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## The Universities and Technical Training

PROF. MAJOR GREENWOOD'S attempt to assess the functions of university education in the conditions of to-day in his stimulating presidential address on university education last November to the Royal Statistical Society, which has recently been published (*J. Roy. Stat. Soc.*, 98, 1; 1935), deserves more than passing attention. There has been much criticism of the efficiency of university education from an industrial point of view, and what has been said about the evils of specialisation and the shortcomings of the graduate in some highly specialised branches of knowledge has scarcely been too strongly expressed. It must be remembered, however, that the graduate is largely the product of a system, and in the average man his merits and demerits at this stage are less the outcome of personal idiosyncrasy than the result of the system under which he has been trained.

This indeed has been fully recognised in such recent discussions as those before the Glasgow Section of the Society of Chemical Industry on the "Education of the Industrial Chemist", or that following Dr. Underwood's address on "The Chemical Engineer and his Training for Industry" before the Manchester Section of the same Society. Both schools of thought to be found at the present time are opposed to excessive specialisation before entering industry. The difference between them lies rather in that one school would confer the technical knowledge and training after entering industry, while the other wishes to carry university or technical training to a point at which the graduate is almost immediately of direct service to industry.

The existence of such divergent opinions is a matter of some embarrassment to those responsible for educational policy at the present time, particularly that of the technical colleges. Generally speaking, it is only the large companies or combines that can afford to devote the first six months or year after a graduate enters their service to definite training courses calculated to give him a grasp of the industry and to test his qualities and particular gifts. The smaller firms require men who can offer an immediate return, if only in the fulfilment of routine duties while gaining a modicum of experience. To them it is highly important that the graduate should have had some broad training in the particular branch of technology underlying their industry.

The comparative indifference of the larger firms to training in technology when selecting staff cannot but have a considerable effect upon the training given in the technical colleges, particularly in the full-time courses, and there is already evidence that even an honours degree in a branch of technology has no advantage over an honours degree in a branch of science when the general training accompanying the latter has been broad and sound. Moreover, it was evident in the discussions at Glasgow that the possession of a 'pass' degree with its grounding in several branches of science is regarded with increasing favour as a satisfactory qualification for entry even to the smaller firms, where promotion may be to chief chemist or engineer, works manager, or the like. A recruit is not expected to possess a large stock of practical knowledge, but high scientific qualifications and a capacity for independent work.

These reasons alone may lead to some change in the functions which technical colleges fulfil in the social and industrial conditions of to-day. Apart from this, there are other factors which are tending to change the functions of university education also. The emphasis on the utilitarian aspects is diminishing. Education is no longer supported, as Prof. Greenwood pointed out, on the ground that the technical efficiency of the educated is in the long run greater than that of the merely instructed, that an educated nation would be better fitted to secure advantages in the international struggle for markets than an uneducated nation. Already there is a demand for higher education for its own sake, not for some material or social advantage it confers but as a path to happiness.

This change is highly significant. It bears closely on the problem of leisure and on the raising of the school-leaving age. It is one of the weightiest objections to the trade continuation school advocated by Sir Kenneth Lee and others as alternative to raising the school-leaving age. The more nearly education at whatever stage succeeds in teaching principles, not practice, in training the mind without neglecting to train the hand, and in sending out those whose training and outlook enable them to attack with confidence the new problems that are perpetually arising, the more it will provide society with those who are capable of adapting themselves quickly and harmoniously not merely to particular industrial positions but also to the utilisation of leisure and the problem of citizenship generally.

Such questions cut deeply into our whole educational system. As Mr. H. T. Tizard pointed out in his presidential address to Section L (Educational Science) at the Aberdeen meeting of the British Association last year, it is no simple matter to encourage a broader education. A policy of making scholarships in science deliberately available for those who have not specialised in science, which the Imperial College of Science and Technology has initiated, would do much to discourage that excessive and premature specialisation in science at school which is a root cause of the lack of culture and sense of values possessed by many honours graduates in science to-day. Such a policy, however, cannot succeed unless it is supported both by the schools and the larger universities, and as Mr. Tizard trenchantly remarked, if it is not considered worth while to reform the university matriculation examination in this way, criticism of the general education of the science student loses most of its point.

There is a further point to be considered in this question of education for life, for leisure as well as for industry. Prof. Greenwood suggested that the total collapse of political freedom throughout the greater part of Central and Eastern Europe is mainly due to the fact that the populations were not educated at all. Instruction may be confused with education when it is a mere question of technical skill for some particular occupation. Such confusion can never exist when we consider the effect on the whole man, and recent events in Germany have made patent the defects in elementary instruction as compared with education. Moreover, the evidence suggests that the present rulers of Germany, so far from making higher education more accessible to the public, are deliberately making it less accessible.

These considerations are not lightly to be dismissed. The dissociation of higher education from industrial or social status may be an essential element in a policy which will provide society with citizens possessing the requisite background of knowledge in this scientific age, for the adequate discharge of civic duties no less than to meet industrial needs. The mere increase of technical efficiency will not avert disaster. The capacity to live fuller and happier lives, to enjoy leisure with less dependence on the service of others—these are closely related to the question whether civilisation is to gain control over the forces placed in its hand or whether it is to relapse as a whole into comparative barbarism.

The functions of a university in the world of to-day cannot be considered apart from the functions of education as a whole. It is no longer sufficient for the universities to provide society with the leaders it requires in the professions, in industry or in the State. More and more it has to assist in developing that background against which constructive virile citizenship is possible, to provide in every sphere of life the mental stimulus and corrective to those habits of mind and tactics which, carried over from an old order, are obstacles to the development of the new. It is in this sense that, as Col. A. G. Lee remarked at the recent Conference of Industrial Physics in Manchester, we require more social workers, and that organisations such as the Institute of Physics should seek to awaken the country to the necessity of adjusting physical discoveries to the rate of advance in economic affairs, so that we can enjoy the leisure and wealth created by the physical sciences.

The ideals of a university set forth by J. H. Newman, Mark Pattison and Walter Bagehot or

J. S. Mill, in essentials, differ little from those expressed by Dr. Abraham Flexner or Prof. Alexander in recent years. Their functions, on the contrary, are rapidly changing, and the future of civilisation depends largely on the skill with which the functions of the universities are adapted to the needs of to-day. Mechanical organisation is never an adequate substitute for effective social organisation or for a sound biological adaptation, and Prof. Greenwood's address should stir scientific workers to probe far more deeply into the question than merely to discuss the best training to be given to chemists or physicists for industry. From the universities, after all, must come once more that floodtide of intellectual life, that spirit of unprejudiced search for truth, which will disdain merely to copy, and will ensure that the mechanisation of life proceeding so fast, follows, not the economic or technical pattern of the past, but develops new structures adapted for the purposes of to-day, and releases for mankind a wealth of creative energy and intellectual power worthy of the discoveries which gave them birth.

## Reviews

### Bull-Worship in Ancient Egypt

*The Bucheum.* By Sir Robert Mond and Oliver H. Myers. With Chapters by T. J. C. Baly, D. B. Harden, Dr. J. W. Jackson, G. Mattha and Alan W. Shorter, and the Hieroglyphic Inscriptions edited by H. W. Fairman. (Forty-first Memoir of the Egypt Exploration Society.) Vol. 1: *The History and Archeology of the Site.* Pp. xii+203. Vol. 2: *The Inscriptions.* Pp. iii+92. Vol. 3: *The Plates.* Pp. iv+173 plates+iv. (London: Egypt Exploration Society; Oxford University Press, 1934.) 50s. net.

NO animal has had a more consistently honourable place in the life of the Egyptians than the ox. The earliest human settlements contain remains which indicate the domestication of cattle, while the special treatment of skeletons in an associated cemetery suggests some sort of veneration already at this date. Before the historic period, ox-headed amulets have appeared. The famous ceremonial palette of the First King of the First Dynasty depicts the Pharaoh as a bull trampling his enemies underfoot—a conception to be made explicit 1500 years or so later, and maintained thereafter until the end of the Dynasties, by the inclusion of a "Strong Bull" name in the royal protocol. Hathor was not the only cow-goddess, and mythology could show other bulls

and cows who did not claim the full status of divinity. To-day the buffalo, though often with a camel for yoke-mate, draws virtually the same plough as is to be seen behind the cattle on the walls of tombs of the Old Kingdom. Small wonder that the three sacred bulls, the animal theophanies of three different and major gods, of the separate worship of which we are certain, are among the most important animal cults known in ancient Egypt.

Bull-worship in Egypt is in fact a large subject for which a great deal more evidence and study is required before much can be said about it, and even the elaborate researches underlying the three volumes under review admittedly only approach the subject. Of the three great cults, that of Apis at Memphis-Saqqarah is the best known, and has left behind the most concrete remains. But the great underground cemetery of these bulls was excavated more than eighty years ago, when methods were less scientific than they are to-day, and a mass of invaluable information, from a site which was for many reasons much richer than that of the Bucheum, was lost. The ancient worship of Apis, however, was used by the Ptolemies as a basis for a mixed mystery cult for their Greek followers, and in the new name of Serapis spread beyond the borders of Egypt. While the crumbly soil of the Bucheum easily gave way, frequently before the

excavator's eyes—as it evidently must have done while the mausoleum was still growing—the vaults of the Serapeum remain to-day one of the important sights of Egypt. The burial stelæ of Apis have given us invaluable chronological checks for the twenty-sixth dynasty. His worship can be shown to go back to the Old Kingdom. In short, the sum of our knowledge of Apis, always the most important, is much greater than that of Buchis, perhaps the least of the three sacred bulls. Hence a brief account of Apis has been given in "The Bucheum" as the basis of the attempt to reconstruct the story of Buchis. On the other hand, much that was known about Apis at second hand only has been confirmed by the actual remains in the cemetery of Buchis, while our knowledge of the original appearance of the Apis burials and their method have been very largely supplied by the careful excavation of the other.

From Mnevis, the bull sacred to Rē' at Heliopolis, little help is to be had. Only two of his tombs have been opened. But from contemporary literature, it appears that his cult was older and more important than that of Buchis—as old, probably, as that of Apis.

There is singularly little material from which to write the history of Buchis. Under that name he does not come into existence until the reign of Nekhtorheb of the last native Egyptian dynasty—a king who gave marked encouragement to the indigenous cults of Egypt and especially that of Apis. The name Buchis (*Ba-hr-khet* or *Bakhe* in Egyptian), however, seems to have been no more than an enhancement of the status of a sacred bull which had represented from the eighteenth dynasty, if not from the twelfth, the God Mentu of Thebes in four different appearances, corresponding with four different towns of the Thebaïd.

At the same time, it is evident that he was even more intimately connected with Rē'. But while bull worship in Egypt was always connected with solar religion, it is by no means clear that Mentu himself was originally a bull-god. Anterior to the twelfth dynasty, it is not possible to trace the bull that became Buchis, unless we assume that his worship was instituted at that date as a southern counterpart of Mnevis. For Hermonthis, the seat of Buchis eventually, was called in Egyptian 'Southern *On*', while Heliopolis, or *On*, in the north, was the home of Mnevis.

"The Bucheum", then, is the definite publication of the excavation of the cemetery of the sacred bull Buchis and that of the cows who had borne Buchis bulls. The cemeteries lie in the desert two or three miles west of the site of Hermonthis (modern Armant) and about ten miles south of Thebes. Their discovery (in the archaeological sense) was not an accident. Native plunderers

had already placed objects now recognised as from the Bucheum on the antiquities market; and there were stories going about which might or might not mean anything. Armed with these fragments of evidence and the brief references to the bull in classical authors, Mr. W. B. Emery, at that time excavating among the tombs of Gurneh for Sir (then Mr.) Robert Mond, spent the greater part of his leisure examining the desert nearest to the village of Armant, where he was confident a second Serapeum was to be sought. It was a carefully worked-out investigation, and the first fortnight's work showed the excavators that they had landed on top of the cows' vaults. The next season, again initiated by Emery, though under the general direction of Frankfort, they dropped directly on to the most sumptuous of the bulls' burials. The success that followed, and finds completion in the present publication, has no doubt obliterated from most minds the memory of the almost universal scepticism, in the face of which Sir Robert Mond decided to move his dig from the classical site of the Theban necropolis to a barren stretch of ground which his colleagues promised would yield only a mare's nest.

If unusual courage and judgment was shown at the outset, the conclusion in the form of the publication is even more remarkable. Excavation reports are as a rule highly technical affairs and dull enough as general reading. The excavation of Buchis yielded about forty tombs of bulls and as many cows, all subterranean. Little is now to be seen on the site, and except for the stelæ, not much more in museums. There are singularly few concrete remains—for a number of reasons—of what was a most important phase of Egyptian life. With one very interesting exception, the sum of our new knowledge resulting from the excavations is confined to a comparatively small, though important, sector of the field of Egyptological research. Yet it has taken three large volumes to say all this, and generally speaking, not only is the size of the publication justified, but also it may be said to constitute a step forward in archaeological science, and to set up a new standard for future work.

"The Bucheum" is an advance on previous excavation memoirs for two reasons. First it is an attempt to deal fully and finally, in so far as the material is available, with the field of study illumined by the excavation of the Bucheum, not merely to record those excavations and draw inferences from them, *within a year or two after the close of work on the site*. Secondly, the principle of seeking expert opinion on every detail of the find has been carried out in it to a greater extent than in any other work of this kind known to the reviewer. There are in fact thirty contributors to

the book, specialists ranging from Coptic to musical instruments, from petrology to Arabic inscriptions, besides another score of experts named whose opinions have been taken on specific points. To Mr. O. H. Myers has fallen the task of holding the team together, and since there was something in the nature of pioneering about it, some unevenness was to be expected and may be passed over. Mr. Myers has also contributed, as director of the excavations during the last two seasons' work, the bulk of the chapters on the history of Buchis, the site, architecture, etc., together with a very elaborate study of the Demotic ostraca, full transcriptions and translations of which form a separate chapter by Mr. G. Mattha in vol. 2.

The outstanding contribution to the work, both for its scholarship and as the main source of new knowledge acquired, is the chapter by Mr. H. W. Fairman on the hieroglyphic inscriptions. The bulk of these, and the most important, are the stelæ set up to each bull, on which are recorded the dates of their birth, installation and death, together with their ages. Here and there an additional comment of historical or sociological importance creeps into the more or less stereotyped formulæ in which the ceremony of installation is described. Once, by the mention of a queen in a royal titulary, whom Fairman proves to be none other than Cleopatra VI, we are lifted for a moment out of the academics of a little-known animal cult in Upper Egypt, into the heart of international politics in a world disputed by Antony and Octavian. How significant such a small detail may be is to be read in Mr. W. W. Tarn's chapter on "The Triumvirs" in vol. 10 of the "Cambridge Ancient History", where Cleopatra's installation of a new Buchis at the beginning of her reign provides important evidence for her popularity with the Egyptians and for her support of the native religion.

Sir Robert Mond has set up a new standard in archaeological publications, which will not easily be repeated. The expense involved in the production of such a work, requiring considerably longer and more concentrated research than can be squeezed into the leisure between successive excavation seasons, is in itself beyond the purse of most bodies such as the Egypt Exploration Society, which was responsible for the greater part of the excavation and for the publication of "The Bucheum". Sir Robert not only provided those funds, but has also allowed the book to be published at a price within the reach of students, to whom a three-volume memoir of this size would normally be unavailable. It is in fact a standard which can only be maintained so long as archaeology can find patrons.

## The New Knowledge of Hydrogen

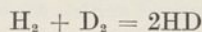
*Orthohydrogen, Parahydrogen and Heavy Hydrogen.*  
By Dr. Adalbert Farkas. (Cambridge Series of Physical Chemistry.) Pp. xiv+215. (Cambridge: At the University Press, 1935.) 12s. 6d. net.

WHEN chemists are told that since the principles governing the outer sphere of the atom are now established, there is little interest left in pure chemistry, they should turn for comfort to contemplate our new knowledge on hydrogen. The book under review will give them competent guidance.

The first half of the book deals with the ortho- and para-modifications of hydrogen proper, the second (smaller) half with heavy hydrogen. Whilst the former presents a well-established body of knowledge, the latter outlines the beginnings of a new, yet unlimited, field of research.

The author, well known by his researches on ortho-, para- and heavy hydrogen, marshals the various features of his subject with equal ease. The quantum mechanical theory and the spectroscopic evidence by which the existence of ortho- and parahydrogen were predicted; the delicate heat conductivity method by which the ortho and para contents of hydrogen are determined; the theory of heat capacity and of other thermodynamic properties of the two modifications are set out with equal precision. The problems of chemical kinetics, arising from the wide range of observations on the conversion of orthohydrogen into parahydrogen are discussed with similar mastery of facts and theories.

To the chemist, these various conversions are the most interesting part of the subject. Not all conversions are based on atomic interchange between a pair of molecules. Comparison with the reaction



has now definitely established this fact.

The interchange between the atoms of hydrogen molecules is caused by the contact with hydrogenating and reducing catalysts. Comparison between the catalysed process of atomic interchange, and the catalysis of the chemical reactions of hydrogen, will show definitely whether this catalysis is based on a preliminary breaking up of the hydrogen molecule, or whether we have to envisage other methods of 'activation' of the hydrogen by the catalyst.

A wider scope for the study of the atomic interchanges of hydrogen which accompany chemical reactions is opened by the discovery of heavy hydrogen. The presentation of this discovery and of the rapidly growing knowledge derived from it embraces the most varied aspects, ranging from

nuclear disintegration to the metabolism of bacteria. Here again we find theory and experiment presented with equal clarity.

This review of our knowledge of heavy hydrogen will be welcomed just as much as the presentation of our knowledge of orthohydrogen and parahydrogen. The linking up of both subjects in one volume may, however, have some disadvantages. The rapid advancement of research on heavy hydrogen tends to make a review written to-day soon become obsolete. It would be regrettable if this should endanger the future popularity of the book, the first half of which will probably retain its usefulness for a long time.

The enduring value of the book lies in the fact that it sets an example for the new spirit of physical chemistry, in which the fusion of physics and chemistry, of theory and experience, should be complete.

### Introductory Logic

*The Principles of Logic: an Introductory Survey.*

By C. A. Mace. Pp. xiii+388. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 12s. 6d. net.

MR. MACE'S purpose is to help students who begin the study of logic, and to supply them with a mental discipline by acquainting them with genuine logical problems rather than by forcing upon them the technicalities of traditional exercises. The "Principles of Logic" will be found extremely valuable by all those who already know some logic. But it is difficult to say whether beginners could master in one year the theories and problems so excellently treated in this book.

The increasing complexity of logical systems makes it more and more difficult to teach logic in its present-day setting to first-year students, who may not have much natural aptitude for the subject and cannot have the philosophical training which, in all fairness, should be assumed for a serious reading of Mr. Mace's book.

The pedagogical problem involved concerns less the students or the teachers themselves than the actual status of logic in our educational system. In order to make sure that students master the rudiments of sound reasoning before attempting prematurely to deal with problems which may be beyond them even later on, lecturers have to check their natural inclination to acquaint their students with some fundamental developments of logic. This difficulty could be easily redressed if logic were given a place in our schools.

Without attempting to deal here with the various details of the theories so very ably analysed and explained, we may indicate two of the principal features of the book. A chapter on the "General Theory of Deduction" introduces in a simple way the principles of symbolic logic; and, secondly, the author has taken great pains in bringing together, often with important additions of his own, the contemporary efforts to improve Mill's theory of induction. Though Mr. Mace treats his problems without exhibiting a partisan attachment to a school, he nevertheless favours the views of logical analysis as against the ontologism of the Aristotelian tradition; while, in the last chapter of his book, he seems to share a kind of pragmatism which may easily turn to scepticism. But after all, is it possible to have any logic without some conscious philosophical background?

### Short Notices

*Index Generalis. Quinzième édition française. Annuaire général des Universités et des Grandes Écoles, Académies, Archives, Bibliothèques, Instituts scientifiques, Jardins botaniques et zoologiques, Musées, Observatoires, Sociétés savantes.* Publié sous la direction de Dr. R. de Montessus de Ballore. Pp. vi + F176 + US228 + BE232 + 1284 + 1921 to 2462. (Paris: Éditions Spes, 1935.) 225 francs.

THE "Index Generalis" began publication shortly after the close of the War, when "Minerva", hitherto the standard reference work to the learned world, had suffered considerable reduction of size. "Minerva" has developed since then into two portly volumes, but the price in English money effectually prohibits their general use except in the wealthiest of institutions. The "Index Generalis", now in its fifteenth year, is a useful single volume substitute.

For those not familiar with the "Index", its arrangement is a little peculiar. The first section

deals with the university institutions of France and its colonies, including a brief statement on general entrance conditions and, under each institution, number of students, budget and a list of the staff with their subjects. These page numbers are preceded by the letter 'F'. Succeeding sections, each with fresh pagination and with the letters 'U.S.' and 'B.E.' respectively, deal similarly with the United States and the British Empire. The remaining countries of Europe, Africa, America and Asia are covered in the next section, which again has new pagination, but without distinguishing letters. Succeeding sections, the pagination continuing, contain details of observatories, libraries, scientific institutions and learned societies respectively, the entries being arranged alphabetically by countries. Then comes the alphabetical index of the personnel named in the text, reference being facilitated by the addition to the page number of a numeral (1-8) indicating

position on the page. A useful list arranged by subjects gives the names of those willing to exchange publications, and there is a geographical index.

The 1935 issue of the "Index" is now available, and the 'working part', the index of personnel, runs to 443 three column pages of small but clear type. The volume should be of service to all who have occasion to deal with scientific and learned institutions. The information published, for the insertion of which no charge is made, is obtained directly from the institutions themselves, and the editor, Dr. R. de Montessus de Ballore, Sorbonne, Paris, 5, informs us that he welcomes corrections and additions to his valuable handbook. We hope this hint will catch the eye of those responsible in the U.S.S.R. for the lack of information from that country.

