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Industrial Psychology and Its Social Significance

THE last few years have seen a remarkable change in the public attitude towards industrial and commercial problems. In every country it has been recognised that many of the most difficult of these problems will be solved only by the application to them of psychological knowledge. It was with this fact in mind, and with a foresight which was well ahead of common opinion at the time, that Dr. C. S. Myers founded the National Institute of Industrial Psychology in 1921. From the beginning, it was realised that the work of the Institute would be two-fold : it must be of service to the particular employer of labour by helping him to attack his own special problems of factory or of industrial organisation, and it must at the same time set itself to stimulate and carry out research into problems of general industrial well-being.

Thirteen years have elapsed, and the Institute has now issued a report of its research work, a forecast of future activity and a plea for wider and more generous support*. The report is a striking and valuable document. On the side of specific factory or works investigations the Institute has proved itself, and is able to support a large and increasing body of trained consultants. But for the research work, which many rightly regard as of even greater significance, it must necessarily depend, and must probably continue to depend for a long time to come, upon public or private benefaction. Extremely valuable aid has been given by the Rockefeller and Carnegie Trustees ; the former, for example, have "up to now given the Institute the total sum of over £22,000, mainly for research". Naturally this particular source of help cannot continue indefinitely. It has set the Institute upon its feet, and assisted its early steps towards the achievement of its aim. But now it is reasonably considered that others must help it along the way to complete success, for within two years the research work of the Institute must be seriously curtailed, or even cease, unless aid is forthcoming from other sources.

What, then, has been accomplished ? The research work of the Institute, as revealed in this report, has been very varied, but it has developed

* An Account of the Research Work Carried out by the National Institute of Industrial Psychology during the years 1921-1934. Report 5 of the National Institute of Industrial Psychology, London, 1934. Pp. 37. 2s. 6d. net.

in the main along three lines : vocational guidance, a study of the abilities particularly required in industrial occupations and their training, and an analysis of human work involved in special industrial directions.

That everybody now knows at least something about vocational guidance is due largely to the enterprise of the Institute. Industrial organisation has increased vastly in complexity and in scope, but it has grown largely without foresight so far as its human problems are concerned—in a haphazard and hand-to-mouth fashion. Hundreds of thousands of young recruits pass into the industrial army every year. They have little direction, except that coming from local demands and immediate opportunity. The result is a great amount of muddle, of wasteful turnover from one occupation to another, of prolonged training resulting in the end often in only a moderate degree of efficiency. The ordinary methods of industrial recruitment rest upon an assumption of a versatility widely spread throughout an entire population which is, in fact, possessed only by the relatively few outstanding persons.

The Institute has carried out five large-scale experiments in order to see what hope there can be of avoiding the waste of human effort produced by lack of direction in industrial recruitment. It is claimed—and no careful and unbiased reader can fail to be impressed by the claim—that a study of the psychological and physiological equipment of young persons who are going into industry, of their aptitudes and of their capacities, of their temperament and of their ambitions, makes it possible to direct them in such a way that they can realise their possibilities more quickly and smoothly, with fewer false starts, with greater chance of ultimate efficiency, to the content both of themselves and of their employers and to the enhancement of the well-being of the community. The Institute has played a large part in proving the case for vocational guidance. The methods by which such guidance can itself be best directed still demand active research. It would be a disaster if the activities of the Institute to further this end were cramped by inadequate public support.

In spite of the rapid mechanisation of industry, manual dexterity in one form or another still plays a predominant part in industrial occupations. Rightly, therefore, the Institute has directed much research into an investigation of the nature and analysis of manual skill, of its general or

specific character, and of the most fruitful ways by which it can be trained. It has shown again, what psychologists often have demonstrated in other directions, that mere repetition is a bad way to learn anything, and about the worst way of all to try to learn more than one thing. Its reports on the training of manual skill establish conclusions that are of importance in practically every factory in the country. But here, again, there is far more to discover than has as yet been made clear, and research must proceed if progress is to be made.

Of the study of somewhat more narrowly defined industrial problems : the effects of rhythm on work ; the influence of visual factors in specific occupations, such as mining ; the ways in which threatened boredom can be controlled and dispelled ; the best working conditions in such abnormal groups as those of the blind ; all that can be said here is that promising work has been initiated and carried through. The investigations touching upon these matters, and many others as well, are considered and described in the report.

In the thirteen years of its existence, the Institute has accomplished a very great and important amount of work. It has powerfully assisted many movements which have given to psychology a social significance altogether out of proportion to the number of people engaged upon the exact investigation of its problems, or to the amount of private and public financial assistance that it is accorded. Nowadays, psychologists are asked to comment upon and even to settle almost every problem of social and public import that arises. If their answers are halting and inadequate—as they very often must be—it is because methods for the collection of data in an exact manner have only recently been devised, and because psychology is, of all sciences, physical or biological, the one which has been most hampered for lack of funds to prosecute research. Both in the case of the National Institute of Industrial Psychology and elsewhere, what has been done has often been accomplished only because trained students have been willing to devote themselves, freely, or for inadequate payment, to the study of pressing social problems. The claim made by the Principal of the Institute for more generous financial assistance is no longer based upon promise alone, but upon substantial performance, and we hope that it will receive a widespread and a ready response.

Geography of Human Endeavour

Economic and Social Geography. By Ellsworth Huntington, Frank E. Williams and Samuel van Valkenburg. Pp. xi+630. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 23s. net.

A BOOK by Prof. Huntington is expected to be stimulating and suggestive, and even if a reader disagrees with a good deal (as easily may happen) the encounter is always worth while. When in addition Profs. Williams and van Valkenburg are collaborating, a book worth reading is assured.

Broadly speaking, the present volume deals with those geographical facts and principles that underlie all the major normal activities of the human race. Food production naturally comes in for the greatest share of space, because the extent to which this can be accomplished in any particular region has in the main determined the distribution of population on the earth, and therefore the extent to which man has altered the face of the earth to make it better suited to his real or fancied requirements. Industry and commerce receive little more than 100 pages; yet so well is the subject matter presented that one feels no distortion of perspective.

The book opens with a discussion of the effect of climatic factors on the growth of crops as food for men and animals, on the distribution of men and animals over the surface of the earth and on numerous human attributes, activities and happenings. It is fully illustrated with maps and charts presenting several novel features—including the cutting out of much of the oceans so as to give more space for the land areas. Some of these show the relation of climate to health and disease, to prosperity and mobility, numbers of motor-cars, education, the liberal professions, and such minor events as convictions for drunkenness, illegitimacy and suicide. The discussions on climate have the special feature that full use is made of the ingenious climatographs or, as the authors prefer to call them, the "climographs" already known to geographers through the advocacy of Griffith Taylor. The mean monthly temperatures are plotted on a vertical scale, the mean monthly rainfalls on the horizontal scale, then the points for the various months with the names of the months written alongside of them are joined, making an irregularly shaped figure which shows at once the general character of the climate and enables comparisons with other regions to be easily made.

The agricultural maps include some interesting isopleths, or 'lines of equal productivity', drawn through points where the average yields over a long period are the same. One thus sees at a

glance the fertility levels; these are marked off and shaded just as in an ordinary contour map. The authors proceed to combine the 'isopleths' with the 'climographs' and so obtain isopleth climographs which show the relation of temperature and rainfall to crop yields. One such chart is drawn for maize for each of the four seasons beginning with winter (December, January, February). The results are exceedingly interesting: they show, as one might expect, that the conditions for high yield are very narrow, but for low yields they widen out to the limits of tolerance for the crop. This method of treatment deserves serious attention not only from geographers, but also from agriculturists.

From the various data accumulated in regard to human health and activity a map is drawn up showing the distribution of 'climatic energy', that is, the energy that human beings would have if climate were the only determining factor. This makes an interesting study. The densest portions, that is, the optimal regions, centre round the North Sea, around the Great Lakes in North America, and in smaller regions on the Pacific coast of North America, and in an area including the south-eastern corner of Australia, Tasmania and New Zealand. Next, with somewhat less climatic energy, come the remainder of Europe including Russia, and the rest of the northern United States and southern Canada, a belt near the south of South America, part of South Africa, the southern part of Australia and Japan. The least satisfactory are of course the desert regions.

One would have liked clearer information about the primary data on which the map is constructed: it certainly forms the basis of a stimulating chapter. The map is closely similar, as might be expected, to one showing the number of persons of all ages in educational institutes calculated per hundred children aged 5-14 years, and to another showing the number of occupied men in the liberal professions including doctors, lawyers, clergymen, teachers, engineers and artists. Charts are drawn showing how drunkenness, suicide and illegitimacy vary in the opposite way, and decline as one moves from the regions of lower to those of higher 'climatic energy'.

Similar maps are constructed for the distribution and the efficiency of animals. A climograph of the number of eggs laid per month in the Storrs contest shows clearly the effect of temperature and rainfall conditions: the isopleths of egg-production in the United States bring out further information of great interest to poultry students; incidentally, the Englishman who has travelled much in the States will find the solution of many a mystery in the authors' terse statement that a chicken is defined in the U.S. census as "any fowl

of the chicken species over three months of age".

Having set out in great detail the general relations of climate, soil and other geographical factors to human activity and crop and animal growth, the authors proceed to discuss the natural regions of the world; they group them as low latitudes, including wet tropical forest, dry tropical forest and savannah, deserts, grassland, mediterranean and mild east coast regions; and higher latitudes. Detailed studies of American regions are given. Then comes a very interesting section on the great products of the world: the food-stuffs, oils, industrial crops, timber, minerals and fuels; and finally, a section on industry and commerce.

The book can be strongly recommended to the student for its interesting presentation of many facts both new and old, for its stimulating and suggestive generalisations, and for the clear relations it brings out between geographical factors and human activity.

E. J. RUSSELL.

History of Theories of the Origin of Ore Deposits

- (1) *Bulletin of the Geological Society of America*. Vol. 45, No. 3: *Origin and Nature of Ore Deposits: an Historical Study*. By Frank Dawson Adams. Pp. 375-424. (New York: Geological Society of America, 1934.)
- (2) *History of the Theory of Ore Deposits: with a Chapter on the Rise of Petrology*. By Thomas Crook. Pp. 163. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., Inc., 1933.) 10s. 6d. net.

SO far as the present writer is aware, no previous publication has appeared in the English language dealing exclusively with the history of theories of the origin and formation of ore deposits. By a coincidence, two essays on the subject have appeared almost simultaneously. Their authors fortunately have approached the subject at different angles, and the essays are to a large extent complementary. Dr. Adams describes especially the ideas on the subject contained in the literature prior to the nineteenth century, covering the ground from the time of Aristotle to that of Hutton and Werner. Mr. Crook, on the other hand, follows up a comparatively brief sketch of the theories of the early writers by a detailed study of those current from the beginning of the nineteenth century onwards.

The importance of ores and minerals to human welfare is such that speculation as to their origin was aroused at an early date. The first European reference to the subject is stated to be that occurring in the writings of Aristotle. Early theories

were of a highly speculative and fantastic nature, and the advent of printing caused them to be widely circulated and perpetuated. It was long believed, for example, that metals and ores grew and increased in the earth by processes analogous to those of the vegetable kingdom; there was, too, a belief that the baser metals were continuously undergoing a gradual transformation into the nobler metals silver and gold.

It was not until the middle of the sixteenth century that any important book on ore deposits appeared, the contents of which were based on actual observation of mining operations. About this time Georgius Agricola, who like many early writers on science was a physician, took up residence in the mining town of Joachimsthal, Saxony. While practising among the miners he took full advantage of the opportunity afforded him to study ore deposits. In 1546 he produced a book, "De Ortu et Causis Subterraneorum", containing the germs of two great theories as to the origin of ore deposits, namely, the theory of ascension and that of lateral secretion. These theories, however, were not to take definite form until some three hundred years later.

About one hundred years after the time of Agricola, shortly after the formation of the Royal Society of London, Robert Boyle drew up, at the instance of the Society, a long questionnaire designed to obtain from mine managers in Great Britain and abroad information concerning the nature and mode of occurrence of ores and other minerals. This questionnaire, which would require little modification to make it useful to-day, shows that the men of science of the period were keenly interested in the subject of ore deposits. Nevertheless, several of the questions make it evident that even the most astute minds of that time were still influenced by the curious beliefs perpetuated in the literature on the subject. It is indeed amusing to find the great Boyle asking: "Whether the Diggers do ever really meet with any subterraneous *Daemons*; and if they do, in what shape and manner they appear; and what they portend; and what they do, &c."

During the eighteenth century, though belief in the old conjectural ideas still lingered on, rational theories were beginning to be evolved. At the end of the eighteenth century there emerged in recognisable form the three theories which are still current to-day, namely, those of ascension, lateral secretion and magmatic segregation.

Dr. Adams has written an extremely interesting and informative account of the speculations of the early philosophers, astrologers, alchemists and miners. He is the possessor of an extensive collection of early works on geology, mining and related subjects, and evidently his paper is the

result of much patient and enthusiastic research in his library.

Mr. Crook carries on the story in a carefully documented study of the developments of various theories advocated during the nineteenth and twentieth centuries. To-day it is generally believed that the genesis of many types of primary ore deposits is connected with igneous activity, though there is still a great variety of opinion among competent authorities. Mr. Crook, while he deals fully with the development and recurrence of this view, will himself have none of it. He maintains that the concentration of ores and minerals in almost all deposits is most probably due to exogenic action. Disagreement with his point of view does not detract from the value of his book as a historical study. It is most interesting to be taken back through the years and to find that there is often nothing essentially new in modern theories. So long ago as 1644, for example, Descartes suggested that metalliferous veins were derived from the molten interior of a partly cooled earth. World-wide mining operations have, however, accumulated observations and facts in support of theories formerly based only on speculation.

The nature of many ore deposits is such that it is unlikely that the truth as to their ultimate origin and mode of formation will ever be known. As Dr. Adams points out, though much has been learned, much remains to be discovered, and the subject is one in which less progress has been made since the Middle Ages than is the case in most other branches of geology.

Neither Dr. Adams nor Mr. Crook mentions the works of Gabriel Plattes, possibly the earliest English writer to produce a book on ore deposits. In 1639 this author published a work entitled "A Discovery of Subterranean Treasure, viz., Of all manner of Mines and Mineralls, from the Gold to the Coale; with plaine Directions and Rules for the finding of them in all Kingdomes and Countries". Several observations of his make it clear that he was an original thinker and a keen observer of geological phenomena. The theory of the origin of mineral veins which he describes corresponds crudely to the modern theory of ascension. While this is possibly even at that date not original, what is remarkable is that he describes a laboratory experiment in which he attempts to prove its truth. In this respect he is a forerunner of Sir James Hall, who has generally been regarded as the pioneer of experimental geology.

In the last chapter of his book Mr. Crook describes the rise of the science of petrology during the first half of the nineteenth century. After about 1860, the tendency to treat the study of

ore deposits as separate from that of petrology became evident. To-day petrologists study the silicate and sedimentary rocks in great detail, but often with little or no interest in the petrology of the metalliferous vein and other ore deposits. Mr. Crook's object in writing this chapter is to deplore this separation of the study of ore deposits from that of the science of petrology, of which it ought to form an important branch. This is a point of view with which many will agree.

Two errors were noticed in reading these essays. In Dr. Adams's paper the reference to the *Phil. Trans. Roy. Soc.*, given in a footnote on p. 393, should be to p. 330 (not 328). In Mr. Crook's book the date of publication of John Woodward's "Essay Towards a Natural History of the Earth" is given as 1665, a misprint for 1695.

V. A. E.

Modern Tendencies in Optics

- (1) *Mirrors, Prisms and Lenses: a Text-Book of Geometrical Optics.* By Prof. James P. C. Southall. Third edition. Pp. xxv+806+8 plates. (New York: The Macmillan Co., 1933.) 22s. 6d. net.
- (2) *Optics.* By W. H. A. Fincham. Pp. vi+462+6 plates. (London: Hatton Press, Ltd., 1934.) 18s. net.

"OF the making of books," said Solomon, "there is no end, . . ." We forbear to finish his quotation, but could he have lived to see the catalogue of a modern publisher his conclusion might have been expressed even more strongly. The flowing tide of books is, of course, only a reflection of the spread of science, a flood which submerges old boundaries, and is ever cutting new channels for its onward rush.

The subject of 'geometrical optics' occupied, a few years ago, a select position as a branch of mathematics taught in certain cases, we are told, by academic gentlemen to whom the sight of a real lens would give a mild shock. When the mathematicians left the subject largely to the physicists, the latter usually found themselves much too busy to study it except in so far as it was necessary for the comprehension of various instruments, and only then in close conjunction with the principles of physical optics.

(1) Prof. Southall's valuable book, first published in 1918, appeared at a time when optical studies had been awakened into feverish activity through the exigencies of the War, and aimed at giving a clear and systematic general account of the geometrical principles of the fundamental constituents of optical instruments—"Mirrors, Prisms and Lenses"—and did not attempt to deal more than briefly with complete optical systems.

The later editions, however, while indicating the well-deserved success of a thorough and consistent piece of work, illustrate very well the tendency which has been indicated above. We now find far more attention paid to the physical sides of the subject. There is a chapter on the microscope included as typical of optical instruments, and another on subjects connected with vision, such as binocular vision, visual acuity, colour vision and the like.

We wish that Prof. Southall had had the courage to go even further, and to include chapters on other instruments as well, since purely geometrical discussions are apt to appear tiresome unless studied in connexion with real instruments, and moreover the chapter on the microscope is written with skill and charm. Moreover, one does not go far with the microscope before feeling the need of a little systematic discussion of photometric principles; this would have made the treatment of light transmission by the instrument much more intelligible. For reasons such as this, we feel that the form of the book is in a transitional stage.

Where the general standard is so high, the one or two defects noticed can only be mentioned in a helpful, and by no means critical, spirit. The amusing misprint on p. 684, *dark-yeild illumination* (sic.), is a unique example of a measure of truth emerging from a printer's error. There are statements in the section on "Colour" which might be challenged. For example, there may be a great difference of hue between a sunlit lawn and grass in shade, especially if the shadow is illuminated by light from a blue sky; the difference is not necessarily one of brightness only, as stated. A little lower we read: "If blackness were simply the absence of all sensation, that is a purely negative thing, the objects behind our eyes ought to look black; which is absurd of course."

This last argument seems to be rather unsuited to elementary notes on colour vision; to begin with, it seems to confuse zero and negative quantities. Since negative quantities may have some

meaning in respect of colour stimulation, if not of sensation, the phrasing is not happily chosen. But surely 'blackness' can only be an attribute of a part of the possible visual field, in which the images of objects behind our backs have no place!

(2) Mr. Fincham's "Optics" aims at roughly the same standard as Prof. Southall's book (university intermediate), but devotes much more attention to physical optics, interference, diffraction and the like; and the geometrical treatment of the Gaussian theory is not so extensive. The text is based on lectures delivered in the Applied Optics Department of the Northampton Polytechnic, and is the product of a good many years' experience of teaching in a technical school. It is intended to cover the work required by a student before he begins to specialise in ophthalmic optics, or in optical instrument design.

The book is clearly and accurately written, and contains a large number of examples, so that it should make a very useful class book. The emphasis given to the physical and geometrical sides of optics is well balanced, and well suited to the needs of those who are going to specialise in some branch of the subject.

Unfortunately, it cannot be said that the book is satisfactorily printed; the pages are badly cut with respect to the lettering, the mathematics is set in very thin type, and several of the diagrams are reproduced on a scale so small as to be confusing. There is a number of good half-tone plates of diffraction phenomena, etc.

Both these books use the ordinary Cartesian sign convention for distances, the positive direction being that of the incident light, but the definitions of the 'focal lengths' differ, though they both agree in assigning a positive power to a 'converging' lens. The object-space focal length agrees in sign with the power in Prof. Southall's book, and the image-space focal length takes the sign of the power in Mr. Fincham's.

L. C. MARTIN.

Short Notices

The Lyophilic Colloids (their Theory and Practice). By Prof. Martin H. Fischer and Marian O. Hooker. Pp. viii+246+24 plates. (London: Baillière, Tindall and Cox, 1933.) 22s. 6d.

THE greater part of this book is given up to a re-statement of the theory of the general nature of lyophilic colloids proposed by the authors fifteen years ago, together with the considerable bulk of evidence supporting it. The most important section, however, is that in which the biological applications of the theory are considered. In brief, protoplasm is to be regarded, not as water containing certain sub-

stances, but as a combination of those substances forming a base-protein-acid compound with water 'dissolved' in it as an integral part. The difference is the same as that between water containing dissolved soap or phenol, and a solution of water in soap or phenol. It follows that the laws governing the behaviour of substances in dilute solution, such as the laws of diffusion and osmotic pressure, cannot be applied, as physiologists and pathologists still apply them, to protoplasm, which has the characteristics of a lyophilic colloid.

