl methane | 100 | 100 |
| Di-(4-Hydroxy-3-methyl phenyl) di methyl methane | 100 | 100 |
| Di-(4-Hydroxy-3-methyl phenyl)-1 : 1-cyclo-hexane | 100 | 100 |
| 2 : 4-Dihydroxy-triphenyl methane carboxylic acid lactone | 100 | 100 |
| 4 : 4¹-Dihydroxy benzophenone | 100 | 60 |
| 4 : 4¹-Dihydroxy diphenyl | 100 | 100 |

* Rats remained in œstrus 40 days.

The technique of testing the activity of these substances is that described in previous communications[4]. In every test, five ovariectomised rats were used. The weighed dose was dissolved or suspended in 3 c.c. of sesame oil and given in six separate injections of 0·5 c.c., morning and evening on three successive days. Vaginal smears were examined twice daily until the œstrus change disappeared. Only full cornification and complete absence of leucocytes was regarded as a positive œstrus response.

Other derivatives of diphenyl and diphenyl methane have been tested, but up to the present only those containing two hydroxyl groups in the para positions have been found to be active. It is premature to discuss the significance of these experiments, and further work on these lines is proceeding.

We wish to thank Dr. F. L. Pyman, of Boots Pure Drug Co. Ltd., Nottingham, for providing samples of the substituted di(hydroxy-phenyl)-methanes.

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[1] Cook, Dodds and Hewett, NATURE, **131**, 56 (1933).
[2] Cook and Dodds, NATURE, **131**, 205 (1933).
[3] Cook, Dodds, Hewett and Lawson, *Proc. Roy. Soc.*, B, **114**, 272 (1934).
[4] Allan, Dickens and Dodds, *J. Physiol.*, **68**, 348 (1930).

## Echinenone as a Provitamin A

THE pigment echinenone was recently isolated by one of us from the sexual glands of the sea urchin *Echinus esculentus*[1]. The glands from 400 urchins were first extracted with acetone. The extracted pigments were then separated into hydrocarbon and xanthophyll fractions by partition between petroleum ether and 90 per cent methyl alcohol. The echinenone was contained in the former solvent both before and after saponification, and was separated from β-carotene by the chromatogram method. The new pigment was absorbed as a dark violet layer in the upper part of the column of slaked lime. After extraction, 4 mgm. of dark violet needles with a metallic lustre (m.p. 192°-193°) were obtained. In carbon disulphide solution a broad band with three ill-defined maxima at 520, 488 and 450 mμ was shown; in alcohol these bands were even less pronounced. From the spectroscopic properties and elementary analysis ($C_{40}H_{58}O$) ($\pm H_2$) it would appear probable that echinenone is a mono-ketone occupying an intermediate position between β-carotene and semi-β-carotene.

A specimen of the pigment, after a preliminary separation from carotene by adsorption on aluminium oxide, was purified by two further adsorptions on the same adsorbent, two adsorptions on slaked lime, two recrystallisations from benzene and ethyl alcohol mixture, one from petrol ether and alcohol, and finally once more from benzene and alcohol. This specimen was sent to Cambridge, and was examined for biological activity as a provitamin A. Rapid restoration in growth was observed in rats restricted to a diet deficient in vitamin A when daily doses of 5γ or 10γ of the pigment were given; a temporary slow resumption of growth was observed with 2·5 γ. The administration of about 4 mgm. of the pigment, spread over several days, to a rat already cured by small doses, resulted in the appearance in the liver of an amount of vitamin A equivalent to 400 blue units (roughly 0·1 mgm. of the 'pure' vitamin). Only traces (30 y.u.) of yellow pigment were present. The band at 630 mμ characteristic of the blue colour given by vitamin A with antimony trichloride was clearly observed.

From this evidence it is clear that echinenone may function as a provitamin A. The degree of activity is apparently of the same order as that of the carotene isomers, although the tests carried out were insufficiently extensive to decide whether the activity approximated more closely to that of β-carotene, or, as might be expected from the presence of only one β-ionone ring system, to that of the presumably somewhat less active α-form. It may be worthy of note that echinenone, apart from β-carotene which is found in both plants and animals, is the first animal carotenoid found to possess vitamin A activity.

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[1] Lederer, *C.R. Acad. Sci.*, **201**, 300 (1935).

## Production of Attached *X*-Chromosomes in *Drosophila melanogaster* Males

KAUFMANN[1] and Neuhaus[2,3] indicated the likelihood of crossing-over between *X*- and *Y*-chromosomes in females of *Drosophila melanogaster*. They explained the frequent attachment of the long arm of the *Y*-chromosome to the proximal end of the *X*-chromo-

some as described by Stern[4], as a result of crossing-over in males between the *X*- and the short arm of the *Y*-chromosome.

To verify the above, I undertook the following experiments: males, having the gene forked and either the short or the long arm of the *Y*-chromosome attached to the proximal end of the *X*-chromosome, were mated to *yy* females. If crossing-over between *X*- and *Y*-chromosomes in males takes place when the *X*-chromosome is divided into two strands, then it may be possible to obtain forked females with attached *X*'s.

The experiments gave the following results: the males forked *XY* short produced 44,240 flies, and among those there were found 26 forked females with attached *X*'s. The males forked *XY* long yielded 43,852 flies among which only one forked female with attached *X*'s was found. Males without any part of *Y*-chromosome attached produced about 100,000 flies, among which no females with attached *X*'s were obtained.

These results indicate that crossing-over in males between *X* and the short arm of the *Y*-chromosome occurs much more frequently than with the long one and that this crossing-over takes place between chromatids.

Further experiments are in progress.

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[1] B. P. Kaufmann, *Proc. Nat. Acad. Sci.*, **19** (1933).
[2] M. I. Neuhaus, *C.R.*, **3**, No. 1 (1935).
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## The 'Photosynthetic Unit' in the Assimilation Process of Green Plants

IN connexion with the recent letter of Henry I. Kohn[1] on the 'photosynthetic unit', I should like to point out briefly the result of a discussion given in a paper which was communicated by Prof. F. G. Donnan to the *Journal of General Physiology* early in April of this year.

An explanation of the fact that the plant can accumulate the four quanta necessary to reduce one molecule of carbon dioxide with practically no loss of energy may be found in the peculiar structure of the chloroplast and in the state of the chlorophyll in the living plastids. According to the investigations of Liebaldt[2] and Mencke[3], the chloroplast consists of a lipoid phase, in which the chlorophyll is dissolved, which is itself dispersed in an aqueous 'hydroid phase'.

It seems that the chlorophyll has to fulfil two different functions, depending on its situation in the chloroplast. The chlorophyll molecules on the surface of the lipoid phase (in contact with an aqueous phase) combine with carbon dioxide to form a light-absorbing chlorophyll carbon dioxide complex, and in this way take part in the reduction of the carbon dioxide.

The greater part of the chlorophyll molecules is dissolved in the interior of the lipoid phase and absorbs the energy of the light, which is then stored in the form of electronic excitation energy. It is well known that electronic excitation energy is practically never directly transferred into kinetic energy (heat)[4]; therefore the quanta absorbed in the interior of the lipoid phase will be handed over from one chlorophyll molecule to another by a sort of resonance effect, and eventually reach the chlorophyll molecules on the surface. In this way all the energy absorbed in the interior can ultimately be used for the assimilation process on the surface. This process implies that the chlorophyll molecules in the lipoid phase are in a state of strong mutual interaction. The observed shift of the absorption maximum of chlorophyll in the living plastids by 150–200 A. towards the red region as compared with chlorophyll in solution or in the colloidal state[5] may be due to interaction forces of this kind.

It is also possible to explain Kautsky's observation[6] that strongly assimilating leaves show a considerably weaker fluorescence than in the normal state. In the case of non-assimilating leaves, the energy coming from the interior of the lipoid phase is not captured on the surface and is eventually given up as fluorescent light.

On the basis of these arguments, the 'photosynthetic unit' of Emerson and Arnold is determined by the ratio

$$\frac{\text{(active) chlorophyll in the surface}}{\text{chlorophyll dissolved in the interior of the lipoid phase.}}$$

The obvious implication is that for every chlorophyll molecule on the surface (actively reducing carbon dioxide) there are about 500 molecules in the interior which provide it with the necessary quanta.

In conclusion, I should like to thank Prof. F. G. Donnan for his continuous help and interest.

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[1] H. I. Kohn, NATURE, **137**, 706 (1936).
[2] E. Liebaldt, *Z. Botanik*, **5** (1913).
[3] W. Mencke, *Protoplasma*, **21**, 279 (1934).
[4] cf. J. Franck und H. Levi, *Z. phys. Chem.*, B, **27**, 409 (1935).
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## Acetylation of Agar

IN view of the recent publication by N. W. Pirie[1] on the acetolysis of agar, it seems advisable to communicate preliminary results from this laboratory, where an investigation on the structure of agar has been proceeding.