*Rayleigh's Principle and its Applications to Engineering: the Theory and Practice of the Energy Method for the Approximate Determination of Critical Loads and Speeds.* By Prof. G. Temple and Prof. W. G. Bickley. Pp. ix+156. (London: Oxford University Press, 1933.) 14s. net.

PROFS. TEMPLE and Bickley have exemplified and extended a principle put forward by Rayleigh so far back as 1877, a principle which, concerned primarily with the calculation of the fundamental frequencies of vibrating systems, has applications to problems of elastic stability, and to various equilibrium configurations of interest and importance to engineers. In the words of the authors, the principle may be enunciated briefly, thus: "In the fundamental mode of vibration of an elastic system, the distribution of kinetic and potential energies is such as to make the frequency a minimum".

Suppose, then, we are faced with a vibrating system the fundamental frequency of which we find it difficult, or impossible, to compute. Let us constrain the system to vibrate in a specified manner in which the mode of vibration is (mathematically) known, and approximates as closely as may be to the mode of vibration of the actual system. We can, by an application of the energy method, calculate the frequency of this artificial system; and the frequency of the actual system will, in general, be less than (in some limiting cases, equal to) this calculated frequency. The difficult task of determining the magnitude of the error has been attacked by Dr. Temple, and we are fortunate in possessing in such an easily accessible form the record of his very interesting results.

The power of the method is shown by a series of thoroughly practical illustrative examples, and the book, which is a very important addition to the literature of physics and engineering, has been written with a mind sympathetically disposed to the capacities of those weaker brethren to whom an austere mathematical argument makes but little appeal. Which is not to say that the book lacks in mathematical rigour, but merely to hint that easier paths are provided for the less mathematically minded.

A. F.

*Physique moléculaire: matière et énergie.* Par Prof. Victor Henri. Pp. 436. (Paris: Hermann et Cie, 1933.) 110 francs.

THE present time appears particularly appropriate for an attempt to form a complete picture of our knowledge concerning matter and energy. Starting from the early controversies fought around the question of continuity and discontinuity, the author describes the origin of the atomic hypothesis, the idea of chemical elements and their periodic classification, and the methods of determining Loschmidt's or Avogadro's number. This is followed by an account of the properties common to all chemical elements, a history of the atom and of its spectral manifestations. The essential features of radioactivity, radioactive elements and isotopes are set out in an easily intelligible and attractive form. Throughout the book are scattered many historical data, useful formulæ and illustrative numerical examples. Particular praise must be given to the line diagrams which are, with few exceptions, models of clearness.

*Handbuch der wissenschaftlichen und angewandten Photographie.* Herausgegeben von Alfred Hay. Band 6: *Wissenschaftliche Anwendungen der Photographie.* Teil 2: *Mikrophotographie.* Bearbeitet von T. Péterfi. Pp. ix+432. (Wien und Berlin: Julius Springer, 1933.) 51.60 gold marks.

THIS book gives a very full account of the modern state of photomicrographic technique in Germany. It constitutes, in fact, not only a textbook of the practice of the various methods, but also a fairly representative handbook on the apparatus manufactured by the various optical firms.

The trouble with a work of this kind is that its detailed character makes it difficult to read as a textbook. It can only function as a reference book, but as such it cannot fail to be of use to a serious worker. It is well printed and illustrated, and those who have occasion to use photomicrographic methods will be indebted to its author for such a useful piece of work.

*Check-List of Birds of the World.* By James Lee Peters. Vol. 2. Pp. xvii+401. (Cambridge, Mass.: Harvard University Press: London: Oxford University Press, 1934.) 17s. net.

THE appearance of the first volume of this most useful adjunct to the work of the scientific ornithologist has already been welcomed in NATURE. It is a book purely for reference, consisting of a systematic list of all known birds, with the authorities for the names used and the distribution of each form. The like has not been attempted on a world-wide basis for a generation, and as the plan and execution are admirable the completed work should be of great service. This second volume covers three great cosmopolitan orders—which incidentally include most of the birds of special interest to sportsmen—the megapodes and game-birds, the cranes, rails and bustards, and the plovers, gulls and auks.

## The Oxford University Arctic Expedition, 1935-36

By A. R. GLEN and D. B. KEITH

AN interesting feature of post-War university life has been the active part played by Cambridge and Oxford in exploration. This activity has by no means been limited to a few places, and to mention only one or two of the places visited, Cambridge expeditions have carried out useful work in various parts of Africa and in Greenland, while Oxford expeditions have obtained valuable scientific results in South America, Borneo and Spitsbergen. The first of this kind to spend a winter in the arctic was the British Arctic Air Route Expedition of 1930-31, and the expedition

A base hut will be built near the head of Rijp's Bay, and after all the stores and equipment have been landed, the ship will return to Norway. The plans are to carry out a topographical and geological survey of the unknown north and east coasts and of as many of the northern and eastern islands as time and ice conditions permit. In addition to the surveys, researches on the ionosphere, atmospheric ozone, electrical disturbances and terrestrial magnetism, will be carried on at the base over the whole year, and two winter stations are to be maintained on the inland ice

with the intention of trying to form an estimate of the present balance of glacial conditions, as well as investigating the crystallography of surface snow, firn, and of blue and white ice.

Finally, a fairly comprehensive biological programme is planned, and the land side of this, which will consist mainly of a study of the birds, will be under the direction of Mr. D. B. Keith, while the marine work will be in the care of the doctor.

In addition to general observations on the bird life, special attention will



FIG. 1. The lake country of north-east Spitsbergen. It is believed that similar country exists to the east of Rijp's Bay, and if so, it should be of considerable biological interest.

which was organised by Mr. E. E. Shackleton and led by Dr. G. N. Humphreys, now making its way from Etah to Ellesmere Land, is the first Oxford expedition to winter.

In July, another Oxford expedition is leaving England to spend fourteen months on the north coast of North-East Land. It is being organised by Mr. A. Dunlop-Mackenzie; Mr. A. R. Glen, leader of the 1933 Oxford University Arctic Expedition, is going as leader. The personnel of nine is made up by three surveyors, two physicists, a wireless operator, a glaciologist, a doctor who will also be in charge of the marine biology, and a dog-driver. The last, Mr. Andrew Croft, was a member of the British Trans-Greenland Expedition of last year, and will be second in command of the present expedition.

The sealer, the M.S. *Polar* of Tromsø, has been chartered, and it is hoped that the north coast will be reached during the first week of August.

be devoted to four problems. The first is that of the non-breeding years which seem to occur every fourth year in the Arctic. It is probable that 1936 will prove to be one of these, and if this should prove to be the case, the gonads of selected species will be examined (and preserved) in May, June and July, and an attempt will be made to discover if there is any evidence that the non-breeding is connected with the weather conditions of the summer or of the previous winter. It has also been suggested that exceptionally late breaking of the sea ice, or late melting of lake ice, might cause interference with the food supply of the birds, and this, together with any other factor affecting the food supply, will be examined. In the event of 1936 not being a year of extensive non-breeding, estimates of the proportion of breeding to non-breeding birds will be made, and this may give interesting results, as it is a subject on which very little work has been carried out.



It is hoped that it will be possible to make a detailed study of the snow bunting throughout the breeding season, with special reference to territory. Much work has been done and is being done at home on the breeding and territorial habits of closely allied species, and this should prove a valuable comparison, for not only is the habitat

population, and it is probably only through the blanketing effect of the silt brought down by en-glacial and sub-glacial streams that it is able to live in the extreme surface layer in this area. As a large glacier flows from the west ice of North-East Land into Rijp's Bay, and as it is the only glacier with a sea face in the bay, it will be of the greatest interest to discover whether the phenomenon is repeated in this area, and also whether it occurs in the other bays of the north coast of North-East Land.

The 130 miles of almost continuous ice cliffs on the east and south coasts may give interesting conclusions, especially as there are several islands off the northern part of the east coast which may offer suitable nesting sites. It is not intended to repeat this study in the detail with which it was carried out in 1933, but rather to see if the birds in these areas resort to these definite feeding zones, and to discover what effect the zones—if any—have on the distribution of the birds. The work will probably be correlated by observations on the marine fauna, and this will be under the direction of the doctor, who is the only member of the expedition not yet appointed.

Little is known of the breeding habits of the Spitsbergen ptarmigan, and there are no skins of the bird in breeding plumage or of the chicks at the British Museum (Natural History). It seems likely that the birds breed on moderately high ground, and that they come down to the coasts and low unglaciated ground when the snow limit



FIG. 2. One of the first colony of ivory gulls to be discovered in western Spitsbergen by the Oxford 1933 Expedition.

so vastly different from that of the species already studied, but also the snow bunting is the most northerly passerine and hence has no food competitors in the form of other passerines. The bird distribution will also be analysed from the point of view of food supply and nesting sites.

During the Oxford 1933 Expedition in Spitsbergen, Mr. Hartley and Mr. Fisher (*Geog. J.*, 84; Aug., 1934) carried out a detailed study of the marine feeding of sea birds, and correlated the facts with the conditions of the marine fauna investigated by Mr. Stott. The fulmar petrels and kittiwakes were found to have a feeding zone about 100 yards long and 50 yards across, close to the ice cliffs of the Nordenskiöld Glacier, at a point roughly half way from either shore (Fig. 3). This zone remained a permanent feature during July and August, and the normal number of kittiwakes was about 3,000, while that of the fulmars varied between 500 and 700, but these numbers rapidly decreased in the beginning of September. From analyses of a large number of stomach contents, the food was found to consist almost entirely of the Euphausiid *Thysanoessa inermis*, although an amphipod, *Euthermistes libellata*, occurred occasionally in small numbers. It was also found that *Thysanoessa* was the basic food of Arctic terns, Brünnich's guillemots and little auks, and also had place in the food of puffins, although these were mainly fish-eaters, and of Mandt's guillemots, which were found to feed also on the general bottom fauna of the inshore zone. Thus it is of the greatest importance to the bird



FIG. 3. Nordenskiöld Glacier sea-face, showing the cave in front of which was the zone frequented by fulmars and kittiwakes.

becomes lower with the approach of winter. Attempts will be made, therefore, to find their breeding places and to examine their winter distribution, as well as the change brought about in this by the approach of spring. Some years ago, reports were brought back from the Ice Fjord region of Spitsbergen that there were remarkable

fluctuations in the numbers of the ptarmigan, but it is very possible that the reports of the scarcity of the birds were made on the evidence of the summer months, when the birds may have been on relatively high ground. One of the parties of the Cambridge 1932 Spitsbergen Expedition spent some time in the Wijde Bay, and while there, found a considerable number of ptarmigan above the 1,500 ft. level. Only on one occasion, and then towards the latter part of August, were birds found below that height. Similarly in 1933, the Oxford Expedition in the north-eastern part of the Ice Fjord found only one family of ptarmigan during July and August, but in September large numbers of the birds were found in the low valleys, the snow level by that time being at about 600 ft. The reports of number fluctuations may thus, in part, be due to variations in the autumn weather conditions at the time when the ptarmigan are likely to be driven from the high ground by the approaching winter into the valleys, where they are most easily seen.

It is hoped that it may be possible to bring back the skins of certain species required by the British Museum (Natural History). Some collecting will be undertaken with the view of ascertaining crop and stomach contents, and all birds shot will be examined for lice, as the parasites of arctic birds are very little known. All bears and seals shot will likewise be examined for parasites. Every effort will be made, however, to restrict the shooting and hunting to a minimum, as the history of the fauna of Spitsbergen during the last fifty years shows only too clearly the havoc wrought by indiscriminate slaughter, although the efforts of the Norwegian Government during recent years are meeting with a well-merited success.

The general observations will include notes on such subjects as numbers, distribution, time of arrival and time of departure, and as no observa-

tions of this kind have yet been made from North-East Land, they may produce some interesting results. The only information brought back during the spring was that gained by Nordenskiöld as a result of his journey with Palander in 1873 along part of the north coast. The first birds to be seen after the winter were some glaucous gulls on March 3, and on April 3 the first snow bunting arrived. By the middle of May millions of sea birds had arrived in the fjords and were breeding on the precipitous slopes of the surrounding mountains, notwithstanding that there was no open water in the near neighbourhood. The length of time to be spent in North-East Land by the present expedition ought to give every opportunity for comprehensive study of this kind.

The remainder of the work will consist of straightforward botanical collecting, and will aim at making as complete an ecological survey as is possible. It is hoped, however, that it will be possible to make a detailed investigation of surface markings, and especially of the polygonal markings which appear to be characteristic of arctic and, to a less extent, of Alpine regions. Various studies have been made of these, and perhaps of greatest interest in this respect is the work which has been recently carried out by Mr. N. Polunin. It seems to be probable that the causes vary from place to place, and that no generally applicable theory can be framed; the investigations of the growth of the polygons over the year may, however, throw some fresh light on the subject.

Weather conditions naturally will control the degree in which the biological programme of the expedition is carried out, although it is much more independent of weather than the survey, for example. With a working period of fourteen months, there is ample scope for varied work. The expedition expects to return during the late summer of 1936.

### Cancer and the Theory of Organisers

By C. H. WADDINGTON, Christ's College, Cambridge

THE fundamental fact about cancerous tissue is that it has escaped from the normal growth-controlling agents of the body. The escape often involves a change in histological type. The problems which are raised are clearly connected with those studied in experimental embryology, where again it is the causal mechanism underlying growth and histological change which is under investigation. Experimental embryology has recently made important advances, and the time has perhaps come when it would be profitable to consider the way in which the new embryological

theories would formulate the well-known problems of cancer research.

The illuminating researches of Spemann<sup>1</sup> provided the beginning of an answer to the outstanding embryological problem of why one part of an egg develops into one organ and another part into a different organ. Spemann showed that in the amphibian gastrula the developmental path followed by any given piece of tissue is defined by its relation to the blastopore region, which was therefore termed the organisation centre. Further research has shown that one facet of the activity

of the organisation centre consists in transmitting a stimulus to the ectoderm which comes to lie above it, causing the latter to develop into the neural plate. This is a two-term reaction, between the stimulus (or evocator<sup>2</sup>), emanating from the organising roof of the primitive gut, and the overlying ectoderm. The ectoderm, it was found, will only react when it is in a reactive, or 'competent'<sup>3</sup>, state. Very little is known about the nature of competence or how it is acquired; probably changes are proceeding within the cells from the time of fertilisation onwards, eventually bringing them into an unstable state, when the evocator-stimulus is able to push them into one developmental path or another. The evocator stimulus has been shown to be due (both in the amphibia<sup>4</sup> and in birds<sup>5</sup>) to the presence of a chemical substance, as to the nature of which a great deal of research is being carried on at the present time.

The two concepts of evocators and competent tissues can be applied, with some modification, to the consideration of cancer. There is little evidence that the susceptibility of adult tissue to cancer-provoking agents varies in the same way as the competence of embryonic tissue varies with the passage of development, although the fact that cancer is to some extent an old-age disease may be suggestive in this connexion. But as between different individuals, the genetic differences in susceptibility to cancer may be considered as differences of competence in the genetically different tissues. Again, changes of competence need not be due to internal causes. Thus it has been suggested<sup>6</sup> that the mammary gland must be acted upon by oestrin before it is capable of reacting to the specific lactation hormone. One can phrase this either as a case in which oestrin brings about a change in the competence of the mammary gland, or one in which lactation depends on the consecutive action of two evocators. In dealing with the facts of the inception of cancer, it may be necessary to envisage similar chains of reactions.

Many types of cancer-producing stimuli, or 'cancer-evocators', have been described: viruses, specific chemical substances, spontaneous changes in the metabolism of the cells, general irritating agents, etc. Particular interest is attached to the sterol-like substances recently isolated and synthesised by Kennaway, Cook and their collaborators<sup>7</sup>. The evocator of the amphibian neural plate probably belongs to the same group of substances<sup>8</sup>. In fact the similarity is so close that one at least of the synthetic carcinogenic substances, namely, 1:2:5:6-dibenzanthracene, is probably capable of acting as an evocator when introduced into the amphibian gastrula<sup>9</sup>. The reciprocal experiment cannot yet be made, as the evocator has not yet been purified. Woerde-

man<sup>10</sup>, some time ago, had the idea that cancer tissue might be able to act as an evocator, and succeeded in confirming the suggestion; but unfortunately it did not occur to him that all adult tissues might have the same capacity, and he made no controls to exclude such a possibility. Later work by Holtfreter<sup>11</sup> and others has shown that this is in fact the case, and it is still unproved that the evocating properties of cancer tissue are any different from those of any other part of the body. Holtfreter also made the very important discovery that the new evocator is present throughout the whole egg, although it is active only in the region of the organisation centre. In the remainder of the egg it can be activated by any process which coagulates the cell proteins. One immediately searches for some metabolic peculiarity of the organisation centre which might explain the liberation of the active evocator in that region. The most striking feature which has been discovered is the extremely rapid disappearance of glycogen<sup>12</sup>. The activation of the evocator may not be necessarily connected with this glycogen anabolism, but the facts suggest that interesting comparisons may be possible between the metabolism of the organisation centre and that of tumour tissue.

The analysis of development into evocators and competent tissues is only half the story. The organisation centre is not uniform; one part of it stimulates the ectoderm to form the neural plate of a head, while another part induces the formation of the spinal column<sup>13</sup>. These regionally different effects cannot be accounted for by the mere presence of one chemical substance; they necessitate the assumption of a regional distribution of one or more active substances within the organisation centre. The processes by which different parts of the centre induce the formation of different definite organs are spoken of as 'individuating actions', and the organisation centre is said to be the centre of an 'individuation field'<sup>2</sup>. The main characteristic of an individuation field is that all tissue lying within it tends to be built up into a complete embryo, and in any one part of the field all tissue tends to be built up into the organ corresponding to that part.

The individuation field, then, is the agent\* which controls the growth of the different parts in a harmonious way so that a normal individual is formed. In later life, the individuation field splits up into smaller separate fields, such as leg fields, head fields, etc. These are the agents from which cancerous growth has escaped. In mammals their effects are normally not very striking; their influence is confined to the control of the minor

\* This is a convenient but loose form of expression. The field really expresses the formal properties of the distribution of the unknown growth-controlling agents.

repair growth of the body, and they are probably capable of very little more than this. The adult fields, however, are much more potent in those animals in which regeneration is possible. In the newt, for example, the leg field can mould into a limb any mass of competent tissue either grafted into it or formed as a regeneration bud.

Possibilities of the experimental testing of the action of powerful individuation fields on cancerous tissue immediately suggest themselves. Is there a difference in the susceptibility to cancer between the Urodeles, which have a high capacity for regeneration, and the Anura, which have a low capacity? If there is, is the difference due to the presence of more potent individuation fields in the Urodeles, or to a greater competence of their tissue for proliferation? In some animals there are differences in the capacity for regeneration in different organs; one would like to know whether these differences are correlated with differences in the susceptibilities of the organs to cancer, or with the behaviour of tumour tissue transplanted to the various sites.

Once the problem of the relation of cancer to the individuation fields has been stated, the

methods of attack are legion. Some work has already been begun; cancer tissue is being transplanted into embryonic regions where powerful fields are at work, and the influence of carcinogenic agents on regeneration is being investigated. But the embryological approach to the study of cancer has been stated here in the hope that workers whose experience has brought them into closer contact with the facts of the incidence of cancer may be led to see whether this point of view may not enable valuable conclusions to be drawn from the facts which are already known.

<sup>1</sup> Spemann, H., *Arch. EntwMech.*, 43, 448; 1918. *Arch. EntwMech.*, 100, 599; 1924.

<sup>2</sup> Waddington and Schmidt, *Arch. EntwMech.*, 128, 522; 1933. Waddington, *J. Exp. Biol.*, 11, 211; 1934. Needham, Waddington and Needham, *Proc. Roy. Soc.*, B, 114, 393; 1934.

<sup>3</sup> Waddington, *Phil. Trans. Roy. Soc.*, B, 221, 179; 1930. Bautzmann, Holtfreter, Spemann, Mangold, *Naturwiss.*, 51, 971; 1932. Holtfreter, *Arch. EntwMech.*, 128, 584; 1933.

<sup>4</sup> Waddington, *NATURE*, 131, 275; 1933. *J. Exp. Biol.*, 11, 218; 1934.

<sup>5</sup> Corner, cit. Robson, "Recent Advances in Sex and Reproductive Physiology", Churchill, 1934, p. 205.

<sup>6</sup> Cf. Review by Dodds, *Lancet*, 1, 987; 1934. Needham, Waddington and Needham, *Proc. Roy. Soc.*, B, 114, 393; 1934. Waddington, Needham, Novinski, Needham and Lemberg, *NATURE*, 134, 103; 1934.

<sup>7</sup> Waddington and Needham, *Proc. Roy. Soc.*, B (in press).

<sup>8</sup> Woerdeman, *Koninkl. Akad. Wet. Amsterdam*, 36, 477; 1933.

<sup>9</sup> Holtfreter, *Naturwiss.*, 21, 766; 1933. *Arch. EntwMech.*, 132, 307; 1934.

<sup>10</sup> Woerdeman, *Koninkl. Akad. Wet. Amsterdam*, 36, 189, 423; 1933.

<sup>11</sup> For example, Spemann, *Arch. EntwMech.*, 123, 289; 1931. Waddington and Schmidt, *Arch. EntwMech.*, 128, 522; 1933. Mangold, *Naturwiss.*, 21, 761; 1933.

## Obituary

SIR EDWARD SHARPEY-SCHAFFER, F.R.S.

THE death of Sir Edward Sharpey-Schafer at North Berwick on March 29, in his eighty-fifth year, will be greatly regretted all the world over. His method of resuscitation of the apparently asphyxiated, for which he was awarded the Distinguished Service Medal of the Royal Life Saving Society in 1909, brought him well-merited fame. Public notices describing the method and placed in conspicuous situations wherever there is danger from death by drowning and gas poisoning, and its use by all first-aid societies and ambulances, have rendered its discoverer the best known of all physiologists so far as the general public is concerned.