The biological corollaries to the theory are drastic

enough. Thus if the water in protoplasm is in combined form, living material within the cell is for all practical purposes anhydrous, and synthesis in the cell takes place in an anhydrous medium. This explains why the chemist, using watery solutions, finds it so difficult to synthesise the complex proteins formed easily by living tissue, when he can readily break down natural products in the aqueous medium which Nature also uses when analysing. The least convincing chapter is that in which the pathological condition of œdema is explained on the basis of increased capacity of tissue colloids for holding water, this taking place when acid accumulates in the tissues. The reasoning from œdema in "organisms [plants] possessed of no circulation" will surprise students of botany; the summary dismissal of hydrostatics and permeability from the picture, and the installation of colloid chemical properties as the root of the problem, will lead the clinician to ask why œdema appears first in the feet when the 'pump' is inefficient, and what colloid retains water in the peritoneal and pleural cavities when ascites and hydro-thorax complicate severe œdema.

An erroneous or perhaps too hasty application of the argument to an isolated case does not, however, invalidate the theory, and the authors may be congratulated on having shown physiologists and biochemists a new route to the possible solution of their problems.

Asymmetric Synthesis and Asymmetric Induction: based on a Thesis for the Degree of Doctor of Philosophy presented to the University of St. Andrews in March 1932. By Dr. Patrick D. Ritchie. (St. Andrews University Publication No. 36.) (Published for St. Andrews University.) Pp. x+155. (London: Oxford University Press, 1933.) 7s. 6d. net.

ONE by one the barriers presumed to exist between the chemical processes of the living cell and those of the laboratory are being shown to be unreal. Wöhler in 1828 converted ammonium cyanate into urea, a typical *organic* compound. Later, tartaric acid, a product of the fermentation of grape juice, was synthesised in the laboratory, but Pasteur showed that the synthetic acid was composed of two chemically identical dissymmetric forms and was therefore optically inactive, whereas during fermentation only one of these optically active forms is produced. Either a living organism or a pre-formed optically active substance was found necessary to effect the separation of the synthetic mixture, and Pasteur concluded that until some dissymmetric agency was developed in the laboratory the synthesis of optically active molecules would remain the prerogative of life.

The monograph under notice contains a careful and detailed account of the numerous investigations undertaken to produce optically active compounds by laboratory methods, culminating in the successful application of circularly polarised light by Kuhn (1929-30) and Mitchell (1930) to effect the preferential photochemical decomposition of mixtures of dissymmetric compounds.

The allied problem of asymmetric induction or the

generation of a second optically active centre in a molecule under the directive influence of a pre-existing asymmetric centre is also dealt with in a very competent manner—the extended researches of Prof. McKenzie and his co-workers in these fields receiving careful and critical consideration.

(1) *Thermochimie.* Par Prof. W. Swietoslawski. Traduit par M. Thon. (Union française: Comité l'expansion du livre scientifique.) Pp. xix+379. (Paris: Félix Alcan, 1933.) 60 francs.

(2) *Union Internationale de Chimie. Premier Rapport de la Commission Permanente de Thermochimie.* Text by W. Swietoslawski and L. Keffler. Pp. 33. (Paris: Union Internationale de Chimie, 49 Rue des Mathurins, 1934.)

(1) SINCE the appearance of the memoirs of Thomsen and of Berthelot, the subject of thermochemistry has made very considerable advances, and the new treatise by Prof. Swietoslawski is a welcome addition to the literature of physical chemistry. It deals with the experimental aspects of the subject in a very comprehensive manner, including recent advances in calorimetry, and then discusses the results for a number of classes of compounds. Theoretical considerations receive adequate treatment, and full references to the literature are given.

(2) The report of the International Union, the text of which is in French, English and German, deals with units, thermochemical standards and the calibration of bomb calorimeters, including corrections and calculations. At the end is a suggested list of data which should always be given in recording the determinations of heats of combustion. The Commission considers that, in order to avoid a lack of homogeneity in the results obtained from measurements of heats of combustion, all calorimeters used for the determination of heats of combustion of pure substances or fuels should be calibrated by means of benzoic acid for solid and liquid substances by means of the bomb, and hydrogen for the determination of heats of combustion of gases or vapours by means of the flame calorimeter. Very full details of units, control of purity and methods of calculation are given.

Aristotle: Fundamentals of the History of his Development. By Werner Jaeger. Translated with the Author's corrections and additions by Richard Robinson. Pp. vi+410. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 18s. net.

THIS excellent translation of Prof. Jaeger's work will bring within a much wider circle of scholars the results of his important researches. These suggest three successive phases in Aristotle's intellectual development: (1) an early Platonic stage during the time he was a student in the Academy; (2) a transitional stage in which Aristotle, though still considering himself a Platonist, had abandoned the theory of ideas for his own metaphysics; and (3) the period commencing with his final return to Athens, in which his scientific researches inspired his empirical outlook.

Recent Glacier Survey

By DR. A. E. H. TUTTON, F.R.S.

THE movements of the glaciers of the European Alps are a perennial source of interest, which has increased of late years, more or less in proportion to the large increase in the number of climbers, skiers, summer holiday-makers and winter-sports visitors. During the same time there has been an immense improvement in the organisation of the systematic study of glacier motion, by the formation of national and international glacier commissions. The Governments of Switzerland, France and Italy in particular have now regular officials of the State engaged in effecting definite observations, surveys and measurements, and reports are issued at stated intervals, of both scientific and general interest. For example, the fifty-fourth annual report, for the year 1933, of "Les Variations périodiques des Glaciers des Alpes Suisses", edited by Prof. P. L. Mercanton, chairman of the Commission Suisse des Glaciers and professor of geophysics at Lausanne, has recently been issued. The observations were made by cantonal forestry officials. Also the Département des Eaux et Forêts of the French Ministry of Agriculture has just issued a voluminous report on the work carried out during 1920-30 on the glaciers of Savoy, Dauphiny and the Tarantaise, under the direction of M. P. Mougin, inspecteur general des eaux et forêts*. One is sorry to learn that M. Mougin has now retired from the post which he has so long and ably filled. In a very kindly letter to the writer, he has given further details of the work, bringing it up to 1933, and thus rendering it comparable with that of Prof. Mercanton, as regards the glaciers of the Mont Blanc chain. The Italian glacier surveys are likewise carried out by specially trained departmental officers of Piedmont and Lombardy.

This glacier research is not merely of scientific, geographic, geodesic and geophysical importance, but has also been the means of preventing the recurrence of those terrible calamities, generally due to the formation and bursting of lakes and water-pockets in the glaciers, which so frequently in the past have appalled the world and brought destruction to whole villages and districts in the Alps; for example, those of 1818, 1898 and 1892, due to lakes and immense pockets in the glaciers of Giétroz, Crête Seche and Tête Rousse. Indeed, I was myself a spectator immediately afterwards in the last instance, and well remember the terrible havoc, and the immense gap in the glacier de Bionnassay, where the torrent from the Tête

Rousse had torn a great portion of the glacier away. The scene at the village of Bionay and at what had been the Baths of St. Gervais, where a hundred and fifty persons had been killed or drowned, was very harrowing. Thanks to these researches, however, siphoning trenches and other suitable means are now constructed and provided in time to obviate such disasters completely, the imprisoned water being released automatically, when the crisis comes, harmlessly and effectually.

It may also not be out of place to mention that careful research is now being carried out concerning snow and ice avalanches, their nature and causes, and not only the best means of avoiding them but also of foreseeing them. On this subject, an admirable article, beautifully illustrated by actual photographs, is contributed by Mr. Gerald Seligman to the 1934 issue of the "British Ski Year-Book".

The usual geodesic and theodolitic methods of glacier survey have now been supplemented by determinations of the annual change in the bulk of the ice and snow, by the regular reading of immense vertical scales, nivometers, engraved on upwards-projecting rocks. These nivometers have during these last two years been read and photographed from aeroplanes, Prof. Mercanton having had the advantage of being taken up by some of the most skilful of the Swiss pilots. Fig. 1 is a reproduction of an aerophotograph taken near the nivometer of the Glacier d'Orny, by Prof. Mercanton, piloted on this occasion by M. Champod. It shows the Saleinaz, d'Orny and Trient group of peaks and glaciers at the north end of the Mont Blanc chain. Efforts have also been made to ascertain the inner movements in the depths of glaciers. For example, Prof. Mercanton and his staff have sunk a considerable number of 75 mm. shells in the Rhone and Great Aletsch Glaciers, each having an identity piece sealed within it, and a sequence number deeply engraved on its outside: the initial position of each was accurately recorded, with reference to fixed marks on adjacent rocks.

Moreover, actual measurements of the daily movements of the extremities (snouts) of glaciers have been made with the aid of the ingenious little instrument devised by Prof. Mercanton—the cryocinometer. These latter measurements, and the new depth-sounding work (determining the thickness of a glacier) by the seismographic method, are particularly interesting. In these latter determinations the length of path of a seismic wave produced by an explosion between surface and rock-bed, is ascertained with the aid

* Ministère de l'Agriculture: Direction des Eaux et du Génie rural. Études glaciologiques, 1920-1930. Par P. Mougin. Tome 7. Pp. vii+306+76 plates. (Paris: Imprimerie Nationale, 1933.)

of a modified form of earthquake seismometer. The many attempts which have been made to employ depth-sounding hydrophones, ultrasones and piezo-electric apparatus have not met with success, and it was a happy thought of Dr. Mothes to adapt the earthquake seismometer to the problem. A photographic recorder for the vertical component and a microphonic attachment are the chief modifications necessary. The time taken by the explosion wave to pass through the thickness of the glacier and to be echoed back to the surface is determined, both the longitudinal waves and the transverse vibrations being recorded; and from the previously determined velocity of the

The preponderating phenomenon is thus that of retreat; that is, the position of the extremity of the snout of the glacier has retrogressed higher up the glacier valley, the total length of the glacier being reduced. As regards the amounts of retreat in the cases of the more famous glaciers they are:—The Rhone glacier 9 m., Fiesch 11 m., Aletsch 3 m., Allalin 10 m., Fee 7 m., Gorner 11 m., Arolla 10 m., Trient 16 m., Oberaar 31 m., Unteraar 54 m., Rosenlauri 12 m., Upper Grindelwald 12 m., Eiger 3 m., Blümlisalp 6 m., Morteratsch 4 m., Forno 40 m., and Palü 39 metres.

Of the better-known glaciers which have advanced, the amounts were only 4 m., 1 m., and 2 m.



FIG. 1. The Saleinaz, d'Orny, Trient group, Mont Blanc massif, from the air.

waves the thickness of the ice can be immediately calculated. Dr. Mothes first employed this method on the Hintereisferner, and in 1929 on the Great Aletsch glacier, near the Concordia hut, where a depth of no less than 700 m. was found, greatly exceeding the 200 m. found by the late M. Joseph Vallot on the Mer de Glace.

Passing now to the main results of the latest surveys, the following table gives them for the last eight years (1926–33), for one hundred Swiss glaciers.

Year	Growing (advancing)	Stationary	Decreasing (in retreat)
1926	52	8	40
1927	22	7	71
1928	14	5	81
1929	11	12	77
1930	8	12	80
1931	22	12	66
1932	13	7	80
1933	15	4	81

respectively for the Ferpècle, Moming, and Lower Grindelwald glaciers.

It is important to note that the average temperature for the quarter July–September, 1933 (most effective in reducing the glacier length) was 1.3° C. above the mean summer average, confirming the view of M. Billwiller that the summer temperature is the principal factor in determining the question of advance or retreat.

The retreat of the Rhone Glacier has caused the disappearance of its beautiful ice-cave, from which issues the infant Rhone. Two lobes were left at the snout, and cryocinometer measurements were made, at their terminations, of the actual forward and downward movement of the ice, on September 4 and 5, 1933; the amounts were 8 cm. and 13.5 cm.

a day. In the previous year, similar determinations gave 2.25 and 11.5 cm., so that the actual downward movement of the ice has accelerated, although more of the glacier has melted away, causing the retrogression in position of the glacier end. There is here afforded a good illustration of the clear distinction, that must ever be remembered, between (a) the 'advance' or 'retreat' of the position of the snout terminus (determining the length of the glacier), as given in the table, and due to the balance between precipitation and fusion, and (b) the ever-persisting downward motion of the ice itself along its natural downward sloping valley, due to the now well-known causes to which ice owes its viscosity and plastic flow, and which is ever being urged by pressure from above.

The outstanding retreat of 54 m. by the Unteraar glacier is largely owing to the enlargement of the

and an advance of 14 m. in 1928. After this, in 1929 it receded for 51 m., and again in 1930 still more, for 108 m. In both 1931 and 1932, however, it retreated for no less than 120 m., the maximum observed for ice fusion in the case of this glacier since observations were made by the Department. In 1933 it had slowed down to a retreat of 75 m.

Similar fluctuations have been observed with the Glacier d'Argentière. In 1920 the mass of this glacier had increased so much that opposite the Pavilion de Lognan the ice was flush with the top of the moraine, and there were further advances that year and 1921 of 40 m. In 1922 and 1923 the amount of advance had diminished to only 3 metres; in 1924 it retreated 2 metres, but 1925 brought a slight advance of 6 metres. In 1926 it was distinctly in retreat (6½ m.), and a particularly beautiful ice-cave was formed at the snout, from

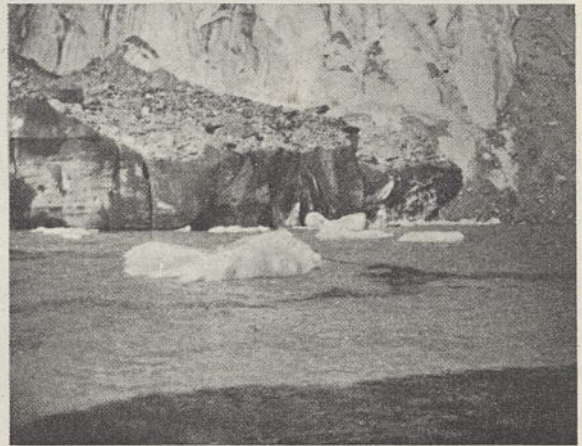
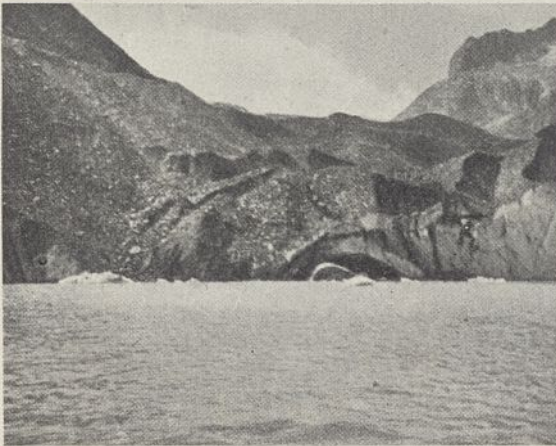


FIG. 2 The Grimsel Lake and Unteraar Glacier.

Grimsel lake, now three and a half miles long, for the provision of immense electric power stations at Handeck, Boden, and Innertkirchen. The end of the glacier is now formed by ice-cliffs bathed by the waters of the lake, and as this has occurred now for three summers it has resulted in excessive fusion of ice and the breaking away of icebergs, as at the Märjelen See by the side of the Aletsch glacier. The cavernous portal of the Aar has moved backwards 70 m., and during 1933 alone nearly a million cubic metres of ice have disappeared. Fig. 2 shows reproductions of photographs taken in 1933 by Prof. Mercanton, showing the remarkable change which has occurred here.

Turning now to the more important Savoy glaciers, the position of the end of the Glacier du Tour had advanced 356 m. in the year 1920, but it then receded 8 m. in 1921, 45 m. in 1922, 66-67 m. in 1923 and 1924, but only 19 m. in 1925. But in 1926 it advanced again, to the extent of 31 m. Then came fluctuations, a retreat of 33 m. in 1927

which issued the River Arve. The retrogression continued during 1927 (9 m.) and increased to 14 m. in 1928 and 35 m. in 1929, a very fine cavern forming again the portal of the Arve. In 1930 the retreat had diminished to 26 m.; by 1932 it had again increased to 55 m., but in 1933 the retrogression was only 5 m.

The Mer de Glace showed even more remarkable fluctuations of advance and retreat, partly owing to its very awkward gorge of exit. In 1920-21 it retreated 25 m., but in 1923 it advanced 132 m., nearly filling the gorge. In 1924 it advanced a further 47 m., but in 1925 suffered a catastrophic fall and receded 52 m. In 1926 it was again coming forward, and had advanced 95 m. since the preceding July. In 1927 it was curiously stationary. In 1928 and 1929 it advanced 96 m. and 8 m. respectively, since which, from 1930 until 1933, it remained stationary.

The Glacier des Bossons had so increased in the year 1920 as to fill up the ravine to the level of

the moraines, below the lower Châlet, and in the next year it advanced still more. But in June that year a great heat wave commenced, and so much fusion occurred, with disintegration of the snout, that great masses of broken ice were carried away by the people of St. Gervais and Sallanches. With the exception of a slight advance in 1928, much fusion continued to occur up to 1930; in 1931 the retrogression occurred for 26 m., but in 1932 for only 8 m. In 1933, however, it retreated no less than 95 m., a fact very evident when I visited it that year. Its twin neighbour, the Glacier de Taconnaz, bifurcating from the Bossons at the celebrated Junction below the Grande Mulets, receded 22 m. in 1931, and 22 m. again in 1932. The Bionnassay Glacier also showed slight retrogression during 1932 (14 m.). But no measurements were made, for reasons of economy, of either of these glaciers in 1933.

Space forbids detailing the observations on the glaciers of Dauphiny, the Tarantaise, the Isère

and the Maurienne, but from the foregoing account concerning the better-known glaciers it will be clear that, on the whole, the glaciers of the main Alpine chains appear to be at present in a period of retreat. The fluctuations, however, have been so great during the last decade and a half, that it is not possible to assign any specific time limits to the period, or assert the occurrence of an alternation of such cycles of advance and retreat of definite duration. What does appear more and more clearly from these researches is that the average summer temperature affects the length of a glacier far more than any other factor, and if this can be shown to vary in clear-cut cycles, then the advance and retreat of glaciers may be found to occur more or less periodically, correspondingly. The figures now available, from more perfect and accurate measurement than has ever before been attempted, certainly do not admit of such broad and sweeping generalisations as have from time to time been put forward.

Boussingault and Agricultural Science

THE year 1934 may well be considered by agricultural chemists as the centenary of the foundation of modern agricultural chemistry. Much work on growing plants had been done before 1834, but it was probably in that year that Boussingault began on a field scale the experiments which led to methods of present-day agricultural science.

Jean Baptiste Boussingault was born in 1802 and took his degree at the School of Mines at St. Etienne. In 1822 he went as a mining engineer to South America, where he spent some years, including six years' service with the armies of Bolivar. During this time, he published several papers on mining and other problems. On his return to France he was elected professor of chemistry in the Faculty of Science at Lyons. In 1833 he married Mdlle. Le Bel and became co-proprietor with his brother-in-law of a farm at Bechelbronn in the Bas-Rhin. It seems more than probable, therefore, that the year 1834 saw the beginnings of the field experiments which he set up in connexion with his work on agricultural chemistry.

De Saussure had, some thirty years previously, grown plants in measured quantities of air and had studied the gaseous exchanges during growth. He had shown that the part played by the soil in plant nutrition was small in amount, but of enormous importance to growth. The constituents of plant ash, he found, varied with the nature of the soil and with the state of development of the plants themselves. His work did not receive the

support it deserved, and for long afterwards it was held by many that the carbon in plant tissues was derived from the humus of the soil in which the plants had grown.

Boussingault reintroduced the methods of de Saussure and applied them to crops grown under field conditions. He grew different crops in rotation and measured carefully the amounts of fertiliser added to the plots and the yield of crop obtained. In this way he was able, at the end of the rotation, to draw up an account of the materials taken in by the plant and the amount of mineral material retained in the soil. He found that more dry matter was obtained from the plants grown in a rotation than was given in the fertiliser in the first instance, and that large amounts of carbon and of oxygen must have been obtained from another source—the atmosphere. On the other hand, much less nitrogen was recovered in the crop than had been applied in the fertiliser treatment, and a considerable proportion of nitrogen must have been retained in the soil. He suggested, therefore, that crops should be grown which gave the greatest increase in dry matter over the amount contained originally in the manures. He found, for example, that rotations which included leguminous plants or successive crops of leguminous plants, such as clovers and lucerne, gave a higher nitrogen content in the harvested crop than could be accounted for in the nitrogen given in the manure.

Boussingault pointed out that atmospheric nitrogen could enter directly into the composition

of those plants which were able to fix it, at the same time showing that leguminous plants grown in sterilised soil were no more able to fix nitrogen than were other plants similarly grown. It was left to later workers, however, to supply the clue which led to the discovery that soil bacteria play an important part in the fixation of atmospheric nitrogen. Boussingault opposed the view of Liebig that plants obtained their nitrogen as well as their carbon dioxide directly from the air. With reference to the vexed problem of the nitrogen content of manures, he wrote:

"Si M. Liebig a raison, nous somme, nous autres cultivateurs, de bien gros maladroits: nous nous donnons beaucoup de peine pour conduire, pendant l'hiver, nos fumiers sur nos terres, nos attelages nous content cher: si le matière minérale des engrais est seul utile, brulons nos fumiers et, pour le transport, une brouette fera l'affaire".