Pirie states that agar is difficult to acetylate in comparison with many other polysaccharides. This does not appear to be the case, however, when suitably prepared agar is treated with pyridine and acetic anhydride, as chloroform-soluble agar acetates are formed, the acetyl content of which varies, with the duration of the time of acetylation, from 36 to 43 per cent (as $CH_3CO$). Deacetylation regenerates agar indistinguishable from the original in its ability to form a gel, and no apparent degradation has therefore occurred during the acetylation process. When a chloroform solution of the acetate is allowed to evaporate, a tough colourless film is obtained.

The low specific rotation of these acetates in chloroform solution ($[\alpha]_D^{15}$ *c.* $-30°$) may be connected with the presence of β-linkages in the molecule, since the hydrolysis of agar gives rise to a solution of positive rotation ($[\alpha]_D^{15}$ *c.* $+30°$).

Experiments on the hydrolysis of agar indicate that the reducing power of the solution after hydrolysis is not wholly accounted for by the presence of

*d*-galactose together with the as yet unidentified reducing acid first described by Lüdtke[2]. The *l*-galactose isolated by Pirie accounts to some extent for this discrepancy. Much further work, however, appears to be necessary before even a tentative structure can be proposed for the polysaccharide, and stress must be laid on the necessity of securing a homogeneous starting material.

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[1] Pirie, *Biochem. J.*, **30**, 369 (1936).
[2] Lüdtke, *Biochem. Z.*, **212**, 419 (1929).

### Diamagnetic Susceptibility of Heavy Water

SINCE our communication in NATURE of April 25 (p. 706), we have repeated the determination of the mass susceptibility of deuterium oxide using two specimens of purity 99·95 per cent. Our mean result now obtained is $0{\cdot}638 \times 10^{-6}$, which agrees excellently with our previous value, obtained with a slightly less pure specimen, and also with the value obtained by Cabrera. This therefore may be taken to establish the value of the mass susceptibility of deuterium oxide at ordinary temperature at the figure named.

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## Points from Foregoing Letters

THE sensitivity to sound of different frequencies shown by certain organs of the cricket (the long hair-sensilla on the cercus) and of the locust (tympanal organ and receptor organs distributed over the body) has been determined by Dr. R. J. Pumphrey and A. F. Rawdon-Smith and found to be in some respects more extensive than the human. In particular, the sensitivity of the anal cercus appears greater than the human for the lowest audible frequencies, whilst there are indications that the tympanal organ possesses superhuman sensitivity at the opposite end of the spectrum.

Sir Ambrose Fleming discusses various numerical characteristics of the number 861, obtained by dividing the product $hc$ (action quantum and velocity of light) by the square of the electronic charge ($e^2$).

An extension of the supraconductivity theory devised for the 'intermediate' state, in which supraconductors are imagined as consisting of many separated microscopic elementary regions, is given by Dr. F. London, to make it applicable to a case where an electric field is also present (with certain restrictive assumptions). Dr. London states that he has met with success in applying the theory to a phase transition brought about in a supraconducting wire by the magnetic field of a current through the wire.

By means of new ultra-violet data, the singlet systems of S III and K VI are partially classified by Dr. H. A. Robinson. These data show that S III is present in nebulæ and, by interpolation, confirm the presence of Ar V.

The quantum energy of γ-rays emitted from twenty-four elements under the bombardment of slow neutrons has been determined by S. Kikuchi, K. Husimi and H. Aoki; they find a striking correlation between energy of γ-rays and atomic number of element bombarded.

Prof. H. T. Stetson, from an analysis of latitude observations for the years 1928–31, finds variations in latitudes with the moon's position amounting to less than half those previously calculated for the 1909–11 period. He also discusses the considerably lower results obtained by Kawasaki for the period 1922–31 and suggests that latitude variations correlating with the moon's position are more apparent during certain years; further, that the problem may be complicated by change of phase and by geophysical movements. He concludes that periods of analysis should not exceed three years.

Assuming that the residual electrical conductivity of hexane, which cannot be decreased by any known method of purification, is due to ionisation by cosmic rays, and taking the number of cosmic rays as given by Millikan to be $1{\cdot}48$ cm.$^{-2}$ min.$^{-1}$, Dr. I. Adamczewski calculates that the ionising power of a cosmic ray in hexane corresponds to 28·6 ion pairs in air at normal conditions, which is of the right order of magnitude.

The electrical conductivity across thin films of non-aqueous liquids (carbon tetrachloride, olive oil, etc.) changes abruptly as the film becomes thinner from a barely detectible to a measurable value, in a stepwise manner, according to experiments by Prof. T. Teorell.

When a single crystal of zinc sulphide is heated in air, it is covered by a film of zinc oxide. This film, when examined by electron diffraction, shows the properties of a single crystal in a crystallographically defined position relative to the ZnS-structure, according to Prof. G. Aminoff and B. Broomé.

A table giving the œstrogenic properties of a number of organic compounds together with a rough indication of their activity is given by Prof. E. C. Dodds and W. Lawson. Of various diphenyl methane derivatives tested, only those containing two hydroxyl groups in the *para* positions have been found to be active; the presence of a phenanthrene condensed ring is not necessary for this sex-hormone activity.

The carotenoid pigment echinenone, recently isolated by Dr. E. Lederer from the sexual glands of the sea urchin, *Echinus esculentus*, has been tested by Dr. T. Moore for activity as a provitamin A, with positive results.

Experiments described by M. J. Neuhaus indicate that, in male fruit flies, crossing-over between the *X*-chromosome and the short arm of the *Y*-chromosome occurs more frequently than with the long arm of the *Y*-chromosome, and that the crossing-over takes place between chromatids.

To explain the process of carbon assimilation by green plants (photosynthesis), Dr. J. Weiss assumes that for every chlorophyll molecule which reduces carbon dioxide at the surface of the fat-soluble (lipoid) particles in the chlorophyll granule, there are about 500 chlorophyll molecules in the interior of the granule, which provide the surface molecule with the four necessary quanta of energy.

# Research Items

### Essex Periwinkles

MR. F. S. WRIGHT has carried on an investigation of the periwinkle *Littorina littorea* in the River Blackwater estuary ("Report on the Maldon (Essex) Periwinkle Fishery". *Fish. Invest.*, Series 11, **14**, No. 6, 1936. Ministry of Agriculture and Fisheries). The main point in question was to ascertain whether dredging was likely to affect the yield seriously if permitted at certain seasons. The conclusions are that, provided a sufficient number of breeding adults are left on the grounds, it is probable that no harm will be done by the dredging, especially as the periwinkles are not collected from April until August, which apparently includes the main spawning period. Small specimens should, however, not be taken and sieving is recommended, also transplantation; but in their own interests the fishermen usually return undersized specimens, thus themselves contributing to the restocking of the beds. The number of specimens used for the experiments on which the curves and tables are based is exceedingly small and the observations on breeding scanty. Seeing that the veligers and very young crawling stages are quite easily recognised, it is surprising that so few were seen. It is stated that both large and small *Littorina littorea* migrate from the mud flats into the tidal pools on the approach of cold weather.

### Herdmania: a Monascidian of the Indian Seas

DR. S. M. DAS has chosen the simple ascidian *Herdmania* as a typical subject for one of the Indian zoological memoirs ("Indian Zoological Memoirs on Indian Animal Types". (5). Lucknow Publishing House, Lucknow, 1936. Rs. 2). In this useful series of publications common animals from India are substituted for those formerly imported from Europe for dissection in the zoological laboratories. The genus *Herdmania* has a world-wide distribution. Only in the Arctic seas is it absent. It possesses calcareous spicules in the tissues, and is the commonest simple ascidian of Indian seas. Two species are recorded from the coastal waters and a third in greater depths. The two coastal species investigated, *H. pallida* and *H. ceylonica*, occur in the Gulf of Mannar at 5–12 fathoms, extending as far as ten miles from the seashore where they inhabit a rocky bed with numerous polychætes and chanks. *H. pallida* is the species specially selected for description, the average size being about 9·5 cm. in length and thus well adapted for laboratory work. The author is to be congratulated on this clearly written and well-illustrated monograph. It is hoped that more volumes in this series will soon appear.