Sharpey-Schafer was a genius in the realm of physiological research and teaching. In all his work he was remarkably lucid and arranged his facts in a very interesting and refreshing manner, keeping his lectures alive by frequent reference to the researchers who were responsible for the work under consideration. Both in his discourses and in his writings he fully realised the value of demonstration and used cleverly selected illustrations in abundance. His system of teaching histology serves as a pattern, and his publications in this field include "A Course of Practical Histology", "Essentials of Histology" which has reached its thirteenth edition, and a "Text-Book of Microscopic Anatomy" which forms Part I of Vol. 2 of "Quain's Anatomy", of which Sharpey-Schafer was one of the editors. For his experimental classes he wrote a concise handbook, "Experimental Physiology".

Sharpey-Schafer was educated at Clewer House School and University College, London, where he gained several scholarships, including the first Sharpey scholarship. He served as assistant professor of physiology from 1874 until 1883 when Burdon-Sanderson was in charge, Sharpey the histologist having resigned in 1874; in this year Sharpey-Schafer gained the M.R.C.S. Burdon-Sanderson was appointed to the chair of physiology at Oxford in 1883 and thus Sharpey-Schafer became Jodrell professor at University College, London, in the same year. He occupied this chair until 1899, when he was elected to the chair in the University of Edinburgh. This he retained until 1933, when on his retirement he had completed fifty years of service as a teacher of his science. Thus he came into contact with large numbers of students, scientific and medical, from all parts of the world. During the same period he encouraged and trained many researchers and future professors of physiology. He kept an active interest in research right up to his retirement, and amongst his most recent work was an experiment on nerve function which involved an experimental section of a nerve in his arm. His researches brought him the fellowship of the Royal Society in 1878 when he was only twenty-eight years of age. The same society awarded him a Royal Medal in 1902 and its most coveted prize, the Copley Medal, in 1924.

Another field of research in which Sharpey-Schafer was actively engaged concerned the ductless glands and internal secretion. With Oliver he was a pioneer in the investigation of the function of the suprarenal

glands. Swale Vincent, one of his assistants, also played a prominent part in the earlier researches on internal secretion and observed development of immunity to hormones. In this field Sharpey-Schafer occupied a leading position and published "The Endocrine Organs", originally founded upon a course of lectures, the Lane Medical Lectures, delivered at Stanford University, California, in the summer of 1913. The first edition of this book was published in 1916 and the second, Part I in 1924 and Part II in 1926. He introduced the term autacoid (*ἀυτὸς*, self and *ἄκος*, a medicinal agent) to include those drug-like substances produced by the organs of internal secretion for the purpose either of exciting or of restraining the activity of other organs; for the excitants he kept Starling's original term 'hormones' and for the restraining substances he introduced the term 'chalones'. His other researches and publications were very numerous and covered nearly the whole field of experimental physiology and histology. His early work on the minute structure of the fibre of the wing muscle of insects and his theory of muscular contraction attracted much attention. He also investigated ciliary and amoeboid movement, the function of the spleen with the plethysmograph, fat absorption by the small intestine, localisation of function in the brain and the tracts of the spinal cord, during his earlier days; the study of pulmonary blood pressure, vagotomy and other nerve section covered later stages of his career.

Three publications deserve special mention, namely, the "Advanced Textbook of Physiology", Volume 1 in 1898 and Volume 2 in 1899, to which many of the leading physiologists—including Gaskell, Gotch, Leonard Hill, Gowland Hopkins, Langley, Burdon-Sanderson and Sherrington in Great Britain—contributed and of which Sharpey-Schafer was editor; also the "History of the Physiological Society 1876-1926"; he was the last of the original members and was elected an honorary member of this Society in 1930. Further, he founded the *Quarterly Journal of Experimental Physiology* in 1908 and edited it until his retirement in 1933. Volume 23, 1933, of this journal consisted entirely of original papers written by past and present assistants numbering twenty-nine and was dedicated to himself. He was presented with a bound copy of the volume containing an interleaf with their signatures; to obtain the signatures the interleaf had to travel to South Africa, New Zealand, Canada, America and China. On receipt of this bound volume on December 26, 1934, Sharpey-Schafer wrote: "I have now received the bound copy of the Honour Volume with the signature pages—which have gone round the world—bound in. It is a very handsome book, but I do not treasure it on that account, but for the pleasant memories it recalls." The *Quarterly Journal of Physiology* is now edited by a board of editors assisted by a number of collaborators, and in a foreword to Volume 24, the editorial board paid him the following tribute, that they will endeavour to continue the traditions and to maintain the level established by its founder, Sharpey-Schafer.

He took an active interest in the proceedings of the British Association for the Advancement of Science, serving as its secretary from 1895 until 1900. He was its president in 1912, and in his presidential address created a sensation by suggesting that early living matter had its origin in colloidal slime and that chemico-physical activity was sufficient to explain vital processes without the aid of any special vital force. He was knighted in the following year, 1913.

Sharpey-Schafer was an honorary fellow of numerous medical societies, and was LL.D. of the universities of Aberdeen 1897, McGill 1908, St. Andrews 1911 and Edinburgh 1933; also D.Sc. of Trinity College, Dublin 1905, Cambridge 1914, Melbourne 1914, Oxford 1926 and the National University of Ireland 1933; he was also M.D. of Berne 1910, Groningen 1914, D.Sci.Méd., Louvain 1930 and Hon. F.R.C.P. of Edinburgh 1931. He received also the Baly Medal of the Royal College of Physicians in 1897. In 1923 he was president of the International Physiological Congress and in 1933 president of the Royal Society, Edinburgh, receiving its Neill Medal in 1922.

Sharpey-Schafer's father was James William Henry Schäfer of Hamburg and Highgate. Sharpey-Schafer married twice, first in 1878, Maud eldest daughter of A. W. Dixey; she died in 1896. His second wife whom he married in 1900 is Ethel Maud, youngest daughter of J. H. Roberts, F.R.C.S. Lady Sharpey-Schafer survives him, as also does a daughter, Miss Sharpey-Schafer. He also had two sons; the eldest became a naval officer and the younger was a medical student at Cambridge when the War broke out. At this time, 1914, the elder son had retired from the Navy and was engaged in planting in Malaya. He left this for War service, at first in connexion with the harbour of Singapore and later with the Home Fleet, in the service of which he lost his life. The younger son joined up almost at once for service in France, was reported missing and lost his life very early in the War. The elder son had two sons, who survive their grandfather; one is a doctor on the medical staff of University College Hospital, and the younger is a lieutenant in the Navy.

While professor at the University of Edinburgh, Sharpey-Schafer resided at North Berwick, at first at 'Marly Knowe'—a fine home occupying a beautiful site on a small hill overlooking the west end of the town and the Firth of Forth. At this home during the summer term he and Lady Sharpey-Schafer graciously entertained members of his staff and numerous undergraduates, arranging all kinds of games from golf on the main links to bowls and tennis on their garden lawn. These functions were always greatly enjoyed by all under the kindly guidance of their esteemed professor and his charming lady. Among those associated with him in his early days in Edinburgh were the late T. H. Milroy (Belfast), John Malcolm (New Zealand), P. T. Herring (St. Andrews), the late Sutherland Simpson (New York), F. H. A. Marshall (Cambridge), John Tait (Montreal), Andrew Hunter (Glasgow), W. A. Jolly (Cape Town), H. Pringle (Dublin), J. Lockhead (Gibraltar) and W. Cramer (London). With these and other assistants

he may be said to have founded the Schafer school of physiologists.

Sometimes when the Physiological Society met in Edinburgh, Sharpey-Schafer would complete the scientific business in the morning and then invite all the members to spend the afternoon with his family at 'Marly Knowe', North Berwick. During his later years he resided at 'Park End', North Berwick—a house on the foreshore of the Firth of Forth near the golf course. In 1933 he underwent an internal operation and withstood it exceedingly bravely but later developed pneumonia. He apparently recovered somewhat from these trials, and was able to go about again slowly and to entertain his friends with his usual mental acuteness. He resigned his chair in Edinburgh in 1933 and remained at 'Park End' but had intended, sooner or later, to move to the south of England to be nearer other members of his family. However, he never left North Berwick and died near the golf course and the Firth of Forth which he loved so much.

With such large numbers of students in his classes, few of them were able to know the man apart from official duty, and to some Sharpey-Schafer appeared rather distant; but all his assistants and research workers were able to appreciate the kindly heart and goodwill which characterised their chief and benefactor. In 1922 his past and present assistants, co-workers and research pupils presented him with

a portrait plaque and medal; the plaque we understand is now at University College, London. Most of his older students did not know him as Sharpey-Schafer but as Schäfer. He adopted the former name in 1918 to emphasise his indebtedness to Sharpey, who inspired his early work. It is impossible for an old assistant to express his feelings adequately for this great scientist and staunch friend.

J. A. C.

WE regret to announce the following deaths:

Mr. C. F. Cross, F.R.S., who was associated with the late Mr. E. J. Bevan in the viscose process for the production of artificial silk, on April 15, aged seventy-nine years.

Prof. W. R. Hodgkinson, formerly professor of chemistry and metallurgy at the Ordnance College, Woolwich, an authority on the chemistry of explosives, on April 8, aged eighty-three years.

Mr. H. R. Kempe, formerly principal technical officer and electrician to the Post Office, and author of the "Engineer's Year Book", on April 10, aged eighty-three years.

Dr. Albert Mann, of the U.S. National Museum, Washington, formerly professor of botany in the Ohio Wesleyan University (1895-1900) and in the George Washington University (1907-9), an authority on diatoms, on February 1, aged eighty-one years.

## News and Views

### The Sugar Beet Industry in Great Britain

THE United Kingdom Sugar Industry Inquiry Committee, the report of which (H.M.S.O. Cmd. 4871) was issued last week, failed to come to a unanimous conclusion on the fundamental issue of whether the beet sugar industry should be carried on with State assistance. The subsidy policy which was initiated in 1924 essentially as an experiment has already cost the Exchequer more than forty million pounds, and its extension for the present season will cost more than seven million pounds. Mr. Wilfred Greene, the chairman, and Sir Kenneth Lee, in their majority report, conclude that there is no reasonable prospect of the industry being permanently self-supporting. The principal value of the industry is as a relief measure to arable farming, but they consider the method extravagant and inequitable. Over the whole period of the subsidy, the cash payments to farmers have only just equalled the cost of assistance. The same acreage of beet could, in fact, have been, and still could be secured as cheaply by paying farmers to grow sugar beet and keep them on the farm for use as they thought fit. The majority is unable to recommend the continuance of State support beyond the maximum rate of duty preference grant to Colonial sugar, and it recognises that this would substantially mean the discontinuance of the beet sugar industry in Great Britain. Compensation to farmers is proposed for three years on an acreage basis.

IN the minority report, Mr. Cyril Lloyd emphasises the difficulties of forecasting the trend of future prices, and of giving precise values to the indirect benefits from the industry. National considerations of the difference between free trade and protectionist policies are, for him, of much greater importance than the contention that, biologically, sugar cane is more efficient than sugar beet for the production of sugar. He recommends continuing the assistance for a long-term period by a levy on all imported sugar. The reports agree on the broad principles of a re-organisation scheme, should it be decided to continue the industry. It is proposed to amalgamate the beet sugar interests, and to control the whole industry by a Permanent Sugar Commission. It is also agreed that any such scheme should provide for a programme of research and education on a scale very much larger than that which has existed up to the present. Valuable educational work has been done locally by the factories' agricultural staffs, county organisers and other educational and research institutes, and, since 1927, about £4,000 a year has been spent by the factories on a national programme of technical experiments and education, including a prize scheme for beet growers. In spite of the very large sums involved in assistance to the industry, no funds whatever have been made available by the State itself for research, and no fundamental research of any kind in sugar beet problems has been initiated.

## Rivers Medal, 1934, and North African Studies

THE selection of Miss Gertrude Caton-Thompson for the award of the Rivers Memorial Medal for 1934 by the Council of the Royal Anthropological Institute will be cordially endorsed by all who follow the progress of archaeological studies with any degree of close interest. The medal is awarded annually, and was founded to perpetuate the memory of the late Dr. W. H. R. Rivers by recognising work of outstanding merit in any branch of anthropological studies. Miss Caton-Thompson's work as an excavator of archaeological sites has covered a varied field in time and space. It has ranged from the earliest prehistoric period to the fringe of historic times in Egypt, the Libyan Desert and southern Africa. Her investigation of the Zimbabwe culture of Southern Rhodesia has not only pricked the bubble of speculation, but it has also based the solution of an obscure problem of African ethnology on an assured body of archaeological fact. No one will question that Miss Caton-Thompson's work is "characterised by wide knowledge, sound judgment and insight", to quote the words of Dr. H. S. Harrison in making the presentation of the medal at the meeting of the Royal Anthropological Institute on April 9, at which Miss Caton-Thompson delivered a lecture on the results of the Institute's archaeological expedition to the oasis of El Kharga, of which she has been in charge. The importance of these investigations may be gauged from her examination of their bearing on some Stone Age problems of North Africa—problems which recent studies, especially by French archaeologists, show to be assuming an increasing importance in the reconsideration of the prehistory of North Africa and its relation to the origin and development of the later palaeolithic and mesolithic cultures of Europe. (See *NATURE*, 133, 107; 1934. 134, 975; 1934. 135, 550; 1935. An account of the investigation of the rock-shelter of Afalou in Algeria will appear shortly.)

MISS CATON-THOMPSON'S investigations of geological and archaeological conditions at Kharga, which have extended over a period of three years, have fulfilled expectation in throwing much light on the succession of cultures in the early stone age of Egypt and the desert, and have provided material of crucial importance for the problem of early man in North Africa as a whole. They have demonstrated the inseparable relation of the distribution of early man to water supply throughout this region, even where no visible indications of water supply are associated with isolated finds in the desert conditions of to-day. Variation in the quantity and distribution of moisture in quaternary times, as indicated by an examination of the geological conditions at Kharga, affords a chronological criterion in determining the age and succession of stone age cultures. Miss Caton-Thompson indicated the significance of the mound springs in French North Africa, where an Upper Acheulean, with which nothing in Egypt is comparable, shows non-local peculiarities which link with Palestine. In comparing and contrasting the succession of cultures at Kharga from Acheuleo-Levalloisean to neolithic

with that of adjacent regions, Miss Caton-Thompson pointed out that M. Vaufrey's views on the dating of the Capsian culture, if fully accepted, force a revision of ideas concerning Aurignacian origins in western Europe and Kenya, and a re-dating of desert pictographs. Certain gaps in the series might, she thought, be bridged by discoveries in the later Aterian series. On the whole, Miss Caton-Thompson's investigations in the later phases of the Kharga series would appear to support the most recent views of French archaeologists on the weight to be given to local development and specialisation rather than to contact and movement.

## F. W. Harmer (1835-1923)

APRIL 24, 1835, saw the birth of Frederic William Harmer, one of the pioneers in the field of East Anglian geology, and one of the last of the distinguished amateurs by whom the science was advanced so much during the Victorian era. Harmer came of an old Norfolk family, and by his public services was prominently identified with the city of Norwich. In his early years he had only scanty leisure to devote to geology, but a chance meeting with the younger Searles Wood was the beginning of a long-continued geological partnership. The map they prepared of the glacial deposits of Norfolk and Suffolk on a scale of 1 inch to the mile was the first 'drift' map of the kind in the world. After the publication of much valuable material on the Pleistocene deposits of the east of England, came Wood's death in 1884. For a time, Harmer devoted himself to municipal duties and the politics of the day, but some ten years later, when he might well have felt entitled to the leisure of life, he resumed an intensive study of the Tertiary and Quaternary geology of East Anglia and the Continent. A series of papers on the Crags, still standards for reference and highly esteemed, inaugurated a new regime in East Anglian geology; and his contributions to glaciology and palaeo-meteorology were no less stimulating. Two outstanding productions of the eve of his life, each entailing immense labour, were the detailed map showing the types of boulder clay and trails of erratics in England and Wales, and the great monograph, published by the Palaeontographical Society, on the Pliocene Mollusca. The latter work was an achievement which will long earn the gratitude of investigators, and will ever remain a fitting monument to his memory. An appreciation of Mr. Harmer's scientific work appeared in *NATURE* for June 9, 1923 (p. 779). Sir Sidney Harmer, formerly director of the Natural History Departments, British Museum, is a son of Mr. F. W. Harmer.

## Franz Chvostek (1834-84)

THIS year marks the centenary of the birth of Franz Chvostek, one of the most eminent Austrian military doctors of the last century. The exact day and month of his birth are not ascertainable. He qualified in 1861, and for the next few years he served as a regimental medical officer. In 1868 he was appointed lecturer in electrotherapy at the

Joseph Academy in Vienna, where he succeeded Duchek as director of the medical clinic in 1871. He held that office until 1874 when he became head of a medical department in the Garrison Hospital, Vienna, and remained there until his death on November 16, 1884. His literary activity is shown by the fact that during the last twenty years of his life he published no less than 163 articles on various medical subjects. Although he specialised in electrotherapy, he published only six papers on the use and value of electricity in medicine, most of his writings being concerned with the pathology and treatment of diseases of the nervous system. His name is attached to a sign consisting in the sudden spasm seen on tapping one side of the face.

#### Excavations at Colchester

THE preliminary survey, anticipatory to complete publication, of the results of five years excavation on the Romano-British site at Colchester, which Mr. Christopher Hawkes contributed to *The Times* of April 12, by bringing together the more significant of the details already reported in the accounts of current progress, gives a clearer conception than has previously been possible of the extent to which this investigation has added to our knowledge of conditions in south-eastern Britain immediately before, and in the early days of Roman conquest. The magnificent system of fortification which has been revealed, in its relation to the occupation site which it defends, bears eloquent testimony to the high degree of organisation and the social and political importance attained by this British town; while the character of the finds, especially the local factory of Samian ware, a feature without known parallel in Britain, indicates, on one side its importance as a centre of British culture, and on the other its standing as a point of close economic, and probably political, relation with the Continent. Although it has been possible to follow the course of events on the area of British occupation and its history in later days in some detail, the position still remains somewhat obscure. It would appear as if still more important discoveries have yet to be made. Nothing that appeals as adequate to the dignity of this centre of the Belgic settlers has as yet been discovered. It is all the more important, therefore, that means should not be lacking to follow up the investigation before the commercial development of the area precludes further excavation. The appeal of the Colchester Excavation Committee for further funds deserves, and should receive, generous support.

#### Unveiling of the Replica of the *Rocket* Locomotive

ON April 11, the Minister of Transport, Mr. L. Hore-Belisha, unveiled the new replica of the *Rocket* which has just been added to the locomotive collection in the Science Museum, South Kensington. Mr. Hore-Belisha pointed out that the importance of the *Rocket* in the history of the locomotive lies in the fact that the chief features of its design had been followed down to the present day. He then referred to the precautions for the public safety which have

been taken from the earliest days of the railway, so that the numerous regulations which govern the movement of traffic on rails are not regarded as restrictions, but as guarantees of efficiency and security. Had similar foresight been shown in connexion with the motor-car, the nation might have been spared the material, economic and personal loss which the weekly casualty lists reveal. We are now trying to make good rapidly the omissions of forty years. The measures we are now forced to institute, had they proceeded *pari passu* with the growth in the numbers of mechanically propelled vehicles on the road, would have been regarded as natural. Methods of road traffic control are being borrowed from the railway. The *Rocket* demonstrated its capacity in a competition on the railway. To-day, it would probably have been sent to the testing station at Vitry, in France, to enable its operation to be scientifically studied. In the country which produced the *Rocket*, there is no similar testing station for locomotives, and Mr. Hore-Belisha expressed the hope that the omission would be repaired.

#### Liverpool Naturalists' Field Club

ON April 27 the Liverpool Naturalists' Field Club celebrates the seventy-fifth anniversary of its foundation by a field meeting at Raby Mere, Cheshire, where its first meeting was held in 1860. The Club has been responsible for three floras of Liverpool, one the work of Mr. Robert Brown, who also wrote the botanical section to the British Association Liverpool Handbook, and the last two the works of Col. C. T. Green. Founded by the Rev. H. H. Higgins (president 1862-93) and Dr. Joseph Dickinson (president 1860-62) the Club has maintained an active and amiable co-operation between professional scientific workers and amateurs in all branches of field natural history, and at present has referees in botany (W. S. Laverock), micro-fungi (Dr. C. T. Green), aquaria (Fred Jefferies), lepidoptera (Mrs. Makinson) and ornithology (Eric Hardy), the ornithological section having plans to form a local bird observatory or ringing station like that at Heligoland, as a mark of the anniversary. Some of the leading members in the Club's history were: Rev. H. H. Higgins, who discovered 200 additions to the local flora in four years, and was author of works on the fungi, Diptera, flora and other subjects of the Liverpool district, and particularly the notable collection of fern fossils he discovered at Ravenhead, Lancashire; G. H. Morton (president 1894), who delivered an address to the Club on the geology of Liverpool which the council published and which was later enlarged into his celebrated "Geology of Liverpool"; Col. J. W. Ellis (president 1899 and 1910) and Prof. Robert Newstead (president 1907-8), entomologists; and Dr. Joseph Dickinson, author of the second "Flora of Liverpool". Since its foundation, the Club has not failed to issue an annual proceedings of 40-50 pages, and at one time its members issued their own monthly journal, the *Liverpool Naturalists' Scrap Book*, followed by the *Liverpool Naturalists' Journal*. The honorary secretary is Mrs. W. S. Laverock, Millbank, Mill Lane, Wallasey.



### Jersey Meeting of the British Empire Naturalists' Association

THE decision of the council of the British Empire Naturalists' Association to hold a summer holiday meeting at Jersey in the latter half of June is an interesting tribute to the natural history interests of the Channel Islands, where so many Continental and North African plants reach the northern limit of their distribution, and certain reptiles and birds unknown in England may be studied. In its flora, Jersey holds most interest to the British naturalist for the very mild winters permitting up to forty species to flower in late December, thus producing a Continental rather than British flora. The most interesting species on the island not found in the rest of the British Isles are the Jersey bugloss; the Jersey toadflax, one of the rarest of European flowers blooming at the end of May; the Jersey star thistle; and the loose-flowered orchid. The region of St. Ouen's Bay is considered the richest botanically, for there are few woods on the island, though such rare flowers elsewhere in Britain as the wild daffodil flourish on the cliffs, maiden hair fern in certain rocks, wild wallflower on the walls of Mont Orgueil Castle, yellow horn poppy, golden samphire, sea-lavender and sea kale on the coast. *Scirpus americanus*, found at St. Ouen's Ponds, is a very rare rush of the Jersey flora, while the Jersey fern (*Gymnogramme leptophylla*, Des.), a North African species, is equally interesting.