As time went on, Boussingault expanded his researches to embrace the whole range of agriculture and kindred sciences. His work on the nitrogen metabolism of plants led directly to the protein metabolism of the animals which fed on the crops on one hand and to the carbohydrate metabolism of plants on the other. Much of his later published work deals with the problems of plant and animal physiology in the more restricted sense.

In 1839, Boussingault left Lyons and was

appointed to the chair of agricultural and analytical chemistry in Paris, where he remained for many years. He was elected to the Paris Academy of Sciences in the same year. The Council of the Royal Society awarded him the Copley Medal in 1878. For a short term, he represented the Bas-Rhin in the National Assembly, but change of Government led to his being defeated after some three years.

Most of Boussingault's life was devoted to his studies on agricultural chemistry, and he published his collected papers under the title of "Agronomie, chemie agricole et physiologie". Unfortunately, the experiments on the farm at Bechelbronn were discontinued after some years, and although Boussingault lived until 1887, he had long before been compelled to conclude his original field experiments. The lead given by Boussingault was, however, followed by Ludwig, by Lawes and by many other workers, and some nine years after Boussingault had laid out his original experimental plots, Lawes at Rothamsted began the experiments which have become classical in agricultural research.

Boussingault—the father of modern agricultural chemistry—must be judged not only by the immense volume of work which he himself carried out, but also by the amazing effect his application of exact measurement and experimentation to agriculture has had on that science.

Interpretation of Animal Behaviour

NO topic of biological discussion is better able to revive old controversies and established cleavages in opinion than the methodology of animal psychology. It owes this propensity to the fact that the comparative study of behaviour is not, and never has been, integrated into a single consistent science. The subject is so wide, its interests so many and varied, that not only may its methods range from those of physiology to those of systematic 'nature study', but also, as was shown in the discussion on the "Interpretation of Animal Behaviour" which took place in Sections D (Zoology) and J (Psychology) at the recent Aberdeen meeting of the British Association, many of its disciples may prove to be both lacking in knowledge of the interests, and of necessity opposed to the outlook, of investigators engaged in trying to advance the same branch of knowledge along paths different from their own. If it did nothing else, the Aberdeen discussion at least clearly defined for animal psychology the opposition between the vitalistic, teleological and subjective points of view on one hand, and the objective and mechanistic on the other.

The primary objection raised against the mechanistic interpretation of behaviour was that animals are not concatenations of mechanical systems in action, and that accordingly their behaviour can neither be adequately explained in mechanical terms, nor satisfactorily investigated by causal-analytical methods alone (to use the term employed by Dr. E. S. Russell in his presidential address to Section D (Zoology)¹). In defence of this view, Dr. Bierens de Haan affirmed that an essential characteristic of the behaviour of living things which distinguishes it from that of non-living systems is organised purposiveness or directiveness. Prof. William McDougall penetrated further into teleology, insisting that it is not enough to accept purpose as a general principle; it is essential, he considers, that it be recognised that all animal activity is 'goal-seeking', for in the appreciation of this fact lies true understanding.

Those opposed to mechanism were, however, not content to argue against the causal-analytical investigation of animal behaviour on account of a teleological distinction alone. They also suggested, as Dr. E. S. Russell implied², that in any

event mechanistic analysis must be fundamentally unsound if modern physics has had to abandon determinism, and as a further argument in support of this view, Dr. Bierens de Haan protested that the mechanistic analysis of a form of activity gives only a number of parts—for example, reflexes—which in themselves provide no understanding of the behaviour, since the bond linking them in the intact animal is missing. This criticism of scientific method and interpretation, with which Dr. Russell is in sympathy, plainly owes its inspiration to the philosophies of emergent evolution and holism.

Not unexpectedly, these views found little favour with those who advocated the mechanistic approach. An appearance of purpose and adaptation, Dr. S. Zuckerman pointed out, is not a characteristic of the activity of living things only. It is manifested equally well in the inorganic world, the scientific exploration of which is nevertheless conducted without the help of teleological speculation. Moreover, as the same speaker remarked, it is misleading to argue, on the basis of some of the uncertainties of atomic physics and on the strength of the opinions of popular expositors of physical science, that mechanistic determinism is dead. In support of this opinion, we may recall a sentence from a recent leading article in *NATURE*³: "Newtonian mechanics, so far from being in ruins, is more firmly established than ever as the form taken in ordinary circumstances by the mechanics of relativity".

The argument that the parts produced by causal-analytical study are an inadequate interpretation of behaviour—in other words, the argument that the whole is greater than the sum of its parts—was countered, and in what is the obvious way from a scientific point of view, by refuting it as a criticism based both upon a primary misinterpretation of scientific method, and upon a misunderstanding of the province of science. A serious attack was also made on Prof. McDougall's teleological doctrines. Quite apart from other considerations, Dr. Knight pointed out that 'goal-seeking' is as much a characteristic of the behaviour of the roots of a plant as it is of the behaviour of animals.

It is difficult to define precisely what those opposed to the usual experimental methods in the study of behaviour offered in their stead. It was suggested that the principle of organisation and the concept of the functional whole should form guiding lines to investigations of animal behaviour. Exactly how this would alter present methods of investigation was not revealed, for it is plain, as the mechanists argued, that the concept of organisation is an implicit premise in any form of behaviour which an experimentalist sets out to

investigate. The most definite suggestion made by the vitalists for the improvement of present experimental methods in comparative psychology was simply a plea to amplify descriptions of animal behaviour with terms derived from introspective human psychology. This proposal was immediately decried by the mechanists, as being a reactionary step which would bring animal psychology back again to its discredited anecdotal phase.

In attempting to judge of the merits of the opposed points of view expressed in Aberdeen, it is well to remember that animal psychology as an experimental laboratory science is a very recent innovation. It is barely forty years since the subject was born out of a mist of anecdote and anthropomorphic description. It was then that Lloyd Morgan made the statement—now revered as 'the canon of Morgan'—that "in no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of one which stands lower in the psychological scale". As a guide to scientific progress, the dictum seems rather inadequate to-day; yet this canon is the only check to the limits which subjective interpretations of animal behaviour may reach, and like all pieces of similar advice, there are no possible limits to the varying complexions it may present to different individuals. Abstract theorising, without fixed standards, brought introspective psychology nowhere as a science. Only by the adoption and application of statistical methods to such of its subject data as were capable of precise definition, has it been in any way prevented from foundering in a torrent of conflicting waves of opinion. *Per se* and in isolation, an interpretation in subjective terms of an act of another organism is not material for scientific treatment; and even less scientific is preoccupation with teleology.

It may well be, as Dr. Bierens de Haan declared, that a purely objective attitude in the study of animal behaviour provides an unsympathetic account of the ways of animals. Be this as it may, one can be certain that its promoters intended the Aberdeen discussion as a statement of how animal behaviour is to be scientifically interpreted, and in the circumstances one cannot doubt that objective analysis alone will provide us with an acceptably expressed and integrated body of knowledge. That, after all, is the business of animal psychology as a science, regardless of the unfounded claims of extreme behaviourists, and in spite of the preoccupation of another school with teleology and other purely philosophical issues.

If the achievement of an exact and organised science of animal behaviour proves slow, let us remember Freud's admonition⁴: "... it looks as

though people did not expect from psychology progress in knowledge, but some other kind of satisfaction; every unsolved problem, every acknowledged uncertainty, is turned into a ground of complaint against it". Such an opinion from one whose chief activities have been concerned with the subjective world reflects poorly on those

who condemn an objective approach to psychology because the fruits it has yielded are as yet neither rich enough nor abundant enough for their taste.

¹"The Advancement of Science, 1934". British Association.

²*ibid.*

³NATURE, 134, 340, Sept. 8, 1934.

⁴"New Introductory Lecture on Psycho-Analysis".

Obituary

PROF. KARL VON LINDE

PROF. KARL VON LINDE, who died on November 16 at the age of ninety-two years, was for more than half a century prominent in the refrigeration industry. He was born on June 11, 1842, in Berndorf, and studied at the Erdgenoss Polytechnic, Zurich, where Zeuner taught the theory of machines. In 1868, at twenty-six years of age, Linde became extraordinary professor of mechanical science at the Munich technical college which had just been founded. In 1870 he produced his main paper on "The Extraction of Heat at Low Temperatures through Mechanical Means", in which he proved that none of the refrigerating machines hitherto built had given more than one-fifth of the theoretical capacity. In 1874 he introduced the ammonia refrigerating machine, the first patents on the ammonia compression machine having been taken out by him in 1870. Linde's machine, besides being thermodynamically efficient, was characterised by the excellence of its mechanical design.

In 1891, the Linde British Refrigeration Co. supplied meat freezing plants to New Zealand and Australia, thus participating in laying the foundation of what is now a huge frozen meat industry.

In Germany Linde's patents were exploited by the Lindes Eismaschinen AG. founded at Wiesbaden in 1879. In 1891 he retired from the chairmanship of the company in order to resume his work at the Technical High School, Munich.

Another notable invention of Linde was his air liquefying and oxygen producing apparatus. The apparatus is described in British Specification No. 12528 of 1895, and it comprises an air compressor communicating with a reversed flow heat interchanger having two tubes of different diameters and about 300 ft. long; one tube is inserted in the other so as to leave an annular space and both are coiled helically, the coils being insulated by raw sheep's wool.

The compressed gas, after expansion at the regulating valve, flows back in the annular space to the compressor, whilst after operating for some time a portion is liquefied. In the same patent, Linde described his apparatus for obtaining oxygen from liquid air by fractional evaporation. The products were substantially pure oxygen and nitrogen mixed with a rather large quantity of oxygen. The purer the oxygen the less was the yield. In a subsequent improvement Linde treated the liquid air in a rectifying column and completed the process of separating the oxygen and nitrogen by a fractional evaporation.

After devising the method for the production of liquid air, Linde found an application for the liquid rich in oxygen obtained by the partial evaporation of liquefied air. He showed that when mixed with wood charcoal or other combustible material a powerful explosive was obtained.

Linde's interest in low temperature technology continued throughout his life, and at the age of eighty-three he applied refrigeration to the problem of separating from coke oven gas the constituents hydrogen, methane, carbon monoxide and nitrogen.

Linde was ennobled for his services to science.

E. G.

MRS. H. S. WILLIAMSON

WE regret to record the death on December 4 of Mrs. H. S. Williamson. She was born in 1884, educated at the Royal Holloway College and published her early papers in her maiden name of Chambers from 1908 onwards. She held posts at the Universities of Sheffield and Belfast, and at the Royal Holloway College. In November 1914, she married Ernest Lee, whose work on leaf-fall indicated his great promise; he was killed in action in 1915. In the autumn of that year, she trained for bacteriological work and replaced in the Seamen's Hospital at Greenwich an official proceeding on active service.

In 1920, while employed at the Imperial College of Science and Technology, she married Mr. J. W. Williamson, secretary to the British Scientific Instrument Research Association. In 1926 she accepted the post of research assistant to the professor of botany at Birkbeck College, and was joint author of a series of papers on the fungi.

Mrs. Williamson possessed an unusually fine technique, was a careful and critical observer and, as many can testify, an excellent friend and colleague.

H. C. I. G.-V.

WE regret to announce the following deaths:

Mr. J. A. Brodie, formerly city engineer of Liverpool, president of the Institution of Civil Engineers in 1921, a pioneer in modern methods of road construction, on November 16, aged seventy-six years.

Prof. S. H. Gaiger, professor of veterinary pathology in the University of Liverpool since 1926, and president of the Royal College of Veterinary Surgeons, on December 14, aged fifty years.

Prof. S. P. Mulliken, professor of organic chemistry in the Massachusetts Institute of Technology, on October 24, aged sixty-nine years.

News and Views

Mechanisation in Industry

IN his chairman's address to the Birmingham and District Association of the Institution of Civil Engineers on October 23, Mr. C. H. Bailey, after indicating the way in which scientific research and its applications have enabled the number of explosions of coal dust and firedamp in mines to be controlled more effectively, so that the loss of life in this way has been reduced to about $1\frac{1}{2}$ per cent of what it was thirty years ago, referred to the growth of the professional spirit in the organisation of industry, alike on its financial, commercial and technical side. Already industry is regarded as a public service to a much greater extent than in previous generations. The professional man carries out his work to the best of his ability for the sake of sound workmanship, and the same spirit makes industry interesting and worth while. The special function of a body such as the Institution of Civil Engineers, however, is to provide a standard of professional conduct and ability for those engaged in the technical direction of industry, and such institutions are accordingly closely concerned with those changes in the structure of industry and society which are associated with rationalisation. Mr. Bailey directed special attention to the unification of an industry and the size of the industrial unit, but in doing so he also pointed out its bearing on individuality.

If democracy means anything, it means a social system which will give free play for individuality, and accordingly free education for all is a first consideration in the minds of the leaders of democracy. If, however, machines can only be used efficiently in large concentrations, there is grave danger that opportunities for the expression of individuality will be severely limited. The real incentive to the best effort is the consciousness of occupying sooner rather than later a position of free responsibility. Engineers are ultimately responsible for the tendencies in industrial organisation and at the same time are the victims of their own machines. The technical side of industry seems to have outrun the financial side, and it may be that the great changes on the technical side demand a reconstruction of the financial framework. The essential problem before us is to fit mechanical manufacture into an organisation which affords more men the opportunity of using their capacities to the fullest extent. Industry should perhaps be organised more in small units in which more men could look forward to occupying positions of real free responsibility, and Mr. Bailey suggested that the Institution of Civil Engineers has a real responsibility to its younger members to see that opportunities of utilising their ability are available from the point of view of the community, as well as of the profession. Industry should be regarded from the point of view of a life as well as of production.

Archæology in Iraq

IT would appear that the way is being paved in Iraq for a drastic revision of the regulations affecting

archæological exploration. That at least is the obvious conclusion to be drawn from the campaign of propaganda to which Dr. C. Leonard Woolley refers in his letter to the *Times* of December 12. It has been known for some time that a new Antiquities Law was contemplated. It was indeed this fact, combined with the difficulties arising from the division of the antiquities from Arpachiyah as between the Bagdad Museum and the organisers of the expedition, which led to the closing down of that important excavation at the end of the season of 1933. The character of the agitation against archæological expeditions from outside may be gauged from the statement made to Dr. Woolley personally by the curator of the Bagdad Museum that the archæological finds assigned to that Museum in the division with foreign missions had amounted only to one half of one per cent. Dr. Woolley, by quoting the actual percentage allotted to the Museum year by year, was able to show that the statement was without foundation so far as concerns the division of antiquities from Ur; while his explanation of the principles which had been followed in making the allocation was sufficient to exonerate the Director of Antiquities from any charge of unfair discrimination, due to his being a foreigner, if indeed any defence were needed.

DR. WOOLLEY places his finger on the crux of the situation in Iraq when he points out that, had it not been for the foreign archæological missions, there would have been no museum at Bagdad, or at least the finest collection of antiquities in the Near East would not have come into existence. The exploration of archæological sites in Iraq has hitherto been carried on by museums or bodies for research and higher education, such as the Oriental Institute of the University of Chicago and the recently constituted British School of Archæology in Iraq, bodies which in the ultimate analysis are normally the channels whereby the private individual is able by subscription to further his interest in archæological research, whether general or specific. While ready to recognise the equity of a division of the material results of excavation with the country of origin, these subscribers look to the enrichment of the collections of the museums through which they contribute as the staple return for their outlay. Further restriction of this return will dry up the source of supply. That it has already had this effect is indicated by Dr. Woolley's statement that, whereas eleven expeditions were recently at work in this field, now there are but two. It is deplorable that, while funds can be raised, archæological activity should be diverted from the area which at present provides the most important and the most fruitful of all the fields for archæological research, and at the same time a possibility of solving some of the most insistent problems of prehistory. A logical solution which would maintain Iraq's control of all antiquities discovered would be the institution of an active Archæological Survey service, on the lines of that of India,

powerfully manned and adequately financed for exploration no less efficient than that carried on by foreign missions; but for this clearly the time is not yet ripe.

Suggested Use of Red Filters for Improving Vision

IN the *Klinische Wochenschrift* for November 3, Dr. Arnold Berliner, editor of *Die Naturwissenschaften*, has advocated the use of a red filter for improving vision when the media of the eye are hazy, as from vitreous opacities, incipient cataract, etc., since in such media light of short wave-length is scattered more than that of longer wave-length. The theoretical validity of this physical argument is undoubted, but physiological considerations render it doubtful whether much advantage would accrue. It is interesting to note that somewhat similar improvement of vision has been predicted for a glass of very different transmission characteristics by Dr. Birch-Hirschfeld (*Z. Augenheilkunde*, 77; 1932) and Dr. Danmeyer (*Hansa Deutsche Schifffarts-Z.*, December 1933). This 'neophan' or 'neodym' glass contains neodymium, and is slightly blue-violet in colour. It will be remembered that Sir William Crookes made and investigated the light transmission of such a glass, which differs little from that of the 'Crookes' glass now on the market, though it apparently has a rather more pronounced absorption band between 550 $m\mu$ and 650 $m\mu$. It is held that the diminution of the yellow reduces the dazzling effect upon the retina. Prof. H. Hartridge, however, has given good reasons for thinking that these rays of highest luminosity in the spectrum are those most important for accurate discrimination of the retinal diffusion image with incident white light.

It might well be expected on physical grounds that monochromatic light would afford the sharpest retinal image, and the observations of Uhthoff and others support this view, provided that the intensity of the light is adequate. The eye, however, is an extremely complex optical instrument, and its physiological properties are such that maximal central discrimination depends not only upon the accuracy of the optical image, but also upon the sensitivity of the neural receiving apparatus. This is profoundly modified by the conditions of adaptation to light, and also by the condition of the surrounding retina. In many cases, central vision is enhanced by moderate illumination of the surrounding field. Hence the normal scattering of light which takes place in the eye may quite possibly be beneficial. Too much optimism should not therefore be indulged in when based only upon theoretical considerations of a purely physical nature.

Eyesight with Yellow Light

THE high luminous efficiency of the sodium vapour electric light makes it probable that it will be more extensively used in the future, if it can be shown to have no deleterious effect on human eyesight. Under the supervision of the Port of New York Authority and the United States Public Health

Service, this question has been investigated by Mr. James E. Ives, senior physicist of the Public Health Service, and his conclusions are included in Public Health Report No. 1640. Two groups of clerks, each about a dozen in number, worked four hours a day at their usual tasks, one group in a room illuminated solely by sodium vapour lamps, the other group with the usual gas-filled tungsten lamps. In each case the illumination of the plane of work was 10 foot candles. The eyes of each subject were examined clinically four times during the investigation, which lasted three months. The sodium light was found soft and easy on the eyes, and no permanent effect on the eyes could be detected, nor was there any difference in the amounts of work done by the two groups.

A Scottish Bird Station

SCOTLAND is well placed for intercepting certain movements of birds on migration. The records made by Dr. Eagle Clarke and after him by the late Admiral J. H. Stenhouse at Fair Isle, ably supplemented by the skill and knowledge of the islanders themselves, have made that remote spot between the Shetland and Orkney Islands a name known to all students of bird migration. But Fair Isle is remote and difficult of access, and it must be admitted that it receives the full tide of migration only under peculiar conditions of weather. On the other hand, the Isle of May, situated off the entrance of the Firth of Forth, is not far from centres of population, is easily reached in most kinds of weather, and has been proved, by many annual visits of Miss Baxter and Miss Rintoul, to be a good post of observation. Accordingly a few enthusiastic ornithologists, the Midlothian Ornithological Club, have decided to make the Isle of May a bird station at which regular, and so far as possible continuous, observations of bird movements will be made, partly by field study, partly by trapping and ringing adult birds. The carrying out of the project has been made possible by the permission of the Commissioners of Northern Lights, and every naturalist will wish success to this promising enterprise.

Pioneer Bird Observatories

THE first bird observatory for making day to day records of passing birds and marking migrating species with numbered aluminium rings in the adult stage, where mortality is much less than in the nestling stage, was formed at the beginning of the present century by Prof. Thienemann at Rossitten, East Prussia, followed shortly after by Prof. Rudolf Drost's observatory at Heligoland. In the United States, the first bird-ringing or 'banding' station was established by S. Prentiss Baldwin on a 100-acre farm at Cleveland, Ohio, with a winter branch at Thomasville, Georgia, but the United States Bureau of Animal Biology now maintains two bird observatories, at Berkeley, California, for migration and waterfowl studies, and North Eastham, Massachusetts, for migration, in addition to general observation reserves for birds and mammals. In the British

Isles the first permanent bird observatory and ringing station was established on Skokholm Island, off Pembrokeshire, in 1932, though since 1927 the Oxford University Ornithological Society has maintained a trapping station at Christ Church meadow and in the Museum grounds. In Denmark, Mr. P. Skovgaard has maintained ringing stations near Copenhagen, and in Russia, the Institut Lesnov carries on the work near Leningrad. In France, the Ministry of Agriculture recently commenced bird migration studies at the Institut des Recherches Agronomiques, at Versailles.