### Oysters of the Limfjord

DR. R. SPÄRCK, in a recent paper ("Investigations on the Biology of the Oyster (11). On the size and age composition of the stock of Native Oyster in 1935." *Rep. Danish. Biol. Stat.*, **40**; 1935), continues work he has been doing for a number of years. In former papers (*Rep. Danish Biol. Stat.*, **31**, **33**, **34** and **37**) he has shown that during a long series of years the size of the native oyster in the Limfjord constantly decreased, the population consisting almost entirely of old individuals, and that the stock has constantly grown less. From 1919, and even from 1914, the annual renewal of the stock has been quite insignificant; but in 1932 and after, there appeared to be an increase of existing stock of several hundreds per cent, the present age-composition of the stock being absolutely different from those former years. In the summer of 1934 the spat-fall, which in some cases showed two or three size groups, covered large areas of the Limfjord. This very satisfactory state of things is most hopeful and, if no extraordinary mortality sets in, a rise in stock of Limfjord native oysters may be expected so that in four or five years some fishing may be allowed. It is suggested that the cause of the extensive spat-falls in 1932 and 1934 may have been the high summer temperatures, which were favourable for a considerable renewal of the oysters. In the same report Dr. Spärck records the presence in the Limfjord in 1934 of *Crepidula fornicata*, the unwelcome mollusc which in 1880 was carried to England with American oysters, and has since spread widely along the southern and eastern coasts and latterly into Holland and Belgium.

### Biology of Staphylinid Beetles

THE prevalent idea that beetles of the extensive family Staphylinidæ are scavengers apparently has relatively few observations in support of the contention. According to Mr. Ralph Voris (*Trans. Acad. Sci. St. Louis*, **28**, No. 8, 233–261, Dec. 1934), in most cases the food of Staphylinidæ has been confused with the habitat in which they are found. He finds that the prevailing type of feeding behaviour is predatism. In fourteen species belonging to eight genera, his observations were that either the larvæ or adults, or both, feed upon living insects. The reported cases of parasitism in the group Aleocharinæ are typical examples of parasitoid behaviour and support the contention that the family as a whole is primarily predaceous. The feeding behaviour of those forms found in the nests of social insects clearly points to the same conclusion. The border-line behaviour of Staphylinidæ supports Wheeler's view that parasitism among insects is a kind of refined predatism, and has its origin in the latter habit. The role of scavengers is only occasionally evidenced, while phytophagous behaviour is apparently rare, and so imperfectly studied, that generalisations in this respect cannot be made. A useful bibliography relating to the feeding and other habits in the family is appended to the paper.

### Biennial Bearing in Apple Trees

SOME observations on the above subject have recently been published by Hoblyn *et al.* (*J. Pom. and Hort. Sci.*, **14**, 1, 39; 1936). The degree to which bearing is biennial, and the average intensity of annual fluctuations in cropping over a period of years, are expressed arithmetically by constants $B$ and $I$ respectively for trees subject to various treatments. Drastic pruning of previously unpruned trees tended to even up the annual crops, and the 'intensity'

was reduced more by pruning in the 'off-year' than the 'on-year'. The cropping of Newton Wonder became more regular after grassing down, but no significant results were obtained with any other variety. Potash manuring also was without effect. There are indications that rootstock may be a relevant factor over a long period, though no marked differences were observed. Stripping of blossom from trees of Early Victoria completely changed the year of cropping and increased the intensity of subsequent fluctuations, but no results were obtained by blossom thinning. Fruit thinning also had very little effect, but complete removal of fruits in June every year eliminated the biennial habit. It seems that no workable method of dealing with biennial bearing is yet available for application in commercial practice.

### An Insect Pest of Orchids

A SHORT paper by Mr. W. H. Nicholls (*Victorian Nat.*, 52, No. 11, March 1936) describes the appearance of numerous viscid blotches upon leek-orchid plants belonging to several species of the genus *Prasophyllum*. It was known that thrip-like insects were often found embedded in the viscid mass, but they were not recognised as a cause. Indeed, one infected plant of *P. australe* had been previously described as a new variety—*viscidum*. The causal relation between thrips and the viscidity has now been established, and the insect is *Thrips imaginis*, a species indigenous to Victoria.

### Molasses and Nitrogen Fixation in Indian Soils

PROF. N. R. DHAR, of the University of Allahabad, writing on April 29 with reference to the article on "Molasses, Nitrogen Fixation and Land Reclamation" which appeared in NATURE of April 11, says: "I am glad to inform you molasses is being utilised in many parts of India for reclamation of alkaline land. The Mysore Government has been able to obtain 1,200–1,800 lb. of rice grains per acre of alkaline land using one ton of molasses per acre on plots where crops failed previously. The normal production of rice in India is 1,250 lb. of grain per acre in ordinary fields. In recent publications, we have shown that the ammoniacal and total nitrogen of ordinary soils mixed with cane sugar or glucose or any other energy-rich compound and exposed to sunlight increase considerably although the *Azotobacter* counts do not change appreciably. In the dark, however, the *Azotobacter* counts are enormously increased, although the ammoniacal and total nitrogen are less than in light. Moreover, we have obtained results showing the accelerating influence of light on ammonification, nitrification and denitrification under aerobic conditions. Hence we have come to the conclusion that sunlight plays an important role in the nitrogen cycle in the soil."

### Drought Resistance in Wheat

MESSRS. O. S. AAMODT and W. H. Johnston are analysing the nature of drought resistance in wheats by a comparison of the Russian varieties Milturum and Cæsium with commonly grown Canadian types which are susceptible to drought (*Canadian J. Res.*, 14, March 1936). The Russian varieties seem equally susceptible when shooting and heading, but during the process of stooling they are much more resistant. This becomes the more significant when it is realised that Milturum has a stooling period some 8–10 days longer, Cæsium 4–5 days longer, than Marquis. In this stooling period the Russian varieties survive periods of drought that ordinarily cause great damage to other varieties. Milturum and Cæsium varieties also develop their root systems comparatively early, a characteristic which enables them to weather early periods of drought more successfully. Finally, these Russian varieties were found to possess a superior capacity to endure drought without permanent injury.

### Crustal Deformations in Japan

DURING the year 1935, new lines of precise levelling were carried across several earthquake districts in Japan. One of the most interesting series is that studied by Prof. A. Imamura (*Proc. Tokyo Imp. Acad.*, 12, 7–9; 1936). The route lies near the west coast of northern Japan and crosses the meizoseismal areas of two important earthquakes in 1694 and 1704. No definite change occurred during the last thirty-five years in the central area of the earlier earthquake, but there were undoubted movements in that of the latter. Here, the changes of level between 1903 and 1935 revealed the existence of several crust-blocks, each of which was tilted towards the north, the maximum elevation in the area being a little more than an inch. Messrs. T. Terada and N. Miyabe (*Proc. Tokyo Imp. Acad.*, 12, 4–6; 1936; and *Earthq. Res. Inst. Bull.*, 14, 146–147; 1936) describe the results of the series of levellings made in the Sanriku district (north-east Japan) from Miyako to Aomori, the general mode of deformation between 1933 and 1935 being an upwarping of the crust between Kamaisi and Hatinohe and a downwarping near Aomori Bay. Mr. R. Takahasi (*Earthq. Res. Inst. Bull.*, 14, 18–25; 1936) describes the precise levelling made for the first time up the west slope of the Asama volcano, round the southern rim of the crater, and down the east slope. Comparing the heights obtained with those given in the topographic map of 1912, it is shown that the principal vertical deformation was a rise of nearly 60 ft. in the eastern rim of the crater, a rise that must be due in part to the accumulation of volcanic material since the eruption of 1912.

### Canadian Crude Oils

DURING recent years a wealth of information has been accumulated at fuel research laboratories on crude oils from the various producing fields of Canada. In view of the increasing importance of petroleum developments in that country and of advancement in refining technology, it has been deemed advisable to publish the data collected in the form of a comprehensive report. The document bears the title "Analyses of Canadian Crude Oils, Naphthas, Shale Oil and Bitumen" and is published by the Canadian Department of Mines (Bulletin 765), the joint authors being P. V. Rosewarne, H. McD. Chantler and A. A. Swinnerton. One hundred and forty-three samples of crude oil were collected over a period of some five years from Canadian fields, and detailed analyses of these, together with notes on methods of examination, form the main part of the report. In addition, results are interpreted, distillates classified, and comparisons made of typical crude oils. The report also includes a brief description of each of the main producing fields, supplemented by an outline map on which these fields are clearly marked and positions of individual samples indicated; a summary of production from each field during recent years; and statistics of the petroleum industry

for the whole country. At the present time, only three per cent of the annual consumption of crude oil in Canada is supplied from home fields, the rest being imported. The remedy for this unsatisfactory position lies first in discovery of new producing fields and secondly in commercial development of bituminous sands in Alberta and oil shale in the Maritime Provinces. This latter course would provide an alternative raw material to crude petroleum from wells for the production of motor spirit and oil products. When crude oil prices stand at a higher level, this should prove a useful resource.