FROM the point of view of marine zoology, Jersey offers invaluable opportunities to the visitor. Frequent storms have revealed the stumps of submerged oak and alder forests in St. Ouen's Bay, the Museum of the Société Jersiaise possessing a photograph of some five hundred stumps visible on one occasion. Of bird-life, the island is rich in sea-birds, and a young herring-gull ringed by the London Natural History Society at the colony at Point Grosnez on June 24, 1934, was recovered at St. Nazair (Loire Inf.), France, on November 1. The beautifully marked wall lizard is found on the island, though it does not occur in Britain except as an escaped pet. Similarly, the insect fauna is rich in Continental forms, particularly butterflies, seldom reaching England. Geologically, Jersey resembles France, though in parts it may be likened to South Ireland, Devon and Cornwall. The rocks are mostly granitic. Jersey has the most varied rocks of the Channel Islands, presenting a mixture of metamorphic rocks, conglomerates, and sandstones with syenites and quartzites, while shale and blown sand are also prevalent. Archaeologically, the island is noteworthy, and its cromlechs have caused wide interest, especially the large one at Mount Orgueil. The president of the British Empire Naturalists' Association is Mr. Douglas English. The arrangements of the Jersey meeting are in the hands of the honorary secretary of the Jersey branch of the Association, Mr. E. R. Casimir, Font Hill, Woodville Avenue, Jersey.

### Rationalisation in Industry and Technical Education

In his presidential address to the Association of Technical Institutions at the annual general meeting

on February 22 and 23, Brig.-General Sir Harold Hartley discussed the question of how far the present trend of industrial development, and particularly the increasing size of industrial units, presents new problems in technical education. Following the rapid progress of both pure and applied science under which co-operative research has been initiated and the processes of the older industries subjected to scientific scrutiny, in addition to the development of entirely new industries, had come the beginnings of rationalisation. The tendency to increase the size of industrial units and to operate on the principles of mass production involves scientific research for the analysis and control of each process. While the disturbance produced by the War was a prime cause of the failure of these methods to raise the standard of living, misuse of opportunities afforded by research could intensify our difficulties. The modern method of production creates a new series of problems involving the co-operation of a team of specialists, and this team work is the characteristic feature of large-scale management. The smooth running of a large-scale unit depends on each of the components engaging intelligently in its task and performing this in proper co-ordination with the rest.

SIR HAROLD HARTLEY suggested that technical institutions can do something to assist those entering industry to understand their functions in relation to others, and in selecting individuals best suited for the various tasks. The extent to which it is possible to give the student a general picture of the industry which he is to enter, its organisation and management, and its relation to other industries requires careful consideration. The relation between the technical and commercial departments and the assistance which statistics afford to management are highly significant to-day, and Sir Harold Hartley urged greater emphasis on cost as opposed to efficiency in the discussion of processes and plant. Finally, he emphasised the importance of a dynamic conception of industry and of co-operation both inside an industry in isolating and solving a problem, and between education and research. The understanding between them must become closer and closer if we are to utilise fully the resources of Nature.

### The Droitwich Broadcasting Station

IN a paper read to the Institution of Electrical Engineers on April 11 by N. Ashbridge, H. Bishop and B. N. MacLarty, a description is given of the new radio broadcasting station at Droitwich in Worcestershire. The station contains two transmitters each performing a separate function. One transmitter works on a 'long' broadcasting wavelength in the band 1250-1875 metres and the other on a medium wave-length between 200 and 545 metres. The long-wave transmitter has replaced Daventry 5XX, which worked with a power of about 25 kilowatts. This station was the first broadcasting station in Europe to employ a power in excess of five kilowatts. The other transmitter replaces Daventry 5GB, which was first erected as an experimental transmitter, but afterwards gave the

regional programme service to the Midlands. The present aim of the British Broadcasting Corporation is to supply every potential listener with a service of two distinct programmes. The distribution scheme which is now approaching completion will make one programme available to 98 per cent of the population and the other programme available to 85 per cent. By virtue of the length of the wave on which it works, and its aerial power of 150 kilowatts, the new long-wave transmitter at Droitwich gives vastly greater possibilities of 'coverage' than any of the other transmitters in the country, all of which work on medium waves. The other Droitwich transmitter covers the densely populated districts in the Midlands. The Droitwich site was found to fulfil the requirements for a station of this type. The subsoil in the immediate neighbourhood is favourable to the propagation of radio waves. Short high-grade telephone circuits connect it with the nearest studio headquarters. It is suitable for building work, and there is plenty of space for the aerial system. Lastly there is a trustworthy and ample water supply.

#### Value of Criticism

PROF. ERWIN SCHRÖDINGER, in an article entitled "Science, Art and Play" (*Philosopher*, 13, No. 1), maintains that the present-day spirit which challenges all authority and allows nothing to be immune from criticism, manifests itself in the 'crisis' now existing in most of the sciences. Science, at any rate research work, together with art and play, provides an outlet for that surplus store of energy which men usually have to spare after satisfying their primary needs. It might be argued that science gives far greater practical benefits than art or play, or that the intellectual joy of the research worker is as nothing to the material value of the results obtained. But the advances of applied science, as exemplified in greater facilities for travel and communication, give not only material benefits but also pleasure for their own sake. Prof. Schrödinger admits that science can rarely give direct joy to the community, but what matters is that the greatest possible number of people should have the opportunity of approach to intellectual pleasures. It is not accidental that at the present moment the sciences are being forced to a complete reassessment of values, for the ideas forming the background of the individual sciences are connected with the ideas of the age, and the dominant spirit will accept nothing on authority. This should not be feared, for what is worth preserving preserves itself, and requires no protection.

#### The Citrus Industry in Jaffa

AN article in the *Fruit, Flower and Vegetable Trades' Journal* of February 16 describes "The Jaffa Citrus Industry". Oranges were introduced to Jaffa in the tenth century; they delighted the eyes of the Crusaders and their opponents. An Egyptian devastated the town and the surrounding country in the fourteenth century, and the orange groves were not re-established until the eighteenth century. Palestine exported nearly 1½ million boxes of oranges

before the War; her export trade disappeared during the conflict, but now it has returned and increased. Jaffa is the chief exporter of grape fruit, and second only to Spain in export of oranges. Forty-five per cent of the exportable crop is at present controlled by Jews and the rest by Arabs, but when present plantings mature, the Jews will control 65 per cent. The development of overseas markets is difficult, owing to the imposition of tariffs, and to the fact that Palestine is a mandated territory and can demand no reciprocity of trade. The Government of Palestine has instituted an inspection service, has established a research station and has created a fund for propaganda. Difficulties of transport from Jaffa to the port have still to be overcome; production promises to be increased threefold by 1938. The industry is launching a large scheme of advertisement, in an attempt to cope with this increase in output, and already the consumption of Jaffa oranges in England has increased considerably since the scheme was initiated.

#### Land Utilisation Survey

THE fourth annual report, for 1934, of this Survey shows that great progress has been made. Of the field work, only about ten per cent of the total area of Great Britain has still to be done. The uncompleted areas are mainly in Sutherland, part of the Southern Uplands, the northern and eastern parts of the West Riding, central and southern Wales, and parts of Wiltshire and Cornwall. In preparation of the six-inch sheets for publication, which entails reduction to a one-inch scale, much progress has also been made. Twelve sheets have been published, seven others are in the press and twenty more have been reduced. Further progress has been delayed solely by lack of funds. For many of the sheets published or in process of publication grants, guarantees or advance orders have been obtained, and the Survey is anxious to obtain further help of this kind. The Survey is planning a series of handbooks to accompany the published sheets.

#### Cultivation of Tomatoes

THE imposition of duties on imported tomatoes has naturally stimulated the production of this fruit in Great Britain, although the industry had already assumed large proportions. The home production under glass is estimated at more than 1,140,000 cwt., but even so, this only accounts for less than one third of the total home consumption, imports for 1932 amounting to as much as 2,442,000 cwt. Very considerable knowledge with regard to tomato growing has been obtained at the Cheshunt Research Station, and at the invitation of the Ministry of Agriculture, the director, Dr. Bewley, has prepared a bulletin on the subject which provides growers with a wealth of valuable information (Bull. No. 77, Tomatoes: Cultivation, Diseases and Pests. H.M. Stationery Office. 1s. 6d. net). Soil treatment before planting, manuring, optimum soil and air temperature during growth are among the aspects of the subject discussed in detail, while recommendations as to the

choice of the best variety, methods of marketing and measures to be adopted for the control of diseases and pests are also supplied. In addition, the construction and heating of glasshouses are considered, and a detailed plan of a low-pressure hot water heating apparatus is appended.

#### Cambridge Philosophical Society

THE *Proceedings of the Cambridge Philosophical Society* now appears in a new and more convenient form. The number of parts in a volume has been reduced from about seven to four, to be published at the ends of January, April, July and October, but the size of the page has been increased, and the general style and layout have been considerably modified so as to bring the journal more into line with the *Proceedings of the Royal Society* and the *London Mathematical Society*. The first issue in this new form contains papers by Prof. G. H. Hardy on "Fourier Kernels", Prof. G. N. Watson on "Ramanujan's Continued Fraction", and six other papers on pure mathematics. As for mathematical physics, M. H. L. Pryce applies Born's new field theory to a simple special case; A. Lees places a new interpretation on Dirac's linear wave equation; H. A. Bethe discusses the neutrino; and W. W. Sawyer deals with a point in the separation of heavy hydrogen. The experimental papers include experiments on neutrons by C. H. Westcott and T. Bjerger, and investigations of downcoming wireless waves by J. L. Pawsey. We regret to notice that the Council has decided not to issue any more parts of the *Transactions* of the Society at present. In the past it has contained many researches which were of great value, but too lengthy for the *Proceedings*.

#### Population Growth and Birth-Control

RAPID increase of the population of India has led to a demand for the inception of preventive measures. Birth-control there, and also in Great Britain, is, however, criticised by Col. C. A. Gill in a recent somewhat polemical paper (*J. Hygiene*, **34**, 502; 1934). According to Col. Gill, population in an area ought to be considered not only from the point of view of numbers, but also from the occurrence of irregular changes or 'movements' in the population, which, apart from migration, are largely determined by forces controlling the birth- and death-rates. Statistical methods forecasting future population ignore such 'movements' of population, and estimates based upon population-growth curves have proved unreliable, for example, in India, and must be accepted with reserve. In a primitive community, prolificity as a means of race survival and an essential factor for progressive evolution is a paramount necessity, and artificial birth-control would constitute racial infanticide. Rural India, it is held, is such a community and is under-populated, and any State action to promote the practice of birth-control there is regarded as being a political crime and a biological blunder. In Great Britain, natural forces are now acting tending to limit increase of population, such

as postponement of the average age of marriage and, possibly, a real decline in fertility. Since Nature requires a wide field of selection, nothing should be done to restrict the reservoir from which in the past many have sprung who have contributed greatly to human progress. The encouragement of birth-control among the masses, it is argued, is therefore to be regarded as being biologically reprehensible.

#### The Geographical Magazine

A NEW monthly publication has appeared entitled the *Geographical Magazine* (London: *Geographical Magazine, Ltd.*, 1s.). The first number fulfils the aim of the editor to depict the geographical background of important events, works of construction and conservation, and the conditions in which various peoples are living throughout the world. Attention will be given also to exploration, travel in little-known lands and among primitive peoples, and the life of animals in relation to their environment. The eight articles include accounts of Abyssinia by Major R. E. Cheesman, India's North-East Frontier by Capt. Kingdon Ward, the routes in the North Syrian desert by Miss C. P. Grant, the aborigines of Central Australia by Mr. B. Macgrath, the "Changing Face of Amsterdam" by Mr. F. R. Yerbury. The home country is represented by an article on the Lake District by Mr. Hugh Walpole and Prof. P. Abercrombie. There are numerous and good illustrations and a small map is given with each article. Half the profits made by the magazine are to be devoted to a fund for the promotion of geographical knowledge to be administered by a body of trustees under the chairmanship of the president of the Royal Geographical Society.

#### World Survey

PUBLISHED under the auspices of the World Power Conference, a new monthly periodical entitled *World Survey* has appeared this month (5s. net), its aim being described as that of presenting and analysing world economic trends. A special feature is the inclusion of a section recording, by means of index numbers, changes in industrial and agricultural production, wholesale and retail prices, unemployment, production of power and fuel and other statistics relating to transport, finance and world trade. In the first number, the articles cover a wide field, including among other subjects the future development of power-producing industries, the international aspects of public works, and machinery and labour displacement. In a special world economic service section, there are articles dealing with Belgium and the gold standard and with the world rubber situation. It is intended that *World Survey* shall facilitate an international exchange of information and opinion between those engaged in the power and fuel industries and economic experts, so that industrial data can be analysed and related continuously to theoretical work. An international bibliography of new publications relating to power and fuel is also included as a monthly feature.

### Science Abstracts

THE two volumes of *Science Abstracts* of 1934 have now been issued. Each is 7-8 per cent smaller than the corresponding volume of 1933, but the decrease in the number of abstracts is in neither case so great. The Physics volume has 1,561 pages, more than 300 of which are devoted to the subject index, the supplementary index of apparatus and instruments and the author index. The Electrical Engineering volume has 905 pages, more than 150 of which are occupied by subject index and author index. Each volume is indispensable to those who would keep themselves up to date in the field it covers.

### British Health Resorts

THE British Health Resorts Association has issued a new edition of its official handbook ("British Health Resorts: Spa, Seaside, Inland (including New Zealand, South Africa, and Canada)"). London: J. and A. Churchill, Ltd. 1s.). The handbook is edited by Dr. Fortescue Fox, and contains a foreword by the Minister of Health, Sir Hilton Young, and it is claimed that there is no other publication like it in Great Britain or any other country. Authoritative information is given of every health resort in the British Empire, and some useful pages are devoted to winter health resorts in Great Britain. The information concerning each resort includes an illustration, and details of climate, the diseases for which it is suitable, and particulars of attractions and accommodation.

### Announcements

SIR HENRY LYONS has been appointed member and chairman of the Advisory Council of the Science Museum in succession to Sir Richard Glazebrook, who has resigned.

ACCORDING to *The Times* of April 12, Mr. Martin Lindsay has been awarded the Alexandre de la Roquette Gold Medal by the French Geographical Society for his leadership of the British Trans-Greenland Expedition, 1934.

PROF. EMIL ABDERHALDEN, director of the Physiological Institute at Halle, has been elected a foreign member of the Lombardy Society of Medicine, and a corresponding member of the Pontifical Academy of Sciences in Vatican City.

THE Committee of the A. Chauveau Foundation has recently awarded the prize in veterinary science to M. C. Dubois, director of the veterinary services of Gard, for his work on undulant fever in animals.

ON April 9, Lady Oppenheimer opened an interesting exhibition of books about trees, collected mainly by certain publishers, under the auspices of the society of "Men of the Trees", and displayed at its headquarters at 10 Victoria St., Westminster, S.W.1.

In addition to modern books and pamphlets, many interesting old books have been gathered together, including a fourteenth century MS. of St. Isidore's "Etymologia", a kind of encyclopædia of all knowledge as it was known in the sixth and seventh centuries, including the properties and care of trees.

THE Tomarkin Foundation is arranging the seventh International Medical Post-Graduate Congress, under the auspices of the University of Brussels, to be held at Brussels on September 12-19, and at Spa on September 20-October 2. The Congress is officially approved by the General Commissariat of the World Exhibition which will be held in Brussels at the same time. Further particulars can be obtained from the Secretary, Tomarkin Foundation, Faculty of Medicine, 97, rue aux Laines, Brussels.

ON April 10, Sir John Gilmour, the Home Secretary, opened the new Metropolitan Police Laboratory for the scientific investigation of crime, which has been established at Hendon. The members of the Committee which has been formed to advise on the development of the Laboratory are: Lord Atkin, Lord Dawson of Penn, Lord Trenchard, Sir Russell Scott (Permanent Under-Secretary of State, Home Office), Sir Edwin Deller (Principal of the University of London), Sir Bernard Spilsbury, Sir Frank Smith (Secretary, Department of Scientific and Industrial Research), Sir Robert Robertson (Government Chemist), and Mr. Hugh Lett (senior surgeon to the London Hospital).

MESSRS. BERNARD QUARITCH, LTD., 11 Grafton Street, W.1, have celebrated this year by issuing an extremely interesting list of five hundred rare and choice books (Cat. 500). Among these is a number of early scientific and medical classics and rarities. To the bibliophile, this catalogue with its bibliographical detail and its thirty illustrations will make a special appeal; and librarians and collectors with funds at their disposal will find many treasures here to tempt them. Prices range from 15s. upwards, but it must be realised that this is emphatically not a bargain hunter's catalogue, since the average price of the books offered is nearly £100 each.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A research assistant to the British Cast Iron Research Association—The Director, 21 St. Paul's Square, Birmingham, 3 (April 23). An assistant lecturer in building in the College of Technology, Manchester—The Registrar (May 3). An advisory economist in the Department of Agriculture, University of Leeds—The Registrar (May 7). A professor of obstetrics and gynaecology in the University of Hong Kong—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, London, W.C.1. Two radio research assistants in the Research Laboratories, G.E.C., Ltd., Wembley, Middlesex—The Director.

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. 624.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Cosmic Rays from Nova Herculis?

THE appearance of a new star in the constellation of Hercules is of considerable interest not only for the astronomer but also for the physicist. W. Baade and F. Zwicky<sup>1</sup> recently advanced tentatively the hypothesis that cosmic rays are produced in the outburst of super-nova. The few communications<sup>2</sup> on Nova Herculis do not show—so far as they are accessible to us—whether this new star can be classed as of the super-nova type. The light emission shows an increase from the date of discovery (December 13) until December 25.

W. Kolhörster<sup>3</sup> has reported that his measurements between December 22 and 31, 1934, with a double coincidence Geiger-Müller counter indicated an increase of 1.7 per cent during the time when the nova was high above the horizon (9–16 M.E.T.). He said that the detection of this effect by the ionisation method would be more difficult on account of the variations of the barometer effect and the directional uncertainties in ionisation methods. Nevertheless, it seemed worth while to investigate if very accurate instruments like our Steinke standard apparatus showed any effect of the appearance of the nova.

Two of our Steinke instruments were placed at 2,300 m. above sea-level (Hafelekar Observatory), and a third apparatus of the same type stood in Innsbruck, under the roof of the University building (600 m. above sea-level). They were kept at constant temperature ( $15^{\circ} \pm 0.2^{\circ}$ ) and were permanently screened from local radiations by lead shields of 10 cm. thickness underneath and on the sides. The hourly mean values of ionisation were reduced to the same barometric pressure.

First we compared the average intensities of a series of days before and after the appearance of Nova Herculis. This is necessary on account of the irregular variations of the cosmic radiation ('variations of the second kind'). The results are given in the following table together with the mean errors.

	Hafelekar (2,300 m.)		Innsbruck (600 m.)
	Instrument No. 9 (no lead on top)	Instrument No. 3 (surrounded by 10 cm. lead)	Instrument No. 8 (surrounded by 10 cm. lead)
December 1–12	4.464 $\pm$ 0.006 J	2.804 $\pm$ 0.004 J	1.777 $\pm$ 0.002 J
December 13–20 and 22	4.465 $\pm$ 0.008 J	2.807 $\pm$ 0.006 J	1.787 $\pm$ 0.003 J
Effect of Nova	+ 0.001 $\pm$ 0.010 J	+ 0.003 $\pm$ 0.007 J	+ 0.010 $\pm$ 0.004 J

We see that a very small increase of ionisation is shown by all three instruments; this effect is, however, well within the limits of the mean errors, with the exception of No. 8, where the increase ( $0.010 J \pm$

10 mJ) is twice as great as the mean error. If we take the average of the values from December 17 to December 20 (or 22) when the new star approached its maximum brightness, we obtain larger effects, which are (compared with the period December 1–12) +13, +10 and +15 mJ, for No. 9, 3 and 8. It must be kept in mind of course that even these effects are of the same order of magnitude as the mean errors.

If the increase mentioned is really due to the new star, we should expect to get a relatively larger increase by taking average values not for whole days but for hours when the nova was high above the horizon. In the week December 13 to December 20 the nova was at its maximum altitude practically at noon. Now we must take into account that, at this time of the day, a maximum of the ionisation has been found to occur<sup>4</sup>. A possible effect of the nova naturally would be superposed on this solar noon maximum which, on the Hafelekar, exceeds the night minimum by about +10 mJ. Therefore in order to separate these effects we must compare the difference of ionisation at noon and at night before and after the appearance of the new star.

This was done by grouping our observations in three different ways as shown below.

Difference of Day and Night Ionisation (in mJ) before and after appearance of Nova Herculis.

	Instrument No. 9		Instrument No. 3		Instrument No. 8	
	Nov. 22– Dec. 12	Dec. 13– Dec. 20	Nov. 22– Dec. 12	Dec. 13– Dec. 20	Nov. 22– Dec. 12	Dec. 13– Dec. 22
(a) Comparison of mean values, 9 <sup>h</sup> –15 <sup>h</sup> and 21 <sup>h</sup> –3 <sup>h</sup>	+ 18	+ 18	+ 4	+ 11	+ 1	+ 2
(b) Comparison of mean values, 11 <sup>h</sup> –13 <sup>h</sup> and 21 <sup>h</sup> –3 <sup>h</sup>	+ 19	+ 13	+ 6	+ 9	0	0
(c) Comparison of mean values, 10 <sup>h</sup> –14 <sup>h</sup> and 22 <sup>h</sup> –2 <sup>h</sup>	+ 17	+ 13	+ 6	+ 6	+ 4	+ 2

The noon maximum is well marked in nearly all cases. An increase of the day-night difference after the appearance of the nova is clearly discernible only in three cases (No. 3 a and b, No. 8 a). Apparatus No. 9 on the Hafelekar, which would also show effects of softer radiations, does not indicate any positive effect of the nova. Instrument No. 3 shows a slight positive effect in (a) and (b). Instrument No. 8 (standing in Innsbruck, only 600 metres above sea-level) does not show any decisive effect. It must be remembered, though, that all these difference effects whether

positive or negative are again within the limits of the possible mean errors, and that these are larger here where the mean values taken were not for the whole day.