Holism in International Affairs

THE *African World* of November 1934 contains full reports of the more important speeches made by General the Right Hon. J. C. Smuts during his visit to Great Britain in October 4–November 15, 1934. These include his installation as Rector of the University of St. Andrews and his impressive address on "Freedom" (see NATURE, Oct. 27, p. 654), his speech in response to the presentation of the freedom of the City of Dundee, in which he pleaded for faith and vision as opposed to the spirit of pessimism and defeatism which is so widely encountered, a speech at Christ's College, Cambridge, on October 21, speeches on African problems, on Jewry, an Armistice Day speech on post-War obligations and his challenging plea for peace at the dinner of the Royal Institute of International Affairs at the Savoy on November 12. In the latter speech he asserted that the way out of our present troubles lay in our steadily increasing sociality, the interweaving of interests, points of view and ideas, in the 'open door' and the removal of barriers and restrictions, in the dominance of large human principles transcending national boundaries and in the recognition that in mankind we are members one of another. The driving power should be the same urge towards integration and co-operation which characterises holism and the creative process in Nature.

Alaskan Archaeology

DR. ALEŠ HRDLIČKA has recently returned to Washington, D.C., from his sixth expedition to Alaska, where he has been engaged in investigating the 'archaic' culture of Kodiak Island. The past season is the third consecutive summer he has spent in extensive excavations on the island, and once more his results have added considerably to knowledge of the culture of the people who have inhabited it, without, however, it may be added, obtaining a solution of the ethnological problem. A peculiar feature by which, according to a communication issued by the Smithsonian Institution of Washington, Dr. Hrdlička has been confronted is the occurrence of 'nest-burials', in which a considerable number of individuals of both sexes have been found together, without any of the customary funerary offerings found in the ordinary graves. It has now been ascertained that many of these skeletons have cracked skulls and broken limbs. Dr. Hrdlička, therefore, concludes that this may be taken as evidence of a village massacre,

from which a few individuals escaped to return and bury their dead. Considerable progress has been made in uncovering the 'metropolis' site of the island, a once important centre of population situated on a bay. It shows three stages of settlement. The first and second, by far the longest, belong to the unknown people, whose culture was considerably richer than that of their successors. They show slight affinities with the Eskimo, but can scarcely be considered as of the same strain. After them come the Konings, who are practically identical with the Aleuts of to-day. As is now well known, the unknown people were master craftsmen, especially in the making of beautiful stone lamps and ivory carvings. Dr. Hrdlička regards as one of the most important results of this year's excavations, the evidence of differentiation and occupational specialisation as between family households.

Staff Management Association

AT the inaugural meeting of the Staff Management Association on December 5, which was recently formed under the auspices of the Institute of Labour Management, Mr. F. W. Lawe, staff manager of Harrods, Ltd., said that the Association and its parent body cover practically the whole field of personnel work between them. The Institute's work is concerned with the operative employees, the new Association with the administrative and clerical employees. To-day there is a marked tendency to develop special departments for staff management in industry and commerce, though for many years Government and municipal departments have had their 'establishment officers' whose duties cover the same field. The new Association aims at improving the technique of staff management by pooling mutual experience and comparing methods, and by exploring the aid which can be derived from various sciences. The application of these methods, however, will always be an individual art which must be exercised with human understanding and wisdom. The field of staff management lies in the recruitment and engagement of suitable employees; the training of employees for their work; all questions of salaries and promotions; a considerable responsibility for conditions of work including hours; direct charge of all social, educational and welfare work and, finally, sole charge of the responsible duty of dismissal. Slipshod methods of learning one's life job are still the rule rather than the exception in Great Britain. The old rough and ready apprenticeship method has largely fallen into disuse, but an enormous all-round improvement could be obtained if training for work were taken seriously. It is significant that most great department stores, for example, have a golf-school for customers but very few have a work-school for their staff.

Electrical Accidents in 1933

THE review of the accidents and dangerous occurrences in Great Britain which took place during 1933 ("Electrical Accidents", 1933. London: H.M. Stationery Office. 6d.) is instructive.

Considering that during the ten years 1923-32 the supply of electricity increased nearly 2½ times and that the number of factories under the Electricity Regulations increased about sixty per cent, it is satisfactory to notice that the number of accidents has remained practically stationary during this period. The total number of accidents reported last year was 346, and of these 25 were fatal accidents. These were accidents reportable under the Factory Acts, but the total number of fatal accidents due to electricity was 91. It is gratifying to notice that there has been a marked increase in the use of small transformers to provide a very low pressure for work in places such as the inside of boilers or in tanks or wet spots where electric shock is likely to be unusually dangerous. The accidents due to electric ignition of inflammable materials include cases where obvious risks are taken. In garages, for example, petrol ignition not infrequently results from a spark at the car equipment or from dropping a hand lamp. It is very inadvisable to use such a dangerous cleaning agent as petrol in a garage. Some difficult problems have arisen in connexion with the development of high-frequency furnaces for melting steel. Up to the present, these furnaces have been of small capacity. Molten steel is now sometimes transferred to large high-frequency furnaces where the final stage of refining is done. In this case special precautions have to be taken.

High-Voltage Alternators

THE time always comes when some type of machinery reaches the limit of its possible development, and if progress is to continue it must be along quite different lines. The physical properties of the materials at his disposal and the laws of Nature fix limits to the designer's progress in every direction. For example, the reciprocating steam engine, after a century of development, reached its limit with an output of about 10,000 horse-power. Then came Parsons's turbine principle, and the piston engine soon became obsolete in electric power stations. In the *Monthly Transactions* of the Junior Institution of Engineers of October, Mr. J. Rosen, of Messrs. C. A. Parsons and Co., Ltd., Newcastle, describes a similar change that is taking place in high-voltage production. Sir Charles Parsons and his colleagues in 1921 invented a new type of generator which permitted the generating voltage to be multiplied several times without submitting the insulation to any greater stresses than those in common use in standard machines. Six years ago a turbo-alternator of 25,000 kilowatt power working at a pressure of 34 kilovolts was installed in the Brimsdown Station of the North Metropolitan Electricity Supply Co. and has now been in uninterrupted service for six years. It has been the precursor of many others. The new construction consists of using triple concentric conductors instead of the usual three separate conductors in the stationary armature. The new machines obviate the necessity of using expensive transformers to raise the pressure and thus considerable economies are effected. Mr. Rosen thinks that the new improvements being developed in the

composition of insulating materials will lead to the use of much higher voltages in the immediate future.

Magnetic Survey of Poland

THE first magnetic survey of Poland is described in *Travaux de l'Observatoire Magnétique de Świdler*, No. 5, Warsaw, 1933. The survey is the work mainly of Stanislaw Kalinowski, who in 1905 conceived the ambition that Poland, then dismembered, should be surveyed by Poles, as a national contribution to science. With some help from his compatriots in buying instruments and in providing transport, he made a number of observations before the War; feeling that a magnetic observatory in Poland was necessary as a base for the survey, he succeeded in collecting funds for this purpose from private donors, and the observatory was established at Świdler, near Warsaw, just when the War started. During the War the instruments were safely stored, and the buildings fortunately remained unscathed until the Armistice, and through the subsequent war between Poland and Soviet Russia, when Świdler was for some days occupied by the Russians. The observatory, with the aid of State subsidies, has functioned regularly since 1921, though as yet funds have not sufficed for the publication of the detailed records. In 1923 Prof. Kalinowski, whose services to the observatory have throughout been honorary, recommended his magnetic survey of Poland, with financial aid from the Ministry of Public Instruction. From 1923 until 1929 the number of stations at which complete observations of declination, dip and horizontal force had been made was 375, some of which had been surveyed two or more times. The epoch to which the data were reduced was 1928.5. The report of the survey gives the history of the work, and a brief description of the stations, in 56 pages, and the observations themselves in 94 pages of tables. The results are represented graphically on three isomagnetic maps.

East Malling Research Station

THE East Malling Research Station, supported by the Kent Incorporated Society for Promoting Experiments in Horticulture, recently celebrated its coming of age. The annual report for 1933, the twenty-first year, contains a number of reports of practical and scientific investigation, on which the promoters, and especially the director (Mr. R. G. Hatton) and his staff, deserve congratulation. The report is in four parts, namely, (1) experimental farm, (2) general review of research work, (3) preliminary research reports, and (4) bulletins for fruit-growers. The section on the experimental farm is by Messrs. R. G. Hatton, J. Amos, F. H. Beard, M. H. Moore and A. C. Painter, and deals with the general management of the farm, new plantings, cultural treatment, marketing and spraying. The debut of East Malling as a research station centred round Mr. Hatton's classical study of clonal rootstocks for the propagation of fruit trees, so it is natural that much of the research work reviewed in Section 2

should relate to this subject. There are also investigations in root development, biennial bearing, double grafting, non-setting of blossom, pruning, thinning, manuring, variety trials, fruit breeding, and many other problems. Extensive research in plant physiology, biochemistry, plant pathology and entomology is carried out in relation to the outdoor investigations. A noticeable feature of the preliminary research reports is the evidence of strong correlation between all branches of the research station. The influence of stock on scion, for example, is being investigated from different angles by the pomologists, the physiologists and the biochemists. Section 4 is a collection of articles which are intended to portray the results of the Station's scientific work in such a way that they may be used by practical fruit-growers. This is a very necessary activity of any research institution, and it is gratifying to note its increasing volume from year to year in East Malling's annual reports.

Hannah Dairy Research Institute

THE fifth annual report of the Hannah Dairy Research Institute describes the work being carried out at Kirkhill, Ayr, and its commercial and practical applications. The chairman of the Council of the Institute is Sir Robert S. Rait, principal of the University of Glasgow, who succeeded the late Sir Donald MacAlister. The work of the Institute has received increasingly wide recognition as shown by the requests received for its publications from all over the world. At home, the advice of the Institute is frequently sought in solving various practical dairying problems. Work has been carried out on the relative nutritive value of different proteins for milk production, on methods of eradication of bovine tuberculosis and the means by which the risk of milk-borne disease can be reduced to negligible proportions, and on the production of condensed and evaporated milks and canned cream. It is of interest to note that the basis of the Institute's experimental eradication scheme of bovine tuberculosis, namely, the provision of free tuberculin-testing and free advice to owners of dairy herds, has been recommended by the Committee on Cattle Diseases, Economic Advisory Council. The results of the experimental scheme have clearly demonstrated the feasibility of effecting a marked reduction in the incidence of tuberculosis amongst dairy cattle. The Institute appeals for funds to wipe out the present indebtedness and to provide an endowment fund which will produce an income of £2,000 a year.

Research on Preservation of Wood

VOL. 4 of the *Journal of the British Wood Preserving Association* has recently appeared (Printed for the Association, 166, Piccadilly, London, W.1. 1934). Sir John Stirling Maxwell has been re-elected chairman. The work of the Association has been maintained at the high standard set when it was founded, and the *Journal* records a number of interesting papers and discussions during the year dealt with. In view of the fact that bungalows and houses constructed entirely of Empire timbers are now to be seen under construction in Great Britain, Mr. O'Hea's

paper on timber buildings proved of considerable interest. Mr. O'Hea dealt with the three distinctive types of timber buildings in the three main parts of the world where they are commonplace, namely, the North American continent, Scandinavia and Russia, and then discussed the timber building in England. Other papers dealt with wood preservation in the service of the Post Office, the use of treated timber in railway stock construction and an excellent paper on the research institutes and forest products laboratories in which work on the preservation of timber is being carried out.

Mining in South Australia

WE have received from the South Australian Department of Mines a review of mining in that country for the half year ending December 31, 1933 (Adelaide: Government Printer, 1934). There is little of permanent interest about this review, but it states that the various Mining Acts have now been consolidated, a new Act to regulate mining on private lands has been passed, and further that copies of the regulations under the Mining Acts were gazetted on March 22, 1934, and can be obtained from the Department of Mines; although the publication under review has condensed some of the more important regulations, those interested are advised to refer to the full text of the regulations. It is stated that the most interesting development is the increase in the production of gold, which is more than double that of 1932, this increased output being of the greater importance on account of the greatly increased value of the gold produced. It appears from the statistics that the total value of mineral produced in 1933 shows a marked increase over the production for 1932.

Greenkeeping Research

THE Board of Greenkeeping Research has recently issued its Report for 1933. Most of the Board's activities are centred round its Research Station at St. Ives, Bingley, Yorks, where experiments on the qualities of various lawn grasses are in progress. During 1933, plots of *Poa annua*, *Agrostis* and *Festuca rubra* have received special investigation in order to determine their suitability for golf green purposes. Manurial experiments have been correlated with yield data. Various compounds are being tried as worm eradicators, whilst the success of the St. Ives leather jacket exterminator (a standardised emulsion of Jeyes' fluid and orthodichlorobenzene) must be very gratifying to its originators. The establishment of greens by means of vegetative propagation is receiving considerable attention, and the aeration of turf is a subject for further experiment. Advisory work is growing, and the financial statement shows a small surplus. Attention is directed to the *Journal* of the Board, which is published twice a year and may be obtained from the Station.

Our Nearest Neighbour

WHEN the star Proxima Centauri was discovered by Innes to have a parallax of 0.88", he realised that

this value implied that it is the closest star to the solar system, and gave the star its present name. The nearest competitor is α Centauri, which has a parallax of $0.76''$. Subsequent measurements, however, have failed to confirm Innes' value of the parallax of Proxima, and in Schlesinger's Catalogue a weighted mean value of $0.802'' \pm 0.050''$ is given. This still makes Proxima nearer to us than α Centauri; but the parallax has recently been determined both at the Yale Observatory at Johannesburg and at the Royal Observatory at the Cape of Good Hope, the results being $0.783''$ and $0.758''$ respectively. The name given to Proxima is accordingly seen to be in grave danger of losing its justification, and it appears possible that α Centauri is after all the closest neighbour of the solar system in space.

Fireball of October 11, 1934

At 10 h. 29 m. p.m. of October 11 a very brilliant meteor appeared over eastern Yorkshire. Mr. A. King, 53 Victoria Road, Ashby, Scunthorpe, Lincolnshire, received nineteen observations, ranging in place from Durham in the north to Chipping Campden in the south-west and Brentwood in the south-east. The total light of the fireball, in Yorkshire and north Lincolnshire, was probably greater than that of the full moon. From the best observations, the following real path is found: Began, 94 miles over 3 miles E.S.E. of East Malton, Yorks.; mean deviation 2.0 miles. Ended, 50.8 miles over 5 miles N.E. of Brigg, Lincs; mean deviation, 0.8 mile. Earth-point, near Boston. Length of visible track, 58 miles; speed, 21 m.p.sec. Radiant, α , 252.3° ; δ , $+75.8^\circ$, in Ursa Minor. The speed, allowing for air resistance, was of the parabolic order; hence, corrections for zenith attraction and diurnal aberration were applied to the observed radiant, and an orbit computed, on the assumption of parabolic velocity. The corrected radiant was $249.6^\circ + 74.9^\circ$, and the orbit: ι , 56.3° ; π , 15.6° ; Ω , 197.9° ; q , 0.998. The meteor left a streak along its track, extending from 77 miles high to 56 miles over 2 miles S.S.E. of Barton-on-Humber. The upper portion quickly vanished, and the part from 69 miles over $4\frac{1}{2}$ miles N.E. of South Cave, Yorks, to end as given above (mean deviations, from three observations, respectively 1.8 m. and 1.9 m.), drifted in an east-north-east direction, taking up, in 3 minutes, a position extending in a curved line from 73 miles (dev. 2.0 m.) over $3\frac{1}{2}$ miles, roughly east of Beverley, to 58 miles (dev. 3.0 m.) over West Hull, the forward point of the bend (one third way from the lower end) being above 1 mile N.W. of Sutton, Hull; height, 64 miles (dev. 3.4 m.). The corresponding rates of drift were thus 168, 156 and 186 miles per hour.

Grants for Metallurgical Research

THE Council of the Iron and Steel Institute awards annually a limited number of grants, each not exceeding £100, from the Andrew Carnegie Research Fund for metallurgical research work. The object of the scheme is to enable students of academic or industrial experience to conduct researches on

problems of practical and scientific importance relating to the metallurgy of iron and steel and allied subjects. Candidates, who must be less than thirty-five years of age, must apply before the end of next January on a special form to be obtained from the Secretary of the Institute.

Aviation and Public Health

THE Third International Congress of Sanitary Aviation will be held at Brussels on June 11-17 at the time of the Universal International Exhibition. The subjects for discussion at the Congress, which has been organised by the Aero-Club of Belgium, of which Dr. Charles Sillevaerts is president, are as follows: utilisation of private and commercial aeroplanes for sanitary objects; collaboration of public services and private organisations for the utilisation of sanitary aviation in peace time; organisation and working of first aid in public aerial transport; and help afforded by aviation in times of calamity. Moscow, Leningrad, Kiev, Odessa, Kharkov, Minsk, Baku, Sverdlovsk, Irkutsk and Khabarovsk have recently been provided with aeroplanes intended to convey first aid to patients in out of the way districts which have no doctors or have been rendered inaccessible by floods, storms and the like. The aeroplanes can be summoned by wireless, telegraph or telephone.

Leipzig International Industries Fair

THE Leipzig Spring Fair 1935 will be open on March 3-10. The Samples Fair closes at noon on March 9, but the Engineering and Building Fair will be open until March 10. The Textile Fair closes on the evening of March 6. The "Bugra" (Book Trades) Machine Fair closes at noon on March 9. The section representing the optical, photographic and cinema industries, which has hitherto been housed in the Gymnasium at the Frankfurter Tor, is being included in the Engineering and Building Fair, and its exhibits will be arranged in Hall 12 (Dome Hall). This will make the Leipzig Fair more self-contained, a fact which should be appreciated. It is announced that the Machine Tool Hall (Hall 9) has been booked up completely, and further exhibits have overflowed into Hall 11. In the Electrotechnical Hall, too, all space available has been booked. General mechanical engineering will be well represented, there being large increases in the department of Diesel engines and foundry machinery. Manufacturers of gas appliances are arranging a special exhibition on a large scale in the Building Trades Hall.

National Academy of Medicine in Spain

THE second centenary of the foundation of the National Academy of Medicine was celebrated at Madrid on December 10 by an exhibition of books and documents dating from the fifteenth century, including treatises on plague and bloodletting and commentaries on Hippocrates, and by an address on the history of the Academy by the librarian, Dr. Goyanes.

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. 1011.

Modes of Stimulation of the Gastric Secretion

THE manner in which gastric secretion is stimulated through the parasympathetic nervous system and by histamine may be better understood by means of combined physiological and histological study.

Rhythmic stimulation of the vagi with a weak induction current produces a scanty flow of slightly alkaline, neutral or slightly acid mucous fluid from the stomach. A stronger current provokes a copious secretion of regular gastric juice of high acidity and peptic power and rich in dissolved mucin¹. If there are in the vagus two kinds of secretory fibres innervating the gastric mucosa, then those which are activated by a weak induction current will have relation chiefly to the surface epithelium cells and perhaps to the mucoid cells. In strong stimulation of the vagi, mucoid, peptic and parietal cells are brought into activity. Under normal conditions, when gastric secretion is produced, for example, reflexly as in 'sham-feeding', the composition of the juice corresponds to that obtained by strong electrical stimulation of the vagi. However, at the end of the secretory period there is an abundant flow of visible mucus, which is much greater than in gastric secretion stimulated by histamine or alcohol^{2, 3}. This suggests the participation of surface epithelium mucous cells in certain phases of reflexly provoked gastric secretion.

The exceptionally high peptic power of 'vagus' gastric juice may be attributed to an enormous discharge of granules from the peptic cells, the granules being presumably vehicles of the enzymes⁴. (Compare Fig. 1(a)—control—with Fig. 1(c)—effect of vagus stimulation—and note the disappearance of the dark-coloured granules from the peptic cells.)

Quite different relations were noted when histamine was administered to an animal. The volume of secretion produced by this drug is no less and sometimes even greater than in experiments involving electrical vagus stimulation or sham-feeding. The acidity of the 'histamine' gastric juice and its total chlorine concentration correspond to those of the 'vagus' juice. This shows that the source of almost all the chlorine is in both cases one and the same⁵. On the other hand, the total organic matter, including the pepsin and dissolved mucin, gradually diminish during secretion. They may practically disappear from the juice if histamine is injected repeatedly^{6, 7, 8}. Therefore it seems legitimate to conclude that histamine stimulates the parietal cells only, producing a flow of acid solution, without having any effect on the peptic cells (Fig. 1(b))⁴. At the beginning of the secretion on histamine, the acid solution produced by the parietal cells washes out from the glandular tubules the zymogen material which may have accumulated there, presumably during the inactivity of the gland.

Histamine action on the gastric glands is not, however, restricted to selective stimulation of the parietal cells. Experiments in which gastric secretion activated by histamine was followed by sham-feeding or a test-meal showed that histamine definitely diminishes the secretory effect of the two latter agents⁹. Histamine exercises its greatest inhibition on the nervous, that is, 'vagal', phase of gastric secretion.