### History of the Dines' Anemometer

IN his presidential address delivered last January to the Royal Meteorological Society and entitled "Wind in Britain: The Dines Anemometer and Some Notable Records during the last Forty Years", Colonel E. Gold traced the historical development of the instrument devised by the late W. H. Dines, from various attempts by earlier workers to make use of the pressure exerted by the wind down a tube directed towards it as a measure of wind velocity (*Quart. J. Roy. Met. Soc.*, **62**, No. 264). In these early instruments, which were generally of the water-filled U-tube pattern, the fallacious assumption was made that the pressure on the arm open to the air, but not exposed to the wind, is constant. Dines arranged for the pressure of the wind down an open tube to act on the underside of a float in water, and for the lower pressure caused by the wind blowing past holes in a vertical tube to act on the upper side of the float. These effects, for a given air density, vary as the square of the wind speed, which necessitated a specially shaped float to make the vertical movement of the float, and the recording pen supported by it, proportional to the increase of wind speed. The required shape of float was worked out from first principles. Accuracy in this instrument was limited by the fact that variations in the density of the air, which affect the pressure of the wind, could not be allowed for. In the British Isles, however, the error due to this cause scarcely ever reaches five per cent, and the instrument, after gradual improvements suggested by experience, has come to occupy a unique position and to achieve a world-wide distribution. In the discussion of notable records, a very remarkable case of disturbance caused by a row of cottages 100 feet away from an anemometer at the Lizard is illustrated; when the vane was 15 feet higher than the ridge of the cottages the wind constantly 'boxed the compass' during the violent fluctuations caused by the obstruction, although very steady when the direction was two or three points off that of the obstruction, the speed dropping frequently to nil; raising the vane 35 feet caused the disturbance to disappear altogether.

### Acoustical Terms

THREE years ago the British Standards Institution set up a committee to prepare a "Glossary of Acoustical Terms and Definitions" which has now been issued. It extends to 48 pages and is published by the Institution at 3*s*. 6*d*. In general, the definitions are on established lines but are given in more precise forms. Pulsatance is introduced for $2\pi$ times the frequency, logarithmic decrement is in terms of deflections on the same side, stationary used instead of standing wave system, the logarithm to base 10 of the ratio of the rates at which energy is emitted by two sources is the number of bels of power separating them. A new unit—the phon—is introduced to express the loudness of a sound in terms of the intensity of one of standard pitch. Unit area impedance is the quotient of the pressure by the particle velocity and is generally a complex quantity. Other electrical terms—resistance, reactance, transducer, microphone, filter—are adopted and defined, and musical terms are interpreted on a physical basis.

### Deflection of Fast Electrons in Magnetised Iron

A NUMBER of experiments have been performed in which cosmic ray electrons (or in one case β-rays) are passed through magnetised iron, and there is some interest in trying to find what is the effective magnetic vector deflecting the particles. The experiments seem to show that this vector is less than the induction $B$. W. F. G. Swann (*Phys. Rev.*, April 15) considers the iron as containing a number of very small magnetic entities (for example, spinning electrons) and shows that, while $B = H + 4\pi I$ does give the true average force deflecting the particles, this average is made up in a peculiar way. A very small number of particles receive large deflections as a result of penetration of the magnetic entities, while for most of the electrons the effective deflecting vector is $H + 2\pi I$. An experimental paper by W. E. Danforth and W. F. G. Swann follows, in which cosmic ray electrons were detected by counters after passing through several centimetres of an iron magnetic circuit. Using Anderson's and Kunze's data on the energy statistics of cosmic ray electrons, the results are found to agree in order of magnitude with the theory.

### Deuterium and Molecular Asymmetry

IN order to test whether the replacement of one hydrogen atom in a methylene group by deuterium is sufficient to produce a measurable degree of molecular asymmetry, E. Biilmann, K. A. Jensen and E. Knuth have carried out some interesting experiments (*Ber. deutsch. chem. Gesells.*, May). The replacement of one hydrogen atom by deuterium is likely to have so small an effect on the symmetry of the molecule that optical resolution of a synthetic racemic compound could scarcely be expected to yield convincing results. Accordingly they adopted the method of replacing chlorine in an optically active compound by deuterium, where ordinary hydrogen was bound to produce inactivity. For this purpose *l*-bornylchloride was converted in parallel experiments to camphane, $C_{10}H_{18}$, and 2-deutero-camphane, $C_{10}H_{17}D$, by decomposing the magnesium derivative with light and heavy water respectively. In both cases, the final product had to be freed by distillation from the high-boiling *d*-hydrodicamphene and by fractional recrystallisation from *l*-camphene. The two final products melt sharply at a temperature (153° C.), which is unaffected by mixing the compounds, but whereas camphene is symmetrical and therefore optically inactive, 2-deutero-camphane is slightly active and indeed shows reversal of sign for sodium light. Thus from observations with a ten per cent solution in ether, the specific rotation $[\alpha]_D$ at 20° C. was calculated to be $+ 0{\cdot}40° \pm 0{\cdot}05°$. The effect is certainly slight, but appears to be unmistakable. The heavy water used was from the Norsk Hydro-Elektrisk Kvaelstofaktieselskab, and contained 99·2 per cent of deuterium oxide.

# Royal Observatory, Greenwich

## ANNUAL VISITATION

THE Astronomer Royal read his annual report to the Board of Visitors of the Royal Observatory, Greenwich, on June 6 last. Although the weather was far from ideal, the Garden Party which is associated with the visitation was well attended, and visitors and guests were shown the new Reversible Transit Circle referred to in the Report. The erection of this instrument was commenced in February and completed in March, but actual observations have not yet been made with it, as it was discovered by tests that the pivots were slightly elliptical in shape ; in the meantime, work has been done on the pivots which it is hoped will shortly be circular within the required limits. This Transit Circle is in the Christie Enclosure, near the Yapp Reflector, and is accordingly some little distance east of the adopted Greenwich Meridian on which Airy's Transit Circle will continue to stand ; the new instrument is reversible and has a travelling micrometer wire which is driven by an electric motor at the speed appropriate to the declination of the star under observation. It is intended to secure observations in fundamental astronomy which will be more accurate than those obtainable with the Airy's Transit Circle, and we may await with some interest the appearance of the results obtained with the new instrument.

A new Free Pendulum Clock is being presented to the Observatory by Mr. H. R. Fry. This clock is a Shortt clock which is similar to those at present in use, except that the slave pendulum of the new clock is of a much more refined construction than the standard pattern and is fully jewelled throughout. The time will be taken from the new clock from the free pendulum itself using a photo-electric method.

The routine astronomical work of the Observatory continues. During the year, 9,899 transit observations and 9,409 observations of zenith distance were secured. Attention has been directed to the minor planets, which are being observed with the intention of using them to fix the equinox and equator point, and 42 transit observations of minor planets were secured during the year, in addition to 139 photographic observations secured with the Astrographic Equatorial. The Astronomer Royal directs special attention to the successful application to the measurement of line contour with the spectrohelioscope which has recently been accomplished at Greenwich. A programme of photometric observations of intensity of bright eruptions and dark markings on the solar disk is now in hand. The observers use a visual method of photometry, and the results promise to be of interest in connexion with the investigation of conditions in the ionosphere besides having astrophysical significance.

The mean values of the magnetic elements at Abinger in 1935 are given below, together with values in recent years for comparison :

| | Declination, W | Horizontal Intensity | Vertical Intensity | Inclination |
|---|---|---|---|---|
| 1932 | 12° 2·6′ | 0·18536 | 0·42940 | 66° 39·1′ |
| 1933 | 11° 51·7′ | 0·18532 | 0·42942 | 66° 39·4′ |
| 1934 | 11° 41·1′ | 0·18533 | 0·42955 | 66° 39·7′ |
| 1935 | 11° 30·3′ | 0·18527 | 0·42981 | 66° 40·9′ |

Regular observations of the amount of solid matter polluting the atmosphere have been continued. A comparison between the pollution at Greenwich during the winter of 1934–35 with the pollution at the worst London station (Westminster) and the worst Glasgow station reveal the fact that Greenwich experiences rather more than fifty per cent more pollution than either of the other stations. During the winter 1935–36, less pollution was observed at Greenwich : the decrease is attributed to the smaller proportion of wind coming from a northerly direction experienced in 1935–36, as the main source of pollution lies in the factory area along the Thames and the densely populated area north of the river, opposite Greenwich. The worst pollution occurs at $20^h$, indicating domestic fires as an important source of atmospheric impurity.

The mean temperature for the twelve months ending April 30, 1936, was 50·2°, which is 0·7° higher than the average for the seventy-five years 1841–1915. The year was remarkable for a temperature below freezing point registered on May 17, 1935.

Hitherto the time service maintained by the Observatory has suffered from a lack of precision in so far as the absolute personal equations of the observers who observe clock corrections with the Small Reversible Transit telescope are not known. A personal equation machine has been constructed with the view of determining these personalities. The machine carrying an artificial star has been installed on the roof of the Octagon Room, and the movement of this artificial star will be observed with a telescope similar to that used in the observations for clock correction which will be mounted on the roof of the Main Building. It is expected to commence these observations shortly. Meanwhile, the annual mean differences between the Greenwich time signals and those sent out by Paris, Nauen and Bordeaux are satisfactorily small, being $-0{\cdot}009^s$, $-0{\cdot}010^s$ and $-0{\cdot}009^s$ respectively, the other observatories being in the mean early on Greenwich.