It is very unfortunate that our measurements had to be discontinued on December 22, so that no measurements at the time of the maximum brightness of the nova were available. Therefore our results are not quite comparable with those of Kolhörster.

From the foregoing results, we can only conclude that it was not possible to prove an effect by the ionisation method in the period December 13-22 due to the appearance of Nova Herculis. There are indications of a small increase of ionisation after the appearance of the nova, when mean values of whole days before and after December 13 are taken. The effect, if it is real, certainly does not exceed 2 per thousand of the total radiation and does not exceed the limits of the mean errors.

VICTOR F. HESS.  
RUDOLF STEINMAURER.

Institut für Strahlenforschung  
der Universität, Innsbruck.  
Feb. 22.

<sup>1</sup> W. Baade and F. Zwicky, *Proc. Nat. Acad. Sci.*, **20**, 254; 1934.  
<sup>2</sup> NATURE, **135**, 193, Feb. 3, 1935. Also K. Graff, *Zirkular der Mittelmeerstation der Wiener Universitätssternwarte*, Nr. 1, 1935.  
<sup>3</sup> W. Kolhörster, *Z. Phys.*, **93**, 429, Jan. 1935.  
<sup>4</sup> V. F. Hess, R. Steinmaurer and H. Graziadei, *Wien. Sitz. Ber.*, **IIa**, **143**, 313; 1934.

IN the period July 1934-March 1935, we have registered the intensity of the cosmic radiation with a coincidence apparatus, kept the whole time in the same position. The counters were arranged with their horizontal axes vertically one above the other, so that the 'field' of the apparatus was 400 square degrees. Nova Herculis was in the field of the apparatus from 16<sup>h</sup>10<sup>m</sup> until 20<sup>h</sup>0<sup>m</sup> sidereal time (all time references are to mean sidereal time); in culmination it showed an angle of 1° 38' 50" towards the south with the vertical line joining the axes of the counters.

The accompanying table contains the experimental data; col. I indicates the mean number of coincidences per hour, while the Nova was in the field of the apparatus (16<sup>h</sup>30<sup>m</sup>-19<sup>h</sup>30<sup>m</sup>); col. II gives similar data during other hours of the day; col. III gives the difference between I and II as a percentage of II. We give the values for the months August, September, October, that is, before the flaring-up of the Nova, and for November, December and January separately. The data for December are repeated in the third row, because that was the time when the greatest changes were occurring in the luminosity of the star; on November 14 it was a star of magnitude 14, while on December 23 it had reached magnitude 1.5. In the fourth row are the data for February, when 36 cm. of lead was placed between the counters.

	I. 16 <sup>h</sup> 30 <sup>m</sup> -19 <sup>h</sup> 30 <sup>m</sup>	II. 20 <sup>h</sup> 30 <sup>m</sup> -15 <sup>h</sup> 30 <sup>m</sup>	III. $\frac{I-II}{II} \cdot 100$
Aug., Sept., Oct.	22.69 ± 0.28	22.04 ± 0.11	2.95 ± 1.36%
Nov., Dec., Jan.	30.41 ± 0.35	30.33 ± 0.14	0.26 ± 1.24%
December	31.21 ± 0.61	30.54 ± 0.24	2.19 ± 2.15%
February (36 cm. lead)	18.97 ± 0.51	19.01 ± 0.20	-0.21 ± 2.88%

The data show that the intensity increase during the time of culmination of the Nova does not exceed in any case four times the mean error, and even

twice the mean error is reached only in the means of August, September, October, before the outburst of the Nova.

We can infer from the foregoing that the effect of undeflected or, in comparison with the field of the apparatus, not essentially deflected cosmic rays, coming from Nova Herculis is not appreciable—in any event, not appreciable beside the oscillations due to other effects such as diurnal variation.

Judging our results from December in a most unfavourable manner by assuming that the error of measurement may be as great as three times the mean error, we can conclude that the intensity of cosmic rays coming from Nova Herculis is even in that case only twenty times as great as the intensity observed from an average surface of 1 square degree of the sky. Astronomically speaking, if we employ the ratio between the average starlight per square degree and the magnitude of the stars, we conclude that the cosmic ray magnitude of Nova Herculis can in no case exceed 1.6<sup>m</sup>.

The apparatus was constructed with the assistance of the Széchenyi Scientific Society.

J. BARNÓTHY.  
M. FORRÓ.

Institute of Experimental Physics,  
University,  
Budapest.  
March 13.

### A Method of Measuring the Collisional Frequency of Electrons in the Ionosphere

I READ Mr. Eckersley's interesting letter<sup>1</sup> concerning the measurement of the collisional frequency of electrons in Region F of the ionosphere, but feel very doubtful whether, as he says, his measurements refer to Region F<sub>1</sub>. It seems to me that they must refer to Region F<sub>2</sub>, the highest and most densely ionised level of the ionosphere. At the time of his measurements (1605 on October 1, 1934), other observations, carried out at the Radio Research Station of the National Physical Laboratory, show that the extraordinary ray critical frequency for Region F<sub>1</sub> was 4.2 mc./sec. which is different from the value of 5 mc./sec. indicated by Mr. Eckersley. Moreover, since the ionisation in Region F<sub>1</sub> exhibits a most regular type of seasonal and diurnal variation, with no abnormalities, it does not seem possible to account for the discrepancy as a local effect observed only at Chelmsford. It must also be pointed out that the formula previously given in a discussion of long-delay echoes for the ionospheric reflection coefficient, used by Mr. Eckersley, is an approximate one and its use in connexion with this particular problem does not seem justifiable. For the ordinary ray reflection coefficient ρ we have, more accurately,

$$\log \rho = -\frac{\nu}{2c} (P' - P) \dots \dots \dots (1)$$

where P' and P are respectively the group and optical paths of the waves, ν is the electron collisional frequency and c the velocity of light. Since Mr. Eckersley's measurements yield values of P' only, he has neglected entirely the value of P in the above formula, although it is known that P' and P are of the same order of magnitude.

It may therefore be of interest that there is a rigorous method of applying (1) in which the neglect of an important term is avoided. Suppose we make

measurements of  $\rho$  and  $P'$  for two wireless frequencies  $f_1$  and  $f_2$ , we have from (1):

$$f_1 \log \rho_1 - f_2 \log \rho_2 = \frac{\nu}{2c} [f_2 (P'_2 - P_2) - f_1 (P'_1 - P_1)] \quad (2)$$

Also we have, generally,

$$P_2 f_2 - P_1 f_1 = \int_{f_1}^{f_2} P' df; \dots \dots \dots (3)$$

so that, with a little reduction, there is obtained

$$\frac{\nu}{2c} = \frac{f_1 \log \rho_1 - f_2 \log \rho_2}{\text{area } X}, \dots \dots \dots (4)$$

where the area  $X$  is shown in Fig. 1 on the usual  $(P', f)$  diagram. From (4)

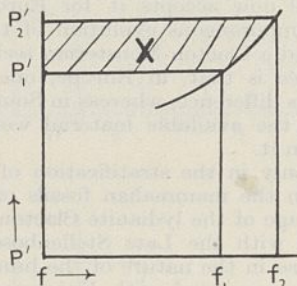


FIG. 1.

$\nu$  can be calculated. In differential notation (4) may also be written

$$\frac{\nu}{2c} = - \frac{1}{f} \frac{\delta(f \log \rho)}{\delta P'} \dots \dots \dots (5)$$

A further point of interest is that when  $\nu$  has been found in this way, the value of  $P$ , the optical path, may be estimated for any frequency with the aid of (1).

E. V. APPLETON.

Halley Stewart Laboratory,  
30 Chesterford Gardens,  
Hampstead, N.W.3.  
April 4.

<sup>1</sup> NATURE, 135, 435, March 16, 1935.

### Ramsay and Helium

A STORY is current in scientific circles which relates to the discovery of helium. It is said that after listening to the lecture on the discovery of argon at the meeting of the Royal Society on January 31, 1895, Mr. H. A. Miers (Sir Henry Miers) wrote to Ramsay, directing his attention to Hillebrand's discovery that minerals of the uraninite group gave off nitrogen, when heated with acids. The story continues to the effect that Ramsay, being a very energetic man, at once went out and bought up all the clévite that was available, treated the mineral with acid, and got off a gas which proved to be helium. The story is told without malice, and, no doubt, would have amused Ramsay, but, unfortunately, it is true neither of the man nor of the period. The true story is characteristic of both.

Ramsay certainly received the letter from Mr. Miers on Friday, February 1, but as he writes in his notebook, he spent that day, and also the following

Saturday and Sunday, in revising and typing the paper for the Royal Society. The next note in the notebook is: "Didn't do much till Friday 15th", when he made and fitted up his first Töpler pump. Actually he had a lot of time to put in at the College, making up arrears of teaching work. Then he carried out some additional determinations on the density of argon, purifying the gas specially for the purpose, the results appearing as an addendum to the argon paper. This completed one piece of work.

Ramsay next turned his attention to some experiments on the direct determination of the specific heat of argon, designed to answer criticisms put forward in the discussion at the Royal Society on January 31. The apparatus was made in the first week in March, and the first experiment was carried out on March 9. About this time his assistant, Mr. Donald Matthews, carried out the first experiment on clévite. Ramsay noted on March 20: "Matthews had obtained from clévite, about a gram of which I bought from Gregory (88, Fitsroy Square) for 3/6, a quantity of gas by boiling with dilute sulphuric acid". However, this work had been completed during the previous week, for there is a note, later: "Crookes got the first lot (Saturday, March 16) but was too busy to examine it all the week". A preliminary examination had, however, been made, for on March 17 Ramsay had written to his friend, Mr. Buchanan: "Crookes thinks that the spectrum is new, and I don't see how it can be anything old, except argon, and that it certainly is not. We are making some more of it, and in a few days I hope that we shall have enough of it to do a density." The original 3s. 6d. worth of clévite had been used up, and a further quantity was purchased.

In the meantime, Ramsay continued the experiments on the specific heat of argon, but as no communication was received from Crookes, on the morning of Saturday, March 23, he borrowed a second induction coil and proceeded to compare the spectrum of the new gas, 'crypton', with that of argon. "While observing Crookes telegraphed—Crypton is helium, 58749. Come and see it. Went and saw it"—so runs the record.

The current story does not accord with the spirit of the man, who could work with amazing rapidity, but who would settle one problem to his own satisfaction before proceeding to the next. Nor is it in accord with the spirit of an age, in which the scramble for priority was rather less obvious than at present.

A note on the discovery was written the same afternoon and communicated to the meeting of the Royal Society on the following Thursday. In those days the Royal Society assumed that the news of a discovery by one of its fellows should first be announced at one of its meetings, if the Society were in session; and in the year 1898 the fact that the discovery of krypton had been communicated simultaneously to the Royal Society and to the Paris Academy, and had become public through the latter body, evoked indignant comments at the meeting at which our paper was read. By relinquishing its prerogative the Society has lost a good deal.

In a dramatised version of the discovery of helium the departure from fact might be justified, but as a matter of mere history the true story is possibly the more interesting.

M. M. TRAVERS.

Department of Chemistry,  
University of Bristol.  
March 15.

### Early Man in South Africa

I WOULD be glad to be allowed to point out that Dr. Leakey's results in Kenya are very closely similar to those found by me on the south coast of Africa—the quartzite area—except in the matter of time.

Leakey's Kanjera skulls are, as stated by Sir Arthur Keith, definitely negroid; in fact to judge merely by his fragments, very closely similar indeed to the man responsible for the Early Mossel Bay industry—of whom I now have three adult (one described by Keith<sup>1</sup>) and one juvenile skulls, that described by Keith, with its boat-shaped frontal region, being very aberrant in this respect. This Early Mossel Bay (without a doubt much earlier than the Still Bay and its associated Fish Hoek skull) is found in natural strata in the Grey Zone at the base of the Superficial Black layer<sup>2</sup> (also recently found much more numerous in the same zone at Plettenberg Bay by me), and this Black layer, representing present climatic conditions, must be taken to be Holocene.

This prehistoric South African (or Kanjera man), however, was not only Holocene. In 1934–35 I found sufficient fragments of a Late Stellenbosch skull in a shelter at Plettenberg Bay to convince anyone seeing them that they represent the very same type of man. These Late Stellenbosch implements are extremely common in the Red Sand below the Black layer (see also ref. 2), that is, in a deposit representing an arid period before the Holocene.

If we now assume that the Middle Stellenbosch, at least, is due to the same human race, we at last come to the prehistoric South African more or less contemporaneous with Leakey's Kanjera man. Here then we have perfect harmony between South and East Africa, except that Leakey, dealing with massive deposits from large volumes of water, may perhaps be overestimating the age of these deposits.

If we now proceed to the lydianite area of the Free State, we find other resemblances—again excepting in the matter of time. A beautifully preserved series of deposits of a streamlet, each carrying implements, is to be seen at Bayswater, Bloemfontein. At a single spot, the following succession is preserved, the whole being more than twenty feet in thickness:—

(1) Gravelly blue clay, blue clay, unconformity, representing a period of erosion (drought) during which the recently laid down strata were eroded away.

(2) Red boulder gravel, red grit, red clay, calcareous clay (only preserved towards the downstream end), black clay (only a small piece preserved at the extreme downstream end of the exposure), unconformity.

(3) Red boulder gravel, red grit, red clay, unconformity (at this spot the expected calcareous clay and black clay were completely eroded away).

(4) Reddish sand with its top heavily impregnated with lime—unconformity.

(5) Black layer. At this exposure the Layer 3 forms a little hillock so that the Layer 5 has been mostly eroded away.

To my mind, this series can only mean one thing—that the strata represent the remains of five climatic cycles—the same number represented by the sand and peat layers twenty-four miles away at Floris Bad; and from Layer 1 to Layer 4 the lydianite culture was evolving in the same way as is to be seen at the Floris Bad and other sites. It, like the quartzite Stellenbosch, commences as a Clacton-like phase,

with large Stellenbosch-like implements in dolerite; but the use of dolerite is almost at once abandoned (except for the production of large horse-hoof shaped cleavers—which are found through all the phases of the culture) and the lydianite flakes pass through Mousterian-like, Aurignacian-like and Magdalenian-like phases, all the phases continuing to be associated with extinct species of mammals. The curious point about this evolution of the lydianite culture is that all its phases, especially the earlier ones, remind one (and Mr. Van Riet Lowe agrees with me here) of Leakey's Early Kenyan Aurignacian.

The early history of South Africa is not therefore as Leakey describes it for Kenya (with a Mousterian-Aurignacian technique following on a Chellean-Acheulean); not as it has been expressed in the accepted classification of South African stone implements; not as it used to be described for Europe—but as Breuil now accepts it for Europe, namely, with a contemporaneous evolution of the Chellean-Acheulean and a Clacton-Mousterian technique. The only difference is that, in Europe, one can see no reason for this difference, whereas in South Africa the difference in the available material would to some extent explain it.

It is not only in the stratification of natural deposits, and in the mammalian fossils of these, that the extreme age of the lydianite Clacton-Mousterian, as compared with the Late Stellenbosch, is to be seen; but also in the nature of the human remains. The latter is associated with Kanjera man (better prehistoric South Africans), the former with the huge, very primitive ancestral form of *H. sapiens*<sup>3</sup>, which, it may be said in passing, has no points of resemblance, except in size, with the extremely dubious Rhodesian man.

T. F. DREYER.

Grey University College,  
Bloemfontein.  
Feb. 25.

<sup>1</sup> *Roy. Soc. S. Africa*, 21, Pt. ii.

<sup>2</sup> Dreyer, *Roy. Soc. S. Africa*, 22, Pt. iii.

<sup>3</sup> "Floris Bad Man", Dreyer and Ariens Kappers, *Kon. Akad. Amsterdam*, 1935.

### Distribution of Nuclear Mechanical Moments

AT present, the nuclear mechanical spins of about fifty atoms, including about sixty isotopes, are known. Of these, the spins of fifty-three odd atomic weight isotopes are known with a fair degree of certainty, some doubt existing only in very few cases. Two types of odd atomic weight atoms exist, namely, those with odd atomic number (*A*) and those with even atomic number (*B*). The former possess an odd nuclear proton, the latter an odd nuclear neutron. Amongst the fifty-three fairly reliable spins, thirty-nine belong to the former class and fourteen to the latter. The distributions of the nuclear mechanical moments in the two classes are shown in Fig. 1.

The difference in the distributions is very striking. No significance is probably to be attached to the missing  $\frac{5}{2}$  spin atoms in the lower curve, for as yet only a little more than half of all the atoms of the Periodic Table have been studied. In spite of this, the above distributions appear to have real significance. Thus although class *B* atoms are only one-third as numerous as class *A*, yet there are more spins of  $\frac{1}{2}$  in class *B* than in class *A*, and this can scarcely be accidental in view of the general trends of both the curves.



The curves must be bound up with considerations of the building up and stability of atomic nuclei. It is apparent that high values for nuclear moments are very improbable in class *B* atoms, and class *A* atoms tend to show that  $\frac{3}{2}$  and  $\frac{5}{2}$  are very stable values when there is an odd nuclear proton. Tamm and Altschuler<sup>1</sup> have shown that class *B* atoms sometimes have three neutrons contributing to the total nuclear moment, their spins totalling  $\frac{3}{2}$ . This spin then combines with an orbital moment to give the

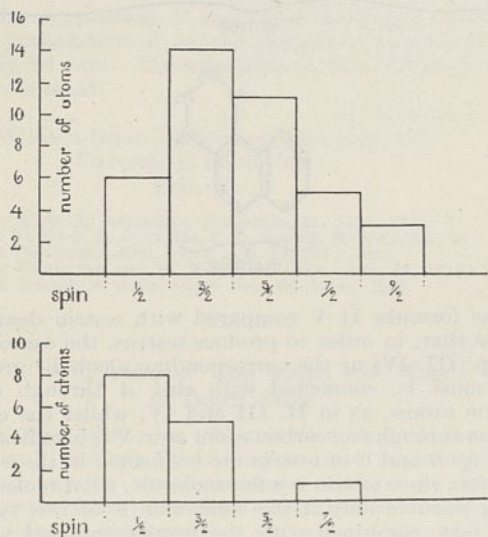


FIG. 1. Distribution of nuclear mechanical moments of odd atomic number atoms (above) and even atomic number atoms (below).

total nuclear mechanical moment of the atom. The lower curve shows that the addition *in parallel* of the neutron spins with higher orbital moments is very improbable. The combination in parallel with a higher orbital moment is obviously still less probable when only one nuclear neutron contributes to the spin.

S. TOLANSKY.

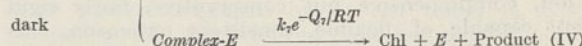
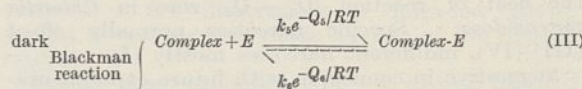
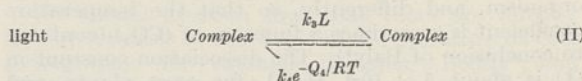
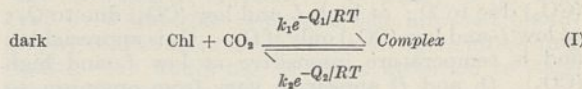
Physical Laboratory,  
University, Manchester.  
Feb. 20.

<sup>1</sup> Tamm and Altschuler, *C. R. Acad. Sci. U.R.S.S.*, 1, 455; 1934.

### The Minimum Kinetic Mechanism of Photosynthesis

KINETICS of photosynthesis recently proposed in these columns<sup>1,2,3</sup> fail to account for all temperature coefficients observed, for demonstrable reversibility of the carbon dioxide - chlorophyll complex, and for known or deducible characteristics of the Blackman reaction. The following kinetic mechanism of photosynthesis, supported in every detail elsewhere<sup>4</sup>, is proposed as representing the *minimum* number of photochemical and thermal reactions needed to cover the several major facts now established for many chlorophyllous plants in connexion with the following variables: temperature *T*, light intensity *L*, concentration of carbon dioxide ( $CO_2$ ), amount of chlorophyll per unit volume (*Chl*), concentration of internal Blackman reaction component (*E*), and specific and

indifferent narcotics, intermittent illumination, fluorescence<sup>5</sup> and induction<sup>6</sup>:



Photosynthesis is a cyclic process consisting of at least four *experimentally recognisable* forward reactions, besides incidental physical diffusion of carbon dioxide. The scheme given indicates the velocity constants, orders and sequence of the four reactions, and contingent equilibria and steady states. The Blackman reaction occurs *after* the light reaction with respect to a given molecule of carbon dioxide, and involves only combined, not free chlorophyll, and no free carbon dioxide (contrary to mechanisms of Emerson and Green<sup>2</sup> and Conant, Dietz and Kamerling<sup>7</sup>). It consists observably<sup>4</sup> of *two consecutive* reactions. The first is second order and possibly appreciably reversible, the second is first order and irreversible. The over-all Blackman reaction varies experimentally from *apparent first order to zero order*, *E* reckoned as catalyst. The order decreases as the ratio  $(\text{Complex-E})/(E_{\text{total}})$  increases with  $(\text{Chl}_{\text{total}})$  ( $\text{HCN}$ ), ( $\text{CO}_2$ ), *L*,  $1/T$ ,  $1/(\text{indifferent narcotic})$  and growth conditions. Chlorophyll does not act as a simple photosensitiser. It first forms some complex with the substrate carbon dioxide, or a derivative thereof, possibly aqueous, *prior* to the light reaction (not provided by mechanism of Kautsky and Hirsch<sup>5</sup>). Although not always equilibrated, the complex is freely and *measurably reversible*<sup>8</sup> (not provided by kinetics of Baly and Morgan<sup>1</sup> or Emerson and Green<sup>2</sup>). Oxygen appears as product in (IV), but present data do not decide as to elimination of carbohydrate in (I), (III) or (IV); (I) may require an additional reducing component if perchance carbon dioxide is reduced thermally by a mechanism similar to that in chemo-autotrophic bacteria prior to the light reaction.