These and other experiments support the theory that many of the digestive glands are composed of different sets of secretory epithelia. The secretory activity of such glands is not regulated *en masse*, but various nerves (for example, those innervating the submaxillary gland¹⁰) or chemical agents stimulate or inhibit each set of secretory elements separately. This does not exclude the mutual influence



FIG. 1. Sections of gastric mucosa. (a) Control; (b) effect of histamine stimulation; (c) effect of vagus stimulation.

of one group of cells on another through the action of 'chemical messengers'^{11, 12}. Therefore it may be concluded that the *qualitative* changes which occur in many digestive secretions under various conditions of stimulation are due to the unequal *quantitative* activity of different groups of secretory cells in a given gland^{13, 14, 15}.

The histological part of the investigations quoted in this letter was performed in the Department of Histology, McGill University, under the direction of Prof. J. C. Simpson.

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Oct. 27.

¹ Vineberg, *Amer. J. Physiol.*, **95**, 363; 1931.

² Webster, *Amer. J. Physiol.*, **90**, 718; 1929.

³ Webster, *Trans. Roy. Soc. Canada*, **25**, Section V, 213; 1931.

⁴ Bowle and Vineberg (in preparation).

⁵ Toby (unpublished).

⁶ Babkin, *Canad. Med. Assoc. J.*, **27**, 268; 1930.

⁷ Vineberg and Babkin, *Amer. J. Physiol.*, **97**, 69; 1931.

⁸ Gilman and Cowling, *Amer. J. Physiol.*, **97**, 124; 1931.

⁹ Alley, *Trans. Roy. Soc. Canada*, **28**; 1934 (in press).

¹⁰ Rawlinson, *Anat. Record*, **57**, 289; 1933.

¹¹ Fleming and MacIntosh, *Amer. J. Physiol.*, **109**, 36; 1934.

¹² MacIntosh and Rawlinson, *Amer. J. Physiol.*, **109**, 70; 1934.

¹³ Babkin, *Trans. Roy. Soc. Canada*, **24**, Section V, 201; 1930.

¹⁴ Babkin, *Trans. Roy. Soc. Canada*, **25**, Section V, 205; 1931.

¹⁵ Babkin, *Canad. Med. Assoc. J.*, **28**, 134; 1931.

Magnitude of Cosmic Ray Bursts

In a paper which I had the privilege of presenting for them at the recent London Congress of Nuclear Physics, R. D. Bennett, G. S. Brown and H. A. Rahmel described some very large cosmic ray bursts, which they recorded using a large argon-filled ionisation chamber stationed on Mount Evans. In six of these bursts the number of ion pairs suddenly appearing within the chamber was greater than 3×10^8 . The largest one threw the electrometer off scale, which meant more than 6.25×10^8 ion pairs. It is of interest to estimate the total energy involved in such a process.

Using Gärtner's value¹ of 29.6 electron volts per ion pair in argon, the energy required to produce the ions caught within the chamber exceeds 1.85×10^{10} e.v. Experiments performed by E. O. Wollan using different pressures of argon in our recording chamber show, however, that the magnitude of the bursts is at least roughly proportional to the pressure. This means that up to the highest pressure employed (50 atmospheres) only a small fraction of the ionising radiation from the burst is absorbed in the argon. We may thus assign as a lower limit to the total energy about four times that which is actually measured.

If we suppose that a burst is merely a large shower, and if we use the interpretation of shower production presented by P. M. S. Blackett and others at the Congress, intense ionisation such as occurs in the bursts should extend throughout the whole region traversed by the shower-producing radiation (photons?) excited by the impact of the cosmic ray particle upon an atomic nucleus. If the region within which this radiation is absorbed is homogeneous, the fraction of its energy spent within a region of small thickness δx is approximately

$$F = \mu e^{-\mu x} \delta x, \quad (1)$$

where μ is the absorption coefficient of the radiation in the medium. If, however, the burst originates in a medium a (the steel walls of the chamber) and spreads through a cavity of thickness δx filled with medium b (argon gas) which absorbs only a small fraction of either the photon radiation or the secondary beta rays which they excite, the fraction of the energy spent within medium b is

$$F = \mu \frac{\mu_b}{\mu_a} e^{-\mu x} \delta x, \quad (2)$$

where μ_a and μ_b are respectively the effective absorption coefficients of the secondary beta rays in the two media. Measurements on the transition effect indicate that μ for the shower-producing radiation in iron is about 0.13 cm.^{-1} . The absorption of the high-speed β -rays is found to be nearly proportional to the density, that is:

$$\mu_b/\mu_a = \rho_{\text{argon}}/\rho_{\text{iron}} = 0.0106.$$

For the largest bursts we may take $e^{-\mu x} = 1$. Thus from equation (2) we get $F = 0.033$ as the fraction of the total energy absorbed within the ionisation chamber. This corresponds to a total energy of about 6×10^{11} electron volts for the largest recorded burst.

Several considerations must increase somewhat this estimate of the energy: (1) The number of ions produced in the chamber was greater than 6.25×10^8 .

(2) It is impossible that all of the secondary shower-producing rays can have passed through the chamber, though most of them may have done so. (3) A part of the shower-producing rays will probably have been absorbed before reaching the chamber. The total energy of the largest burst must thus have been between 10^{11} and 10^{12} electron volts, and probably nearer the latter value.

These energies correspond to the masses of atoms of atomic weight 100–1,000. They are thus too great to arise from any kind of nuclear process, unless it be the improbable one of a nuclear chain reaction within the instrument, and involving many atoms. The apparent absence of any possible mechanism whereby such a chain reaction might be effected seems sufficient to rule out this suggestion.

It is noteworthy, however, that in order to penetrate to 600 m. of water, where cosmic rays are still perceptible, according to recent calculations of Bethe a proton must have an energy of the order of 2×10^{11} electron volts, and an electron greater energy, while no photon should reach such a depth. It would thus appear probable that cosmic rays occur with sufficient energy to produce directly all the ionisation observed in these bursts.

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Dec. 1.

¹ O. Gärtner, *Ann. Phys.*, 2, 94; 1929.

Heavy Water in the Animal Body

IN NATURE of December 8, p. 879, Hevesy and Hofer report an experiment in which they study the rate of elimination of a quantity of heavy water ingested (in man). They found that half the quantity was excreted in the urine 9 (± 1) days after the ingestion. From this they calculated that "the average time a water molecule spends in the body is 13 ± 1.5 days", and assume "that most of the water taken becomes completely mixed with the water content of the body".

Some time ago, we made an experiment on the absorption of heavy water from the small intestine of the rat. We had already made the following calculations, and now bring them forward in support of Hevesy and Hofer's view.

A 4.5 per cent xylose solution, that is, a solution isotonic with the blood, was made in a 1.66 per cent solution of heavy water in ordinary water. By the exchange of four OH groups, the heavy water had now a concentration of 1.64 per cent. 6 c.c. and 4 c.c. respectively of this solution were injected into 60 cm. jejunal loops of two anaesthetised rats, which had fasted for 20 hours. After one hour the animals were killed, and the contents of the loops taken for analysis. We know from previous experience that in such experiments the quantity of fluid remains about the same, while about one fifth of the xylose is absorbed, and sufficient sodium chloride diffuses in to keep the solution about isotonic with the blood.

The heavy water content of the intestinal fluid was then analysed, after thorough purification and repeated acid and alkaline distillation. It was found to be 0.07 per cent in the first case, and 0.05 per cent in the second. This shows that there is a very rapid exchange of water injected (with its indicator

of heavy water) with the water of the whole body, independent of the change in the concentration of the dissolved substance. There was no loss of water during the hour by excretion of urine (not counting the urine in the bladder), and the amount of water expired in such a period is negligible. The supposition that a complete distribution of the injected water has occurred, that is, that the concentration of 0.07 per cent, or 0.05 per cent, is the same throughout the whole body, can therefore be controlled by calculating the quantity of water required to give these dilutions, and comparing it with the total body fluid as calculated from the body weight of the animals. The amounts of water required to dilute 6 c.c. of 1.64 per cent heavy water to 0.07 per cent, and 4 c.c. of 1.64 per cent to 0.05 per cent, are 135 c.c. and 127 c.c. respectively. The body weight of each rat was 200 gm.; taking the water content of the body to be 66 per cent of the weight, we calculate that these rats contained 132 gm. of water each. It is, therefore, clear that the water injected, with its heavy water indicator, has distributed itself throughout the entire body in one hour.

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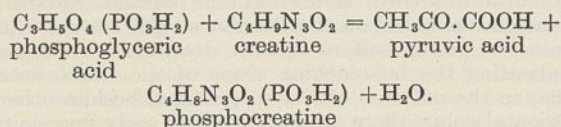
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Linkage of Chemical Changes in Muscle

WE have found recently¹ that addition of phosphoglyceric acid to frog's muscle pulp, poisoned with iodoacetic acid, stops the formation of ammonia which is released by this poison; and we have explained this effect of phosphoglycerate, and a similar action of pyruvic salts in fluoride poisoned muscle, by the hypothesis that the resynthesis of adenosinetriphosphoric acid—which cannot be deaminated directly in muscle—is kept going, in absence of glycogenolysis, by the transport of phosphate groups to adenylic acid from phosphoglyceric acid, or from a related phosphate carrier. This transport we have supposed to be indirect; from the intermediary product of glycogenolysis, the phosphate group being transported to creatine, with formation of phosphocreatine, from which it is transported, in Lohmann's reaction, to adenylic acid as phosphate acceptor. The supposed intermediary reaction of the intermediary phosphorus compound with creatine we have written in our scheme of glycogenolysis² as reaction (3).

We have now been able to obtain evidence that phosphocreatine is formed readily in muscle pulp poisoned with iodoacetic acid, when phosphoglyceric acid is present: this phosphate carrier is converted into pyruvic acid. The resynthesis of phosphocreatine out of creatine cannot be produced, in such poisoned muscle, either by free phosphate, or by any intermediary product of glycogenolysis: for example, glyceraldehydphosphoric ester, phosphoglycerol, Harden-Young ester, pyruvic acid, lactic acid, diphosphoglyceric acid. Reaction (3) in our scheme may be written as follows:



The intermediary phosphate carrier is probably phosphopyruvic acid, recently discovered in muscle by Lohmann and Meyerhof³.

As in iodoacetate poisoned muscle pulp phosphoglyceric acid is readily transformed into pyruvic acid, but no pyruvic acid is formed from other intermediary products of glycogenolysis more proximate than phosphoglyceric acid, the point at which iodoacetate interrupts the sequency of glycolysis must be situated above the formation of phosphoglyceric acid, and *not below*, as G. Embden⁴ and O. Meyerhof⁵ have supposed. Their statement that the oxidation-reduction between pyruvic acid and phosphoglycerol does not occur in the presence of iodoacetate, is doubtless correct: but glycogenolysis does not proceed to the formation of phosphoglyceric acid, still less of pyruvic acid.

In the presence simultaneously of pyruvic acid and free phosphates, the formation of ammonia is stopped, and the resynthesis of adenosinetriphosphoric acid is kept going in fluoride poisoned muscle pulp; but when no phosphates have been added—those present in the tissue being converted to esters at the onset of crushing—pyruvic acid has no effect; neither on ammonia formation, which is proceeding rapidly, nor in preventing the splitting of adenosinetriphosphoric acid. A carrier of phosphate groups, transporting these groups to creatine and in this way to adenylic acid is formed, therefore, from pyruvic acid and phosphate—possibly the same as is produced from phosphoglyceric acid.

Pyruvic acid is an intermediary product of anaerobic glycogenolysis, and of lactic acid oxidation in aerobic recovery. As a phosphate carrier specific for the phosphorylation of creatine and adenylic acid can be produced from pyruvic acid and inorganic phosphate, it becomes clear that the same intermediary phosphate carrier may act in the anaerobic and oxibiotic recovery of muscle, leading in both changes to the resynthesis of phosphocreatine and adenosinetriphosphoric acid.

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Nov. 4.¹ *Biochem. Z.*, **64**, 272; 1934.² *NATURE*, **134**, 627, Oct. 20, 1934.³ *Biochem. Z.*, **60**, 273; 1934.⁴ Not published, read in Basel, May 1933.⁵ *NATURE*, **132**, 337 (v.p. 340), Sept. 2, 1933.

Non-Identity of Vitamin B₂ and Flavines

DURING the past two years, we have been working on the isolation of vitamin B₂, using the chick for assay work. Only those fractions which had the power of preventing pellagra and allowing normal growth in chicks on the vitamin B₂ low ration described by Kline, Keenan, Elvehjem and Hart¹ were considered to be potent in vitamin B₂. All our results point to the fact that vitamin B₂ and flavines are not identical.

The flavine or the lumiflavine prepared from a liver extract did not protect chicks from pellagra. The animals receiving the flavine showed more severe symptoms of pellagra than those on the basal ration. The liver extract fraction remaining after the flavines had been removed by adsorption on fuller's earth

was highly active in the prevention of pellagra. When the fraction was purified and concentrated, the concentrate was practically colourless, but the vitamin B₂ activity was retained. The flavine was removed from another fraction by irradiation and extraction of the lumiflavine with chloroform. The remaining solution was again active.

A complete survey of the literature has been made and we find no decisive evidence which would prevent us from concluding that vitamin B₂ and flavines are two separate and distinct chemical entities. We wish to retain the term vitamin B₂ for the antipellagric factor, and suggest a reclassification of the flavines.

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¹ Kline, O. L., Keenan, J. A., Elvehjem, C. A., and Hart, E. B., *J. Biol. Chem.*, **99**, 295; 1932.

Production of Ethylene by Some Ripening Fruits

It was observed by Elmer¹ in 1931 that the presence of ripe apples and pears—but not oranges or bananas—caused abnormalities in the sprouting of potato tubers; and Huelin² pointed out that the effects were similar to those produced in potato sprouts by exposure to ethylene. Later, Smith and the writer³ showed that the growth of pea seedlings was affected by an active substance produced by ripe apples, again with results which were paralleled by ethylene.

Kidd and West⁴ had previously noted that a substance produced by ripe apples would stimulate the so-called 'climacteric' in unripe apples; and the writer had shown⁵ that an active substance generated in traces by ripe bananas has corresponding effects on the rate of respiration and the ripening of green bananas and on the growth of pea seedlings. In each case, similar results could be produced by exposure to a trace of ethylene.

Analogies between the biological behaviour of ethylene and the active substance, particularly in relation to the epinasty of leaves, have been accumulated in more recent work by the writer⁶; but the purpose of the present note is to record chemical identification of the active substance.

An air-stream containing the whole of the gaseous products of metabolism from some 60 lb. of Worcester Pearmain apples was led, during a period of 4 weeks, through Newth collecting tubes containing bromine at -65° C. 0.85 gm. of oil was obtained, which on fractional distillation yielded 0.65 gm. boiling below 140° C. Heated with aniline this gave a solid which crystallised from dilute alcohol as lustrous plates, melting at 62.5° C. A mixture, with a prepared sample of *N. N'* diphenyl ethylene diamine (melting point 62.5° C.) also melted at 62.5° C.

The particular interest of this identification lies in the definite linking together of two lines of research in the metabolism of fruits—the well-established effects of ethylene on ripening, and the relations between one fruit and its neighbours which were brought to light by Kidd and West.

The amount of ethylene produced is very small—perhaps of the order of 1 cubic centimetre during the whole life-history of the fruit⁶; and the cause of its prodigious biological activity in such small concentrations is a problem for further research. Its

production by apples ceases or is very much reduced in the absence of oxygen. Further experiments are in progress.

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Nov. 30.

¹ Elmer, O. H., *Science*, **75**, 193; 1932.

² Huelin, F. E., Report of the Food Investigation Board for 1932, p. 53. H.M. Stationery Office.

³ Smith, A. J. M., and Gane, R., *ibid.*, p. 156.

⁴ Kidd, F., and West, C., *ibid.*, p. 55.

⁵ Gane, R., *ibid.*, 1933, p. 122.

⁶ Gane, R., *ibid.*, 1934 (in the press).

Introduction of Hindu-Arabic Numerals into Western Europe

EVIDENCE is sometimes adduced to indicate that the Hindu-Arabic numerals, or closely allied forms of them, were known in western Europe before this knowledge could have passed through Muslim Spain. For example, Alcuin of York (735-804) is said to show at least partial knowledge of the numerals. If this is so, whence did the information come?

In this connexion Smith-Karpinsky ("The Hindu-Arabic Numerals", p. 103) point out that adventurous scholars must have gone with ambassadors, travellers and merchants to seek learning in other lands. Reference is also made to a cruciform brooch in the British Museum, perhaps dating from the time of Alcuin, and bearing the Muslim inscription in Kufic characters: "There is no God but God." Smith-Karpinsky ask: If these Kufic characters reached England at that time, why not the numeral forms as well?

When making some notes on the history of money, I collected from various sources fragments of information which may reinforce the implications of the cruciform brooch, and at the same time indicate a route by which some knowledge of the numerals may have reached western Europe in the eighth century.

(1) There is a gold dinar of Offa, King of Mercia, bearing in Latin the words "Offa Rex", and in Arabic the inscriptions: "Mahomet is the messenger of God. . . In the name of God. This dinar was struck in the year 157" (A.D. 774). It may be noted in passing that Alcuin was in touch with Offa on several occasions. An illustrated description of Offa's dinar will be found in Kenyon's "Gold Coins of England", 1884. It is possible that Offa, who, like Charlemagne, was interested in coinage reform, employed Arab moneyers; Arabs being more highly skilled in the arts associated with coining than his own people.

(2) From the eighth century onward, for several centuries, there was a very large volume of trade between north-western Europe and the Orient. We know this because huge quantities of Arabic and Persian coins (Sir T. W. Arnold says upward of ten million) have been found in Scandinavia and other north European countries. The earliest of these is dated 79 A.H. (A.D. 699). Many were minted at Samarkand and at Bagdad. There can be no reasonable doubt that a great number, if not all, reached Europe by the Baltic-Volga-Caspian trade route, along the Russian portion of which many similar coins have been found. As further evidence of Oriental influence, note that the earliest Swedish coinage was based on the Persian weight system, the coins weighing half a Persian drachma. Also, as indicating the far-reaching scope of the trade, note that in the museum at Oslo-Christiana, besides other Oriental coins, there are specimens of early porcelain

money, found in Scandinavia, from Tibet and Siam.

I would add here that some historians have made too much of Viking raids; overlooking the fact that piracy implies plunder, and plunder implies trade. It is fairly clear that many raids during the eighth century were in fact persistent struggles to secure control of the still highly lucrative Frisian trade and trading stations.

(3) Alcuin spent fifteen years in Aachen, at the home of Charlemagne, whose not unfavourable attitude towards the eastern Arabs is shown by his correspondence and diplomatic exchanges with Haroun-al-Raschid. Aachen was within fairly easy reach of Frisia (much the same territory as modern Holland, where Arabic coins have been found).

(4) In Alcuin's time scholars were more closely associated with commercial activities than might be supposed. The great monasteries of the eighth and ninth centuries were among the largest traders of the time in certain lines. Those which were situated on or near the north European rivers often owned fleets of barges, ships for coasting voyages, and permanent depots for their traffic. They also sent agents to distant cities to buy and sell on their behalf. Arabic coins must not infrequently have passed through the hands of some of these officials; and as there is evidence that at least a few Arab traders travelled from the East far into northern latitudes, it is not inconceivable that they sometimes (however rarely) made actual contact with monastic agents in the West.

My purpose here, however, is not to enter the region of hypothesis, but to indicate a possible field for research which has not yet been adequately explored.

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Orientation of Oxide Films on Metals

It was suggested by Tammann¹ in 1922 that the different rates of oxidation exhibited by iron crystals of different orientations can best be explained by a fixed orientation relationship between the lattice of the iron crystal and the lattice of the oxide film. During the succeeding years, fixed orientation relationships have been demonstrated for reaction products of many kinds, such as recrystallisation structures, products of transformation in the solid state, Widmanstätten figures and others; in view of the general occurrence of such orientation relationships, it now seems more than likely that oxide (and other) reaction films grown on metal crystals will upon analysis also be found to exhibit fixed orientation relationships. Indeed the results of Finch and Quarrell², published during the course of our work, seem to prove that films of zinc oxide on zinc, and magnesium oxide on magnesium possess such a relationship, though the analysis does not seem to be complete. We have been successful in demonstrating a fixed orientation relationship for wüstite ("FeO") films grown on iron, and for cuprous oxide films grown on copper.