The old system of employing unestablished computers at Greenwich is to go. This scheme was instituted by Sir George Airy, and it worked admirably in the past. Some of the boys employed as temporary computers were incorporated in the established staff and have gone on to render distinguished service as assistants at the Observatory ; others who have left have found their Greenwich training of great service to them, and several have gone on to hold very responsible appointments. But the times have changed and there is no longer a market amongst employers for an accomplished computer, with the result that computing at Greenwich is now a blind-alley occupation for a young man, since all the computers could not be absorbed on the established staff. The Lords Commissioners of H.M. Treasury have approved a new scheme according to which the unestablished computers will disappear while the permanent staff will be increased, the computing duties being performed for the most part by twelve established women writing assistants. The transition will be made gradually.

# Problems of Plant Classification

THE Masters Lectures of the Royal Horticultural Society were delivered in 1935 by Sir William Wright Smith, who chose as his subject "Problems in Classification of Plants". A very considerable field of botanical research was reviewed in the two discourses (*J. Roy. Hort. Soc.*, 61, No. 2, 77–90 and No. 3, 117–134, February and March, 1936).

Beginning with the need of the gardener for definite names for his plants, Sir William traced the history of plant groupings. He commenced with Theophrastus, Dioscorides and Pliny, evaluated the work of Cœsalpinus, Ray and Tournefort, made suitable homage to the genius of Linnæus, and also reviewed the more recent work of Darwin, Hooker and others. A teacher of classification would there find a useful, if succinct, résumé of taxonomic history.

Sir William's deft handling of the vexed question of the subdivision or condensation of species is shown by his definition that "a 'splitter' is one who fails to recognize that his three species are only one, as you see it, while a 'lumper' is so bold as to include in one species what you clearly see contains at least six different ones". Inequality in the application of criteria to genera was discussed, and Sir William urged that sharp and wide diversity of generic characters should have value as a possible indication of a primitive nature. The genera of the Polypetalæ, for example, stand out more distinctly from one another than do those of the less primitive Gamopetalæ. The subdivision of sharply-defined primary units of classification, such as the Leguminosæ, was deprecated.

Much recent work upon intergeneric hybrids was marshalled to show that a broad concept of the genus is more in keeping with the facts presented by Nature, and no useful purpose is served by separating plants which give such adequate testimony of their affinity.

Classification must eventually stand the test of utility, either for accurate nomenclature, or as an indication of phylogeny, and to the gardener, species are almost invariably the broader concepts of Linnæus, rather than the unserviceable subordinate units of more modern tendency. The trend towards subdivision of species through natural hybridisation is greater in some parts of the world than in others—it is common in New Zealand, and rare in the Himalayas and western China. A recent analysis by Sir William and Mr. H. F. Tagg made it possible to determine the genetic constitution of several rhododendrons, and to prophesy, with some measure of success, which combinations could ultimately be found by exploration. The possible contributions of genetics to taxonomy were discussed, though it is still too early to appraise this point of view.

Sir William is, in the designation of his lectures, obviously a 'lumper', yet a 'splitter' could find no reasonable complaint in this quite impartial analysis of classification problems.

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# Association of Teachers in Technical Institutions

## Annual Conference at Plymouth

THE twenty-seventh annual conference of the Association of Teachers in Technical Institutions was held at Plymouth during Whitsuntide, when the president for 1936–37, Mr. W. T. Maccall, head of the Electrical Engineering Department, Sunderland Technical College, was inducted by the retiring president, Mr. D. W. Lloyd, principal of the Technical College, Stretford, Manchester.

In his presidential address, Mr. Maccall referred to the many new demands which the development of the petrol engine and the ever-widening use of radio and the films make upon the technical college. These demands touch nearly all departments of technical work, and range from the need for schemes of certification of garage attendants to the growing and varied courses in workshop management and production engineering.

Despite the suggestion that the art of invention is making workers into machine-minders, Mr. Maccall referred to the shortage of skilled workers, particularly in the several branches of the engineering industry. He asked how far that shortage is due to the lack of a proper recruitment policy, and how far to circumstances beyond the control of industry. Clearly a scientific age demands a scientific planning if the danger of lack of skilled workers is to be averted. Each industry must consider what type and grades of workers it requires. It should make a complete review of its methods of recruitment, conditions of service, and the normal number of its annual recruits. In proper conjunction with the local education authorities and the Board of Education, educational provision for every type of worker could be ensured. Mr. Maccall expressed the opinion that, broadly speaking, industry has not co-operated fully with education. In many cases, such full co-operation has been prevented by fear. Employers have 'feared' that technical colleges are training all to become works managers. Trade unions have 'feared' that colleges are short-circuiting apprenticeship and providing cheap labour. It should be widely known that colleges cannot *make* engineers, builders, etc.: they can but teach the underlying principles.

After a review of matters concerning examinations, the raising of the school-leaving age, the arguments against the multiple-bias secondary school and the possibilities of the junior technical school, Mr. Maccall referred to the relationship of the technologist to the world about him. Despite the joy which lies in seeing the applications of technology applied to the benefit of mankind, the technologist sometimes tends to lose hope when he surveys the world and sees, over

certain of its great and important tracts, his specialist knowledge seized and directed in the service of might rather than right. He sees ideals overthrown and reason treated with contempt. He sees freedom of speech threatened and the visions of democracy spurned. He sees education itself made subservient to ignoble ends, and he asks sometimes what he as an individual or as a member of an association can do when values become so twisted and the world appears to move towards such disastrous ends. The man of science, said Mr. Maccall, believes in the methods of reason and freedom. The technical institution, despite the charge which is sometimes made of narrow specialisation, would fail to be scientific if specialisation produced ignorance of the ways and aims of mankind. Students must be trained to think clearly not only about the special subjects, but also about the relationship of those subjects to a world contracted and spanned by wireless, by the cinema and by the internal combustion engine. Citizenship is a matter of scientific thinking just as much as any more obviously scientific subject.

The resolutions debated and passed by the Conference included one which urged the development of full-time and part-time day courses in technical education rather than the present system in which so much technical work is done in the evening. Other resolutions dealt with overtime and the shift system, the school leaving age, recruitment in industry and the extension of technical education. In connexion with the latter, the Conference welcomed the policy of the Government, which is to make increased financial provision, but asked that in the allocation of financial assistance, special regard be had to the needs of depressed areas.

Mr. John Sargent, director of education for Essex, addressed the closing meeting of the Conference. He outlined the policy which is guiding the development of technical education in Essex—a county which was once largely rural and in which areas are now rapidly becoming industrialised. The first step in connexion with that policy is to create four large technical colleges. Their buildings, as well as their curriculum and organisation, have been designed to give the greatest flexibility. The old idea of one industry dominating one area would in the future be avoided. In places like Dagenham, for example, there are new and diversified industries. They can therefore look forward to an escape from the general depression which devastates a 'one industry' area when that one industry falls upon evil days.

# Sea Fisheries of Europe

ONE of the most valuable of the various publications of the Conseil Permanent International pour l'Exploration de la Mer is its Statistical Bulletin, in which are tabulated the statistics relating to the sea fisheries of all the maritime countries of northern and western Europe. Such ample and diverse data require much time and labour to assemble and work up; vol. 23*, which has just appeared, presents the data for the year 1933. For the use of those whose interest in the work and welfare of the great fishing industries may exceed their ability to interpret detailed tabular data, a very comprehensive yet extremely lucid summary of the statistical tables is given.

The British reader, unfortunately, will derive but little comfort from the tale this Bulletin has to tell. The total quantity of fish landed by all the countries concerned—from Norway to Portugal—was greater by some 200,000 tons (about 6 per cent) in 1933 than in 1932. It was 5 per cent less than the 1930 yield (the highest on record) but 26 per cent greater than in 1913—the last normal pre-War year. Unfortunately, Great Britain has no share in this increase. Both absolutely and relatively, English and Scottish landings have fallen sharply. The English landings, though only very little smaller in 1933 than in 1932, showed nevertheless a decrease of no less than 15 per cent on pre-War figures. In Scotland the fall has been even greater. In 1933, Scottish landings diminished by 12 per cent as compared with 1932, and by as much as 36 per cent as compared with 1913.