Kinetics derived for the complete mechanism yield an inconvenient quadratic in *y*, the steady state rate of photosynthesis in the absence of limiting carbon dioxide diffusion. However, the reverse reaction in (II) is normally negligible<sup>9</sup>, whence<sup>4,8</sup>

$$y = \frac{k_1 k_3 L (\text{CO}_2) (\text{Chl}_{\text{total}})}{D k_3 k_1 L (\text{CO}_2) + k_1 (\text{CO}_2) + k_3 L e^{Q_1/RT} + k_2 e^{(Q_1 - Q_2)/RT}} \quad (A)$$

where *D*, temperature sensitive, is

$$(E) k_7 e^{-Q_7/RT} / [(E) k_5 e^{-Q_5/RT} + k_6 e^{-Q_6/RT} + k_7 e^{-Q_7/RT}].$$

When the Blackman reaction is apparently first order ( $(E) \sim (E_{\text{total}})$ ), equation *A* is explicit in *y*, and provides, in accordance with experiment, for hyperbolic relations<sup>8</sup> between *y* and  $(\text{CO}_2)$ , and *y* and *L*; for temperature coefficients independent of  $(\text{Chl}_{\text{total}})$ ; and for strict linearity of  $\log y$  in  $1/T$  *only* when

any one term in the denominator in equation (A) exclusively dominates, except conditionally the first term.  $y$  is temperature sensitive at high  $L$  and high ( $\text{CO}_2$ ) due to  $D$ ; at high  $L$  and low ( $\text{CO}_2$ ) due to  $Q_1$ ; at low  $L$  and low ( $\text{CO}_2$ ) only if  $Q_1 - Q_2$  is appreciable; and is temperature insensitive at low  $L$  and high ( $\text{CO}_2$ ).  $Q_1$  and  $D$  appear to vary from organism to organism, and differently, so that the temperature coefficient is sometimes a function of ( $\text{CO}_2$ ) (contrary to conclusion of Baly<sup>3</sup>). The dissociation constant in (I) is about  $5 \times 10^{-6} M.\text{CO}_2$  for most plants, and the heat of reaction ( $Q_1 - Q_2$ ) zero in *Chlorella pyrenoidosa*. Specific narcotics normally effect (III)-(IV), indifferent narcotics mostly (I).

Suggestive in connexion with future experimentation, comprehensive but conservative, fairly rigid but capable of flexible, consistent extension, this 'minimum' mechanism may be harmonised, for common points considered, with the well-known mechanisms of Willstätter and Stoll, Warburg and Uyesugi, James, van den Honert, Müller, and Emerson and Arnold<sup>9</sup>.

DEAN BURK.

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<sup>1</sup> Baly and Morgan, *NATURE*, **133**, 414; 1934.

<sup>2</sup> Emerson and Green, *NATURE*, **134**, 289; 1934.

<sup>3</sup> Baly, *NATURE*, **134**, 933; 1934.

<sup>4</sup> Submitted to *J. Amer. Chem. Soc.*

<sup>5</sup> Kautsky and Hirsch, *Biochem. Z.*, **274**, 422; 1934.

<sup>6</sup> Van der Pauw, *Rec. Trav. bot. néerl.*, **29**, 497; 1932.

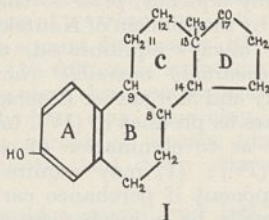
<sup>7</sup> *Science*, **73**, 268; 1931.

<sup>8</sup> Lineweaver and Burk, *J. Amer. Chem. Soc.*, **56**, 658; 1934.

<sup>9</sup> *J. Gen. Physiol.*, **15**, 391; 1932.

### Chemistry of Œstrogenic Substances

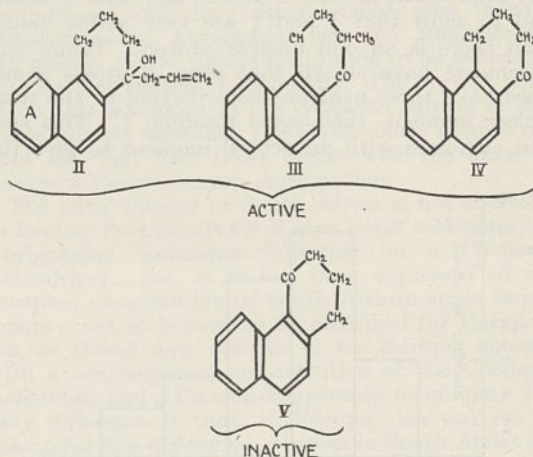
In œstrin (I) the carbonyl group in 17 is connected with the aromatic ring *A* through the carbon atoms 13, 12, 11, 9 and through the atoms 13, 14, 8, 9.



The four carbon atoms 13, 14, 8, 9 are the four centres of asymmetry of œstrin. At the same time, they form the junctions between rings *B* and *C* (8, 9) and *C* and *D* (13, 14). The orientation in the space of the whole œstrin molecule therefore is due to the arrangement of the four carbon atoms 13, 14, 8, 9.

It is remarkable that, in order to induce œstrogenic activity, it is not necessary to connect the carbonyl group with the aromatic ring through four carbon atoms orientated in a definite way. A connexion through two carbon atoms is sufficient to produce distinct, although weak, œstrogenic activity. This result can be deduced from the work of Blum and Bergmann<sup>1</sup> and Cook, Dodds and Hewett<sup>2</sup>. These authors investigated some hydrogenated phenanthrene compounds. In the work of Blum and Bergmann, 1-oxy-1-allyl-1.2.3.4-tetrahydrophenanthrene (II) and 1-keto-2-methyl-1.2.3.4-tetrahydrophenanthrene (III) were active. Cook, Dodds and Hewett got œstrus production with 1-keto-1.2.3.4-

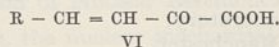
tetrahydrophenanthrene (IV), whilst 4-keto-1.2.3.4-tetrahydrophenanthrene (V) was completely inactive:



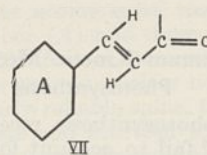
The formulæ II-V compared with œstrin demonstrate that, in order to produce œstrus, the carbonyl group (III, IV) or the corresponding alcoholic group (II) must be connected with ring *A* through two carbon atoms, as in II, III and IV, whilst the connexion through one carbon atom as in V is insufficient.

Rings *B* and *C* of œstrin are connected in the *trans* position, since œstrin is a flat molecule, a flat molecule being possible only if the connexion is of this type. This fact, combined with the results obtained with hydrogenated phenanthrene derivatives, suggested the question as to whether rings *B* and *C* are necessary for the synthesis of substances having œstrogenic properties, and if not, whether fatty-aromatic compounds, in which a carbonyl group is connected with an aromatic ring through two carbon atoms in the *trans* position would be œstrogenic.

Substances fulfilling these conditions are easily available. Aromatic aldehydes, combined with pyruvic acid by caustic soda, give unsaturated  $\alpha$ -ketic acids of the general formula (VI):



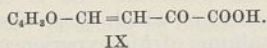
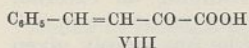
Their connexion with the problem under investigation is shown by the following formulation (VII):



The sodium salts of these unsaturated  $\alpha$ -ketic acids can easily be prepared in high purity, as I have shown recently<sup>3,4</sup>, and it was found that the aldehydes and pyruvic acid are condensed in these compounds in the *trans* position (M. Reimer<sup>5</sup>, E. Friedmann<sup>3</sup>). So far as tested, unsaturated  $\alpha$ -ketic acids, injected into spayed mice, produce œstrus of the same order as 1-keto-1.2.3.4-tetrahydrophenanthrene.

This result can be developed further. Even the aromatic ring, corresponding to ring *A* of œstrin, is not necessary for the development of the œstrogenic effect, as the benzene nucleus can be replaced

by the furane ring, fural-pyruvic acid (IX) being even more active than benzal-pyruvic acid (VIII):



Recent experiments suggest the possibility of getting oestrogenetic activity in ring-free compounds by arranging the carbon atoms 13, 14, 8, 9 of oestrin in a suitable way. Work is in progress to see whether these results can be confirmed by the capon-plumage test.

The application of the views developed above for the preparation of cancer producing substances can easily be seen. Investigations in this direction have been started.

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Feb. 25.

- <sup>1</sup> O. Blum, E. Bergmann, *Naturwiss.*, **21**, 578; 1933.  
<sup>2</sup> J. W. Cook, E. C. Dodds, C. L. Hewett, *NATURE*, **131**, 56; 1933.  
<sup>3</sup> E. Friedmann, *Helv. Chim. Acta*, **14**, 783; 1931.  
<sup>4</sup> E. Friedmann and H. Mai, *Helv. Chim. Acta*, **14**, 1213; 1931.  
<sup>5</sup> M. Reimer, *J. Amer. Chem. Soc.*, **43**, 2454; 1926.

### A Gyroscopic Top which will Walk Down Steps

In his book on "Gyrostatics and Rotational Motion", the late Prof. Andrew Gray explained how a top can be made to move along two parallel horizontal wires when they are rocked so as to change the point of support from one wire to the other. A few years ago, I discovered that a spinning top will automatically walk down two parallel wires arranged as an inclined plane.

While working with high speed motors, it occurred to me that a rapidly spinning top would have a very slow precession and could be made to walk down two wires bent so as to form a succession of steps. The top and steps are shown in Fig. 1.

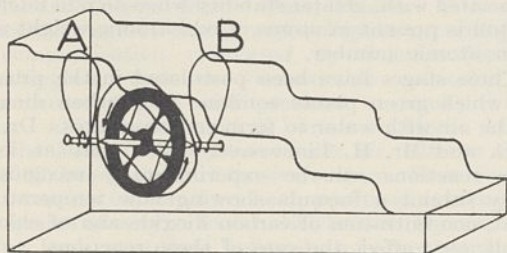


FIG. 1.

My assistant, Mr. Fullmer, who built the top, found that the length of the steps and the height of the risers must be very accurately proportioned to the type of top used. The steps should not form a sharp corner with the risers, but must be curved at each junction.

The top is spun at four to five thousand revolutions per minute and held with one hook in the middle of the highest step while the hook on the opposite side is pressed against the second highest riser (see points A and B in Fig. 1). The top, when released, will walk down the steps.

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### Infra-Red Photography of Coal

In a letter in *NATURE* of February 2 (p. 265) Prof. J. Walton has remarked that infra-red photography of thin sections of coal should give interesting results. We would like to direct attention to some results of work on this subject.

We should mention first that there are already some references to this topic in the literature of coal petrography—for example, Klingner<sup>1</sup>, Boddy<sup>2</sup>, and Wandless and Macrae<sup>3</sup>. The last-mentioned paper includes a few illustrations of infra-red photographs of coal sections made by one of the present writers.

Besides these examples, however, several hundred other photomicrographs have been taken in this laboratory, and the infra-red plate has proved more generally useful than the panchromatic. Our experience of the two types of plates enables us to make the following generalisations concerning their use in this class of work.

(1) The principal advantage of the infra-red plate will be better understood if we first consider briefly the special photographic problems presented by coal sections. These sections consist of heterogeneous mixtures of substances of the following colours: white (empty spaces), brilliant yellow (spores and cuticles), and a continuous series of shades from pale red through deep red to black (vitrain, fusain, etc.). Obviously it is extremely difficult to make realistic pictures of such objects in black and white, no matter what photographic plate is used. In order to obtain detail in any one of these colours, detail in others must necessarily be sacrificed.

Panchromatic plates, even when the developing and printing process is adjusted to give a 'soft' effect, generally give prints which suggest that the colour transition between pale red and black is less gradual than is actually the case. In infra-red photographs, however, this defect is considerably reduced; hence they generally produce much more realistic pictures.

(2) There are special cases in which the panchromatic is still to be preferred to the infra-red plate; for example, photographs of cell structure in vitrain. In such cases, there may be no yellows and whites to be depicted, the entire field consisting of reds; so, contrary to the usual rule, 'contrasty' prints may be required.

(3) Infra-red plates show another advantage over panchromatics for this work. The field appears to be flattened.

(4) Our laboratory methods for infra-red photography involve the use of the Ilford infra-red plate in conjunction with the deep red filter specified by the plate-makers, and a light source sufficiently intense to enable the image to be focused by eye. Using a weaker light and focusing by computation has not proved a success.

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- <sup>1</sup> *Montanistische Rundschau*, **26**, 1; 1934.  
<sup>2</sup> Eleventh Annual Report, Safety in Mines Research Board, p. 16; 1932.  
<sup>3</sup> *Fuel in Science and Practice*, **13**, 4; 1934.

### Philosophical Interpretation of Science

IN reviews and articles that have appeared over the name of Prof. Dingle in *NATURE*, a particular philosophical point of view has been presented as if it were one to which scientific men must necessarily subscribe. In his review of Eddington's "New Pathways in Science" in *NATURE* of March 23, p. 451, for example, it is again explicitly stated, and although I am at one with him in many of his criticisms of that book, I am certain I speak not for myself alone when I dissent strongly from Dingle's philosophical outlook on science. "We start with experience," he says, "pick out those elements which are common to all observers, represent them by concepts defined in such a way that . . . they relate together as many as possible of the common experiences, and the resulting logical network is the 'external world'".

Now this viewpoint is put forward as if it were a necessary consequence of scientific discovery; indeed we are informed that relativity has saved the man of science from being "forced to admit an external objective world of which his experience was only one aspect". May I suggest that very many men of science assert that science is the result of man's interference in and study of the external world, and that without the latter there would be no science and no men; that they regard the statement that the *logical network* constitutes the *external world* as a fantastic misuse of terms; that when Prof. Dingle

says "We start with experience" he means "I [H. D.] start my analysis . . ."; that when he talks of "all observers" he is either assuming an external world of which these observers are part or he is still talking of *his* experiences, and he has simply given the rather misleading title of "all observers" to them; that when he uses the English language in writing the review, either he is again using words evolved during the history of an external world and writing them for people all of whom are part of that external world, neither of which has been created out of Prof. Dingle's *logical network*, or alternatively *his* mind has built this language and these people out of his experiences; that in the latter event the whole of science, art, literature and philosophy become the organised experience of Prof. Dingle himself. Does all this not look as if Prof. Dingle is trying to pull himself up by his own bootlaces?

Finally, since it is certainly true that a great number of scientific men of philosophical understanding would not accept Prof. Dingle's interpretation (itself surely an experience), is he not compelled on his own criteria as to what constitutes the external world to refuse to accord his philosophy any status in that world?

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### Points from Foregoing Letters

By pointing his cosmic ray detectors to Nova Herculis, W. Kolhörster observed between December 22 and 31 an increase of 1.7 per cent in the amount of cosmic rays and brought this as evidence that cosmic rays are produced during stellar outbursts. Prof. V. F. Hess and Dr. R. Steinmaurer now give figures obtained by a different method showing that in the period December 13-22 a small increase in ionisation due to cosmic rays was recorded (less than 0.2 per cent), an amount within the limits of experimental error. Mr. J. Barnóthy and Mr. M. Forró, from continuous records with an instrument similar to that of Kolhörster, conclude that cosmic rays coming direct from Nova Herculis were not an appreciable factor in the variations observed during the month of December.

Prof. E. V. Appleton gives a new formula for calculating the frequency of collisions between electrons and molecules in the upper atmosphere. He points out that the earlier equation recently used by Mr. T. L. Eckersley left out an important factor (the optical path) and that Mr. Eckersley's measurements probably refer to the uppermost  $F_2$  region, at about 300 km.

The antiquity of the human remains found by Dr. Leakey in Kenya has recently been questioned. Prof. T. F. Dreyer directs attention to three adult and one juvenile skull found in South Africa. These are closely similar to the Kanjera finds and are considered by Prof. Dreyer to be of Holocene (post-Pleistocene or recent) age; indirect evidence, from implements, indicates that the South African and Kanjera men already existed in pre-Holocene times. Prof. Dreyer further believes that the two types of implements (Chellean-Acheulean and Mousterian) usually considered to belong to two successive periods

(lower and middle Palæolithic, respectively) were in fact evolved contemporaneously.

The 'spin' of the atomic nuclei is an important factor in determining the probability of disintegration during atomic collisions. Dr. S. Tolansky discusses the relation between the nuclear mechanical moments (due to spin) and the constitution of the nuclei. He infers that spin values of  $3/2$  and  $5/2$  lead to, or are associated with, greater stability when an odd nuclear proton is present in atoms of odd atomic weight and even atomic number.

Three stages have been postulated in the process by which green plants combine the carbon dioxide of the air with water to form carbohydrates. Dr. D. Burk and Mr. H. Lineweaver claim that at least four reactions can be experimentally recognised. They submit a formula showing how temperature, light, concentration of carbon dioxide and of chlorophyll, etc., affect the rate of these reactions.

The chemical structure of the female sex hormone, oestrin, and of related synthetic chemical compounds with similar properties, is discussed by Mr. E. Friedmann. He concludes that molecules with oestrogenic activity, so far prepared, contain the carbonyl (CO) or hydroxyl (OH) group, connected through two carbon atoms with a benzene or other 'ring'; other combinations may also be active.

Mr. J. J. Walker and Dr. L. Slater discuss the application of infra-red photography to the examination of thin sections of coal. In their opinion the method is useful in giving a more accurate reproduction of the colour transition between pale red and black, and in producing a 'flatter field'. Under certain conditions, however, the panchromatic is still to be preferred to the infra-red photographic plate.

## Research Items

**Dating by Beads at Zimbabwe.** A study of beads in Africa south of the Zambezi by Mr. P. W. Laidler (*Proc. Rhodesia Sci. Assoc.*, 34, pt. 1) aims at a classification of beads, ancient and modern, now or formerly in use among the natives. They are divided into ten classes, which are examined in relation, according to chronological considerations, with the stone structure culture of Rhodesia, thus incidentally raising the question of the tenability of Miss G. Caton-Thompson's dating of the Zimbabwe and associated cultures upon the basis of this class of evidence. Viewing the historical evidence, it would appear that no finds have been made which point to contact between South Africa and early Egypt. The Arabs landed trade beads on the East African coast previously to A.D. 1400; but it is impossible to say how much earlier, though Al Masoudi suggests that it was not long before A.D. 900. Before A.D. 1500, sites will show Indian beads only; after that date, European beads appear in increasing proportion. The Rhodesian excavations show three groups, of which Group I is judged to be pre-Zimbabwe; but there is little or nothing to distinguish it from Group II, which was regarded by Miss Caton-Thompson as belonging to a later occupation. Group I, showing beads with Indian affinities, was regarded by her as a "foundation deposit", pointing to an eighth or ninth century date for the Zimbabwe type of building. This ignores in this assemblage of beads one example which is probably of late origin and does not fit in with the historical record. It is more probable that it is a 'pre-Zimbabwe' deposit. Miss Caton-Thompson's dating leaves Class II of the second occupation period with an intervening gap of six hundred years; whereas there is evidence to show that there is continuity of importation as between Class I and II. If Group I is, in fact, related to a pre-Zimbabwe culture, it is probable that the foundation date is much later than is suggested by Miss Caton-Thompson.

**Cultural Origins, Monte Alban, Mexico.** It is now practically agreed among archaeologists, according to a communication circulated by Science Service, Washington, that the remarkable collection of ornaments of gold and precious or semi-precious stone, which were found in burials on Monte Alban by the Mexican expedition under Dr. Alfonso Caso in 1932, belong to an intrusive culture. Four seasons of intensive explorations have produced evidence of structures of a type found elsewhere in Mexico, and going back to a date believed to be contemporary with the Mayan Old Empire culture of Guatemala and Chiapas; but there is nothing to suggest any relation with the treasure find. More than seventy tombs have been explored, but no metal has been found. Recent excavation points to the civilisation of Monte Alban having flourished in A.D. 300-500; and it would appear possible that it may have been the point of origin of features, architectural and other, which appear on other sites of ancient Mexico. Among these is the cross-shaped tomb. An examination of the Dancers' Pyramid, so called from its carved dancing figures, has shown that its interior is a simple stone tomb, rectangular in shape, but with large niches on either side which are virtually the arms of a cross. This appears to be the germ of the idea which blossomed into the huge, mosaic-covered, cross-shaped tomb of Mitla, the site which stands

some twenty miles away. When the tomb of the Dancers' Pyramid was opened, it was found to contain the skeletons of several individuals in complete disorder. Among these scattered remains were five human teeth which had been inlaid with jade, while others were incrustated with hæmatite. The pyramid also had three temple bases with sloping stone sides and jutting wall panels. These are found in other parts of Mexico, but nowhere of an earlier date.

**Man-Eating Sharks.** A paper by Gilbert Whitley upon Australian shark tragedies shows that not only are attacks frequent, but also they have been increasing in number during the last few decades (*Victorian Naturalist*, Jan. 1935, p. 195). During the present century, whereas the number of records of attack traced in the ten years from 1912-21 was 13, the number between 1922 and 1931 was 45 and in the three years 1932-34, 16. The increase is probably associated with the more extensive use of shallow waters for bathing. In New South Wales, which yields more than forty records or more than half the Australian total, the greater number of shark attacks were made during the months December to April, and this coincides with the most popular bathing season. No attack occurred between May and September, although in May and June boats have been bumped or attacked. The only safe means of combatting this danger is the building of nets, fences or other enclosures for swimmers. On isolated beaches, observations from aeroplanes or from shark towers are said to have proved useful.