Wüstite, "FeO", was grown on single crystals of hydrogen-purified, remelted electrolytic iron, by heating at 700° C. in a mixture of hydrogen and water vapour of appropriate composition. Several samples, cooled at a rate which prevented sensible decomposition of the phase, showed, upon X-ray analysis of orientation, the existence of a simple orientation

relationship between the oxide film and the base metal. This orientation relationship is as follows: the cube or (100) plane in "FeO" lies parallel to the cube or (100) plane in the iron; the [110] direction in the (100) plane of "FeO" lies parallel to the [100] direction in the (100) plane of Fe. That is, the cube planes are parallel, but the cube axes in these planes form an angle of 45°. "FeO" has a sodium chloride type of structure with the iron atoms forming a face-centred cubic lattice, the side of which is 4.29 Å. The iron atoms on any cube face form small squares (defined by [110] directions), the side of which is 2.99 Å. Iron is body-centred cubic, with the side of the cell 2.86 Å. The atoms on the cube faces of the two phases, in conjunction in the manner stated, are thus nearly in coincidence. It follows that three orientations of "FeO" can form on each iron crystal, one on each cube face; these are distinct orientations, for the three "FeO" lattices on inspection will be seen not to be continuous. This orientation relationship suggests that the formation of "FeO" from iron consists in the expansion of the body-centred cubic cell of α -iron to form a body-centred tetragonal cell of axial ratio 1.414, which is identical with the face-centred cubic cell of the iron atoms in "FeO". The oxygen atoms in solid solution in α -iron are probably interstitial; they may also be so considered in "FeO".

In another experiment, cuprous oxide was grown on a single crystal of copper by oxidation in air. This film is almost entirely cuprous oxide, for only an extremely thin film of cupric oxide is formed. Simultaneous determinations of the orientation of the underlying copper crystal and the cuprous oxide film showed that the cube axes in both crystals lay accurately parallel. The copper atoms in cuprous oxide form a face-centred cubic lattice, and the oxygen atoms form an interpenetrating body-centred cubic lattice; the side of the unit face-centred cubic lattice of copper atoms in cuprous oxide is 4.26 Å., whereas that in pure copper is 3.61 Å. In this case, therefore, the oxide film is formed merely by an expansion of the copper lattice without change in orientation. Thus only one orientation of cuprous oxide will form on a single crystal of copper. The orientation relationship described is the more nearly perfect the thinner the film; as the film becomes thicker the perfection in orientation is progressively lost, owing largely, no doubt, to distortion effects coming from the large difference in volume. At a thickness of 0.002 in., little evidence of preferred orientation remains. Even in the thinnest films there is evidence of lattice distortion, coming probably from the necessity for adaptation in lattice dimensions at the interface, similar to that found by Finch and Quarrell for metallic films deposited on platinum.

How useful these orientation relationships might be in explaining the differences in rates of oxidation on different crystal faces is at the moment quite uncertain. Work now current in our laboratory may, however, lead to definite issue on this point.

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Oct. 26.

¹ *Stahl und Eisen*, 42, 617; 1922.

² *NATURE*, 131, 842, June 10, 1933. *Proc. Roy. Soc., A*, 141, 398; 1933.

Synthesis of Thiocamphor and other Cyclic Thioketones

THIOCAMPHOR has been synthesised in good yield in my laboratory by Mr. D. C. Sen, by the simultaneous action of dry sulphuretted hydrogen and dry hydrochloric acid gas, at 0° , on a solution of camphor in absolute alcohol. The substance is crystallised from aqueous alcohol or from benzene and it melts at 145° . It is a red crystalline substance having the aroma of camphor combined with a slight foetid smell. Attempts have been made to synthesise the compound by the action of ammonium sulphide or hydrosulphide on camphor, or on the pernitroso derivative of camphor quinone and from bornyl magnesium chloride and sulphur¹. But in these cases the yield appears to have been low, due to the accompanying by-products, and the purity of the substance also seems to be doubtful, as the melting points described are different in different cases.

The physical and chemical properties of the substance have been studied and important derivatives are being prepared. Thiocyclohexanone (non-polymerised) has been synthesised by the same method along with its tripolymerised derivative. Fromm² also studied the same reaction but isolated the tripolymerised derivative only. The method is being extended for the synthesis of cyclic thioketones containing different ring systems. The results of these investigations will be published in due course in the *Journal of the Indian Chemical Society*.

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Nov. 14.

¹ *Ber.*, 39, 3503. *Ber.*, 36, 863. *Gazzetta*, 39, 11, 196.

² *Ber.*, 60, 2090; 1927.

Series of Cæsium Atoms in an Electric Field

WE have investigated the absorption spectrum of cæsium vapour in an electric field by a method similar to that used by C. J. Bakker in Prof. Zeeman's laboratory¹ and by E. Amaldi and E. Segrè² in studying potassium and sodium. The background was given by a high purity carbon arc. A Hilger large quartz spectrograph E_1 was used. A spar

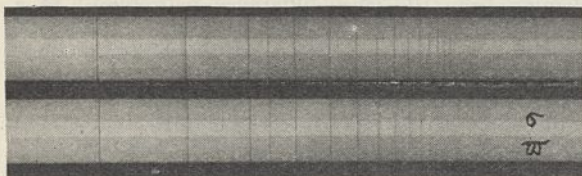


FIG. 1. Absorption spectra of cæsium near the limit of the principal series $6S-mP$: above, without electric field; below, in an electric field of 900 volts/cm.

crystal was placed in the light beam before the slit of the spectrograph, so that polarisations parallel to the electric field (ω -component) and perpendicular to it (σ -component) could be photographed simultaneously and separately.

Fig. 1 shows the absorption spectrum of cæsium near the limit of the principal series $6S-mP$ without an electric field (upper spectrum) and with a field of about 900 volts/cm. (lower spectrum). The first doublet on the left is the $6S-11P$, $\lambda = 3398.14$ and

3400.00 Å. Without the electric field, one may follow the series $6S-mP$ up to its thirty-first term; while in the electric field the intensity of the lines diminishes progressively and the series breaks down. The lines of the principal series are split owing to the occurrence of forbidden lines corresponding to $6S-mD$ transitions. For high terms the electric perturbation increases to such a degree that P and D terms become indistinguishable, and the splitting becomes an almost symmetrical one on both sides of the unperturbed P terms. In the region between the permitted lines of the series $6S-mP$, there appear some combination lines belonging to the $6S-mS$ series.

The forbidden lines of the $6S-mD$ and $6S-mS$ series begin to be detectable at a certain value of m (m is 14 for the $6S-mD$ series and 17 for the $6S-mS$ series in the ω component in the electric field of 900 volts/cm.). Their intensities increase with m , until they are stronger than the neighbouring permitted ones; then they become weaker and fade away.

The effect of the electric field is greater on the ω components than on the σ ones.

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¹ *Proc. Roy. Acad. Sci. Amst.*, 35, 589; 1933.

² *NATURE*, 132, 444, Sept. 16, 1933.

Interaction of Neutrons and Protons

HEISENBERG'S well-known assumption, ascribing the neutron-proton interaction to the exchange of the electric charge, seems to be irreconcilable with Fermi's theory of β -radioactivity¹. On the other hand, a natural generalisation of Fermi's theory may perhaps account for the interaction of heavy particles.

According to Fermi², a heavy particle (a neutron or a proton) may emit (and absorb) a pair of light particles—an electron or a positron and a neutrino. It seems natural to assume that a heavy particle may also emit (and absorb) a pair of neutrinos, whereas the emission of a single neutrino would violate the conservation of spin. Of course, in distinction to processes considered by Fermi, the emission of a pair of neutrinos will not affect the charge of the heavy particle.

The Coulomb interaction of charged particles may be deduced from the laws governing the emission and absorption of photons by a charged particle. Exactly in the same way we may calculate the interaction of particles endowed with the power of emitting and absorbing pairs of neutrinos. For the potential energy V of such an interaction one gets

$$V = \frac{\eta_1 \eta_2}{r^5} \dots (1)$$

where r is the distance between the particles and the 'neutral charges', η_1, η_2 , are constants, characterising the properties of the particles in question. It may be assumed that the η -charge of neutrons and of protons are numerically equal and of opposite sign. If one takes account of the finite radius r_0 of heavy particles, one finds that (1) is valid only so long as

$r \gg 0$, and that V remains finite when $r \rightarrow 0$. Estimating the value of η from the mass-defect of the deuteron, one finds that the probability of emission of a γ -quantum is for an excited proton far larger than the probability of emission of a pair of neutrinos, so that the latter possibility does not lead to contradictions with experimental facts.

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Moscow. Nov. 14.

¹ Ig. Tamm, NATURE, 133, 981, June 30, 1934.

² E. Fermi, Z. Phys., 88, 161, 1934.

Symbols for Chromosome Numbers

In a paper on the chromosomes of *Chrysanthemum*, Shimotomai¹ pointed out the need for a special symbol to represent the basic number of chromosomes in genera containing polyploid species. He suggests, however, that n should be used for this purpose, ϕ and 2ϕ being introduced as new symbols for the gametic and zygotic numbers of chromosomes respectively in a particular species. This usage has been followed by Dr. I. V. Newman in a paper² recently issued. The need for an additional symbol for the fundamental number in a genus has been evident for some time, but as n and $2n$ have long been in use for the haploid and diploid chromosome numbers of a species, it seems clear that

they should remain unchanged, and the new symbol should be introduced for the new conception of a basic number for the genus.

If this suggestion is adopted, then in the genus *Chrysanthemum*, for example, $\phi = 9$, in *C. indicum* $n = 18$, $2n = 36$, in *C. yezeensis* $n = 45$, $2n = 90$, etc. To show the polyploid nature of particular species we may then write for *C. indicum* $n = 2\phi$ or $2n = 4\phi$, showing that it is a tetraploid species. Similarly for *C. yezeensis* we may write $n = 5\phi$ or $2n = 10\phi$, showing it to be decaploid. This will avoid the confusion which is bound to result if the use of n to represent the haploid number in any species is changed.

Sansome and Philp³ have suggested x as the symbol for the fundamental number, but x was formerly used in place of n , and is still so used by some⁴. Hence confusion can only be avoided by adopting a new symbol such as ϕ for the basic number.

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Nov. 22.

¹ Shimotomai, N., "Zur Karyogenetik der Gattung *Chrysanthemum*", J. Sci. Hiroshima Univ., B, Div. 2, 2; 1933.

² Newman, I. V., "Studies in the Australian Acacias. III", Proc. Linn. Soc. N.S.W., 59; 1934.

³ "Recent Advances in Plant Genetics", p. 165, 1932.

⁴ For example, Fernandes, A., "Nouvelles études caryologiques sur le genre *Narcissus* L.", Boletim Soc. Broteriana, 9, 23; 1934.

Points from Foregoing Letters

USING three different methods of stimulating stomach secretions, Prof. B. P. Babkin infers that digestive glands are composed of various sets of cells, connected to separate nerves, so that different types of secretions are possible. Slight stimulation of the vagus nerve causes scanty flow of mucous fluid; stronger current provokes copious flow of gastric juice and digestive enzymes similar to those produced by the sham-feeding of a test-meal; the drug histamine stimulates gastric juice secretion but not enzyme production.

Prof. A. H. Compton of Chicago, now visiting lecturer at the University of Oxford, calculates that the energy liberated in the atomic explosions, observed at higher altitudes by means of the 'cloud chamber', may be so high as 600,000 million volts. This energy would correspond to the annihilation of the mass of an atom of weight 600. No such heavy atom, nor any mechanism whereby several atoms would be simultaneously destroyed, is known. Hence it may be assumed that the atomic explosions are due to cosmic rays, which are known to possess energy of that order of magnitude.

A group of investigators from Switzerland corroborates Hevesy and Hofer's recent inference that water introduced into the body becomes completely mixed with the total water content. The Swiss investigators injected a solution of xylose, a sugar-like substance obtainable from beechwood or jute, in water containing 1.66 per cent of the heavy variety, into the intestine of fasting rats. It was found that the water injected, with the heavy water as indicator, distributed itself throughout the entire body in one hour.

Muscle derives its energy from a chemical change in which the sugar-like substance—glycogen—is

transformed into lactic acid. For this conversion several other substances are necessary intermediaries, among them creatine, adenylic acid and their phospho-combinations. Prof. J. K. Parnas and his collaborators, as a result of experiments on muscle pulp poisoned with iodoacetic acid, find that phosphoglyceric and pyruvic acids are also intermediaries, the latter acting as phosphate carrier both in the presence and absence of air, and leading to the formation of phosphocreatine and adenosinetriphosphoric acid.

Various investigators have observed that the proximity of ripe apples and pears stimulates the sprouting of potatoes and the growth of pea-seedlings. Similar effects can be obtained with traces of ethylene. Mr. R. Gane has now been able to detect ethylene among the gases given off by ripe apples.

X-ray studies of crystal structure carried out by Dr. Mehl and his collaborators show that very thin films of oxides (less than 1/500 in. in thickness) grown upon crystals of iron and copper, have an atomic arrangement in definite relationship to the lattice structure of the metals on which they are formed. It is as yet uncertain whether the difference in orientation on different crystal faces is related to the observed variations in the rate of oxidation.

Prof. Tamm points out that the emission or absorption of two neutrinos by the neutron or proton, though less probable than the emission of a γ -ray by the excited proton, is also a possible occurrence. It would not change the spin or the electrical charge of the heavier particle, which would be the case when a single neutrino is given off, as postulated by Fermi in order to account for the emission of β -rays (electrons) by some of the radioactive substances.

Research Items

Weight of Negro Brains. Prof. Raymond Pearl points out in *Science* (Nov. 9, 1934, vol. 90, No. 2080) that the data upon which is based the generally accepted view that the skull capacity and the brain weight of the Negro, whether pure or mixed, tends on the average to be smaller than in whites, are meagre; but the older records contain much of value, only needing biometric analysis for present day purpose. Morton (1849) gives a combined mean cranial capacity for Negroes of 1,360.1 c.c. as against whites, 1,489.6 c.c. (91.3 per cent); Peacock (1865), Negro, 1,295 c.c., as against whites, 1,465 c.c.; Duckworth (1904), Group ii, (African), 1,388 c.c. Group iv, (Eurasian), about 1,500 c.c. (92.5 per cent). Calculations of weight are, Peacock (1865) 1,256.3 gm. (calculated from Peacock's data); Waldeyer (1894) 1,148 gm. and 1,234 gm. (from Topinard). Bean (1927) reported from 117 autopsies that the Negro males had a smaller brain weight than whites, the difference being larger relatively than in respect of either liver, kidneys, spleen, heart, appendix or pancreas. The most recent figures are F. W. Vint (1934), the average adult Kenya male being 1,276 gm., the extremes 1,006 gm. and 1,644 gm.; that is, being 10.6 per cent lighter than a not too sound general European mean brain weight; the average skull capacity was 1,230 c.c. Next to Vint's series, the longest series of Negro brain weights is derived from 400 autopsies made during the American Civil War by Surgeon Ira Russell. These data were dissected by S. B. Hunt and published in the *J. Anthropol. Soc. London*, 7, 1869. The biometric constants have now been calculated. The mean is, white, 1,470.6 gm. \pm 16.2; black, 1,354.8 gm. \pm 6.8. Coefficient of variations, white, 8.02 gm. \pm 0.79; black, 8.87 gm. \pm 0.36. The mean is about 207 gm. greater than Waldeyer's figure and only 78.8 gm. greater than Vint's. The value of the coefficient of variation is not far from the 8 per cent which has been shown to be characteristic for brain weight variability in accurately weighed samples. The mean brain weight for the black series is 92.1 per cent of the white, agreeing approximately with Morton, Duckworth, Peacock and Vint. The smoothness in the decline of the means with a putative increase in Negro blood is noticeable. The relative variability of the Negro brain weight appears to be slightly greater than that of the whites.

'Little People' of the Gold Coast. Mr. M. J. Field contributes to *Man* of December an account of the *Asamanukpai* of the Gold Coast—dwarf-men, with feet turned back to front, a little bigger than a monkey, and black, white or red, who inhabit a forested hill behind the Ga village of Bawyi, where monkeys and pigs live, but which no hunter will visit by himself, because of fear of these 'little people'. The old dwarfs are the biggest and they are bearded. They eat and dance on outcrops of stone which they themselves have polished. The disc-shaped quartz thunder-stones, holed through the middle, which are plentiful in the district, are said to have fallen from heaven; but they are also said to have had their holes made by being caught, as they fall, between the finger and thumb of an *asamanukpa*. Hunters who have to invade their district propitiate them with rum, which is laid against their dancing stones. If angered, they stone the offender and, leading him away into the forest, lose him. Sometimes they lead

away a man to befriend him, and then they teach him all they know. When he returns to his home after a week or two, he becomes a much revered fortune teller. The dwarfs are known by the sea as well as in the forest. Before the lagoon was drained, they were so plentiful that one day in the week, Friday, was set aside for them and no one would go to the shore to fish on that day. According to one story, they acted as the benefactors of two fishermen and brought them good catches night after night; but when the fishermen spied on them, the luck vanished and in a few weeks the fishermen died of melancholy. The *Asamanukpai* seem comparable to the *mmatia* described by Rattray, who seems to think that there may be a reminiscence of a real pygmy tribe, as has been suggested for the origin of the fairy belief in Europe. It is possible, however, that the belief may have originated in the form of lunacy familiar in European lunatic asylums, in which the patient suffers from the delusion of seeing 'little people'—usually said to be due to 'frustrated maternal instinct'. Though this would not take in every case on the Gold Coast, there does seem to be some evidence for regarding normal married life as a bar to fairy friendship.

Studies of Identical Twins. *Character and Personality*, 3, No. 1, contains a full account by Mr. Robert Saudek of psychological tests carried out on "A British Pair of Identical Twins Reared Apart". This is the first case to be traced in the British Isles. Careful comparisons were made between the finger and palm prints of the two brothers, and the conclusion was that finger print patterns are not a reliable index of identical twinning, although palmar markings are very similar. Various emotional and intelligence tests were given and these were supplemented by a graphological analysis. Owing to this being but a single case, only tentative conclusions as to the influence of environment on identical genetic constitution have been propounded. The main conclusion is that there is greater similarity in intelligence than in emotional reactions. The chief differences in personality appear to be of degree rather than kind. One twin is apparently "more extroverted and sociable, better adjusted, somewhat self-assertive and rather independent and on the whole more impulsive and the quicker of the two. The other is less extroverted, according to some tests even introverted and less well-adjusted; he also shows inner instability and more cautiousness". This is the nineteenth of such cases to be investigated.

Blood Groups of Rabbits. New facts concerning the blood groups of rabbits are brought out in an article by Drs. C. E. Keeler and W. E. Castle (*J. Heredity*, 25, No. 11). They find two agglutinogens which they call H_1 and H_2 , thus making four blood groups (H_1 , H_2 , H_1H_2 and O), as in man. The corresponding agglutinins, h_1 and h_2 , are, however, not normally present in the blood plasma of rabbits, at least in sufficient quantity to produce a reaction. But if blood from a rabbit containing an agglutinin is injected into a rabbit which does not have this agglutinin, then the corresponding agglutinin arises as an immune reaction. It is also shown that if a O female rabbit is injected with blood from an H_1H_2 rabbit, the agglutinins h_1 and h_2 will develop

in her blood and will be transmitted through the placenta to the blood of her offspring. It was found that the agglutinogens are already developed in embryos only 14 mm. in length, while in still younger embryos 4 mm. long they were present in the nucleated blood cells. These facts led to the anticipation that in certain matings incompatibilities would develop between mother and fetus. No such results were found, however, from mating a *O* mother with an *H₂* father. Three litters of young, numbering 14 in all, included 9 young rabbits with incompatible red corpuscles, but none of them showed adverse effects. The basis of this protective action is not at present understood.

Antarctic Nudibranchs. In his account of the nudibranchs in the British Antarctic (*Terra Nova*) Expedition Reports (Zoology, vol. 7, No. 5; 1934) Dr. Nils H. Odhner considers that the subdivisions Cladohepatica and Holohepatica should be abandoned, as they are not adequate to cover every form of liver differentiation in the nudibranchs. Further, the cladohepatic organisation does not imply a uniform or monophyletic development, for the branching of the liver may be brought about in different ways, and hence does not form a basis for a natural classification. The author divides nudibranchs into four groups—Doridacea, Arminacea (a new division which comprises the genera and families grouped round *Armina*), Eolidacea and Dendronotacea. In describing a new species of *Bathydoris* collected in McMurdo Sound, at a depth of 366 metres, he supports the view of Evans that the gills of Dorids are to be considered as homologous with the ctenidium in the Tectibranchia. The gill in this new species consists of a right and a left stem, the left one in front of the anus, the right one on the right of the anus. One new genus and nine new species are described.

Parasites of Lepidoptera. Miscellaneous Publication No. 188 (July 1934) of the U.S. Department of Agriculture is entitled "Macrolepidoptera and their Parasites Reared from Field Collections in the North-eastern Part of the United States", by Messrs. J. V. Schaffner and C. L. Griswold. This bulletin is the result of studies begun in 1915 at the Melrose Highlands Laboratory of the U.S. Bureau of Entomology, and it brings together a large number of records and data respecting hymenopterous and dipterous parasites bred from the larger Lepidoptera. It is divided into two sections, which facilitates reference. The first consists of a host list with the respective parasites, while the second part is a classified list of parasites with their known hosts. During the course of the work, twelve new species of Tachinidæ and twenty-one of Hymenoptera were bred and have already been described, while many more await description. The publication is one likely to interest workers on biological control, and on host-parasite relationships, in Europe as well as in North America.