A very different state of affairs is revealed in Norway, Germany and Iceland, each of which has had a very marked increase. In fact, almost every important fishing country except Great Britain shows increased landings in recent years. The accompanying table of the total quantity of fish landed (in thousand tons) is highly illuminating, though somewhat disquieting from the British point of view.

| | Total Quantity | | | | Ratio to 1913 | | | |
|---|---|---|---|---|---|---|---|---|
| | 1913 | 1931 | 1932 | 1933 | 1913 | 1931 | 1932 | 1933 |
| Iceland ... | 92 | 311 | 288 | 328 | 100 | 338 | 313 | 357 |
| Germany ... | 181 | 370 | 353 | 387 | 100 | 204 | 195 | 214 |
| Norway ... | 732 | 843 | 1019 | 1162 | 100 | 115 | 139 | 159 |
| France ... | 193 | 247 | 262 | 277 | 100 | 128 | 136 | 144 |
| England ... | 821 | 752 | 702 | 698 | 100 | 92 | 86 | 85 |
| Holland ... | 147 | 168 | 116 | 111 | 100 | 114 | 79 | 76 |
| Scotland ... | 398 | 263 | 292 | 255 | 100 | 66 | 73 | 64 |

The fishing grounds from which the fish are drawn extend from Bear Island to Morocco; but the North Sea still retains its position as "the most interesting, the most important and the most productive" of them all. From 1924 until 1933, the North Sea yielded on an average about 1,155,000 tons of fish a year. 1,171,000 tons were landed in 1933—a quantity which was exceeded only twice in the ten-year period. Relative to the grand total of fish from all grounds, however, the North Sea's contribution is tending to fall slightly. This is due not to any actual decrease in its own productivity, but to increased landings from elsewhere. Over the ten years 1924–33, the North Sea yielded an average of 34·4 per cent, or a little more than one third of the grand total. But in 1924 it yielded 39·7 per cent, whereas in 1933 the proportion had dropped to 31·7 per cent.

That the North Sea maintains its yield is a satisfactory condition little expected by the prophets of twenty years ago. Nevertheless, the constancy of the yield is quantitative only; qualitatively, considerable change of a disturbing kind has taken place.

* Bulletin Statistique des Pêches Maritimes des Pays du Nord et de l'Ouest de L'Europe. Vol. 23 (pour l'année 1933). (Copenhague: Andr. Fred Høst et Fils, 1935.) Kr. 3,00.

The average size of certain important fishes, for example, plaice, soles and haddocks, in the North Sea landings has been materially—perhaps even alarmingly—reduced. In other words, an increased proportion of the catches now consists of small fish. For full details of this and other changes in the nature of the landings the reader must consult the tables as set out *in extenso* in the Bulletin. But certain important details concerning the North Sea plaice may be usefully included here.

It is now generally known that the percentage of small plaice landed in England fell rapidly during the Great War. From 45–50 per cent in the immediate pre-War years, it dropped to 24 per cent in 1915 and even fell so low as 7 per cent in 1919. After that year, it rose again, and has kept a steady average of about 70 per cent from 1925 onwards. Thus, during the War and for several years afterwards, the English market was supplied with plaice larger on an average than either before or afterwards. Temporary abandonment of 'small fish' grounds is not regarded by the compiler of the Bulletin as a satisfactory explanation of this; nor does he regard with favour the more usual suggestion that the North Sea plaice had a respite from too intensive fishing during the War so that a larger number lived longer, grew bigger and eventually came into the market until the accumulation dwindled. On this point, attention is directed to the significant fact that, in England, the proportion of small plaice began to fall in the year 1914, *before* any great restriction of fishing grounds had taken place and long before the fish on any closed area had had time to grow. It is interesting to note that the haddock showed no sign of any post-War period of comparatively large fish, that is, there was no benefit from partial closure of the North Sea grounds.

With regard to the other plaice-producing countries, we find that in the seven years 1907–13 the mean percentage of small plaice was 47 per cent in England; 83 per cent in Germany; 87 per cent in Holland. In the seven years 1927–33 the corresponding figures are given as 74 per cent, 90 per cent and 95 per cent. Whatever be its cause or causes, this great increase in the percentage of small plaice—and other fishes—in the North Sea catches is a phenomenon the effect of which on the future of the fisheries of Great Britain and other countries seems likely to be of extreme importance.

## Uplift Pressure on Dams

WHEN a dam is built on porous strata such as generally exist at the beds of rivers, there is a flow through these porous strata under the masonry from the upstream to the downstream side. Accompanying this, there will be a pressure acting upwards on the masonry floor. An accurate knowledge of this uplift pressure and of the nature of its distribution is of fundamental importance for the purpose of designing a dam. There have been many attempts to investigate by direct measurements from models the way in which this pressure varies with different forms of design.

The usual method of building a tank provided with holes for manometers and filled with sand to represent the subsoil strata and of arranging a model of the dam with a suitable head of water upstream involves a very large number of readings, and is most laborious. Observing the analogy between Ohm's law for the conduction of electricity and Darcy's law for the conduction of water through porous media, N. N. Pavlovsky in 1921 suggested that an electrical method could be employed for studying the subsoil pressures under dams (Proceedings of the International Congress on Dams, 1933). In a paper to the Indian Academy of Sciences (*Proc.*, 2, No. 1, July 1935), Mr. G. Ram, Dr. V. I. Vaidhianathan and Dr. E. McKenzie Taylor, of the Irrigation Research Institute, Lahore, have described their investigations and the methods and apparatus used in determining to what extent this suggestion could be made the basis of a successful attack on the problem of subsoil flow under dams.

In the several cases examined of simple impervious floors with and without sheet piling, the curves obtained by the direct and the indirect methods and by theoretical calculations agreed so closely as to give support to the claim of the authors that the indirect electrical method is trustworthy. They consider that earlier failures have been due to faulty technique, and assert that the fact that the potential distribution in conductors has been shown to be of the same form as the pressure distribution in the subsoil under dams, establishes the mathematical foundation for designs of these works, and, as such, should be considered a great advance on our existing knowledge.

## Educational Topics and Events

BIRMINGHAM.—The Poynting chair of physics, which will be vacated by the retirement at the end of the present session of Prof. S. W. J. Smith, is to be filled by the appointment of Dr. M. L. Oliphant, assistant director of research in physics at the Cavendish Laboratory, Cambridge.

Mr. J. W. Drinkwater has been appointed lecturer in mechanical engineering.

CAMBRIDGE.—C. H. Thompson, Queens' College, has been appointed Gurney lecturer in forestry, and J. H. Lockhead, Christ's College, University demonstrator in zoology.

In its annual report, the Committee of Management of the Scott Polar Research Institute states that the Oxford University Expedition to North East Land before its departure, and the Oxford University Ellesmere Land Expedition 1934–35, since its return, have both made use of the facilities of the Institute, which have also been of service to the forthcoming Cambridge expeditions to Iceland, members of which have been at work for some time in the library and map room.

DURHAM.—At the Convocation to be held on June 30, the honorary degree of D.Sc. will be conferred on Mr. G. S. Baker, superintendent of the William Froude Laboratory at the National Physical Laboratory, and the honorary degree of D.Litt. on Mr. Robert Steele, editor of the works of Roger Bacon and other medieval literature.

OXFORD.—On June 6, the honorary degree of D.Litt. was conferred on Mr. E. A. Lowe, University reader in palæography. At Encænia on June 24, the honorary degree of D.Sc. will be conferred on Prof. E. D. Adrian, Foulerton research professor of the Royal Society. Among those who will then receive honorary degrees of D.C.L. are Prof. Gilbert Murray and Mr. Anthony Eden.

IT is stated that some two thousand people representing fifty different countries will be present at the Seventh World Conference of the New Education Fellowship to be held at Cheltenham on July 31–August 14, under the presidency of Sir Percy Nunn. The theme of the Conference will be "Education and a Free Society". One main lecture will be delivered each day and translated from French into English or vice versa ; the same evening the lecture will be discussed in a symposium, to which educationists from different lands will contribute. During the first week, the Conference will consider "The Individual and Freedom" and during the second, "Human Relationships and Freedom". Particulars can be obtained from Miss Clare Soper, 29 Tavistock Square, London, W.C.1.

RESEARCH studies in education occupy some thousands of university graduates every year in the United States. A bibliography published by the Office of Education, Washington, as Bulletin No. 5 of 1935 (pp. 328, price 25 cents) lists 3,506 such studies reported in 1933–34, including 465 doctors' dissertations, 2,763 masters' theses and 274 studies reported as faculty research. Many of them deal with topics of current controversies : special taxation for support of schools, equalisation of educational opportunity, emergency feeding, emergency schools, effects of the depression, child-labour and unemployment, the new systems of education in Italy, U.S.S.R., Greece and Germany, Federal emergency relief and leisure-time activities. The Office of Education has in its library a collection of 1,811 of these studies, which is said to be in constant use both in Washington and, through inter-library loans, throughout the country.