**Pairing and Non-Disjunction of Sex Chromosomes in *Drosophila*.** In *Drosophila* females with  $XXY$  as sex chromosomes, there have been two views as to how synapsis takes place. It is agreed that they synapse in pairs and not in a triad, but Bridges suggested that there is an equal chance of any two of these chromosomes pairing, while Anderson concluded that pairing and crossing-over between the  $X$ 's is independent of the presence of the  $Y$ . Gershenson (*J. Genet.*, 30, No. 1) has obtained further evidence regarding the nature of the pairing and non-disjunction in  $XXY$  females by using so-called *CIB* stock in which one of the  $X$ 's has a large inverted section, which reduces crossing-over in females heterozygous for the *CIB* chromosome to a very low value. He found that the percentage of cross-over  $X$ -chromosomes is the same in the gametes of  $XX$  females and  $XXY$  females in this stock, indicating that synapsis is regularly between the two  $X$ 's, while the  $Y$  goes later to either pole independently. In females having the composition  $XX - CIB$ , it is found that about 99 per cent of the eggs produced have a non-cross-over  $X$ . Comparison of this frequency with the frequency of non-disjunction indicates that the mechanism of non-disjunction is similar in males and females of *Drosophila*, and is contrary to the hypothesis that regular chromosome pairing and disjunction depends upon chiasma formation.

**Excretion of Glucose by the Rabbit Kidney.** At a meeting of the Royal Irish Academy held on January 28, T. Dillon and R. O'Donnell described the excretion of glucose by the rabbit kidney. The threshold for the excretion of glucose by the kidney was defined as that blood plasma concentration ( $C_B$ ) above which

glucose is concentrated in the urine. Glucose was found to be present in the urine below threshold level, the concentration increasing with the urine rate. Considering the distribution of the threshold values in the experimental animal, the mode of the distribution was 230 mgm. per cent, but an individual value may lie in the range 180-420. The threshold level was increased by intravenous injections of sulphate and urea, but remained unchanged after chloride injection. It behaved therefore in an analogous manner to the chloride threshold as determined by Conway. The important quality of the threshold as above defined is that it is independent of the rate of urine flow. The excretion of glucose below the threshold value may be expressed by the equation:  $K = A\sqrt{(V/T - C_B)}$  where  $T$  = threshold,  $V$  = urine volume in c.c.'s per minute, and  $A = (C_B - C_u)/C_B$ , which is closely analogous to the equation derived by Conway for the diffusion of iodine from chloroform to potassium iodide solutions perfused over it, and also to the excretion of chloride below the threshold value. The value of  $K$  has a coefficient of variation for the individual result of 26, but this variation is independent of the variables used in equation. Above the threshold, glucose excretion is expressed by the equation:  $K_2 = \sqrt{V(C_u - C_B)/(C_B - T)}$ . The results in this region are obscured by the concomitant high chloride excretion. They indicate that glucose and chloride excretion are dealt with by the same kidney mechanism. In both cases the 'diffusion-secretion' theory as established by Conway alone accounts for the observed relationships.

**Hepatics of Southern Japan.** Y. Horikawa has made an important contribution to bryology entitled "Monographia Hepaticarum Australi-Japonicarum" (*J. Sci. Hiroshima Univ.*, B, Div. 2 (Botany). Tokyo: Maruzen Co., Ltd. 2.10 yen). Southern Japan is one of the least-explored regions of the world for the hepaticologist; high mountains (up to 3,962 m.), primeval forest and numerous streams are favourable for a rich and abundant hepatic flora. Reports by Stephani (1899-1924) and Okamura (1915-16) record 57 species; this number is reduced to 43, and the author collates later scattered records, including his own discoveries, based on the study of 5,000 gatherings made by himself in twelve visits covering seventy-one days (1930-34). Three hundred and one species, eighty-four genera, twenty-one families and four orders are credited to the region, of which one genus and one hundred and seven species are new to science. The text is in English with diagnoses in Latin; there is a list of Japanese names; the extensive field work and the care given to descriptive matter, illustrations, synonymy, etc., command attention. The conclusion is drawn from phytogeographical data that a land connexion lasted longer on the Japan proper side than on the South China side; the first separation came from the Formosan Channel and later erosion led to the successive separation of the islands of the Liukiu archipelago. Endemism is strongly marked. In the hepatic flora there is an almost total absence of Philippine elements. The presence of many boreal elements proves a former glacial epoch.

**Early Daffodil Blooms.** An article by Dr. J. Grainger (*Gardeners' Chron.*, March 9, 1935) outlines the principles underlying the production of precocious blooms from daffodil bulbs. The period between mid-

November and Christmas is usually characterised by a paucity of decorative flowers, and the process described in the article should help to bridge this gap. The young flower of a daffodil is normally formed during the period between lifting in June, until the end of August. A rest period then sets in, and usually lasts about six weeks. The period of flower bud formation can be hastened by about three weeks if the bulb is kept at a warm temperature (75° F.), whilst the rest period is shortened by storage in an ice-box, at a temperature of 40°-45° F. Planting is performed immediately after the low temperature treatment, and the application of suitable growth temperatures results in the production of blooms as early as November 25. The hastening of flower bud formation is the treatment already known as 'preparation' by bulb growers, but in the paper under review, emphasis is laid on the additional need for low temperatures to shorten the rest period.

**Antiquarian Study of Fungi.** A short paper by Messrs. G. W. Hendry and H. N. Hansen in *Phytopathology* (24, No. 11, 1313-1314, November, 1934) records a novel method of studying the fungi of bygone times. The church building of the Mission Nuestra Senora De La Soledad was erected in the Salinas valley of California in 1793-94, and was rebuilt in 1832, from adobe or sun-dried bricks. Wheat straw had been used to bind the clay of which these bricks were made, and it has been found possible to identify remains of *Triticum compactum humboldtii*, Keke. in bricks from the ruins. The straw also bore evidence of fungal attack, and *Puccinia graminis* and *Ustilago tritici* have been identified. These two fungi must have been present in California in 1832, and it is perhaps rather significant that the earliest mycological survey of California (that of Harkness and Moore in 1880) records *P. graminis*, but makes no mention of *U. tritici*.

**Weed Killers.** It has been said that agriculture is a 'controversy with weeds', and weed plants are certainly obstacles to the directive ecology of the gardener. Dr. M. A. H. Tincker has recently reviewed different types of weed-killers (*J. Roy. Hort. Soc.*, 60, Part 2, pp. 68-79, February 1935). The article deals mainly with chemical methods, although biological means of control are also mentioned. Common salt, petrol, ammonium and ferrous sulphates, carbolic acid, creosote, arsenic compounds, chlorates of sodium and calcium, sulphuric acid, copper sulphate, calcium cyanamide and ammonium thiocyanate are all useful for special purposes, though it would seem that the ideal weed destroyer has still to be discovered. Chlorates are regarded as the most practical weed killers, in spite of the danger of fire. Biological methods of control include the provision of vigorous 'smother crops', and the distribution of specific insect pests of weeds. Insects are sometimes too discriminating, however, as happened when the cochineal insect was used to control the prickly-pear cactus; it attacked only one species, *Opuntia monacantha*, and further methods had to be used to effect complete eradication.

**Coal of the Upper Beeston Seam in West Yorks.** Pub. No. 35, Physical and Chemical Survey of the National Coal Resources, issued by the Fuel Research Station of the Department of Scientific and Industrial Research (London: H.M. Stationery Office) constitutes Part 1 on the Upper Beeston seam, a highly important

seam in this coalfield, which extends through the Yorkshire, Nottinghamshire and Derbyshire coalfields, forming one complete unit extending continuously for nearly seventy miles in a southerly direction from Leeds. It is stated that "For convenience the field has long been arbitrarily divided into three areas, Nottinghamshire and Derbyshire, South Yorkshire, and West Yorkshire. The present report deals with the northernmost of these, the West Yorkshire area". The Upper Beeston seam has been the most widely worked in the above area since 1917. A characteristic of this seam consists in a very dull durain, which is a particularly good and clean coal, but hard and usually spoken of as 'hard bands'. A large number of samples have been analysed, and the position of these is indicated on a map forming the frontispiece of this volume. Upon that map the area of the seam is divided into five parts, in each of which the Upper Beeston seam exhibits a characteristic thickness and structural development; the thicknesses vary from 2 ft. 6 in. to 4 ft. 6 in., the latter containing the dull bands of durain at their maximum development. The volume contains a large number of detailed analyses, in which the durain, vitrain, clarain and fusain have been analysed separately, whilst in many cases the calorific power was also determined separately. The coal is typically banded throughout, and is shown to contain a number of bands and partings, which in some cases divide the seam into an Upper and Lower part. Where this is the case, the Upper part alone appears to be worked.

**Study of Earthquakes in California.** Several articles have recently appeared on the study of earthquakes in southern California. Mr. H. O. Wood, to whom we are indebted for the plan of investigation, has described its details and the work carried on in the Seismological Laboratory at Pasadena ("Yearbook of the Carnegie Institution of Washington", 1934, 2347-2353). Dr. B. Gutenberg has given a full account of this building and its valuable instruments (*Ergebnisse der kosmischen Physik*, 2, 213-237; 1934). Auxiliary stations have also been founded at Riverside, La Jolla, Santa Barbara and Mount Wilson, and at Haiwee and Tinemaha in the Owens Valley, the scene of the great earthquake of 1872. In 1922, Mr. Wood published a map of all the known faults in southern California. Soon afterwards, the Wood-Anderson torsion seismometer was devised, and this has proved most useful in the study of local earthquakes. More than 200 epicentral tracts have been determined. In most of them, less than a dozen shocks have originated, in others some scores or hundreds, and, in a few, thousands of after-shocks of strong local earthquakes. It is interesting to notice that, with one or two exceptions, these epicentral tracts do not cluster along known faults, and that very few of them are connected with the well-known San Andreas fault along which the earthquake of 1906 originated. Indeed, the section of this fault between Tejon Pass and Cajon Pass, the seat of the great earthquake of 1857, was almost completely inactive during the six years before 1933.

**The Upper Atmosphere.** In a paper entitled "Some Facts and Theories about the Upper Atmosphere" by C. K. M. Douglas (*Quart. J. Met. Soc.*, 61, No. 258) various observations of pressure and temperature made in recent years in the upper atmosphere with the aid of specially equipped aeroplanes in

different parts of Europe are discussed, with special reference to the light that they throw upon the mechanism of anticyclones and cyclones. During the year 1932-33, in which many countries co-operated in a special study of the meteorological conditions of polar regions, the so-called Polar Year, a Dutch expedition went to Reykjavik, and upper air data were extended temporarily to Iceland. These furnished a good opportunity for studying the changes in a given air mass in the course of one or two days while the air was travelling from Iceland to places in western Europe, where further observations aloft allowed its condition at the end of that journey to be ascertained. It was found that the change of temperature of a given air mass for a given height between 2 km. and 5 km. was often slow, but that rapid rises of temperature, up to 10° F. in 24 hours, occasionally took place, apparently as a result of the sinking of initially cold air to a lower level, which resulted in dynamical warming. Air which has been warmed in that way may often be identified by its very low relative humidity. The author came to regard subsidence of rather less than 1 km. a day as an average in an anticyclone that is developing in cold air of polar origin. He showed that the air ascending over a rain area is generally warmer than the adjacent air at a height of 4 km. Discussing the variations in the height of the tropopause, he comes strongly to the opinion that the air masses just above and below the tropopause move slowly up or down together. The parts played by various air movements in the life history of anticyclones and depressions are discussed.

**Synchronous Time Motors and Accurate Time-keeping.** A valuable property in connexion with alternating current motors of the 'synchronous' type is that they keep exactly in step with the frequency of the supply. With the advent of the national grid system in Great Britain, which eventually will give time-controlled frequency throughout the whole area, the synchronous motor enables a very satisfactory method of accurate time-keeping to be obtained. A paper on this subject by W. Holmes and E. Grundy was read on March 1 to the Institution of Electrical Engineers. The frequency of the supply given by many authorities is time-controlled, and the close relation it bears to standard time is very remarkable. Records of the error of a large supply undertaking connected with the grid show that the average errors from the standard time during the day varied between two seconds fast and one second slow. Continuity of supply has been observed independently in Cheshire, Lancashire and Yorkshire at private residences having synchronous clocks of the hand starting time. The interruptions occurred about once a year and varied in duration between a few seconds and a few hours. Considering that the tiny little motor rotates at a very high speed and receives no attention this is excellent. These motors are rapidly being applied for other purposes wherever accurate time-indicating is required. In the time switches used in electric supply they are rapidly superseding the spring driven clock movement generally used. It obviates the necessity for periodical winding and so is economical to supply authorities. For laboratory purposes an electric stop watch has been produced embodying a synchronous motor. When used on time-controlled frequencies, it will measure short intervals of time with an accuracy up to the twentieth of a second.

## Biology and the Nation in Germany

THE administrative appreciation of the biological outlook in national development is nowhere so evident to-day as in Germany and Soviet Russia. A brief account of the current exhibition in Berlin on "Das Wunder des Lebens", which crystallises the use and abuse of biology by the third Reich, may therefore have some general interest. The policy on which it is based was outlined by Dr. Frick, Reichsminister of the Interior, in his inaugural speech on March 23. Unlike the 'liberalistisch-marxistischen' regime, he said, National Socialism views the individual as an inseparable part of the family, and the family as the basis of the nation. The individual therefore has increased duties to the State, but receives in return more rights, more protection, and the immediate promise of a happier and healthier life, secured through education, eugenic legislation and social assistance by the State. It is significant that he did not take a narrow national view of these activities. Indeed, he hoped that the Exhibition would be regarded as a renewed token of international friendship, and expressed the belief that the German people are anxious to work in a spirit of amiable co-operation not only for themselves but also for the growth of a healthy Europe.

Conceived in this spirit, the Exhibition is presented with a freshness and technical excellence which one expects from the organisation behind it—the Deutsches Hygiene-Museum at Dresden. It is also noteworthy that it makes no demand on the State budget, advertisers providing the cost and visitors an anticipated profit. Two halls concerned with 'Bekleidung-Schmuck' and 'Ernährung' are entirely devoted to products which not only harmonise with the motif of the Exhibition, but also supplement the technical halls in a most attractive manner. The first and most interesting of these scientific halls deals with 'Die Lehre vom Lebens', and is approached through an impressive 'Ehrenhalle' dominated by a monumental relief (*Empor*) symbolising the release of the German people under the new administration. Among the exhibits, the place of honour is given to 'The Transparent Man', a model under automatic electrical control which illuminates and explains each system of the body in turn. It is a masterpiece of museum technique, enshrined in a darkened chamber in which these words of Augustinus are prominently inscribed:

"Es bewundern die Menschen das rauschende Meer,  
Die fließenden Gewässer und den Anblick des  
Himmels,  
Und vergessen über allem Bewundern der Dinge  
Das Wunder, das sie selber sind."

In the main body of this hall, working models and striking diagrams demonstrate the elements of anatomy and physiology in relation to personal and public health. A lattice tower, for example, shows that the daily energy involved in the mechanism of the heart could take two persons to the top of the 'Funkturn' (138 metres high) adjoining the Exhibition. Nearby a large wire cage illustrates the average volume of air (32 cubic metres) required by a man in one day, while neighbouring exhibits indicate respiratory needs during various activities and postures, and the relation between the respiratory and circulatory systems. A square

relief conspicuous on the ceiling represents the surface area of the normal number of red blood corpuscles in man. Among the working models, of particular interest are those concerned with the circulation of the blood, the importance of water, the processes of digestion and the time taken to digest various foods, the mechanism and causes of dreams, the cerebral area involved in different actions, the location of bodily pains and the possible diseases they indicate, the functions of the ductless glands and their correlation with abnormalities, and the discrimination of 'basic smells', which visitors may experience for themselves. A small cinema shows biological films ranging from cellular activities to the intelligence of monkeys, while a section for 'Biologische-Leistungsprüfungen' encourages visitors to test their own lung capacity, vocal range, cardiac normality and colour vision.

From this hall one passes over an attractive 'Terrasse Restauration', with a symbolic fountain, to that which deals with 'Der Träger des Lebens'. An ante-chamber, decorated with impressive reliefs and diagrams of vital statistics in Europe, emphasises the importance attached to a large population of working-class families in the new Germany. In the centre, a 'Glockenturm' rings out the information that nine children are born in Germany every five minutes, while at the base of the structure a huge hour-glass records the death of seven persons during the same period. Two quotations from the Chancellor's "Mein Kampf" illustrate the spirit in which this hall is conceived. One is the familiar "Honour the work and honour the worker", while the other sermonises more voluminously as follows: "Auch die Ehe kann nicht Selbstwert sein, sondern muss dem einen grösseren Ziele, der Vermehrung und Erhaltung der Art und Rasse, dienen". To the right of this chamber is a nursery where the children of visitors can rest and play.

Passing into the main hall, one is confronted with an imposing illuminated exhibit, dominated by the national emblem, showing that National Socialism endeavours to protect every aspect of family life from childhood to old age. Freely translated, the words written over the eagle state that "The hereditary healthy family is the basis of life. The maintenance of their ability to work, and their protection and education in self-help, is therefore one of the great tasks of the NSDAP". And the most confirmed opponent of dictatorship must admit that the new party has attacked that task with commendable energy. One sees in this hall the results of a determined effort for the betterment of the family, through such avenues as education and care of mothers and children, the training of the average girl for her share in the development of the State, and poor-relief measures extending from the provision of food, clothes and coal to travelling schools and clinics which tour the districts. The central organisation for these activities, which cover the entire country, is the *NS-Volkswohlfahrt*, the funds of which are largely obtained from voluntary subscriptions, street collections from the sale of badges made by the rural workers, and so on. In the winter a special effort is made, its success being partly indicated by the fact that nearly 360 million marks were contributed to 'Winterhilfswerk' in the winter of 1933-34. The



monthly 'Eintopfgericht' Sunday alone, when a majority of the population contributes to 'winter-help' the savings resulting from restricting the mid-day meal to one dish, provided more than 25 million marks.

The next hall, 'Die Erhaltung des Lebens', illustrates the protection of public health in all its aspects, and the visitor can see in it many of the latest devices of preventive and curative medicine, ranging from occupational therapy and radium treatment to the latest Junkers 'Sanitätsflugzeuges'. The sanitary and educational activities of the Nazi party are also amply illustrated. A feature of the hall is a model marriage consultation centre, to which attention is attracted by illuminated curves, correlated with pictures of social conditions, of the birth- and death-rates since 1820. They show that the birth-rate rose from 1820 until 1875, and fell in response to increasing industrialisation between 1875 and 1933, when it again assumed an upward trend. The inclination of the death-rate follows, as usual, that of the birth-rate. The elevation of the birth-rate in the new regime has been secured not only by propaganda but also by State aid, 20 marks a month being given for each child in families of more than three children, provided they are 'racially healthy'. It should be added that these consultation centres will increase in importance, for further measures for the betterment of national health are to be introduced very shortly, including legislation for health certificates before marriage.

Special attention is also paid to racial 'purity', Gobineau being given an important niche in the portrait gallery of great men who have influenced the Nazi philosophy. In one popular section the Nordic farmer and fighter is glorified in pictures reminiscent of juvenile editions of the "Nibelungen-sage", surmounted by the statement that "There is

nothing more precious on this earth than the seeds of noble blood". On the opposite wall a quotation from "Mein Kampf" stands out in equally bold relief: "Indem ich für die Deutsches Zukunft kämpfe, muss ich kämpfen für die Deutsche Scholle, und muss ich kämpfen für den Deutschen Bauern". In an adjoining section a propagandic pedigree of the 'Führer' emphasises his association with the peasant class. The inevitable Jew-baiting takes the form of a series of 'selected' pictures of Semitic types bearing the sarcastic legend "Der Jude Harry Chaim genannt Heinrich Heine sagt im Buch der Lieder: 'Alle Menschen gleich geboren, sind ein adliges Geschlecht'." Alongside are several anti-Semitic cartoons, supported by Herr Hitler's opinion that the Jew can never be a German and that he will always work for the 'Grossere Idee' of his own race. The organisers of the Exhibition would have done better if they had refrained from degrading an otherwise excellent scientific exhibition with such propaganda.

The Exhibition concludes with a 'Mikrovivarium' and a section entitled 'Wohnung und Siedlung'. In the former, living micro-organisms and parasites are projected on a screen and explained by attendant demonstrators. In the latter, a series of models illustrates the improvement of housing conditions for the working classes, the central attraction being a full-size example of the suburban houses provided for working men. As one leaves the Exhibition, one feels that modern Germany has not only caught something of the spirit of the lines which adorn the cover of this journal, but has also succeeded to an admirable degree in translating it into practice.

I am indebted to the Hon. Mrs. Ursula Grant Duff and Dr. Bruno Gebhard, scientific director of the Exhibition, for many courtesies in connexion with my biological inquiries in Germany.

CEDRIC DOVER.

### Constitution and Properties of Some Non-Ferrous Metals and Alloys

THE spring meeting of the Institute of Metals was held on March 6-7, in the hall of the Institution of Mechanical Engineers.

To all interested in the lead-tin-antimony alloys, and particularly those used for type metals, the paper by Frances D. Weaver will be of especial value. In addition to the working out of at any rate the main features of this diagram, a considerable amount of data is available concerning the hardness properties of those alloys most commonly employed.

Prof. D. Hanson, in collaboration with Mr. E. J. Sandford, has continued his work on the influence of small amounts of other elements on the properties of tin. The metals investigated in the present work are aluminium, manganese and bismuth, the results with the first metal being perhaps particularly important in that there is a very definite time effect. The greatly improved properties obtained immediately after preparation are not permanent; deterioration of the alloy commences at the skin and spreads slowly inwards and spontaneous cracking takes place. Bismuth also increases the tensile strength of tin very considerably and refines the grain size.