Production of Dwarf Amphidiploid Tobacco Plants. In a series of cross pollinations of certain *Nicotiana* species, Prof. Dontcho Kostoff, of the Institute of Genetics, Moscow, reports in a communication to NATURE that *N. glauca* ($2n = 24$) gave inviable embryos with *N. rustica* var. *humilis* ($2n = 48$), but viable plants with *N. rustica* var. *texana* ($2n = 48$). The resulting hybrids were, however, self-sterile and showed irregular meiosis. When pollinated by *N. rustica* var. *humilis* (or var. *texana*), a variety of

plants with chromosome numbers ranging from 48 to 96 was produced. Among these were two tetraploids (amphidiploids) with 72 chromosomes. They were dwarfs, growing to a height of 12 cm. and 73 cm. respectively, the latter being self-fertile. Under similar conditions, the parental species reached a height of 80 cm. and 150 cm., and the *F₁* hybrid 150 cm. Hence the result of the chromosome doubling is to reduce the size. Too great an increase in chromosome number also lowers viability. There are few plants in Nature with 200 or more chromosomes, but these plants are never 'giants' in comparison to the other species of the same genus having a smaller chromosome number.

The Genus *Isaria*. *Isaria* is usually thought of as the name given to a genus of fungi the principal members of which attack various insects, and send up small, ivory-white, branched conidiophores, often about half an inch high. The group has, however, been used as a taxonomic reservoir for many apparently unrelated species, as is shown by Mr. T. Petch ("*Isaria*", *Trans. Brit. Mycol. Soc.*, 19, Part 1, 34-38, Oct. 1934). The paper traces the chequered history of the genus since it was first mentioned by Hill, apparently to denote a species of *Puccinia*. The principal authorities quoted are Persoon, Nees, Saccardo, Lindau and Fries. Persoon appears to have originated the modern conception of the genus, and must be cited if the genus is to be retained. Mr. Petch suggests, however, that the species could all be included amongst the various existing genera of the Mucedinaceæ, a simplification which should commend itself to most mycologists. He has a wide experience of entomogenous fungi, and it is gratifying to note that increasing knowledge is leading to simplification of classification, rather than to its complication.

World Coffee Production. The International Institute of Agriculture, Rome, has issued a monograph entitled "Coffee in 1931 and 1932: Economic and Technical Aspects". This publication, which has been prepared by Dr. W. Bally, is the first of a series of monographs that it is intended to publish on the principal crops grown in tropical countries. The subject is treated from a variety of aspects, opening with an introductory account of the economic situation of the coffee industry in general. Statistical data on production, consumption and prices follow, but the major portion of the monograph is devoted to a detailed account of the economic position in each of the various coffee-producing countries of the world. The present phase of over-production seems to have been brought about largely by increase in area under the crop, rather than by higher yields due to agricultural improvement as is the case with sugar and rubber. Further, over-production is probably a temporary phenomenon only, and agricultural problems such as soil exhaustion already evident in Brazil, or pests and diseases are in reality of no less importance than the economic. A further section of the monograph takes the form of a review of works dealing with the technical and ecological aspects of coffee growing, and a detailed account of the fungus and insect pests that attack the crop in the different countries follows, even a hasty perusal of which will impress the reader with the serious problems on this side of coffee growing. An account of the product and its preparation forms the subject of the final part of the monograph. Considerable value is added to the whole publication by the inclusion of a bibliography at the end of each sub-section.

Phosphatic Calculi in Silurian Polyzoa. The results of a palæo-biochemical investigation of the pearl-like spherules found in the zoecia of Ceramoporoid Polyzoa from the Wenlock and Gothland Limestones are recorded in a paper of unusual interest by K. P. Oakley (*Proc. Roy. Soc., B*, 116, 296-314; 1934). The spherules resemble pearls in respect of their opalescent lustre and fine concentrically laminated structure, but they are shown to consist of cryptocrystalline calcium carbo-phosphate (dahllite). It is probable that the 'pearls' were formed by the simultaneous precipitation of carbonate and phosphate around nuclei in the coelomic fluid of the separated distal portions of the zooids after periods of polypide degeneration. The fact that a strongly alkaline solution was a necessary condition for precipitation of phosphate suggests that the main factor was a marked rise in the pH value of the coelomic fluids during the periodic degeneration of the internal organs. Such rise would presumably be brought about by ammoniacal decomposition of proteins. The liberation of ammonia might also account for the association of carbonate with the phosphate. From the results of the experimental work of Schade on the formation of concretions, the mode of growth of the spherules has been deduced. The spherules are clearly of the nature of calculi; they are comparable with such pathological structures as human gall-stones and bladder-stones.

Ordovician Faunas of Korea. A monographic account of the Middle and Upper Ordovician faunas of South Chosen (Korea) is given by T. Kobayashi (*J. Fac. Sci. Imp. Univ. Tokyo*, Sect. 2, 3, pts. 8, 9, 1934, pp. 329-585, pls. i-xliv, i-viii). In the Middle Ordovician the Chikunsan fauna includes 87 species and corresponds to the Upper Llandeilian of Europe; it is remarkable for the great development of Nautiloid Cephalopods, which show relationship to those of central and southern China and also to those of the Upper Chazyan of North America. The Trilobites are mainly Asaphids. The Tsuibun fauna corresponds to the Lower Caradocian, and its Cephalopods are mainly Actinoceroids. In the Upper Ordovician the Tomkol and Shokudo faunas are of interest as representing new or little-known horizons in eastern Asia. These faunas are divided into three zones: (1) *Asaphellus*, (2) *Protopliomerops*, and (3) *Clarkella*. The first and second show relationship to European faunas, the first corresponding to the British Tremadoc, the second to the *Apatokephalus* zone of the Baltic region. The *Clarkella* fauna, on the other hand, is of a Pacific type. Trilobites form the main part of the fauna; other groups represented are cystids, worms, brachiopods and molluscs.

A World-Wide Survey of Microseisms. *Geophysical Memoir*, No. 62 (Meteorological Office, 1934; London: H.M. Stationery Office, 3s. net), with this title, embodies an important study by A. W. Lee of microseisms observed during a single month, January 1930, in many parts of the world. The study is based on the records of no less than fifty-seven seismological observatories; the data studied are presented in numerous tables, reproductions of records, diagrams and synoptic charts. It is shown that the mean east-west and north-south amplitudes of microseisms, though normally equal, are different if the local geological formation round the station is unsymmetrical; the local geology also affects the ratio of the mean horizontal and mean vertical amplitudes, which varies at different stations from

3 to 0.6. A method is developed of allowing for these local peculiarities of substructure and putting the data from different observatories on a comparable basis, so that the geographical distribution of microseisms can be properly mapped. Usually, Iceland and the British Isles are affected by much larger microseisms than the continental area of Europe. In Europe, microseismic storms are generally associated with cyclonic depression off the coasts, though such depressions do not always produce large microseisms.

Capture of Electrons by Positive Ions. R. A. Smith (*Proc. Camb. Phil. Soc.*, 30, 514; 1934) has examined the exponential decrease of intensity of a beam of protons or He⁺ ions passing through helium gas. The slits of the collector were so wide that the ions scattered through small angles were not excluded, and under these conditions the loss of intensity is due mainly to neutralisation of the ions in the beam by the capture of electrons from the helium atoms. The ions were drawn out of a low-voltage arc and accelerated to energies of a few kilovolts. The beam was collected by one of several shielded Faraday cylinders. The results were compared with the theory of Massey and Smith and show fairly good agreement. The case of He⁺ ions in helium is a case of 'resonance' and the cross-section for capture falls off steadily with increasing energy. Protons in helium or in hydrogen show a maximum at a certain energy of the ions. According to theory, capture does not become important in this case until the ions have a certain energy (activation energy) and the probability of capture passes through a maximum and falls off with increasing energy.

Spaced-Aerial Radio Direction-Finders. It is now well-known that the ordinary closed-coil type of radio direction-finder is seriously limited in its application in the presence of downcoming waves polarised with their electric force in a horizontal direction. The basic principle of the means of overcoming this limitation, so as to enable correct bearings to be obtained under all conditions of radio reception, was patented by F. Adcock in 1916. This method utilises a system of spaced vertical aeriels, and the principle was verified experimentally in 1926. Since that time, the system has been under continuous investigation in Great Britain, with the view of its development as a practical instrument of navigation. In a paper, entitled "Some Principles underlying the Design of Spaced-Aerial Direction-finders", read before the Wireless Section of the Institution of Electrical Engineers on December 5, Mr. R. H. Barfield gave an account of the results of a quantitative examination of the various aerial systems by means of which Adcock's invention may be realised in practice. To enable this examination to be carried out, the author has introduced two quantities, termed 'standard-wave error' and 'pick-up factor' respectively, by means of which the relative performance of different direction-finders may be assessed. In some cases, the method under discussion was amenable to theoretical calculation, and the agreement between values of performance obtained in this way and the experimental results was found to be satisfactory. The paper concludes with a comparative table of standard wave errors and pick-up factors for the ordinary closed-loop direction-finders, and for six different arrangements of the spaced-aerial systems. This table, together with the detailed conclusions given, serves to illustrate clearly the stage at which this phase of radio research has arrived.

Forest Policy in New Zealand

NEW ZEALAND'S Arbor Day is held on August 1, and on the previous day this year, Lord Bledisloe, Governor-General of the Dominion, delivered an address at the annual meeting of the New Zealand Forestry League. He took as his text, "New Zealand's Timber: A Great National Asset" (Wellington, N.Z.: Blundell Bros, Ltd., 1934). The position of the afforestation question in New Zealand has been discussed in NATURE on several occasions, and Lord Bledisloe's review covered many of these points in connexion with the exotic plantations formed by the State and those of private companies and others amounting to 396,000 acres and 260,000 acres respectively.

The most interesting and, as some foresters will think, the most valuable part of Lord Bledisloe's address was that dealing with the remaining indigenous forests of the country. In recent months, special attention has been directed in NATURE to the position of these forests, and the opinion expressed that they should receive attention on the part of the skilled forester. On this subject, Lord Bledisloe's opinions after visiting many of these areas are of value:

"To those interested in forestry scientifically, ecologically, archæologically, and romantically (not to mention aesthetically), rather than commercially, it is the indigenous forests rather than the exotic forests which make a strong and special appeal. There is, in fact, a glamour about these ancient tree communities which grips the mind of those interested in the natural products of their country, and such, I know, form no inconsiderable number amongst members of the Forestry League. According to the late Dr. Leonard Cockayne, the indigenous forests as a whole differ essentially from those of the temperate parts of Europe, Asia and North America, so that the forestry practice of Europe in general cannot apply to New Zealand, and it is the foresters of this country who must put forth rational methods for their permanent management, and who also must decide, in friendly co-operation and consultation with enlightened agriculturists, what shall be permanently preserved as forest land, and what shall be concerted into pasture."

The late Dr. Cockayne considered the study of the New Zealand rain forest, dependent on a heavy rainfall, as peculiarly difficult for the scientific forester, owing to the slow but constant changes which are always in progress, new combinations of plant and timber growths coming into being only to pass away and gradually to give place to other combinations. The same is, however, common to this type of forest in India and West Africa, and there does not appear, on the face of it, any reason why the regeneration of the type should prove more difficult in New Zealand than in the other countries where the necessary technique based on a close study is being acquired.

That the Forestry Department in the country is now turning its attention seriously to this question of the indigenous forests, the annual report of the State Forest Service for the year ending March 31, 1934 (Government Printer, Wellington, 1934) well shows. Here, the Director of Forestry, Mr. A. D. McGavock, points out that owing to the prominence given to the afforestation work with exotics during the past nine years, it has become necessary to

restate the policy under which the forest service is operating. This policy is two-fold—the maintenance of climatic, soil and water equilibria, and the supply of timber and other forest produce. Owing to its influence upon agriculture, the former objective, namely, the conservation and the protection of the forests is of greater national significance.

"Conservation," says the Director, "may be defined as the preservation of the forests by wise use, and the intensive management of these forests will assist to solve the problem of timber-supplies. It is with this latter consideration that the establishment of exotic forests is most intimately associated."

"The outstanding features of the national timber-supply situation are—

(1) That of the remaining virgin forests over 80 per cent. are overmature stands in which there is no net growth. New growth is offset by decay, &c.;

(2) That the conversion of this 80 per cent. of overmature forests into healthy growing stands of indigenous species producing timber to the maximum capacity of the forest soil will necessitate silvicultural management extending over a long period, probably one hundred and fifty years;

(3) That current timber demands are depleting the virgin indigenous forests at such a rate that, without other provision being made, an adequate supply of timber would not be available during the whole of the intervening period;

(4) That the early establishment of exotic plantations as a supplementary forest capital resource is therefore of great importance, and it is for this reason that the establishment of large forests of exotic trees has assumed such proportions during recent years;

(5) That the part which these exotic forests will ultimately play in the forest economy of the Dominion, one hundred to one hundred and fifty years hence, is difficult to predict. Experience in foreign countries where forestry has been practised over a period of several centuries indicates, however, that exotic species have definite limitations, and for this reason the national policy must envisage the management of the indigenous forests to secure their maximum possible production of timber."

It is proposed that on the early completion of the exotic forests, as a supplementary resource, more attention will be given to the silvicultural treatment of the indigenous forests.

There are some interesting remarks on the "Management of Indigenous Forests". The Director states that the public appears to think that all that is necessary to preserve this type is to fence against stock and to protect them against fire. This idea he holds is quite erroneous since "The composition of forest gradually changes, one type of forest growth succeeding another. Generally the valuable timber-producing species are replaced by weed species".

These changes are common to all primeval forests, but in their natural state the change from one forest type to another probably takes many centuries. When man interferes, with destructive fellings, fire and so forth, the process is quicker. But there does not appear any reason to imagine that the difficulties which the New Zealand scientific forest officer will have to face in the regeneration of the indigenous forests will prove greater than those which have faced the forest officer in India during the past half century,

some of which have been successfully surmounted.

The following remark will be read with appreciation by those having the forest policy of the British Empire at heart. "The general forest policy may be stated as the perpetuation of the indigenous forests and the provision of a supplementary exotic-forest capital which, by rapid growth, will eke out the supplies of indigenous timber and bridge the gap between the exhaustion of the overmature indigenous forests which otherwise would occur, and their conversion into healthy productive forests.

With the establishment of the exotic plantations now approaching completion, it will be possible to give proper attention to the silvicultural treatment of the indigenous forests. The timber-supply position of the future envisages a balanced yield from both exotic and indigenous forests, and the future alone will determine the relative importance of the two sources of supply."

It is refreshing to have a forest policy for a country so clearly laid down, and one calculated to fulfil the objects aimed at and the requirements of the people.

British Hydro-Electric Development

THE paper on "Hydro-Electric Development in Great Britain", read at a meeting of the Institution of Electrical Engineers on November 8 by Messrs. A. S. Valentine and E. M. Bergstrom, dealt more particularly, as indicated by its sub-title, with the works of the Grampian Electricity Supply Co., but it contained an interesting summary of the present situation of hydro-electrical development in the country. It is well known, of course, that the water-power resources of Great Britain do not compare in extent with those of some other countries, but, on the other hand, there are abundant supplies of coal, and by reason of this cheap and adequate supply of fuel for steam-power plants, water-power developments here do not present the same attraction as they do in countries lacking carboniferous deposits but possessing abundant water resources.

At the beginning of the present century, the census of power production showed that less than two per cent of the power requirements of Great Britain was produced from water-power. "By reason of the fact," say Messrs. Valentine and Bergstrom, "that in Great Britain water power can only be regarded as a contributory element, supplemental to the main power supply derived from coal, the technical and economic factors enter far more prominently into the problem of its utilisation than in countries where the economic policy is dictated by far less onerous conditions and where the natural advantages facilitate the solution of the many difficult technical questions inevitably connected with water-power developments".

According to the report of the Water Power Resources Committee constituted by the Government in 1918, the estimated output on a continuous basis for Great Britain was 250,000 kilowatts, in the ratio of 8 per cent, 77.5 per cent and 14.5 per cent for England, Scotland and Wales respectively. The limited resources of England, say the authors of the present paper, are easily appreciated in view of the low average elevation above sea-level, and the consequent flat gradient of the rivers, which must form the principal source for water-power development. Developments of any size cannot be looked for, but notable examples of what can be achieved to a limited extent are provided by the installations at Chester and Worcester and the more recent development at Linton Lock, York. The available fall does not exceed 11 ft. in any of these installations and the total electrical energy generated aggregates not more than an average of 5.25 million kwh. per annum.

In Wales, the conditions are more favourable, particularly in the northern area. The total energy available from the hydro-electric plants in operation in North Wales is about 95 million units a year.

This total can probably be increased to approximately 140 million units a year. Apart therefrom, any further large developments cannot be anticipated in Wales, owing to the limited extent of available catchment areas.

The topographical features of the Highlands of Scotland, which are the most prolific source of supply in Great Britain, are favourable, the country being mountainous and consisting mainly of impermeable strata with steep slopes and comparatively high average rainfall. The area is also characterised by numerous lochs, situated at a considerable elevation, which can be utilised as impounding reservoirs at low cost. Among installations already made, or in progress, may be instanced those at Lochaber (800-ft. head; 33,000-75,000 kw.), Tongland (102-ft. head; 36,000 kw.), Tummel (160-ft. head; 34,000 kw.), Rannoch (465-ft. head; 32,000 kw.) and Kinlochleven (900-ft. head; 23,000 kw.).

If the cost of transmission be left out of consideration, it can be accepted as a general condition for the adoption of a hydro-electric scheme in Great Britain that the economic limit of capital cost is the amount represented by the capital cost of a thermal station of equivalent output plus the capitalised value of the annual cost of fuel. When the cost of coal is relatively low, as here, the economic margin in favour of hydro-electric power is correspondingly reduced in comparison with countries in which the cost of fuel is high, and consequently the field for development is much more restricted. The load factor is also a matter of importance. With continuous operation at a high load factor, the economic margin is increased, and it diminishes with a decreasing load factor to a point at which it changes over in favour of steam plant. Questions of transport of material and availability of skilled labour also enter into the problem. The interconnexion of steam and hydro-electric power plants will, in certain cases, promote the best economic results by utilising the available water flow to the greatest advantage, particularly if possibilities of storage are absent or deficient. With the construction of a Grid and the co-ordination of electric supplies on a regional basis, opportunities are afforded for a wider application of hydro-electric stations to supplement the supply from large steam generating stations.

Messrs. Valentine and Bergstrom also touched upon the subject of electrical generation by tidal power, the conditions for which are most favourable on the west coast of England and Wales. They state that the technical difficulties in obtaining efficient results from water turbines operating under the onerous conditions of a widely fluctuating head of water have now been satisfactorily disposed of through the introduction of the Kaplan and other

types of propeller turbine. The utilisation of tidal power resolves itself, therefore, into an economic question in relation to other available, or potential, power supplies in the area under consideration. As a rule, the cost of the civil engineering works is considerable, so that tidal-electric developments can only be contemplated at certain selected sites, as on the Severn, where the topographical features and

other conditions in respect of the foundations, the tidal flow and the geographical position in general, favour the production of a large block of electrical energy at the lowest possible cost per unit. The large amount of capital required in such cases makes it unlikely that they could be financed from private sources alone, and Government aid must be forthcoming for their realisation.

Inheritance and Mental Deficiency

IN a paper on the inheritance of mental ability read at Aberdeen before Section J (Psychology) of the British Association, Dr. L. S. Penrose gave an account of a survey of a group of mentally defective patients whose relatives were tested by standardised intelligence tests. The patients were grouped into severe and mild cases, and certain significant differences were found between the two groups. The relatives of the severe cases were, on the whole, distinctly more intelligent than the relatives of the milder cases, and there was a marked incidence of consanguinity among the parents of the severe cases.

Dr. Penrose concludes that the influence of heredity in the causation of severe mental deficiency is shown (1) by the sharp distinction between normal and abnormal brothers and sisters; and (2) by the high incidence of consanguinity among the parents, which indicates the presence of rare recessive characters. The arguments against hereditary influence are the possibility of causation by physical disease among the patients and the demonstrable importance of environmental factors—as in mongolism. The low familial incidence is not strong evidence against hereditary causation here because severe mental deficiency tends to cause family limitation, and the affected individuals do not have offspring.

Within the group of mild cases, where the mental ability extends from 40 per cent to within the normal range, hereditary influence is indicated (1) by the high familial incidence of mild defect, and (2) by the characteristic regression towards the normal of the mean intelligence of relatives. In the absence of

sharp segregation, these findings suggest multifactorial inheritance. The points indicating the influence of environmental causation are the lack of correlation between mentality of patient and mentality of relative as judged by the Binet tests, and the poor social conditions under which defectives of this group are nurtured.

A practical consequence of the lack of correlation between the test scores of patients and their relatives is that, within a wide range, the knowledge of the mental grade of an individual gives no information about the probable mentalities of brothers, sisters or children. One can only say that, given a large enough group, the average mentality of the relatives of defectives will be a certain distance below the normal. This fact puts serious difficulties in the way of the application of eugenic measures designed to control mental defect; it points to the importance of exercising educational and social influences to the fullest extent.