## Science News a Century Ago

### William Radcliffe and the Textile Industry

WILLIAM RADCLIFFE (1760–1841) was one of the improvers of cotton machinery who failed to reap any reward for his work. He died in poverty in 1841. *The Times* of June 14, 1836, contained the following quotation from *Blackwood's Magazine* regarding him : "The power-loom system, commonly so known, ought to be called the Radcliffe system. Without the dressing machine invented by Mr. William Radcliffe, of Stockport, the power loom was utterly worthless, except as a piece of curious mechanism. That of Dr. Cartwright has never been other than useless ; yet he obtained a grant from Parliament of £10,000 for the invention. Mr. Samuel Crompton, for his splendid discovery of the spinning mule, received the niggardly award of £5,000 from the same source ; but Mr. Radcliffe was beggared by his inventions. His patents were invaded by a joint-stock purse combination ; and he himself, from a prosperous manufacturer, brought to bankruptcy through expenses, time, and labour lavished upon his valuable inventions. . . ."

### Ventilation at the Custom House

AT the last ordinary meeting of the session of the Royal Society held on June 16, 1836, twenty communications were made. Among the subjects dealt with were the tides, magnetic observations, the respiration of insects, the human voice, the fermentation of vegetable matter, voltaic batteries and heating and ventilating. After the meeting, the Society adjourned for the long vacation to meet again on November 17.

The paper on warming and ventilating apartments was by Dr. Andrew Ure (1778–1857), then an analytical chemist in London. He had, he said, been consulted by the directors of the Customs Fund of Life Assurance, on the mode of ventilating the Long Room in the Custom House. In this room, about two hundred persons were employed. All these persons were found to suffer more or less from ailments of the same general character, the leading symptoms of which were a sense of fulness and tension in the head, throbbing of the temples, giddiness and occasional confusion of ideas, depriving them of the power of discharging their duties, in which important and frequently intricate calculations were required. Dr. Ure examined the condition of the air in the room, and said that : "In all these qualities the air respired by the inmates of the room bears a close resemblance to the pestilential blasts of wind, which, having passed over the scorching deserts of Arabia and Africa constitutes the *Simoom* of those regions, and is well known by its injurious effects on animal and vegetable life."

Dr. Ure expressed surprise that in the report of the Parliamentary Committee on Ventilation, no reference had been made to the methods employed in factories, although they afford the best models for imitation, being the results of innumerable experiments made on a magnificent scale, with all the lights of science and all the resources of the ablest engineers. He showed that the ventilation effect of a steam-driven fan was thirty-eight times greater than the effect produced by a fire using the same amount of coal.

### Reform of Medical Education

IN *The Times* of June 16, 1836, a letter appeared from "M. D.", the object of which, he said, was to direct attention "to a subject which I am quite sure will be acknowledged by every medical practitioner in the kingdom to be of the first importance to the community. . . . I allude to the unprotected state of the obstetric department, a branch of medicine practiced by males and females without any responsibility, and by too many who are perfectly ignorant, or who possess a superficial knowledge only, of the important duties which they are often called upon to perform. . . . At the present moment, there is not even the form of an examination by either of the English medical corporate bodies into the acquirements of either male or female practitioners. This, Sir, is a simple statement of a monstrous anomaly which exists in the medical profession."

### The Sussex Scientific and Literary Institution

ON June 18, 1836, the *Athenæum* published a note from a correspondent regarding the above institution, which he said "owes its existence to the exertions of Mr. Ricardo, Mr. Horace Smith, Sir Richard Hunter, and a few other gentlemen, who originated a plan for the admission of the public to Dr. Mantell's Museum of Geology and Comparative Anatomy. . . . Reading rooms are opened for the members ; the formation of a library is commenced ; and the unique collection of organic remains, belonging to Dr. Mantell, are exhibited in these rooms and arranged with great taste. Dr. Mantell has given three lectures in the Town Hall on behalf of the Institution ; and a short time since, a geological excursion to Lewes took place, under his guidance, and he conducted the members to the quarries, which had afforded many of the interesting organic remains in the Museum."

## Societies and Academies

### PARIS

Academy of Sciences, May 4 (*C.R.*, **202**, 1469–1540). ERNEST ESCLANGON : The dynamics of limited relativity applied to central forces. The case of the planets. VICTOR GRÉGOIRE was elected *Correspondant* for the Section of Botany in succession to the late Hugo de Vries. C. TIKHOTZKY : The $K$ transformation of congruences. NATAN ARONSZAJN : $N$-dimensional homotropy. ALEXANDRE GHIKA : A property of functions representable by Cauchy's integral. H. MILLOUX : The study of meromorph functions in a circle. CHARLES JAEGER : Theory of the ram strokes in forced [water] mains with multiple characteristics. Distribution of the resonance surcharges along any main. G. RUMER : Wave theory of the neutrino. ARSÈNE DATZEFF : The properties of the acceleration operator and a remark on potential. ALBERT ARNULF, DANIEL BARBIER, DANIEL CHALONGE and MLLE. RENÉE CANAVAGGIA : Results of the study of 48 stellar spectra made at the Jungfraujoch in 1935. ALEXANDRE PROCA : The fundamental equations of elementary particles. J. CLAEYS, J. ERRERA and H. SACK : The absorption of ultra-sounds in liquids. Confirmation of work by Biquard, with extension to a wider range of frequencies. The absorption measured is many times that calculated from the classical formulæ. CHARLES REICHART : The electrification of insulating liquids by flow or filtration. With petrol as the fluid, it was found that the negative charges hitherto observed are only the beginning of the phenomenon, and were followed by positive charges. During the purification of the petrol, it was noted that electric charges were produced by filtration. PIERRE JOLIBOIS and PIERRE DE BECO : Faraday's law and electrolysis by the spark. W. UYTERHOEVEN and C. VERBURG : The temperature of the electrons ($T_\varepsilon$) in a discharge in the positive column in a neon–sodium mixture. ROBERT J. WALEN : The disintegration of boron by neutrons. GEORGES GOLDFINGER : Study of the photochemical decomposition of azomethane. No definite order can be assigned to the reaction. It may vary between 0 and 2. The experimental results are given graphically. RENÉ AUDUBERT and OTAKAR VIKTORIN : The emission of ultra-violet light during the anodic oxidation of aluminium. WILFRIED HELLER : The dynamic principle of thixotropic solidification and its application. JEAN AMIEL : The application to the slow combustion of benzene of the theory of chain reactions. The author shows that there is no real contradiction between his experimental results and those of Hinshelwood and Fort. A formula is developed which accounts qualitatively for both sets of experiments. GEORGES COSTEANU and PAUL RENAUD : The diffusion of gases on leaving capillary tubes. MLADEN PAIĆ and MLLE. VALÉRIE DEUTSCH : The absorption of proteins. The influence of salts on the adsorption of hæmoglobin by kaolin. MARCEL PATRY : The potassium tellurates. Analogy with sulphates and selenates. The potassium salts, metatellurate, selenate and sulphate, give analogous X-ray diagrams. The metatellurate is not isomorphous with the osmate. ETIENNE CANALS, MAX MOUSSERON, LOUIS SOUCHE and PIERRE PEYROT : The Raman spectra of some substituted cyclohexenes. PIERRE CARRÉ and P. JULLIEN : Pyruvyl chloride. One of the products of the reaction between thionyl chloride and pyruvic acid in the presence of pyridine is pyruvyl chloride. It could not be isolated but was identified by forming its anilide. GILBERT MATHIEU : The Givetian age of the marbles of Ville-Dé-d'Ardin (Deux-Sèvres). DANIEL BARBIER, DANIEL CHALONGE and ETIENNE VASSY : The measurement of the amount of ozone in the lower layers of the atmosphere during the winter at Abisko (Swedish Lapland). MLLE. MADELEINE FOURCROY : The progressive attenuation of the acceleration transmitted to a rootlet by a wounded root. JEAN CHAZE : Complements to the study of the humoral properties of the mushroom towards the mole. MLLE. ANDRÉE TÉTRY : Description of a worm new to the French fauna, *Eisenia metallorum*. RADU VLADESCO and GEORGES NICHITA : The influence of pilocarpine on glandular and muscular metabolism. ANDRÉ KLING and GUY LECORDIER : The influence exerted by vitamin D and by certain cancer forming hydrocarbons on the values taken by the hydrophily coefficient of the lipids. JACQUES POCHON : Ubiquity and plasticity of *Plectridium cellulolyticum*.