Mr. W. E. Prytherk has examined the mechanical properties of some wrought magnesium alloys, and although no alloys of this metal have yet been produced which respond to heat treatment in the manner which is characteristic of certain well-known

aluminium alloys, some of the materials studied have distinctly interesting and promising properties. The work which they have carried out over a number of years on the investigation of unsoundness in aluminium alloy castings is continued by Prof. Hanson and Mr. I. G. Slater, who have examined the effect of the pressure of the atmosphere under which a metal solidifies. They have shown that pressures from fifty to a hundred pounds per square inch are sufficient to remove all visible traces of pin-holes from sand-cast ingots, and that the densities of such castings, particularly those prepared under the higher pressures, are appreciably greater than can be obtained from ingots poured from melts treated by the various de-gassing processes. The tensile properties of certain alloys are considerably improved by solidification under pressure, but the fact is noted that in some instances, reheating the casting, by causing the liberation of the gases contained in solution, may give rise to blisters and cavities.

The penetration of molten solders into strained non-ferrous metals has been examined by a number of workers. Mr. L. J. G. van Ewijk contributes an account of a similar type of cracking in heat-treated nickel-chromium steel. The zinc chloride flux is shown to be innocuous, and it is clear from the inter-crystalline nature of the fracture that the penetration here is of exactly the same order as that which has been found in non-ferrous alloys. One of the interesting

features of the work is the considerable difference in the susceptibility to this type of embrittlement to be found in the various nickel-chromium steels themselves. There is some indication, however, that a high impact value results in a material which is relatively immune. Tests carried out on two plain carbon steels suggest that these are not liable to fracture under the conditions of the test. Whether, however, this is due merely to the composition of the material, or to the fact that the tensile strengths of these plain carbon steels were distinctly lower than those of the nickel-chromium ones, whence presumably the carbon steel contained less internal stress, is not clear.

The effect of five years exposure to urban atmospheric conditions on the strength and electrical resistance of some non-ferrous wires is reported on by Mr. J. C. Hudson. The work shows that electrical resistance measurements may be used to give a fair idea of the extent to which corrosion proceeds. Among the materials investigated copper stands out pre-eminently, whilst the most corroded material of all was galvanised iron wire, which rapidly failed once the zinc coating had been corroded away.

Dr. H. J. Gough and Mr. D. G. Sopwith give an account of further experiments on atmospheric action in connexion with fatigue. The results of the tests on copper and brass suggest strongly that the acid and alkaline impurities present in the atmosphere can have little, if any, influence on atmospheric corrosion fatigue, and that oxygen in the presence of moisture is probably primarily responsible. The results of the tests on oxygen-containing and de-oxygenated coppers show that the comparative behaviour of these materials, when tested in air and in a partial vacuum, is unaffected by the different compositions of the dissolved gases present. Corrosion fatigue, in this instance of duralumin, is also the subject of the paper by Messrs. I. J. Gerard and H. Sutton, who show that coatings of organic resins and enamels afford a very high degree of protection, especially when the metal had previously been subjected to the anodic treatment. The best results were obtained with a coating of synthetic resin varnish stoved for two hours at 150°C., metal so treated giving a fatigue limit of plus or minus 12.2 tons per square inch for ten million reversals.

Other papers were concerned with the reduction by hydrogen of stannic oxide in high conductivity copper, by Dr. Alkins and Mr. A. P. C. Hallows, the spectrographic analysis of aluminium and a consideration of certain phases in the silver-cadmium alloys.

F. C. T.

## Science News a Century Ago

### Shipping Statistics for 1834

On April 20, 1835, Lieut.-Col. Sykes communicated to the Statistical Society an appendix to his paper on "The Increase of Wealth and Expenditure in the Various Classes of Society". In this he gave particulars of shipping and trade from January 5, 1834 until January 5, 1835. The increase in this period in the number of British vessels employed in foreign commerce, he said, was 689 ships of 108,562 tons burthen, value £1,411,356. The net receipts in the Customs duties had risen from £17,577,549 to £19,931,687. In the year there cleared inwards 11,678 British vessels employed in the foreign trade of a burthen of 2,108,492 tons, which at £12 a ton

represented a capital embarked of £25,301,904. The increase in the declared value of exports of the British and Irish manufacturers was £2,052,542, the total amount for the year being £36,541,926. The surplus disposable balance of the public revenue for the year ending January 5, 1835 was £1,608,155 after payment of all charges.

### Meteorological Observations by Sir John Herschel

The *Athenæum* of April 25, 1835, contained a long abstract from a letter from Sir John Herschel at the Cape, to J. Hudson, late assistant secretary to the Royal Society. The letter dealt mainly with meteorology, and in it Herschel said that the South African Literary and Philosophical Institution had appointed a Meteorological Committee and had passed a resolution that "On four fixed days in each year, 21st of March, 21st of June, 21st of September and 21st of December . . . we undertake to make horary observations of the barometer, wet and dry thermometer, clouds, wind, meteors, etc. etc. at the commencement of each hour (per clock) mean time at the place for thirty-six hours, beginning at six o'clock in the morning of the 21st and ending at six o'clock in the evening of the 22nd. Thus a complete twenty-four hours is sure to be embraced in corresponding, or at least, interpolable observations for all *longitudes*". Speaking of his measures with his actinometer, Herschel said, "The following may give you some notion of the purity of our sky and the force of our sunshine:

Effect observed here the day before yesterday 48°75  
Usual effect of ordinary good sunshine in England  
25°30

I find this instrument extremely sure and uniform in its indications, and having now had nearly eleven years' experience of it, I can safely say that it is perfectly adapted to the purpose. For this reason I shall draw up and forward to the Royal Society, very shortly an account of its construction and use".

### Death of Capt. Henry Kater

On April 26, 1835, Capt. Henry Kater died in London. Born at Bristol on April 16, 1777, he came of a family of German extraction. At first he studied law, but at his father's death in 1794 he joined the Army as an ensign and sailed for India. There he came under Lambton's notice, and was employed on geodetical work. After a few years work in various parts of India, ill-health drove him home, and after further service in England in 1814 he was placed on half-pay and henceforth devoted himself to science.

Kater was best known for his geodetical work. His memoirs in the *Philosophical Transactions* from 1813 until 1828 refer mainly to the accurate construction and use of the pendulum, the balance and astronomical instruments. He applied Huygens's principle of the reciprocity of the centres of oscillation and suspension of pendulums; in 1818 ascertained accurately the length of the seconds pendulum in London, and during 1821-23 was associated with Arago, Mathieu and Colby in the determination of the difference of longitude between Paris and Greenwich. He compared the standard weights and measures of France, England and Russia, and also constructed various standards for Russia. Elected fellow of the Royal Society in 1815, he was awarded the Copley Medal in 1817 for his experiments on pendulums, and from November 1827 until November 1830 was treasurer to the Royal Society.

## Societies and Academies

## DUBLIN

Royal Dublin Society, March 26. W. HUGHES: Investigations on the control of seedling disease of sugar beet. A trial was made of the effectiveness against the blackleg disease of sugar beet, of the bulk seed treatment carried out by the Continental producers, in comparison with treatment with various disinfectants in small lots before sowing and with no treatment. A germination test indicated that in the bulk seed treatment some injury was caused by too long contact between seed and disinfectant. In a randomised field experiment, the following materials used before sowing gave a significant increase in establishment of seedlings over the control—Germisan and Ceresan (U.T. 1875 A.), 27.6 per cent, Granosan, 25.6 per cent, and Ceresan (old), 21.7 per cent. The remaining five treatments, which included the seed producers' treatment in bulk, were not significantly better than the control. Seed treatment is recommended as a necessary insurance. E. T. S. WALTON: Artificial radioactivity.

## PARIS

Academy of Sciences, March 4 (*C.R.*, 200, 793–868). EMMANUEL LECLAINCHE: Notice on [the late] Theobald Smith. MARK KREIN: Derivatives of Mercer's nuclei. A. TIEMLAOFF: The growth of functions satisfying linear partial differential equations of the second order. ALEXANDRE SMORSHESKYY: Orthogonal polynomials. ANTOINE MAGNAN: A rapid kinematograph for films 9 mm. wide, giving 1,500–2,000 images per second. A simplification of an apparatus previously described. A film taken with 2,000 images per second can be projected showing 16 views per second. This slow-motion film has been applied to show the motion of a rebounding ball, the wing motion of a bird and the movement of the lips of a person speaking. PIERRE LEJAY: The interpretation of observations of the intensity of gravity made in the Philippines, in Malaya and in the Dutch Indies. The anomalies found on land confirm the results of Vening-Meinesz made at sea. The results appear to be connected with the great instability of the surface layers. There is great tectonic activity, there are dozens of active volcanoes and earthquakes almost daily. JACQUES MÉTADIER: The Brownian movement in the Hilbert space. Hyperquantification and superquantification. PIERRE VERNOTTE: The formulation of experimental laws. The uncertainty which results for the interpretation of physical phenomena. Application to the law of reactivity. A discussion of the representation of experimental facts by mathematical expressions. It is concluded that although an expression can be found which will represent a set of experiments with precision, a physical interpretation of a phenomenon cannot be based on the analytical expression which represents the experiments. ANDRÉ EGAL: The measurement of the velocity of marine, submarine or aerial vessels by compensated thermocouples. JACQUES ERRERA and POL MOLLET: Intramolecular isomerisms and infra-red absorption spectra. The absorption spectra of the three hydroxybenzoic acids and of *o*-chlorophenol confirm Sidgwick's theory of cycle formation. A. IONESCO: Structure of the absorption bands of acetylene in the ultra-violet. GEORGES COSTEANU, RENÉ FREYMAN and AUREL NAHERNIAC: Study of the absorption spectra in

the near infra-red of liquid, gaseous and dissolved ammonia. The observations suggest the existence of polymers for liquid ammonia or ammonia in concentrated solutions. MME. JACQUELINE ZADOC-KAHN EISENMANN: The electric double refraction of para-azoxyanisole in the isotropic state. RENÉ DE MALLEMANN and PIERRE GABIANO: The magnetic rotatory power of ammoniacal nitrogen. FRÉDÉRIC JOLIOT and LEW KOWARSKI: The production of a radiation with energy comparable with that of the soft cosmic rays. Study of the radiation produced by irradiating a silver plate with neutrons emitted by polonium + beryllium. PIERRE PREISWERK: Experiments on the radio-activity produced by neutrons. VICTOR HENRI and WLADIMIR LASAREFF: The ultra-violet absorption spectrum of methylamine. PAUL JOB: The coloration of nickel salts in hydrobromic acid solution. Application of the law of mass action in concentrated solution. ANDRÉ BOULLÉ: The application of differential thermal analysis to the study of the anhydrous sodium metaphosphates. ANDRÉ CHRÉTIEN and PIERRE GENET: Disodium ortho-arsenate and its hydrates. FERNAND GALLAIS: Iodomeric acid. From a study of the changes in the magneto-optical properties of solutions of mercuric chloride produced by the gradual addition of hydriodic acid, it is inferred that iodomeric acid has the composition  $H_2HgI_4$ . AL. FAVORSKY and MLE. TATIANA FAVORSKAJA: The gradual molecular acetylene-allene-dienic transposition of the halo-hydrins. JOSEPH WIEMANN: The synthesis of a methyl and dimethylhexite. J. FRANC DE FERRIÈRE: The history of the soils of the lower terraces of the Rhine in Haute-Alsace. GEORGES RENOARD: The upper Stephanian and the Permian of the Villé basin in Alsace. GEORGES DUBOIS and MME. CAMILLE DUBOIS: The results of pollen analyses of Flandrian coastal peat between Penmarc'h and Concarneau. GEORGES SCHNEIDER: The variations of the yield of the thermal springs of Aix-les-Bains. G. DEMETRESCU: The study of seismograms. R. GUIZONNIER: The phase of the diurnal component of the gradient of terrestrial electric potential. HENRI COLIN and EUGÈNE BOUGY: Sugar, ash, nitrogen and phosphorus in fodder and sugar beets and in their hybrids. The forage beet has more ash, less sugar, more nitrogen and more phosphorus than the sugar beet. JEAN CHAZE and ANDRÉ SARAZIN: Contribution to the study of the mole, a disease of cultivated mushrooms. MME. ANDRÉE DRILHON: Calcium and casting the shell in Crustacea. JOSEPH MEIERHANS: The behaviour of physostome fishes after extirpation of the air bladder. YERVANTE MANOUÉLIAN: Rabies, Borna's disease and peripheral neurones. BARUCH SAMUEL LEVIN and IWO LOMINSKI: The action of soft X-rays on micro-organisms. GEORGES BLANC and L. A. MARTIN: Experimental iridocyclitis produced by the typhic virus.

## BRUSSELS

Royal Academy (*Bull. Classe Sci.*, 21, No. 1). G. CESÀRO: Equation and form of the curve for which  $\delta = k \cdot \sin \alpha / \alpha$  ( $k = \text{const.}$ ), if  $\delta$  is the length of the perpendicular from the origin on to one of its tangents and  $\alpha$  the angle which this perpendicular makes with the  $x$ -axis. E. HENRIOT: The antisymmetric aspect of electro-magnetism: torque and momentor. The importance of antisymmetrical quantities in electro-magnetic theory is emphasised, and two tensors are defined—the torque tensor and the momentor. E. DE WILDEMAN: Adventitious buds in Congolesse varieties

of *Hæmanthus*. P. BURNIAT: Birational transformations of space having two isolated associated fundamental points. (3) Transformations  $T_3$  and  $T_4$ . J. F. COX: Representation of the whole surface of the earth in an equilateral triangle. Formulæ and examples of conformal and equivalent projections in an equilateral triangle. J. VAN MEIGHEM: Equations of perturbation of perfect piezotropic fluids. This paper establishes the equations in the case when the field of the Lagrangian variables of the perturbed movement does not coincide with that of the unperturbed movement. G. BALASSE and Mlle. GALET: Spectra of iodine with feeble excitation. A correction. J. PASTEELS: Morphogenetic movements of the gastrulation in turtles. J. TERBY: Attempt to explain the mitosis of *Spirogyra* by that of *Plasmodiophora*.

## GENEVA

Society of Physics and Natural History, February 7. B. SUSZ and E. BRINER: The Raman spectra of mixtures of nitric acid and nitrogen pentoxide. The frequencies  $1048^{-1}$  and  $1396^{-1}$ , the intensity of which increases with the concentration of the pentoxide, appear to be connected with the presence of this substance. W. H. SCHOPFER: The solubility of growth factors.

February 21. P. ROSSIER: (1) A colorimetric equivalent. The application to a group of all spectral types of stars of a linear function of the abscissæ of the extremities of spectrograms of type *A* stars leads to an expression sensibly proportional to the colour index. (2) The natural classification of stars. If a number proportional to the percentage of stars of a spectral type less advanced than a certain limit is chosen as a variable independent of classification, it appears that certain inflections of some curves of colorimetric equivalents disappear.

## VIENNA

Academy of Sciences, January 24. ERICH TSCHERMAK-SEYSENEGG: Hybridogenic pseudo-parthenogenesis. ALEXANDER TORNQVIST: The high metamorphic gravel beds of Tessenberg-Panzendorf in the eastern Tyrol. RICHARD WEISS and JAKOB KOLTES: Derivatives of 1:4-di- $\alpha$ -naphthyl-naphthalene. RUDOLF WAGNER: Prefloration polymorphism of hexamerous blossoms. A methodological investigation. RUDOLF ZIMARA: Mammals of West Africa.

## Forthcoming Events

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

Sunday, April 21

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Gem Stones".\*

Friday, April 26

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Discussion on "Gravity Measurements" to be opened by Dr. E. C. Bullard.

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP), at 6.45.—Annual General Meeting to be held at the Waldorf Hotel, Aldwych, London, W.C.2. Lord Amulree: "A Historical Survey of Wage Adjustments".

GEOGRAPHICAL ASSOCIATION, April 26–29. Spring Conference to be held in Nottingham.

## Official Publications Received

## GREAT BRITAIN AND IRELAND

Post Office Publicity. By Sir Stephen Tallents. (The Post Office Green Papers, No. 8.) Pp. 24+12 plates. (London: H.M. Stationery Office.) 6d. net.

Annual Reports on the Progress of Chemistry for 1934. Vol. 31. Pp. 442. (London: Chemical Society.) 10s. 6d.

International Conference on Physics, London 1934. A Joint Conference organized by the International Union of Pure and Applied Physics and the Physical Society. Papers and Discussions. In 2 vols. Vol. 1: Nuclear Physics. Pp. vii+257. 10s. Vol. 2: The Solid State of Matter. Pp. viii+183. 10s. Reports on Symbols, Units and Nomenclature approved by the General Assembly of the Union at its Meeting in London on 5th October 1934. Pp. iv+40. 2s. 9d. (London: Physical Society.)

Association of British Chemical Manufacturers. Directory of British Fine Chemicals produced by Members of the Association. Pp. 62. (London: Association of British Chemical Manufacturers.)

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1934, presented to the Annual Meeting, February 11th, 1935. Pp. 51+6. (York: Yorkshire Philosophical Society.)

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution: Report on Observations in the Year ended 31st March 1934. (Twentieth Report.) Pp. vii+108. (London: H.M. Stationery Office.) 5s. net.

Census of England and Wales, 1931. General Tables comprising Population, Institutions, Ages and Marital Conditions, Birthplace and Nationality, Welsh Language. Pp. ix+246. (London: H.M. Stationery Office.) 11s. net.

## OTHER COUNTRIES

U.S. Department of the Interior: Geological Survey. Professional Paper 185-C: The Recognizable Species of the Green River Flora. By Roland W. Brown. (Shorter Contributions to General Geology, 1934–35.) Pp. ii+45–77+plates 8–15. 10 cents. Professional Paper 185-E: Miocene Plants from Idaho. By Edward Wilber Berry. (Shorter Contributions to General Geology, 1934–35.) Pp. ii+97–125+plates 19–24. 10 cents. (Washington, D.C.: Government Printing Office.)

The Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 4: Host Plant Index of Indo-Ceylonese Coccidæ. By S. Ramachandran and Dr. T. V. Ramakrishna Ayyar. Pp. iii+113+x. (Delhi: Manager of Publications.) 1.10 rupees; 2s. 9d.

The Woody Plants of Natal and Zululand. By Dr. J. S. Henkel. Pp. xii+252. (Pietmaritzburg: Natal University College.)

Argeologische Navorsing van die Nasionale Museum, Bloemfontein. Deel 2, Stuk 1: Die Oorblyfsels van Buispoort en Braklaagte, Noordwes van Zeerust. Deur Dr. Ir. E. C. N. Van Hoepen en Dr. A. C. Hoffman. Pp. ii+25+12 plates. (Bloemfontein: Nasionale Museum.)

U.S. Department of Agriculture. Miscellaneous Publication No. 207: Raising Reindeer in Alaska. By Lawrence J. Palmer. Pp. ii+41. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Department of the Interior: Office of Education. Bibliography No. 29: Good References on The Curriculum and Social Change. Compiled by Katherine M. Cook and Florence E. Reynolds. Pp. 10. Gratis. Bulletin, 1934, No. 12: Privately Controlled Higher Education in the United States. By Fred J. Kelly and Ella B. Ratcliffe. Pp. v+56. 10 cents. Bulletin, 1934, No. 18: High-School Clubs. By Maris M. Proffitt. Pp. v+64. 10 cents. Pamphlet No. 50: Public Education in the Virgin Islands. By Katherine M. Cook. Pp. viii+32. 10 cents. Vocational Education Bulletin, No. 177: Vocational Agriculture in relation to Economic and Social Adjustments; Report of Conference on the relation of Vocational Agricultural Education to Emergency and Long-Time Programs affecting Agriculture. Pp. xviii+67. 10 cents. (Washington, D.C.: Government Printing Office.)

Transactions of the San Diego Society of Natural History. Vol. 8, No. 5: Three New Species of Pinnixa from the Gulf of California. By Steve A. Glassell. Pp. 13–14. Vol. 8, No. 6: New Marine Mollusca from West Mexico, together with a List of Shells collected at Punta Penasco, Sonora, Mexico. By Herbert N. Lowe. Pp. 15–34+plates 1–4. Vol. 8, No. 7: New Species of Mollusks of the Genus *Triphora*. By Fred Baker and V. D. P. Spicer. Pp. 35–46+plate 5. Vol. 8, No. 8: New Trilobite Species from the Anthracolithic of Northern California, and *Griffithides* *Conwayensis*, a New Name for a Trilobite Species from the Atoka Formation of Arkansas. By Harry E. Wheeler. Pp. 47–58+plate 6. Vol. 8, No. 9: Revision of some California Species of *Astrodapsis*. By George L. Richards, Jr. Pp. 59–66+plate 7. (San Diego: Society of Natural History.)

India Meteorological Department: Scientific Notes. Vol. 6, No. 61: Evaporation in India calculated from other Meteorological Factors. By P. K. Raman and V. Satakopan. Pp. 52. 1.12 rupees; 3s. Vol. 6, No. 62: The Distribution of Temperature in the Upper Levels of a Depression originating in the Bay of Bengal during the Indian South-west Monsoon. By N. K. Sur. Pp. 53–56+2 plates. 5 annas. 6d. (Delhi: Manager of Publications.)

Smithsonian Miscellaneous Collections. Vol. 93, No. 3: New Earthworms from China, with Notes on the Synonymy of some Chinese Species of *Drawida* and *Pheretima*. By G. E. Gates. (Publication 3293.) Pp. 19. (Washington, D.C.: Smithsonian Institution.)

## CATALOGUES

A Catalogue of Books in New Condition offered at Greatly Reduced Prices. (Catalogue 449.) Pp. 80. (Cambridge: W. Heffer and Sons, Ltd.)

The Gardener's Library: a Comprehensive List of Books on all Branches of Modern Horticulture and a Selection of the Early Literature. (New Series, No. 39.) Pp. 44. (London: Wheldon and Wesley, Ltd.)

Zeiss Microscopes and Accessories. (Mikro le.) 1934 edition. Pp. 158. (London: Carl Zeiss (London), Ltd.)