Mr. D. Kennedy-Fraser discussed in a paper before Section J the immature reactions to number of older feeble-minded boys. A group of 200 older feeble-minded boys reacted to five groups of xn dots. The responses are classifiable into 288 primitive unit counting, 445 adding by groups, and only 289 multiplicative reactions. On the other hand, a comparative group of 76 normal boys of the same age only gives 2 per cent unit counts, 9 per cent additions and 89 per cent multiplications. Further investigation is to be made into the probable relation between mental age and number maturity with both normal and subnormal girls and boys.

Structure of Amphoteric Ions

IN a communication to the September issue of the *Berichte der deutschen chemischen Gesellschaft*, Werner Kuhn and Hans Martin discuss recent conclusions as to the structure of amphoteric or zwitter ions from measurements of dielectric constants.

The important part which amino-acids play in biochemical processes has attracted attention to their properties, and numerous observations of dielectric constants of aqueous solutions of these compounds have been made in recent years.

It has been noticed that the rate of change of dielectric constant with concentration, particularly in dilute solutions, varies between -10 and zero in the case of compounds like aniline, biuret or acetanilide, which do not yield amphoteric ions, whereas the amino-acids and their derivatives give high positive values, ranging from $+23$ in the case of alanine to $+290$ for heptaglycylglycine. While there seems to be general agreement that this discrepancy is the direct outcome of amphoteric ion formation, the present authors believe that incorrect conclusions have been made about the form of the molecular

chains. Thus in the United States, Messrs. Wyman and McMeekin have found that the rate of change of dielectric constant with concentration increases proportionally with the length of the chain, and conclude that the molecules exist as long, rigid, extended rods.

Now the nature of the equilibrium between different dipolar molecules is not yet well understood, so that at present one has to be content with an incomplete mathematical analysis. Even an approximately accurate determination of dielectric constants in a strongly polar medium like water is at present out of the question. Nevertheless, one ought not to ignore the requirements of the existing formula, which, as is shown, leads undoubtedly to low values for μ , the effective electric moment. Thus for hexaglycylglycine, the value of μ works out to about 3.4×10^{-18} , whereas an extended rod-like structure would necessitate a value of about 180×10^{-18} . The authors feel justified, therefore, in concluding that the rod structure is highly improbable, and point out that existing evidence does nothing to invalidate the older theory of chain-coiling.

University and Educational Intelligence

CAMBRIDGE.—Sir Daniel Hall has been appointed Rede lecturer for the year 1935. The lecture will be delivered at 5 p.m. on Monday, March 4, 1935.

Dr. M. E. Adair, of Girton College, has been elected to a second John Lucas Walker studentship.

LONDON.—The title of emeritus professor of civil and mechanical engineering has been conferred on Prof. E. G. Coker on his retirement from the Kennedy chair of civil and mechanical engineering at University College.

Prof. A. E. Jolliffe, professor of mathematics at King's College since 1924, and Mr. Noel Ashbridge, a former student of King's College, chief engineer to the British Broadcasting Corporation, have been appointed fellows of the College.

SHEFFIELD.—The following appointments have been made: J. C. Anderson, as a lecturer in applied anatomy and demonstrator in anatomy; A. W. Fawcett, as lecturer in surgical pathology; E. F. Skinner, as lecturer in psychology in the faculty of medicine.

A CECIL PEACE PRIZE of £100 is being offered in 1935 to members of any university or university college in Great Britain or Northern Ireland for an essay on the following subject: "The Manufacture by Private Enterprise of Munitions and Implements of War is open to Grave Objections. How far is this true and what is the Remedy?" Further information can be obtained from the Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1.

ADMISSION to secondary schools being, for many children, contingent on the results of scholarship examinations, it is a matter of considerable national importance that they should be conducted with a maximum of knowledge, intelligence and care. The report of the Education Committee of the West Riding of Yorkshire on the examinations for county minor scholarships, 1934, affords evidence that the Committee is fully alive to their importance. It is only in connexion with the recommendation of candidates for admission to the examination that the Committee finds cause for anxiety as to the working of its scheme. The meshes of the net spread for catching the gifted children seem too wide for the younger ones in the age group 10-11, for only 22 per cent of the children whose tenth birthday fell in the quarter January-March were recommended for admission as compared with 36 per cent of those who reached that age in the preceding April-June, and a similar disparity was noticed in the preceding year. It is thought to be due to overlooking the merits of children who have not completed all the work undertaken in the class from which candidates are usually presented. The chief examiner in English comments on the prevalence, more conspicuous this year than ever before, of a tendency to read the questions carelessly and to introduce irrelevant matter into the answers. Much, one feels, might be forgiven to the girl who put into the mouth of the conductor of a bus which was in danger in a fog the appeal—"Keep your heads and your seats, for peril is nigh". The report on the examination in arithmetic throws interesting sidelights on various methods of teaching.

Science News a Century Ago

The *Beagle* sails Northward

By the end of 1834, Capt. FitzRoy had practically completed the survey of the Chonos archipelago and much to Darwin's relief the *Beagle* again headed northward. On December 30 he recorded: "We anchored in a snug little cove at the foot of some high hills near the northern extremity of Tres Montes." Next morning a party ascended one of the mountains. "The scenery," he says, "was remarkable. The chief part of the range was composed of grand, solid, abrupt masses of granite, which appeared as if they had been coeval with the beginning of the world. . . . I took much delight in examining the structure of these mountains. The complicated and lofty ranges bore a noble aspect of durability—equally profitless, however, to man and to all other animals. Granite to the geologist is classic ground: from its widespread limits, and its beautiful and compact structure, few rocks have been more anciently recognised. Granite has given rise, perhaps, to more discussion concerning its origin than any other formation." The day following his ascent of the mountain, on January 1, 1835, Darwin wrote: "The new year is ushered in with the ceremonies proper to it in these regions. She lays out no false hopes; a heavy north-western gale, with steady rain, bespeaks the rising year. Thank God, we are not destined here to see the end of it, but hope then to be in the Pacific Ocean, where a blue sky tells one there is a heaven,—a something beyond the clouds above our heads."

J. D. Forbes and his Researches on Heat

The opening of the year 1835 found Forbes engrossed with his heat investigations, and on January 1 he wrote to Whewell: "I am quite full of polarization. I do not exactly understand what you mean by double refraction existing without polarization, but at all events since I wrote to Airy I have made great progress. My original experiments related to polarization unconnected with double refraction, but I have since extended the proof to every recognised species of polarization; and non-luminous heat must be doubly refracted, because it can be polarised by tourmaline and depolarized, or di-polarized if you will by other crystals. Hence we are entitled to conclude that we might feel brushes and rays of dark heat if our hands were delicate enough thermometers. I can also make some approximation to the length of a wave. I have as yet communicated this to no one. I shall read it on Monday to the Royal Society when it will be immediately printed." He concludes his letter by asking, "Have you anything to say about the Rumford Medal? I think Melloni ought certainly to get it, for his two masterly papers in the *Annales de Chimie*. There have been few of the adjudications for researches so accurately fulfilling the founder's intentions."

Eruption of Vesuvius

The first note in the chronicle of events of January 1835 given in the "Annual Register" for that year is an extract from a letter written from Sorrento giving an account of an eruption of Vesuvius. "It is scarcely possible to imagine," the writer said, "much less to describe the awful character of the scene. An immense body of liquid fire silently, yet rapidly

advancing; then the noise of falling poplars encircled by clustering vines laden with fruit, with the glare reflected upon us from the flowing lava, produced an effect altogether so terrific that I was at first more inclined to a hasty retreat than to continue watching the progress of destruction . . . the stream of lava must have been a mile and a half broad whilst its extent from the crater was nine miles, with a depth of thirty feet, so that instead of commencing with the base of the houses, it approached and flowed at once over their roofs; entering the doors and windows till the whole was buried, the roofs falling in with a loud crash. . . . According to Salvator, the lava, which continued flowing more or less for six days, destroyed about 300 acres of valuable land and injured or destroyed nearly 800 houses. . . . Pompeii was considered not to be free from a second interment, Naples herself not free from risk. The old crater had previously fallen in, and had continued for a week throwing out ashes in such quantities as to envelope many neighbouring districts in darkness. . . ."

Societies and Academies

PARIS

Academy of Sciences, November 26 (*C.R.*, 199, 1165-1260). LOUIS DE BROGLIE: The expression of density in the new theory of the photon. CHARLES NICOLLE and PAUL GIROUD: The non-transmission to the rat, by ingestion, of the bacillus of historical typhus contained in infected lice. LUCIEN DANIEL: A case of accidental crossing in the bean. E. J. GUMBEL: The final distribution of values near the median. G. DARMOIS: The theory of two Spearman factors. J. R. BRAITZEFF: The representation of the function which is given by its development in a Dirichlet series. PIERRE BERGÉOT: The convergence in quadratic mean. MAX. SERRUYS: Conditions imposed on the working characteristics of internal combustion motors by the necessity of avoiding detonating régimes. An application of the theory of nuclear inflammation given in an earlier communication, with experimental confirmation. MARCUS BRUTZKUS: A method for the appreciation *a priori* of the shock effect of combustibles. BINAYENDRA NATH SEN: The diffusion of elements in the solid state. A new view. ALBERT TURPAIN: The echoes of short waves and attempts to explain these phenomena. MARCEL PAUTHENIER and MME. MARGUERITE MOREAU-HANOT: The suppression of the coronal discharge by particles in suspension in the electric field. RAYMOND JOUAUST: The variation of the rigidity coefficient of nickel as a function of the magnetisation. JACQUES MÉTADIER: The action of the magnetic field on the Brownian movement. From the results of numerous experiments, it is concluded that magnetic fields up to 20,000 gauss have no action on the Brownian movement. IVAN PEYCHÈS: Contribution to the study of some dry rectifiers. PIERRE URBAIN and MASAO WADA: The detection of the alkali metals by the arc spectra method. The establishment of sensibility curves. The minimum quantities of the alkali metals which can be detected by the method described range between 0.000,002 mgm. for lithium to 0.008 mgm. for caesium. ADOLFE T. WILLIAMS: The structure of the spectra of hafnium and tungsten. JEAN LECOMTE and JACQUES PERICHET: The rotatory dispersion in the ultra-violet of camphor in sulphuric acid solution. The existence

of a substance in solution other than camphor or sulphuric acid is proved. V. HENRI, CH. WEIZMANN and Y. HIRSBERG: The photochemical decomposition of glycocoll. The influence of the medium and of the wave-length. CHARLES HAENNY: The thermal variation of the magnetic double refraction of paramagnetic solutions of salts of rare earths. The experimental facts prove the predominating importance of the paramagnetism term in the theoretical expression for this double refraction. WENLI YEH: A new experimental proof of the layers of neutrons in the nuclei. WOLFGANG GENTNER: The disintegration of beryllium by γ -rays. WALTER M. ELSASSER: The constitution of the elementary particles and nuclear forces. ANDRÉ LÉAUTÉ: The laboratory measurement of the roughness index of road coverings. E. RINCK: Solidification diagrams of the alloys formed by two alkali metals: sodium-caesium alloys. AUGUSTIN BOUTARIC and MME. MADELEINE ROY: The physico-chemical transformations of gum arabic sols in the course of heating. MME. PAULETTE BERTHIER: The influence of the surface tension on the velocity of ascent of aqueous solutions through porous bodies. From the data given it appears that the surface tension has little or no effect on the velocity of ascent of aqueous solutions through porous substances. PIERRE PINGAULT: The preparation of certain definite alloys. Methods for preparing the alloy FeSn₂. LUCIEN LEROUX: The detection and rapid estimation of very low concentrations of active chlorine in water. Potassium bromide is added and the bromine thus liberated determined by the fuchsin method of Denigès and Chelle. The lower limit is 0.005 mgm. chlorine per litre. ALBERT KIRRMANN: The allyl transposition. Studies by the Raman effect. The dichloride obtained by the interaction of phosphorus pentachloride with crotonaldehyde, regarded by Kekulé as a single substance, can be shown by Raman spectra to be a mixture of two isomers. M. FAVORSKY, M. TCHITCHONKINE and I. IWANOW: The molecular transpositions of the α bissecondary oxides of the fatty series and of normal structure. GEORGES ARRAGON: Methylation by the Fischer method of sorbose and its acetyl derivatives. MARCEL GODCHOT, MAX MOUSSERON and ROGER RICHAUD: The resolution of some cyclanediols. JACQUES BONDON and LOUIS CLARIOND: The geological itinerary of Agqa à Tindouf (Moroccan Sahara). JOSUÉ HOFFET: The presence of the lower fossiliferous Permian in the western Haut-Laos. PAUL JAEGER: New cases of gynodimorphism in the Dipsacæ. MME. BERTHE BIECHELER. Proof of a mitochondrial network in some autotrophic Peridinians. J. LEGENDRE: The maritime mosquito. Description of the habits of *Aedes punctatus*. This mosquito requires salt water for its development, and the succession and development of the generations of this insect are controlled, not by the rainfall, but by the height of the tides. LÉON BINET and DANIEL BARGETON: The action of the lung on aminoacids. The lung is capable of attacking an aminoacid, alanine, as shown by the production of ammonia, appearance of pyruvic acid and modification of the respiratory coefficient. ETIENNE RABAUD and MME. MARIE LOUISE VERRIER: The swim bladder, density and equilibrium plane of fishes. PAUL MEUNIER: A new method for the determination of very small amounts of aluminium in complex media. Application to plants. The method is based on the precipitation with cupferron after removing interfering metals by a simple

process. JEAN COURTOIS: The influence of the reaction of the medium on the hydrolysis of the α - and β -glycerophosphoric acids by various phosphatases from seeds. RAOUL LECOCQ and Mlle. MARIE LOUISE BARBAN: Modification of the antirachitic activity of orthophosphoric acid by phenol esterification. ALBERT DEMOLON and ANTOINE DUNEZ: New observations on the 'sickness' of soils growing lucerne.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 6). N. KOSHLIAKOV: Some summation formulæ connected with the theory of numbers. E. BRUMBERG and S. VAVILOV: The accuracy of the photometric method of extinction. The method consists in the reduction of the intensity of light to be measured until it reaches the threshold of perception by an eye adapted to darkness. V. ARKADJEV: Pseudo-chemical action of the Hertzian waves and its application. V. GLAGOLEVA-ARKADJEVA: Separation of monochromatic rays in the white rays of a mass radiator. The method of a step-grid (*echelette*) proved to be eminently suitable for the purpose. I. KIKOIN: Effects observed by the illumination of cuprous oxide in a magnetic field. I. KURCHATOV, L. MYSOVSKIJ, B. KURCHATOV, G. SHCHEPKIN and A. WIEBE: Fermi effect in aluminium (2). A. VOROBJEV: Electrical resistance of rock salt irradiated with X-rays. The resistance in darkness remains the same, but that in light is reduced by about 30 per cent. A. MITKEVICH: An anomalous case of magnetic viscosity. On certain parts of the hysteresis loop, the changes of magnetic induction due to magnetic viscosity can have the opposite direction as compared with the changes of the induction that could be explained as eddy current lag. Therefore the phenomena of magnetic viscosity and eddy current lag are quite different in nature. V. ANTONOV-ROMANOVSKIJ: Natural extinction of phosphorescence in isolated zinc crystals. V. FABRIKANT and V. PULVER: Concentration of excited atoms in a mercury discharge at high pressure. H. HELLMANN: Combined approximate calculation of the problem of numerous electrons. V. FESENKOV: Determination of the polarisation of the solar corona. A method of three polarising mirrors is described as giving exact results. P. ZIMAKOV: Behaviour of some aqueous solutions in an electromagnetic field of high frequency. A. VINOGRADOV: Distribution of vanadium in organisms. An exceptionally high concentration of vanadium is to be found in Ascidians, and in some species of *Holothurians*. P. LAZAREV, Z. BULANOVA and L. COUPER: Fluctuations of the sensibility of the eye in peripheric vision. E. PRUZHANSKAJA: Symbiosis as a factor producing races in micro-organisms. When *Bacillus mycoides* was cultivated in the presence of *Bacterium pyocyaneum*, *B. prateus vulgaris* and *Sarcina ureæ*, four different races of the *B. mycoides* were obtained. N. ORLOVSKIJ: Importance of a biological study of varieties of beetroot in connexion with selection problems. V. CERLING and A. CHEPIKOVA: The results of varying the intensity of the factors of yarovisation. The biological properties of the plants have less effect on the intensity of growth than on its rate. The duration of the process of yarovisation is one of the primary factors responsible for the formation of reproductive organs, that is, for the yield. E. VLADIMIROVA: The content of amino-acids in the regenerating extremities of the axolotl, at different stages of regeneration.

Forthcoming Events

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

Sunday, December 30

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—
J. R. Norman: "Fishes".*

Monday, December 31

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Capt.
Guy Dollman: "Great Game Animals of Africa".*

Friday, January 4

ROYAL GEOGRAPHICAL SOCIETY, at 3.30. R. Kaulbeck:
"A Journey in Unknown Tibet".

CONFERENCE OF EDUCATIONAL ASSOCIATIONS, December
31-January 7. Annual conference to be held at Uni-
versity College, Gower Street, London, W.C.1.
Marquess of Lothian: "Liberty and Collectivism"
(Presidential Address).

PHYSICAL SOCIETY, January 1-3. Annual exhibition to
be held at the Imperial College, South Kensington, S.W.7.
January 1, at 8.—Dr. B. Wheeler Robinson: "The
Architecture of Molecules".

January 2, at 8.—Dr. C. V. Drysdale: "The Problem
of Ether Drift".

January 3, at 8.—Dr. H. Spencer Jones: "Giant
Telescopes".*

SCIENCE MASTERS' ASSOCIATION, January 1-4. Annual
meeting to be held at Oxford. N. V. Sidgwick: Presi-
dent.

GEOGRAPHICAL ASSOCIATION, January 2-5. Annual
conference to be held at the London School of Economics,
Houghton Street, Aldwych, London, W.C.2.

Lord Meston: "Geography of an Indian Village"
(Presidential Address).

Official Publications Received

GREAT BRITAIN AND IRELAND

The South-Eastern Naturalist and Antiquary: being the Thirty-
ninth Volume of Transactions of the South-Eastern Union of Scientific
Societies, including the Proceedings at the Thirty-ninth Annual
Congress, held at Reading, 1934. Pp. xviii+128+5 plates. (London:
E. A. Martin, Hon. Sec., 14 High View Close, S.E. 19.) 5s. net.

Air Ministry: Aeronautical Research Committee: Reports and
Memoranda. No. 1609 (T. 3525): Wind Tunnel Tests on Bristol
Fighter Model with Slotted R.A.F. 34 Section Wings. By K. W.
Clark. Pp. 5+3 plates. 6d. net. No. 1617 (Strut. 199): Stiffness
Determination in certain Cantilever Wings. By Dr. H. Roxbee Cox,
J. Hanson and W. T. Sandford. Pp. 17+5 plates. 1s. net. No. 1618
(T. 3028): Wind Tunnel Tests on a Model Gloster Troop Carrier. By
W. G. A. Perring and C. Callen. Pp. 15+9 plates. 1s. net. No. 1604
(F.M. 101 and 101a): Arithmetical Solution of Equations of the
Type $\nabla^4\psi = \text{Const.}$ By Dr. A. Thom. Pp. 12+4 plates. 9d. net.
No. 1613 (T. 3474): Windscreens with Openings. By F. B. Bradfield
and B. Lockspeiser. Pp. 7+6 plates. 9d. net. No. 1615 (T. 3493):
Hot-Wire Type of Instrument for Recording Gusts. By L. F. G.
Simmons and J. A. Beavan. Pp. 16+8 plates. 1s. net. (London:
H.M. Stationery Office.)

OTHER COUNTRIES

Chinese Materia Medica, 7: Dragon and Snake Drugs. By Bernard
E. Read. (Published by the Peking Natural History Bulletin.) Pp.
66+6 plates. (Peiping: The French Bookstore.) 1.50 dollars.

Department of Agriculture, Mauritius: Sugarcane Research Station.
Bulletin No. 5: Studies on Root-Exudation and Root-Types in Sugar-
cane. By Dr. H. Evans. Pp. 13+7 plates. (Port Louis: Government
Printer.)

Report of the Aeronautical Research Institute, Tôkyô Imperial
University. No. 113: The Experimental Investigation on the Effects
of a Cut-out on the Wing Characteristics. By Tetusi Okamoto. Pp.
101-137. 35 sen. No. 114: Effect of Shape of Discharge Valve on
the Cut-off of Fuel Spray in Injection Systems with Open Nozzles.
By Fujio Nakanishi, Masaharu Itô and Kikuo Kitamura. Pp. 139-
57. 20 Isen. (Tôkyô: Koseikai Publishing Office.)

Annual Report of the Royal Alfred Observatory for the year 1933.
Pp. 7. Miscellaneous Publications, No. 15: The Cyclone Season
1932-33 at Mauritius. By N. R. McCurdy. Pp. 4+2 charts. (Port
Louis: Government Printer.)

Report of the President of the Carnegie Institution of Washington
for the Year ending October 31, 1933. Pp. 59. (Washington, D.C.:
Carnegie Institution.)