### AMSTERDAM

Royal Academy (*Proc.*, **39**, No. 4, April, 1936). F. M. JAEGER, E. ROSENBOHM and R. FONTEYNE : The exact measurement of the specific heats of metals at high temperatures (23). The calorimetric, electric and thermoelectric behaviour of ductile titanium. (1), (2) and (3) Measurements on purest titanium of the specific heat, electrical resistance and thermoelectric E.M.F. against gold show the transition point $\alpha \rightarrow \beta$ titanium at 905° C. as well as a number of subsidiary transition points, the nature of which is investigated. E. ROSENBOHM and F. M. JAEGER : The determination of the thermoelectric force of metals in a vacuum by means of the photographically recording double galvanometer. Application of the Saladin–Le Chatelier method to the determination of the electrical resistance of iron and the thermoelectric forces of the Fe-Cu and Ni-Cu thermocouples at high temperatures. A. VAN KREVELD and L. S. ORNSTEIN : The most general photographic density law. Mathematical discussion of the most general law and comparison with experimental data. L. S. ORNSTEIN and H. BRINKMAN : Remark on the paper "The Mechanism in the Positive Column of a Discharge". Generalisation of an equation given in a previous paper by the authors and T. Hamada. J. DE VRIES : Configurations of points and circles. J. G. VAN DER CORPUT : Distribution functions (7). J. G. VAN DER CORPUT : On some Vinogradoff methods (2). R. WEITZENBÖCK : On the theory of $p$-relations. A. A. NIJLAND : Mean light curves of long-period variables (27). R. Canum Venaticorum. The light of this star varies with a period of 326 days and an amplitude of 2 magnitudes. J. H. DE BOER, W. G. BURGERS and J. D. FAST : The transition of hexagonal $\alpha$-titanium into cubic $\beta$-titanium at a high temperature. Electrical resistance and X-ray measurements indicate the existence of a transition at $882 \pm 20°$ C. C. S. MEYER : Some integrals from the theory of Bessel and Whittaker functions (2). C. A. SPIERENBURG : The comitant system of a cubic and two quadratic binary forms. M. P. BOTH : Transport of nitrogenous substances under the influence of differences in humidity. Transport occurs when there is a difference in humidity between different leaves, and takes place through the sieve tubes. B. VAN DER EYKEN : Dentition and teeth development in the irisforelle (*Salmo irideus*) (4). Intermaxillary and ploughshare bone. J. OHM :

Interference of several kinds of nystagmus. A. DE BUCK: Degenerated cysts and black spores in *Anopheles* infected with benign tertian malaria. Typical banana-shaped black spores are not found before the cysts reach maturity, and are never found in uninfected *Anopheles*.

### CRACOW

Polish Academy of Science and Letters, March 2. F. LEJA: A family of harmonic functions in the plane connected with a given function on the frontier of a domain. T. BANACHIEWICZ: Various points concerning the theory of stars with eclipses. E. R. SMITH and M. WOJCIECHOWSKI: A differential method for determining density by means of twin flasks. The method is capable of measuring the density of a solution of heavy water in comparison with that of ordinary water with an accuracy of one part per million. B. KAMIENSKI and B. ZAPIOR: The dielectric potential and surface tension of β-eucaine, procaine and orthocaine for various concentrations of hydrogen ions. J. TOKARSKI: The podolian loess. (2) The physiography of the podolian loess and the problem of its stratigraphy. J. LATKOWSKI and MLLE. B. CHARLAMPOWICZ: The biological action of short waves ($\lambda = 6$ m.). Physico-chemical and morphological researches on the influence of short waves on the composition of the blood. The modifications observed are attributed to the rise of temperature produced in the blood of the animals examined. S. KÉLER: *Hordahlemia*, a new species of the genus *Mallophaga*. H. LICHE: Contributions to the ethology of the Dermestes (Coleoptera). MLLE. J. ACKERMANN: (1) Methodical researches on the determination of lipids in the organs of animals. (2) Experimental histochemical researches on the metabolism of lecithine in the animal organism. The absorption of lecithine in the intestine.

### MOSCOW

Academy of Sciences, *C.R.*, **1**, No. 4, 1936. J. A. MINDLIN: Expansion of any function into a Schlömilch series. A. POLAK: Open expressions and stable transformations. Z. SURIKOVA: Generalised linear differential systems. N. MOISSEJEV: Unessential character of one of the limitations imposed on topographical systems in Liapunov's theory of stability. K. M. KOSONOGOVA: A new method of photography. The new process is based on the combined action of light and electrochemical polarisation. P. PAVINSKIJ: Heisenberg's oscillator model and nuclear momenta. D. AVADALIAN: Exothermic transformations of aluminium oxide. A. J. CHARIT and N. V. CHAUSTOV: Flavins and metabolism (4). Flavin content in the liver of cattle during different seasons. M. MITZKEVICH: Stimulating action of 'catabolists' on the regeneration of the extremities in *Triton cristatus* and *Amblystoma tigrinum*. H. FRIESEN: Cosmic rays and mutations. No increase in mutations was observed in *Drosophila* exposed to cosmic rays of great intensity during the stratosphere ascent to the altitude of 15,900 m. (see also NATURE of May 23, p. 870). P. A. SCHWARZ and S. F. KUZMIN: Investigation of the potato in its genetic aspect. (1) Protein content of certain species and hybrids of potato. J. M. URANOWSKY: Determination of the longitudinal axis of extremities in the transplantation of regeneration buds in a late stage.

## Forthcoming Events

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

### Monday, June 15

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Miss Mary Doveton: "Economic Geography of Swaziland".
A. Geddes: "Population Maps of Bengal".

### Tuesday, June 16

EUGENICS SOCIETY, at 5.15.—(at the Linnean Society, Burlington House, Piccadilly, W.1).—Dr. R. B. Cattell: "Is National Intelligence Declining?"*

ROYAL STATISTICAL SOCIETY, at 5.15.—(at the Royal Society of Arts, John Street, Adelphi, W.C.2).—Prof. Major Greenwood, F.R.S.: "English Death Rates, Past, Present and Future" (Valedictory Address as President).

INSTITUTION OF CIVIL ENGINEERS, at 6.—Asa W. K. Billings: "Water Power in Brazil, with Special Reference to the São Paulo Development" (Special Lecture).

### Wednesday, June 17

ROYAL METEOROLOGICAL SOCIETY, at 5.—Discussion on "Thunderstorm Researches" to be opened by Prof. T. H. Laby, F.R.S.

### Thursday, June 18

ROYAL SOCIETY, at 4.30.—Dr. F. H. A. Marshall, F.R.S.: "Sexual Periodicity and the Causes which Determine it" (Croonian Lecture).

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INSTITUTION OF ELECTRICAL ENGINEERS, June 15–20. Summer Meeting to be held in Glasgow and the West of Scotland.

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## Official Publications Received

### Great Britain and Ireland

The Institution of Professional Civil Servants. Annual Report of Council for the Year 1935. Pp. xiv+46. (London: Institution of Professional Civil Servants.) [185

Proceedings of the Royal Irish Academy. Vol. 43, Section B, No. 1: The Pigment of the Flowering Currant (*Ribes sanguineum*), varieties *Splendens* and *Atrosanguineum*. By Dr. Thomas J. Nolan and Thomas G. Brady. Pp. 12. 1*s*. Vol. 43, Section B, No. 2: A Note on Dalradian Pillow Lavas, Strabane, Co. Tyrone. By Dr. William J. McCallien. Pp. 13–22+1 plate. 1*s*. Vol. 43, Section B, Nos. 3 and 4: The Physiological Basis of the Sensation of Cold; iv. An Analysis of the Influence of Temperature and of Thyroid Extract on the Oxygen Consumption of the Anaesthetised Rabbit; v. The Relation between Basal Metabolism, the Regulation of Temperature and the Sensation of Cold. By J. M. O'Connor. Pp. 23–42. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [185

The Carnegie United Kingdom Trust. Twenty-second Annual Report, January–December 1935, approved by the Trustees at their General Meeting held on Friday, March 6th, 1936. Pp. vi+103+4 plates. (Dunfermline: Carnegie United Kingdom Trust.) [195

### Other Countries

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 15, No. 4: Die Während der schwedischen Expedition nach Spitzbergen 1898 und nach Grönland 1899 eingesammelten Harpacticiden. Von Karl Lang. Pp. 55. Serien 3, Band 15, No. 5: Femte jämförelsen mellan Svenska Riksprorotyperna för metern och kilogrammet och mynt- och juste- ringsverkets huvudlikare. Av A. Grabe, T. Swensson och E. Walldow. Pp. 57. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.) [125

Ochrona Przyrody: Organ Państwowej Rady Ochrony Przyrody. Rocznik 15. Pp. vi+338. (Kraków: Państwowej Rady Ochrony Przyrody.) 7 zl. [155

Instituto Español de Oceanografía. Notas y Resúmenes, Serie 2, No. 86: Hidrografía del Estrecho de Gibraltar en Marzo de 1933 (Campañas del guardacostas *Xauen*). Por Prof. Rafael de Buen. Pp. 16. Notas y Resúmenes, Serie 2, No. 91: Caracteres oceanográficos del Estrecho de Gibraltar en 1934 (Campañas del *Xauen*). Por Prof. Rafael de Buen. Pp. 20. Trabajos, No. 14: Condiciones oceanográficas de la costa Catalana entre la frontera francesa y el Golfo de San Jorge (Campañas del *Xauen* en Marzo de 1933 y de 1934). Por Prof. Rafael de Buen y Francisco de P. Navarro. Pp. 47+1 plate. (Madrid: Instituto Español de Oceanografía.) [155